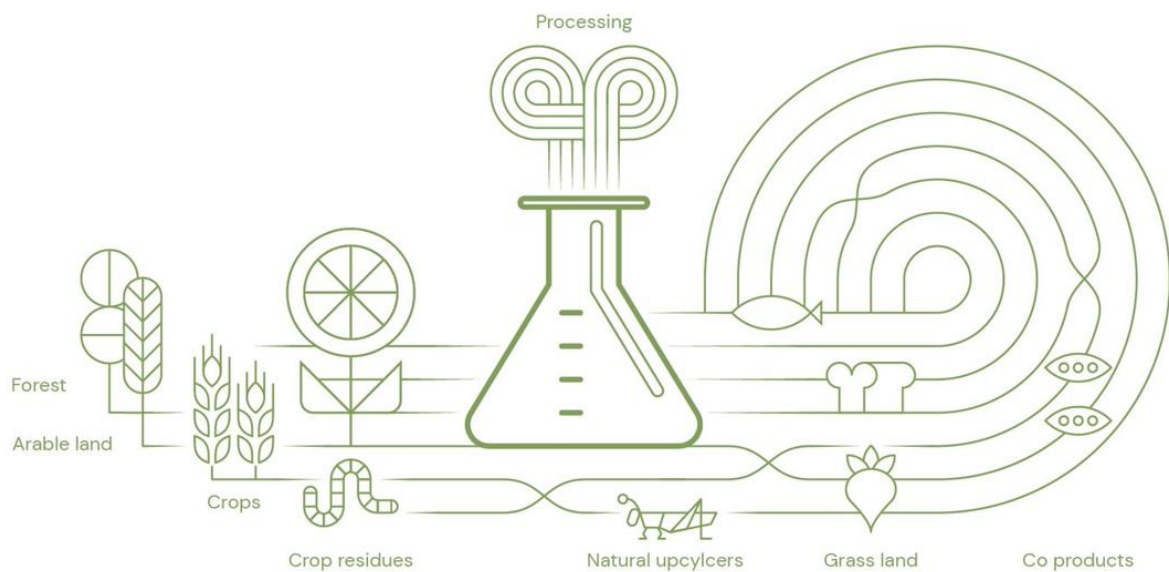


Master Thesis ESS

Risks and opportunity for transition: The protein transition compared to the new concept of upcycled foods

What can the current transition of upcycling to food learn from the successes and risks that the protein transition experienced over the past ten years in creating a more sustainable food system in the Netherlands?



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Risks and opportunity for transition: The protein transition compared to the new concept of upcycled foods

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Summary

Food security, climate change and biodiversity loss are all global crises related to the current food system. Because of the urgency of these problems, it is important to act quickly and become sustainable. There are several reasons why the current food system is unsustainable. One-third of all food produced is wasted or lost every year. This has a negative impact on the environment and contributes to both food insecurity and financial losses (FAO et al., 2013). About 17% of all food between retail and consumer is wasted (UNEP, 2021). Before food even gets to the retailers, already 14% gets lost on an annual basis between harvesting the food and retailers (FAO, 2019). This study is about how the current food system of the Netherlands can become more sustainable by comparing the two sub-transitions: the transition of upcycling and the protein transition. Within the food waste reduction toolbox, there is a new emerging concept called upcycling. Aschemann-Witzel et al. (2023) identified three important and common characteristics in the definition of 'upcycled food'. These three characteristics are the following; 1) a product should consist of or contain materials that otherwise would be waste, 2) this material is turned into food that is used for human consumption and, 3) this is done via a process where the value of the product is increased. Upcycling ingredients and products into food is important for the food security of future generations and plays an important role in circular agriculture. This study compares the current transition of upcycling to the protein transition. For both sustainability and food security of food we must transition from a mainly animal protein-based diet towards a primarily plant-based protein diet (Aiking & De Boer, 2020). The protein transition has already been taking many steps for a few years. Meat consumption decreased by 18% between 2007 and 2021 and dairy consumption decreased by 14% within that same period (RIVM, n.d.). Transitions are an ongoing learning process, but it is important to learn from the risks and successes of transitions already ahead. Therefore, this study's research question is as follows: *What can the current transition of upcycling to food learn from the successes and risks that the protein transition experienced over the past ten years in creating a more sustainable food system in the Netherlands?* To answer this main question, several stakeholders are interviewed on both the transition of upcycling and the protein transition. Table 1, chapter 8 shows a list of these stakeholders. Opinions differ on how long the protein transition has been going on and how successful it has been. The targets set for the protein transition are clear. The Dutch national government has set a target of a 50% vegetable and 50% animal protein diet by 2030. Several stakeholders have pointed out that this target is unlikely to be met. Can the protein transition be considered successful if national targets are unlikely to be met? Most respondents said that if you look beyond national targets, the protein transition has indeed been successful in recent years. There are more flexitarians than ever and meat consumption is decreasing. The protein transition has been going on longer than the transition of upcycling and therefore the transition of upcycling can learn from the protein transition. Concluding this research there are a few important parts where the transition of upcycling can learn from the protein transition's risks and successes. In terms of development, upcycling is not significantly behind, and there is an expectation that the transition of upcycling can progress at a faster pace than the protein transition did. Firstly, looking at the protein transition, there is mainly one stakeholder that many respondents agreed on was behind in the transition while having a crucial role, namely the national government. Setting national targets on upcycling for human consumption quickly would provide a clear direction and facilitate a faster transition process by aligning efforts with the other stakeholders. Action must be taken to avoid further delays by the national government in setting national targets for upcycled foods. Secondly, an advantage of the transition of upcycling is that alternative protein sources have been on the market for a longer time. This means that citizens are already starting to get used to dietary changes. This increases the likelihood of consumer acceleration. The potential for consumer acceleration is further

enhanced by the fact that upcycled products do not completely transform an entire market segment and require less dietary and purchasing behaviour adjustment. Thirdly, what is important to keep in mind is to ensure the taste and texture of new products. Sustainability is still in a phase where consumers expect the same level of quality, even if the products or ingredients are different. The protein transition made the mistake of going to the market too soon with some of its products. In some cases this has put consumers off, which is unfortunate. Fourthly, the protein transition made good use of the negative perception of meat and shifted the narrative to something that has a positive impact on consumers' use of alternative proteins. Describing food waste as 'bad for the climate' may seem distant to some people. But if they understand how much their food choices and food waste contribute to whether their children will have enough to eat in the future, they may be more inclined to make different choices. Fifthly, there is a significant economic advantage to be gained by industries with abundant side streams. At a certain point the protein transition made good use of the fact that there was economic value to their products. The transition of upcycling should do the same, in that case organisations and companies will more likely take the risk of investing. Finally, it is important to emphasise that a transition is an evolving process. Everyone continuously learns during a transition. Ultimately, the focus is on achieving the goals and learning from the successes and risks of others along the way, in order to work together to rapidly achieve a sustainable food system. Therefore, it is important that the transition of upcycling takes away the key aspects of the risks and successes of the protein transition of recent years.

Preface

Dear reader,

Before you, you see my master's thesis on the sustainability of the food system by comparing the transition of upcycling with the protein transition. This thesis focuses on the case study of the Netherlands. The main research question is: What can the transition of upcycling learn from the risks and successes of the protein transition over the past ten years, in order to facilitate the transition to a sustainable food system as quickly and effectively as possible?

This master's thesis is the final component that I need to submit before completing my master's degree in Global Environment and Sustainability. I have been working towards this moment for the past two years. Throughout the master's program, I have had the opportunity to learn a lot about the transition towards sustainability, the policies to achieve sustainable developments and various sub-themes within sustainability. In addition to the mandatory internship for my thesis, I decided to do an additional internship at the Ministry of Infrastructure and Water Management. This was followed by my research internship at Foodvalley NL.

During my research internship, I received excellent guidance at Foodvalley NL. I would like to express special thanks to Jolijn Zwart-van Kessel. She provided me with excellent support during my four months at Foodvalley NL; helping me with the process regarding the involvement of relevant stakeholders for my research, and giving me the opportunity to grow and explore within the organisation. Also a special thanks to Thomas and Caroline for creating a pleasant working environment in the Circular Agrifood team and always being willing to answer questions.

I have enjoyed writing my thesis and immerse into a subject that I knew very little about before I started. Along the way I have encountered some personal difficulties and situations. Therefore, first and foremost, I would like to express my immense gratitude to my parents and friends for their constant support and motivation to persevere, even at moments when I felt overwhelmed. Secondly, I would like to thank the interviewees for taking the time to be interviewed. Without them I would not have been able to write this thesis. Finally, I would like to thank my thesis supervisor, Cristina Inoue, for her support and guidance throughout the writing process. It is because of all of these people that the final product you see before you now exists.

Enjoy reading!

Ellen Pouwels
Nijmegen, June 2023

Table of content

Summary	2
Preface.....	4
Keywords	7
List of Table and Figures.....	8
1. Introduction.....	9
2. Question, goals and problem definition.....	11
2.1 Problem definition.....	11
2.2 Research Question	11
2.3 Research aim	12
3. Conceptualisation.....	13
3.1 The SDG's.....	13
3.2 Transition on food	13
3.3 Food losses, food waste and upcycling	14
4. Scientific and societal relevance	15
4.1 Scientific relevance.....	15
4.2 Societal relevance.....	16
5. Theoretical framework.....	17
5.1 Critical literature analysis.....	17
5.1.1 The protein transition.....	17
5.1.2 Upcycling food.....	19
5.1.3 Protein transition combined with the transition of upcycling	21
5.1.4 Stakeholders within the transition towards a more sustainable food system	21
5.1.5 Transition model: Changing the Game.....	23
5.2 Important theories and concepts.....	28
5.2.1 Transition.....	28
5.2.2 Sustainable Food System.....	28
5.2.3 Upcycling	28
5.3 Conceptual model	29
6. Methodology	31
7. Case study: Food transition in the Netherlands.....	33
8. Results	35
8.1 Definition of Upcycling	36
8.2 Definition of plant-based protein.....	37
8.3 Definition of sustainable food system.....	38
8.4 Critiques on transition model 'Changing the Game'	39

8.5 Signs of a transition towards a more sustainable food system.....	40
8.6 The protein transition.....	41
8.6.1 The protein transition ten years ago	42
8.6.2 The protein transition now.....	44
8.6.3 The risks and successes of the protein transition	46
8.7 The transition of upcycling	47
8.7.1 The current transition of upcycling	49
8.7.2 Important elements of the transition of upcycling	50
8.7.3 The future of transition	52
9. Discussion.....	54
10. Conclusion	56
11. Reflection.....	59
12. References.....	60
13. Appendices	66
13.1 Interviewguide.....	66

Keywords

Sustainability

Food system

Upcycled foods

Transition of upcycling

Plant-based protein

Protein transition

List of Table and Figures

Frontpage: Circular Agrifood Systems (Foodvalley, 2023)

Figure 1: The history of proteins on policy and two options for the future (from 2008 on) (Vijver, 2005)	18
Figure 2: A simplified waste hierarchy and the contribution of upcycling (Aschemann-Witzel et al., 2023).	19
Figure 3: The Ladder of Moerman (Tracé, 2019)	20
Figure 4: Upcycled & Upcycling Plant Proteins (Foodvalley, 2022)	21
Figure 5: Figure 1: Influence in the chain. The food chain from producer to consumer (PBL, 2014)	22
Figure 6: Transition model Changing the Game.	25
Figure 7: S-curve in transition model Changing the Game (Ter Haar & Simons, 2019)	26
Figure 8: Conceptual model	30
Table 1: Overview of respondents	35
Figure 9: Definition of upcycling	36
Figure 10: Definition of plant-based protein	37
Figure 11: Definition of a sustainable food system	38
Figure 12: Phases protein transition 10 years ago according to the respondents	43
Figure 13: Phases of the current protein transition according to the respondents	45
Figure 14: Phases current transition of upcycling according to the respondents	49

1. Introduction

Over the years sustainability is starting to play a more and more important role in various sectors. There are multiple global crises, including a food crisis in development towards 2050. The prediction for 2050 is a population of 10 billion people on earth (UN, 2017). All these people need to be fed and the FAO project expects an increase of 60% food demand by 2050 (Alexandratos & Bruinsma, 2012). The current food system faces four main challenges that undermine its sustainability. Firstly, food production involves extensive use of natural resources and generates significant waste, which has negative environmental, economic and social impacts. Secondly, the process of food production contributes directly to environmental pollution through the release of greenhouse gases, pesticides and use of antibiotics, thereby negatively affecting biodiversity and human health. Thirdly, soil degradation and erosion associated with food production further complicate the economic impacts. Finally, inequitable access to food maintains a paradox of overconsumption and obesity on the one hand, and hunger and malnutrition on the other (Aiking & de Boer, 2020). In order to promote a more sustainable food system that is more inclusive and more equally balanced, significant changes are required, which will require the collaborative efforts of multiple stakeholders. In recent years, a growing number of policies have been developed to achieve a more sustainable food system. Simultaneously, innovative ideas are emerging and individuals are increasingly aware of the consequences that their dietary choices have on their surroundings and the earth. Global attention is also being paid to sustainability, as evidenced by the establishment of the seventeen Sustainable Development Goals (SDGs) at global level. One of these SDGs specifically addresses a target for the reduction of food waste and another SDG is about fighting hunger. This highlights the importance of transforming our food system globally. An example of the different policies on EU level are the Farm to Fork strategy or the European Alternative Protein Strategy, these developments have been driven in part by initiatives originating in the European Union. The Netherlands itself for example has a National Protein Strategy. Agriculture is one of the biggest economically strong sectors of the Netherlands. The past decades the food system has already become more sustainable. Agricultural systems align their products with the changing climate and taking into account the species living in agricultural landscapes. An emerging concept in the quest for sustainability in agriculture is circular agriculture. One of the rather unknown concepts in the Netherlands, a component of circular agriculture, is upcycling. The definition of upcycling is not yet unified and will be further elaborated during this study. For now, the following definition is used: *“Upcycling is the creation or modification of a product from used materials, components and products which is of equal or higher quality or value than the original.”* (Sung, 2017, p.3). There are different valorisation levels of upcycling (see paragraph 5.1.2). The idea of upcycled foods that this research is focused on is that the food losses are used for the second layer ‘use for human food’. This is an important difference with upcycling the food to use it for animal feed. Using it for human food will help reduce the amount of people that live in hunger at the moment and in the future and might eventually turn out to have more environmental benefits. There is not a lot yet researched and known about upcycling. This study wants to provide knowledge to help the transition of upcycling develop more efficiently to eventually achieve a more sustainable food system. This is done by comparing the transition of upcycling to the protein transition that has been on its way for some years now. For both sustainability and the security of food it is extremely urgent that we make the transition from a mainly animal protein based diet towards a more plant-based protein diet (Aiking & De Boer, 2020). The transition that is named here, is an example of the so-called Protein Transition (Protein Transition Conference, 2021). Direct consumption of plant proteins is less environmentally damaging as it removes a link, livestock farming, from the chain of producing proteins (Food & Nutrition Delta, 2011). Looking at the risks and successes of the protein transition over the years will

give valuable insights on what lessons the transition of upcycling can learn to accelerate the transition for upcycling side streams to food and including upcycled plant-based proteins in the protein even faster. The protein transition and the transition of upcycling are two examples of sub-transitions within the broader food transition. A food system to be sustainable is defined as followed: *“A sustainable food system is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised”* (HLPE, 2014, p.12). Both sub-transitions play a role in the current food system becoming more sustainable.

2. Question, goals and problem definition

2.1 Problem definition

Food security, climate change and biodiversity loss are all global crises that are influenced by the current food system. Because of the urgency of these problems, it is important to act quickly and become sustainable. In recent decades, the food system has already become more sustainable. Agricultural systems are adapting their products to a changing climate and taking into account the species that live in agricultural landscapes. However, there are also many farmers, producers and consumers who focus on optimising food production purely from an economic perspective. Recently, European and Dutch policy has been steering more and more towards a sustainable food system, i.e. 'From farm to fork', indicating that a transition is needed from the developed food system in the last century, focussing on high yields and cost effectiveness, to a more balanced ecological and economical sustainable food system. However, there are a lot of different layers/projects/stakeholders etcetera within the food system and there is not much information about the best way to make a smooth and quick transition. How can the process best proceed? What are the possible bottlenecks? Who are the key stakeholders in a transition? How can they best be involved in the process? A new sub-transition of the food system transitioning towards a more circular food system is upcycling. *“Upcycling is the creation or modification of a product from used materials, components and products which is of equal or higher quality or value than the original.”* (Sung, 2017, p.3). This research compares the protein transition and the transition of upcycling. The protein transition is also an example of a sub-transition within the food system that is already quite well developed. However, the transition of upcycling, as an element of a circular agrifood system, is still at the beginning of its journey. Because of the need for rapid action, the transition of upcycling should be able to reach its end goals as quickly as possible. However, for this specific transition, knowledge is needed on how to proceed and it is currently unknown who the key stakeholders are, what the key elements and processes are and what risks might need to be addressed.

2.2 Research Question

These days, there is a lot of focus on living more sustainably. Making the food system more sustainable is one way of doing this. The research in this thesis focuses on two parts of realising a sustainable and circular food system; the protein transition and the transition of upcycling. The protein transition has already developed much over the past ten years. The transition of upcycling is only getting started. Can the transition of upcycling learn from the protein transition? How can the transition of upcycling proceed properly and quickly? The main question is therefore as follows:

What can the current transition of upcycling to food learn from the successes and risks that the protein transition experienced over the past ten years in creating a more sustainable food system in the Netherlands?

To answer this main question, a few sub-questions have been formulated;

- What are signs a transition towards a more sustainable food system is happening?
- What has the protein transition looked like from ten years ago until now?
- To what extent can the protein transition be considered successful?
- What are the key aspects that made the protein transition successful or created risks?
- Where does the transition of upcycling to food currently stand?
- What things can the different stakeholders learn about their role and the different phases of transition within the transition of upcycling from the example of the protein transition?

To answer these sub-questions several sources were used. The main three sources used are: a document analysis, literature review and interviews with various stakeholders. These sources used are described in chapter 6, the methodology. Based on the literature read and the information received from different interviews an impression is given on how the protein transition has evolved over the years and what the role of the different stakeholders is in both transitions. This is used to provide insights for the transition of upcycling in the upcoming years.

2.3 Research aim

The aim of this research is to learn from the progress made in the protein transition in recent years in order to contribute to developments of the current transition of upcycling to accelerate the sustainable transformation of the food system. Through an analysis of the developments in the protein transition, this study seeks to provide insights into the current state of the transition of upcycling within the context of a more sustainable food system. The findings aim to enhance our understanding of key aspects and contribute to updating existing knowledge. Furthermore, this research has the potential to enrich existing theories related to the transition towards a more sustainable food system in general, offering new insights that can improve current theories and concepts associated with the transitions towards a sustainable society.

3. Conceptualisation

This chapter has been drafted to provide an overview of the current food system and related concepts. The situation will be presented and examined, accompanied by the inclusion of relevant statistics to illustrate the state of transition of the existing food system, with a particular focus on the two sub-transitions of upcycling and protein.

3.1 The SDG's

The SDGs were adopted by the United Nations in 2015. The Agenda 2030 provides a collective blueprint for promoting peace and prosperity for present and future generations, encompassing both human well-being and the well-being of the planet. 17 Sustainable Development Goals were set to tackle climate change, taking into account everything from economic growth to health, education and reducing inequality (United Nations, n.d.). The second SDG is food security. The prediction for 2050 is a population of 10 billion people on the planet (UN, 2017). All these people will need to be fed, and the FAO project predicts a 60% increase in food demand by 2050 (Alexandratos & Bruinsma, 2012). With increasing urbanisation and incomes, it is expected that there will be an increase in diets containing more animal products (FAO, 2017). Another thing that could increase rapidly in the coming decades is food prices, which could lead to conflicts and migration (Natalini et al., 2015). Therefore, a (rapid) transition to more sustainable diet and food system worldwide is important. With both zero hunger (SDG 2) and responsible consumption and production (SDG 12) being part of the adopted agenda, shows the worldwide responsibility that is felt when it comes to changing the food system. It is important for both the environment as well as for the people living on the planet that the current food system transitions towards a more sustainable one.

3.2 Transition on food

How a transition unfolds is difficult to say at the outset. It depends on many different factors. Leaders in a transition may invest a lot in technological innovation, but after that it is still essential that other actors and people start to adapt to the transition. With the protein transition, many investments have been made in technological innovations the past couple of years (Pyett et al., 2023). *“Transitions for sustainability are driven by optimistic expectations, positive values, and desires to contribute to a better world. Yet, because transitions entail an overhaul of complete sectors, they are also ridden with uncertainties, conflicts, setbacks, hindrances, failures, and disappointments”* (Pyett et al., 2023, p. 485). There are four challenges to the protein transition that are not well known. These four challenges will be explained to give an insight into how the protein transition happens. Firstly, it is important to understand that there is no such thing as 'the consumer'. Many different factors, such as cultures and financial situations, influence consumption patterns. For example, if the transition to more plant-based protein were to occur and products were to become very expensive, only an elite group would be able to pay for these products. This would affect the equity of the transition. Secondly, *“as long as meat is still the visible default, it acts as a societal norm influencing individual consumer behaviour”* (Pyett et al., 2023, p. 486). What would help is to give information about the consumers that already changed their behaviour. This could create more dynamic norms within society. Thirdly, an important realisation is that the transition does not come down to choosing explicitly one product over the other. Eating more plant-based, and more sustainable food overall, should become an integrated alternative in people's cooking, grocery choices and availability elsewhere outside their homes (Pyett et al., 2023). Lastly, *“the broad ideological base in Western society is still strongly pro-meat as evidenced by the resistance in various countries to taxing meat and to targeted policies to reduce livestock numbers, such as in the*

Netherlands" (Pyett et al., 2023, p.486). For the protein transition to become even more successful, the ideology around it needs to change.

Food should become more available in the next three decades as the world population is still increasing. There is still a lot that can be improved regarding both consumption as well as production in the current food system. I.e. when the prices of food would go up, this could have a positive impact on the reduction of food waste, as well as on the demand of animal protein. *"For the food system to become more sustainable it should be made more efficient"* (Aiking & de Boer, 2020, p.517). It is noticed that food is often lost and wasted. This should be reduced within the whole global food supply chain, including the households in particular (Eberle & Fels, 2015). Meat production that relies exclusively on sustainable grazing practices, the rotation of forage with food crops, and the optimal use of crop and processing residues is inherently limited and even then *"it will not be able to satisfy global demand anticipated for 2030 and even less so for 2050. Innovations and productivity improvements alone cannot prevent further increases in the already significant environmental burden of meat production and to reduce them we will also need to moderate our meat consumption."* (Smil, 2014, p.68). It is important that the consumers are also included as an important part of the solution towards a more sustainable food system.

3.3 Food losses, food waste and upcycling

Food waste and losses are a global problem. One third of all food produced is wasted every year. This has a negative impact on the environment and contributes to both food insecurity and financial losses. Annually, 1.3 billion tonnes of edible food is lost and wasted worldwide (FAO et al., 2013). Reducing this amount increases the number of people in need that can be fed, thus reducing food insecurity (Reynolds et al., 2015). The economic cost of this food waste is estimated at 750 billion every year (FAO et al., 2013). About 17% of all food between retail and consumer is wasted (UNEP, 2021). Before food even gets to the retailers, already 14% gets lost on an annual basis between harvesting the food and retailers (FAO, 2019). Managing food waste can have financial benefits. In addition, food waste produces about 4.4 billion tonnes of CO₂ per year (FAO, 2015). Reducing food waste will reduce its negative impact on the environment.

Within the food waste reduction toolbox, there is a new emerging concept called upcycling. This term is increasingly being used in the food sector and, according to trend reporters Business Wire (2021) and Euromonitor International (2022), there is enormous market potential. Upcycled food is food that contains unmarketable ingredients (e.g. damaged food products, by-products and food preparation waste). These ingredients would otherwise have not been intended for human consumption (Moshtaghian et al., 2021). The concept of 'upcycled food' introduces a key concept for circular economy in the food sector. It aligns with policy trends that support 'closing the loop' in various industries, including the food sector. With this being the conceptualisation, chapter 5 will focus more on the definition of both the protein transition as well as the transition of upcycling and how they interact with each other.

4. Scientific and societal relevance

4.1 Scientific relevance

There have been various studies on the protein transition, as discussed in paragraph 5.1; The critical literature review. However, research on upcycling is lacking because the concept is still very new. There is not much literature on how this transition can proceed in the best way. Given the emerging concept of upcycling, this study contributes to the existing literature by broadening our understanding of the term itself. A unified definition of upcycling has not yet been established. Sung (2015) shows how the definitions presented in different reports have different focuses. This study aims to shed light on how different stakeholders perceive and define upcycling. As a result, it adds to the overall knowledge of the definition of upcycling and may assist in the formulation of a unified definition. The concept is perceived as novel mainly because it has recently received increased attention on a larger scale. However, for millennia, upcycling has been practiced as an individual endeavour, transforming waste or used items into objects of higher value or quality (Szaky, 2014). According to Szaky (2014), the practice of reusing and upcycling was widespread around the world before the industrial revolution, and is now more common in developing countries due to limited resources. However, it is still new on a larger scale. This research has added value in facilitating a smooth transition of upcycling on a larger scale. The protein transition has been happening on a larger scale for a longer time now. Therefore, much could be learned from the protein transition, which is also a transition towards a more sustainable food system. By analysing the protein transition and determining how best to develop these transitions, future transitions towards a more sustainable food system, and in this case the transition of upcycled food, could start more easily and develop more efficiently. Transitions will happen quicker and more easily. The comparison of the two transitions will also add on existing literature. It will add knowledge on how certain transitions can be compared and therefore how there can be learned from previous transitions.

Upcycling is an integral component of the circular economy. As such, it is crucial that this transition happens in order to reduce the use of raw materials and thereby enable the world population to be fed. However, the current literature on the actual impact of upcycling, such as its effectiveness in reducing greenhouse gas emissions, remains limited. From one recent research it becomes clear that in a majority of the fieldwork they did was followed by the result of a carbon footprint that was 25% lower for upcycled by-products than the carbon footprint associated with the original virgin ingredients and products (Jain & Gualandris, 2023). The lack of literature on the environmental impacts of upcycling underlines the importance of further research in this area. This study can contribute to a better understanding of how to accelerate the transition of upcycling. By accelerating the transition process, upcycling can gain wider recognition, leading to increased investment of resources, both in terms of time and money, in valuable research efforts.

Taking a realistic perspective on transition models, it becomes clear that they often involve the mapping of a complex reality. Most transition models tend to overlook certain factors or fail to consider all relevant aspects. As a result, practical implementation often differs from what the model suggests. This study aims to link the practical context to a transition model. By critically examining the used transition model, it becomes possible to incorporate elements that may be important in practice but are not explicitly captured by the model. Therefore, his research will provide knowledge on what works in practice and what might need to be improved for transitions towards a more sustainable food system. Where are the gaps?/What went wrong?/What went well? during the protein transition. Ultimately, knowledge of how best to make sustainable transitions will play a small part in solving the problem of climate change. Comparing the process of the protein transition over the last ten years with where the transition of upcycling stands now, will give an overview of the

road ahead for the transition of upcycling and could be at the beginning of how to best manage a new transition.

4.2 Societal relevance

Today's society needs to become more sustainable in order to tackle global crises such as climate change and biodiversity loss. If we do not change radically by 2030, the consequences will be irreversible. For the world to become more sustainable, changes must be made across the whole of society. This means that the food system must also change. The current food system is highly unsustainable. For example, the meat industry is one of the largest contributors to greenhouse gas emissions. Another example of the unsustainability of the food system is the fact that it takes 3 to 10 kg of plant protein to produce 1 kg of meat protein (Aiking, 2008). This clearly shows that more people could be fed with the same amount of resources if plant-based proteins were consumed directly. Furthermore, skipping the intermediate step of animals in the production chain results in fewer emissions per consumption per person. Ultimately, this shift is necessary to achieve global food security and minimise environmental impact. This underlines the importance of the protein transition, which aims to transform the current food system into a sustainable one.

Circularity is another crucial aspect of a more sustainable food system. In order to eventually feed the entire population, we need to increase food production. However, current production methods and resource use are inadequate. It is essential that responsible practices are adopted with the natural resources at our disposal. Upcycling aims to maximise the use of all available resources. Turning food waste or losses into food through upcycling contributes to a more circular food system. The transition of upcycling to food is crucial in today's society to ensure the provision of food for future generations. This research will add to the knowledge available on upcycling. It is important for society to have more knowledge about upcycling, for food security in the future.

The responsibility for the change towards a more sustainable food system lies with different stakeholders in society. For a whole system, in this case the food system, to change, everyone's behaviour has to change. Consumers need to be willing to buy different products or change their grocery shopping habits, and governments may need to change their policies. The ingredients for the products need to be available, the products need to be produced and placed in supermarkets. In order to change a whole system that involves a lot of people, everyone has to be willing to change things in their work or lifestyle. This research will provide more information on how to make the transition to a more sustainable food system more efficient and also gives more information on why it is important that the food system becomes more sustainable. With this information, different stakeholders may be more willing to change. If they know the risks beforehand and are more certain about the positive effects a transition can have, they will feel more comfortable with change and may be willing to take a leap of faith even earlier.

5. Theoretical framework

5.1 Critical literature analysis

As sustainability becomes an increasingly important issue in today's world, it is being integrated into many areas of our daily lives. One of them is food. In order to create a more sustainable world, it is important to also look at the production and consumption of food in a sustainable way (Matassa et al., 2016). In this research, the focus will be on the transition towards a circular agrifood system with total use of raw materials via upcycled ingredients to foods by comparing it to the protein transition from ten years ago until now.

There are a number of reasons why the current food system is unsustainable. As mentioned in the introduction (chapter 1) there are four; food production generates a lot of food losses and waste, food production directly leads to pollution (e.g. greenhouse gas emissions, pesticides and use of antibiotics), soil quality continues to decline and the accessibility of food is inequitable (leading to overconsumption and obesity on the one hand, and hunger and malnutrition on the other). (Aiking & de Boer, 2020). *“Thus, food consumption does not have impacts on human health, exclusively, but huge overall impacts on ecology, economy and society”* (Aiking & de Boer, 2020, p. 520). To create a more sustainable food system, a lot needs to change and different stakeholders will have to work together.

5.1.1 The protein transition

For a transition it is important to bring supply and demand together. A transition can be seen as a point on the horizon, but the road there is unknown and often chaotic and it is not sure how and when to arrive at the destination. Regarding the system of animal protein there already is a growing consensus *“that animal protein has disproportionate environmental impacts, particularly when produced in intensive production systems employing massive use of feed crops (Aiking, 2014; McMichael et al., 2007; Smil, 2001; Steinfeld et al., 2006; Westhoek et al., 2011)”* (Aiking & de Boer, 2020, p. 515). There are various options that could be used to make either food production or consumption more sustainable. Various trends are already being implemented to change either food production or consumption. However, food production is accelerating and so are the environmental impacts of food production. Also, smallholder farmers still produce only half of the world's food (Johnson, 2017) and funding for this remains a bottleneck. There is insufficient capital and a lack of land ownership for smallholders to produce. These are the bottlenecks that are driving smallholders out. As this happens, one of the most important parts of our food system is now in the hands of fewer people (FAO, 2017). The consumption of food is a different story. This transition is going in two directions. On the one hand, developing countries in the semi-periphery are over-consuming meat and dairy products, just as Western Europe did half a century ago (Grigg, 1995). On the other hand, in Europe, for example, the transition away from animal products is about to break through (Geijer, 2017). Protein plays an important role in food security. *“Malfunction is often caused by a lack of protein, rather than a lack of calories”* (McLeod & FAO, 2011, p.6). It is therefore important that when people are fed, the meals include enough protein. When it comes to climate change plant protein has a lot more advantages than animal protein. For example, *“intensive animal protein production requires 10-1000 times more water than plant protein (Aiking, 2011)”* (Aiking & de Boer, 2020, p.517). Also from a climate change perspective it is important that the transition towards more plant protein happens quickly to decrease the impact the current food system has on greenhouse gas emissions and biodiversity. In addition to environmental reasons, animal rights and animal welfare are also reasons for individuals to adopt a more plant-based diet. Today's intensive farming practices often confine cows, calves, pigs, chickens, turkeys, ducks and other animals in densely populated enclosures such as stalls, cages, crates or sheds. These conditions often prevent them from moving freely or even turning around. For some people, coexistence with nature and other living creatures

on Earth is a motivating factor to consume fewer animal products. Likewise, current animal production practices in many regions are a reason for some people to reduce their consumption of animal products.

The transition towards more planetary protein, is an example of the so-called Protein Transition (Protein Transition Conference, 2021). For both sustainability and the security of food it is extremely urgent that we make the transition from a mainly animal protein based diet towards a primarily plant-based protein diet (Aiking & De Boer, 2020). The production of plant-based protein is more efficient than the production of animal protein. Direct consumption of plant proteins is less environmentally damaging as it removes a link, livestock farming, from the chain of producing proteins (Food & Nutrition Delta, 2011). In 1945 a shift happened. Increased organisation and innovation, rising incomes and the homogenisation of the post-1945 European menu all contribute to accelerating the transition. Food choices are no longer dictated by the natural rhythm of agriculture, and food becomes a "socio-economic field in itself" with a global exchange of ingredients. After a century of development, the food production system begins to excel in terms of yield per hectare. It is therefore remarkable that the consumption of plant-based proteins remained consistent between 1961 and 2001. Since the 70s there were protests that started to happen more often and intensified in 2000/2001 and 2008/2009. This was the start of the so-called protein transition (Hoogland et al., 2008).

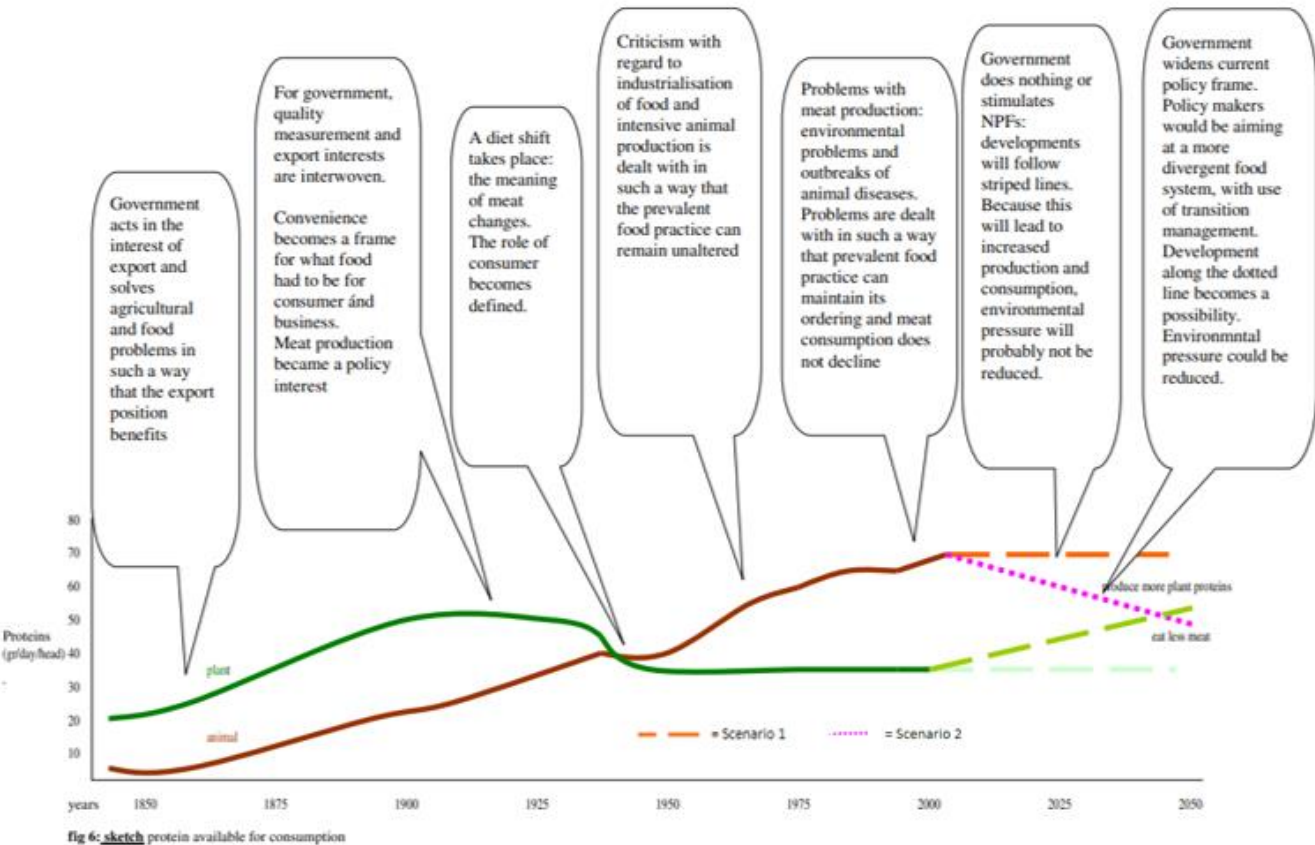


Figure 1: The history of proteins on policy and two options for the future (from 2008 on) (Vijver, 2005)

The figure above (figure 1) shows how the protein transition has evolved over the years since 1850 and what was expected for the future in 2008. There are two scenarios: a government that does nothing and keeps animal protein consumption at the same level. Or a government that takes

action and reduces animal protein and increases plant-based protein. The reality is that since 2008 the Dutch government has taken steps to move towards a more plant-based food system and started to follow scenario 2. Based on recent research in the Netherlands, RIVM (n.d.) shows that the total meat consumption of people aged 7-65 has decreased by 18% between 2007 and 2021. The consumption of dairy products has also decreased, in this case by 14%. These numbers show that there has been a real shift towards a more plant-based diet since 2007. An example of how the government has taken action is adopting the agenda of the SDG's (Sustainable Development Goals) in 2015. In order to achieve the SDG's by 2030, a circular economy is urgently needed. (Aiking & de Boer, 2020). *“Effective governance mechanisms must be organised to deal with these different views and find synergies to address trade-offs between the different parts of the protein supply chain, within the context of multi-layered food systems (local/regional/urban, national, global) and the presence of many different stakeholders”* (Pyett et al., 2023, p.537).

5.1.2 Upcycling food

The term ‘upcycling’ is in contrast with ‘recycling’. Recycling can also be seen as ‘downcycling’ (Aschemann-Witzel et al., 2023). This is also shown in the figure on the right (figure 2). Recycling means that the material is downgraded and therefore also loses its value. It can be seen as just another stage on the way to disposal (Braungart et al., 2007). *“‘Upcycling’ in contrast would be ways of reusing that allow the material to become purer and better or add additional value to society”* (Aschemann-Witzel et al., 2023, p.133). Upcycling can be defined in different ways; *“Reuse of discarded materials which results in an increase in ‘value’”* (Bridgens et al., 2018, p.146) or *“a process of converting materials into new materials of higher quality and increased functionality”* (Ellen MacArthur Foundation, 2019).

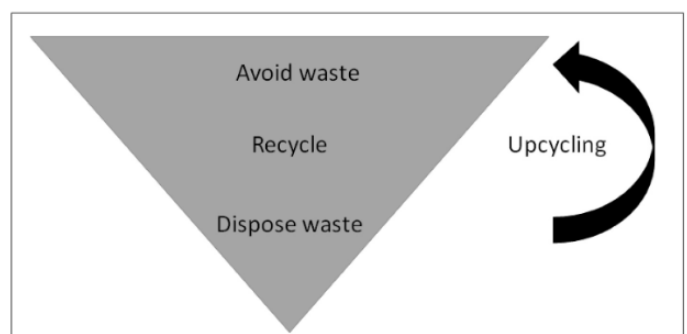


Figure 2: A simplified waste hierarchy and the contribution of upcycling (Aschemann-Witzel et al., 2023).

Recently, an upcycled food association has been formed in the USA. They are developing a definitional framework and are launching a certification for ingredients and products (Upcycled Food Association, 2022). The Upcycled Food Association also suggested a definition for upcycled foods in 2020; *“Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment”* (Upcycled foods definition task force, 2020, p.2).

Aschemann-Witzel et al. (2023) compared the various definitions and identified three important and common characteristics in the definition of ‘upcycled food’. These three characteristics are the following; 1) a product should consist or contain materials that otherwise would be waste, 2) this material is turned into food that is used for human consumption and 3) this is done via a process where the value of the product is increased. *“When these three come together, the food can be regarded as ‘upcycled food’”* (Aschemann-Witzel et al., 2023, p.133). These three points are explained as follows.

- Waste

An upcycled product can only be called upcycled if it starts with a product or ingredient that would otherwise have been wasted. It starts with rescuing material from the bottom, shown in Figure 2 as 'Dumping'. The hierarchy in Figure 2 shows how to deal with waste in a preferred order from an environmental perspective. Step one would be to dispose of waste properly, better still step two would be to recycle and prevent waste. At the top of the

pyramid is prevention, followed by upcycling. This brings food back to its intended use and diverts it from disposal.

- Food

The second point that is needed for food to be upcycled is: The product should be for human consumption. *“This characteristic is important to underline because even though a re-use as feed or pet food might as well be a valuable upcycling of material, it is not an example of upcycled food, given food is per definition for human consumption”* (Aschemann-Witzel et al., 2023, p.133).

- Value

The third point is that the process must involve value creation. This can mean one of two things. On the one hand, it could mean that the value moves up the hierarchy as shown in figure 3, adding value to the environment. On the other hand, it could mean that the value is added to the product itself. This means that the direct user would experience benefits from using the product.

Based on these three characteristics, Aschemann-Witzel et al. (2023) proposes two types of upcycled food. Both have the potential to contribute to the conservation of natural resources. There are upcycled foods that are produced from alternative uses. This means that the ingredients of the products produced are edible but would otherwise been wasted. The second type of upcycled foods are produced in a novel use sense. This means that the product is made from ingredients that would normally not be considered edible. In one way or another, these products are made into new ingredients for novel uses of upcycled food.

In the process of upcycling, there are several steps. The theoretical model ‘Ladder of Moerman’ (figure 3) shows these different steps in a pyramid shape. The lowest level is 'dumping', indicating that no upcycling is taking place. The highest form of upcycling is the prevention of food waste. As mentioned above, the top of the pyramid is one of the prerequisites for food to be considered 'upcycled' (Aschemann-Witzel et al., 2023). The top of the pyramid can be seen as the best form of upcycling for the environment. The lower the pyramid, the lower the environmental benefits. In some parts of the world, food waste is already commonly used as animal feed (Salemdeeb et al., 2017). This is the fourth level of the Ladder of Moerman. The idea of upcycling food, which is the focus of this research, is that food waste is used for the second layer 'use for human food'. This is an important difference to upcycling food for use in animal feed. Using it for human food will have more environmental benefits, will help reduce hunger and in the future and prevent too much raw materials being used for producing food.

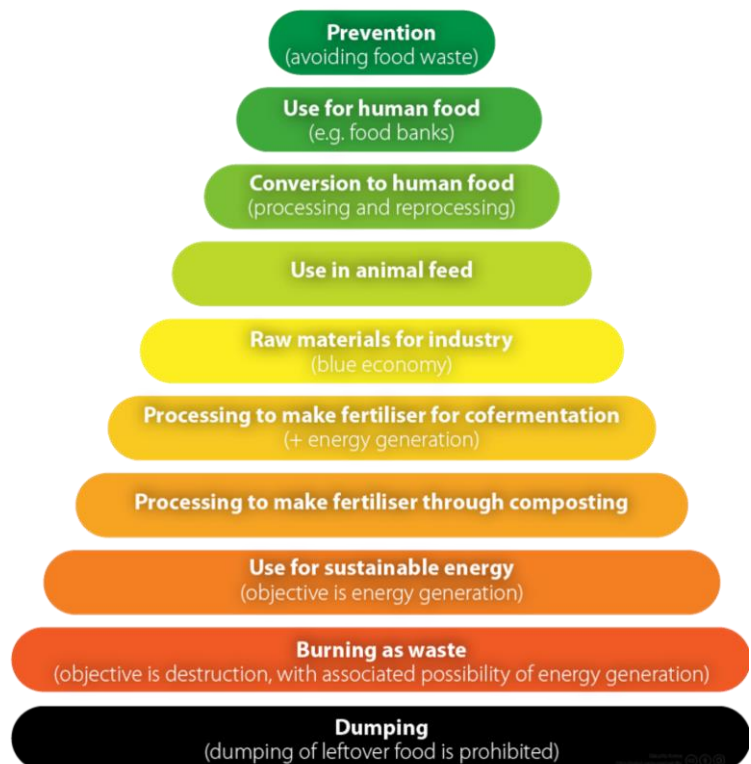


Figure 3: The Ladder of Moerman (Tracé, 2019)

5.1.3 Protein transition combined with the transition of upcycling

To provide an illustration of how the protein transition and the transition of upcycling can be combined, the following image has been used. The two transitions are separate entities but want to meet the same goal. As they work towards the same objective, there are also several similarities between them. Those similarities are explained in the image down below (figure 4).

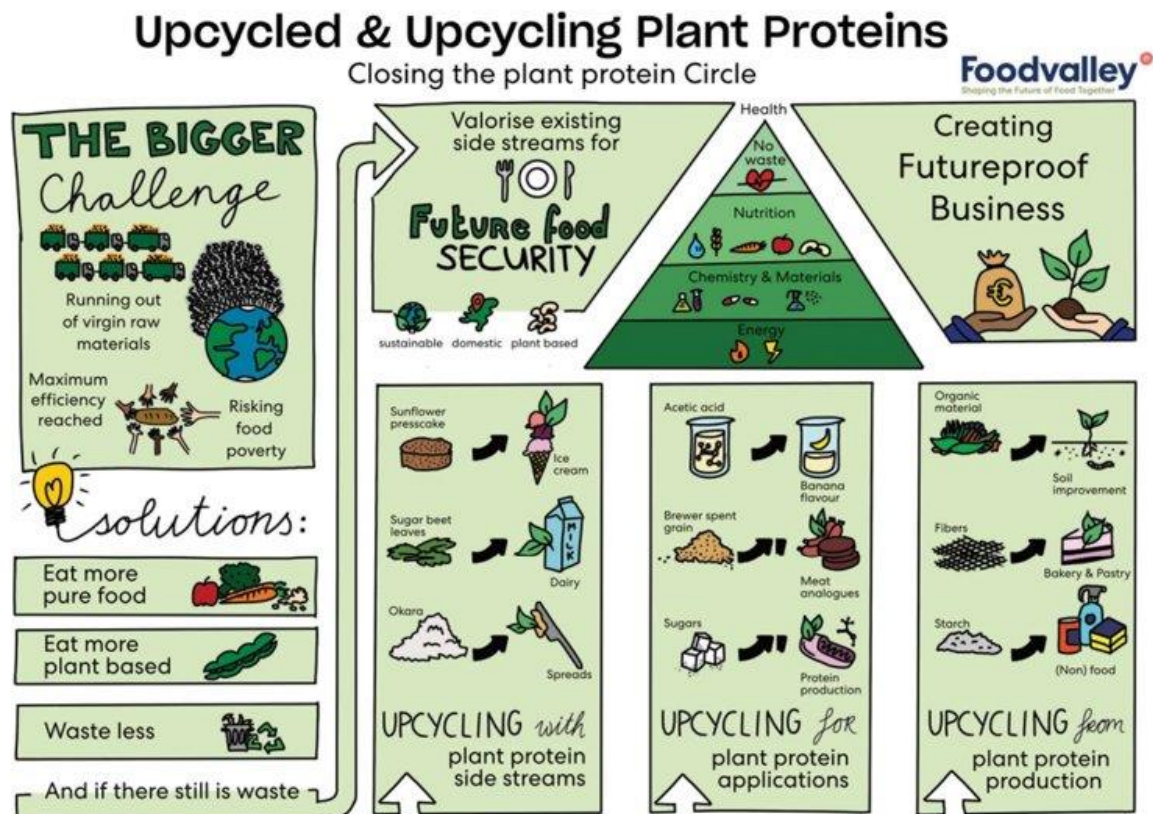


Figure 4: Upcycled & Upcycling Plant Proteins (Foodvalley NL, 2022)

As can be seen in the image (figure 4) the protein transition and the transition of upcycling can converge in three ways. Firstly, upcycled food could be produced from the by-products of plant-based proteins, such as beet leaves being transformed into dairy alternatives. Secondly, upcycled ingredients could be created and used in the production of plant-based proteins, for instance, using brewer's spent grain in the manufacturing of meat analogues. Lastly, upcycling could be applied to plant-based proteins themselves, for example with fibres being used to create pastries.

5.1.4 Stakeholders within the transition towards a more sustainable food system

A number of stakeholders have a role to play in the transition to producing more upcycled food. The acceptance of upcycled food can also be influenced by public beliefs and attitudes. This is shown by the theory of Planned Behaviour. How people behave is related to their beliefs and attitudes (Ajzen, 1991). For example, if consumers have a preference to eat more sustainable food, they are more likely to buy upcycled food (Coderoni & Perito, 2020). Similarly, if consumers are concerned about the consequences of food waste, they are more likely to make changes (McCarthy et al., 2020). There are also things that can have a negative impact on acceptability, for example, if a product contains unfamiliar ingredients, the consumer may find it less attractive to buy (Moshtaghian et al., 2021). However, a transition is not only possible if consumers change their

behaviour. There is a whole network behind the consumer that influences their behaviour and that needs to make its own transition to achieve the best outcome.

Research on the history of innovation shows that when a system changes, different actors (and hence the resulting elements) co-evolve (Geels, 2002). When one actor takes a step, the others react to it, and so on. Sequentially, therefore, the directions of system components shift. System components such as social norms, laws, alliances, institutions, product/service/infrastructure systems and knowledge development. It is a long-term interaction of actors and elements and the outcome does not necessarily follow the will of a few (Te Riele et al., 2000; Rotmans et al., 2001).

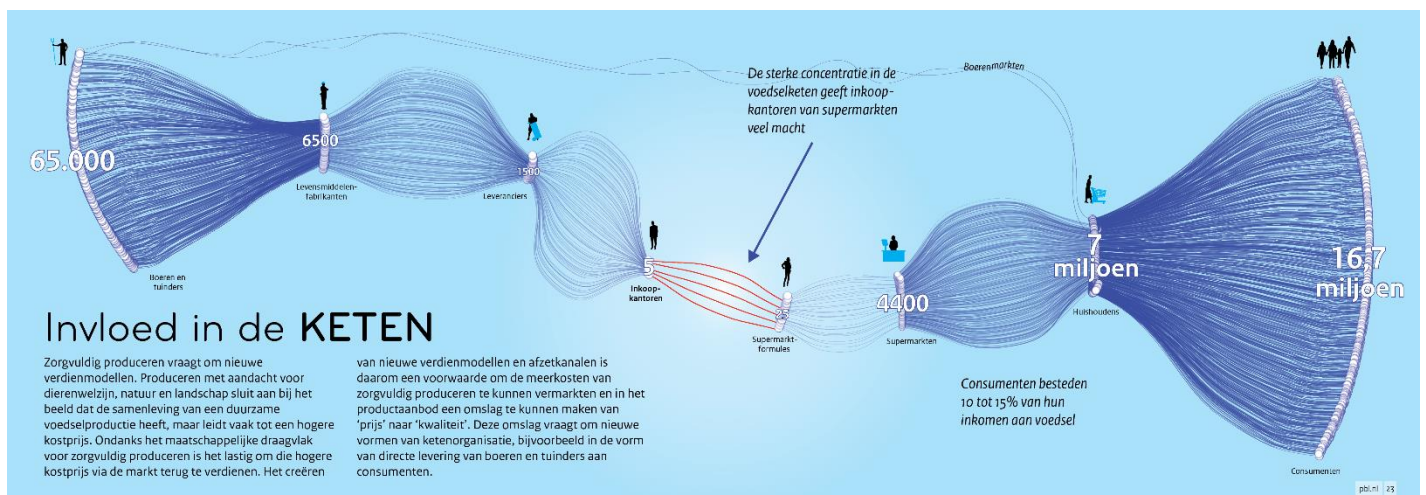


Figure 5: Influence in the chain. The food chain from producer to consumer (PBL, 2014).

As shown in figure 5, there is a long supply chain in the Netherlands from the production of food to its consumption. In this big chain food waste is part of the process and the transition to upcycling food has to become part of this big chain and the cooperation between different stakeholders. According to this figure, there are eight large stakeholders involved in the Dutch food chain. These stakeholders are from left to right (figure 5): farmers and gardeners, food producers, suppliers, buying companies, supermarket concepts, supermarkets, households and consumers (PBL, 2014). These stakeholders also play an important role in the transition. For example, animal protein products and dairy products are an important economic income for supermarkets and suppliers (Aiking & de Boer, 2020). However, if animal protein comes from “intensive production systems, these are wasteful of plant protein from an environmental point of view and inherently, therefore, wasteful of the resources required to grow feed crops, such as land, water, phosphate and fuel.” (Aiking & de Boer, 2020, p.516). It is crucial for all stakeholders to make the transition to a more sustainable food system. What is important to note is that different actors may have different levels of power in different transitions. In one transition, the government may have significant power, while in another transition, industry may have more influence. It remains a multi-actor collaboration, but it is important to remember that power structures may exist in certain cases. The overall challenge is that in 2050 the food system needs to bring food security to all 10 billion people in the world (Foodvalley NL, 2021). The goal to reach in 2050 is: “Tasty, affordable, healthy and sustainable food, produced with respect for animals and our planet.” (Foodvalley NL, 2021). In order for the upcycling of currently underused or otherwise wasted ingredients to be established throughout the system, two things are required: circularity or system thinking by all stakeholders and consideration of the boundary conditions. Within the food system, system thinking means being aware of all the interdependencies and complexities. It is essential to consider the boundary conditions of each independent case and within each value chain when looking for a solution. Different cases can have different boundaries that should be taken into account (Aschemann-Witzel et al., 2023). With the

food system an example could be taste and texture. These are two elements that need to be taken into account for the food system to transition successfully, and bad taste and texture could be seen as a boundary not to cross.

5.1.5 Transition model: Changing the Game

This research uses the 'Changing the Game' transition model by Lucas Simons and André Nijhof (2020). The model is retrieved from the source Simons & Nijhof (2020), however it is further elaborated on scientifically in Nijhof et al. (2022). Because it is retrieved from Simons & Nijhof (2020) this is the source chosen to refer to. There are several transition models that are known. Within this paragraph there will be elaborated on why the transition model of 'Changing the Game' was chosen for this study. One of the examples of other transition models is the multi-level perspective of Geels (2011). Geels (2011) suggests that there are three different levels of transition. It starts with niche, followed by regime and lastly landscape changes. When it comes to changing the food system, this would also be a good transition model to use, because it is also necessary to fully change diets of people and therefore the landscape. However, Geels (2011) does not focus enough on the fact that the landscape has to change as well. Also does Geels (2011) not show the role of various stakeholders and how they have to develop towards a more sustainable food system. In addition, there is limited emphasis on the indirect drivers of the food system and their impact on climate change. Indirect drivers of the food system include, for example, consumer preferences shaped by culture or the need to increase food production due to population growth.

Another well-known transition model is Kate Raworth's doughnut model (2012). This model combines the concept of planetary boundaries with the complementary concept of social boundaries. The model takes the form of a doughnut, with planetary boundaries forming the outside border and social boundaries forming the inside border. The strength of this transition model for this study lies in its dual focus on both the social and climate aspects as reasons for the need for transition. This also applies to the food system. On the one hand, the transition is needed to avoid exceeding our planetary boundaries and to reduce the environmental impacts of the food system, such as emissions and biodiversity loss. On the other hand, the global population continues to grow and it is important to ensure that everyone can live without hunger, as stated in SDG 2. However, the transition model also places great emphasis on the interdependence between the social and climate aspects. In contrast, this study focuses less on examining the interdependence between these two aspects and instead approaches the food transition separately, considering each aspect as an individual solution. In addition, the model provides limited guidance on how to achieve a transition, in this case to a more sustainable food system, but is primarily providing general guidelines within which the transition should take place.

A third model considered for this research is Dobson's model (1996). Dobson developed a model that describes four different states (A to D) of the sustainability concept. This model illustrates that sustainability is a desirable, knowable, and feasible end-situation. It is viewed as an open-ended process of societal search, guided by sustainability as an ethical and political value. What aligns with the transition towards a sustainable food system is that sustainability is seen as the ultimate desired solution in Dobson's model. It also takes into account the needs of both present and future generations. However, the model does not provide clear direction on how a transition should unfold. This is essential for this research in order to examine how the transition of upcycling can learn from the protein transition.

The transition model 'Mapping Sustainable Development' of Hopwood et al. (2005) is the fourth model that this study compares with the transition model of Changing the Game. Similarly to Kate Raworth's model, Hopwood's model also effectively combines humanity with nature/environment. In order to better understand sustainable development, Hopwood et al. (2005)

propose "*a mapping methodology based on combining environmental and socio-economic issues*" (p. 41) to provide a more comprehensive perspective. Three overarching perspectives are overlain on this map regarding the nature of the changes required in society's political, economic and human-environment relationships to achieve sustainable development: the belief that it can be achieved within current structures, known as the status quo; the recognition of the need for significant reform while maintaining some continuity with existing arrangements, known as reform; and the understanding that radical change is essential because of fundamental flaws in society's economic and power structures, known as transformation (Rees, 1995). This model does not entirely align with the transition of the food system. In the case of the food transition, it is crucial for it to undergo a true transformation of e.g. people's diets and buying behaviour. Thus, this transition only partially corresponds to the Hopwood et al. (2005) transition model. However, it does effectively illustrate how different individuals may perceive the protein transition. According to Hopwood et al. (2005), "*supporters of the status quo recognize the need for change but see neither the environment nor society as facing insuperable problems*" (p. 42). Reformers recognise the escalating problems and are critical of the prevailing policies of various companies, governments and social trends. However, they do not anticipate a potential collapse of ecological or social systems, nor do they see the need for fundamental change. In both the protein transition and the transition of upcycling, it is essential that fundamental change takes place in order for the food system to become sustainable. What this model does well is incorporating stakeholders into the framework, thereby representing the different perspectives and insights of stakeholders regarding the transition towards sustainable development.

The last model to be discussed is the IPBES conceptual framework (Díaz et al., 2015). This model also emphasises the combination of nature and people, which fits well with the food transition. In addition, the model has a strong focus on nature and the benefits that people derive from it. This is certainly relevant to the transition to a more sustainable food system, as the goal is to feed everyone in cooperation with nature. A notable aspect of the IPBES transition model is that it starts with a relatively small segment where a shift towards a new idea/concept occurs, followed by a clear depiction of the impact on factors such as legislation, regulations and other indirect drivers, and how these in turn affect the direct drivers. The model then examines the impact on nature and ultimately the quality of life. It provides a comprehensive understanding of the consequences of innovation, but only represents a small part of the niche/innovation itself. For the food transition, this innovation aspect is crucial as it involves entirely new products and ingredients. Similar to other models, the indirect drivers are not prominently visible or addressed in the IPBES model, whereas they are better integrated in the transition model of "Changing the Game". Where IPBES excels is in bringing together different stakeholders, although the model does not clearly illustrate the role or growth of stakeholders within a transition.

After reviewing various transition models, the choice was made to use the transition model 'Changing the Game' by Lucas Simons and André Nijhof (2020) for this research. One of the reasons for this is that it has a greater focus on different stakeholders. All the different market actors within transition are taken into account within this transition model (Nijhof et al., 2022). The five stakeholders included are: industry (such as primary producers and retailers), government (such as municipalities and the national government), NGOs, Financial Institutions and Research Institutions. All have their role to play within a transition. This research will use the point of view from the different stakeholders to distinguish what phase the transition of upcycling currently is in and how the protein transition has developed over the years. The distinguishing of different stakeholders and their role is why the 'Changing the Game' model from Simons & Nijhof (2020) is preferred over the other transition models. It provides a clear picture of the current state of transition through bullet points per phase per stakeholder, illustrating the roles that stakeholders need to play and what still remains to come within the transition.

©from Changing the Game – Lucas Simons & André Nijhof	1. Inception	2. Competitive advantage	3. Pre-competitive collaboration	4. Institutionalization
Industry	<ul style="list-style-type: none"> Stop denying the issue Partner with NGOs Pilots, CSR projects Identify solutions 	<ul style="list-style-type: none"> Business models Use labels Engage value chains Rankings and benchmarks 	<ul style="list-style-type: none"> Communicate a non-competitive agenda Join platforms Be inclusive Sector strategy 	<ul style="list-style-type: none"> Lobby new normal Recognize politicians Comply legislation Take on subsequent issues
Government	<ul style="list-style-type: none"> Embrace the crisis Long-term vision Experiments and fund projects Solution principles 	<ul style="list-style-type: none"> long-term vision Challenge companies Launching customer Recognize leaders 	<ul style="list-style-type: none"> Develop measures Support platforms Influence behavior of consumers Tax incentives 	<ul style="list-style-type: none"> Political leadership Announce legislation New normal Remove the laggards
NGOs	<ul style="list-style-type: none"> Raise awareness Join projects Campaign against laggards Argue for next steps 	<ul style="list-style-type: none"> Reward first movers Support frontrunners Name and shame time to move on 	<ul style="list-style-type: none"> Engage frontrunners Join platforms Be a watchdog Transparency about desired future 	<ul style="list-style-type: none"> Lobby Policy developers Monitor progress Shift attention to new issues
Financial Institutions	<ul style="list-style-type: none"> Donate to charity Finance projects Apply negative screening Clear positioning 	<ul style="list-style-type: none"> Provide funding Financial benefits Engage all clients Best-in-class screening 	<ul style="list-style-type: none"> Join platforms Collaborate Create financial solutions for scaling Invest long-term 	<ul style="list-style-type: none"> Lobby Investment criteria Exclude clients Potential risks linked to new issues
Research Institutions	<ul style="list-style-type: none"> Prioritize issues Study system loops Study practices Identify good practices 	<ul style="list-style-type: none"> Showcase good practices Investigate failures Develop benchmarks Research agenda 	<ul style="list-style-type: none"> Change agenda Be objective Calculate potential impacts Scientific evidence 	<ul style="list-style-type: none"> Provide overview Argue policies Monitor impact Identify new and emerging issues

Figure 6: Transition model Changing the Game. Retrieved from: <https://www.duurzaam-ondernemen.nl/lucas-simons-andre-nijhof-systeemverandering-is-wel-mogelijk/>

The model from Simons & Nijhof (2020) is shown in the figure on the right (figure 6).

The transition model of Simons & Nijhof (2020) states that a transition can be initiated, driven, and accelerated towards a systematic change. It is possible to work towards a vision. Provided the right strategy is followed everyone could and even should make an important contribution to system change and market transformation from their own role. The problem with systematic change is not that there is not enough action. Problems might occur as the change is not organised and that there is no real strategy behind it. This model (figure 6) shows that a transition to change a market and system cannot be made at once.

There are 4 phases distinguished:

1. Inception: the problem is recognised and projects and pilots are getting started. The objective should be to learn what the impact of different solutions might be.
2. Competitive advantage: ensuring that the market can start competing on the solutions that are identified in the first phase. Competition is the best mechanism to get companies involved and to get the solutions tested in reality and more efficiently.
3. Pre-competitive collaboration: competing parties come together and scale up solutions and remove barriers. A key question in this phase is what the role is of government vis-à-vis business, banks and NGOs. This is a very delicate phase.

4. Institutionalisation: the solutions from the third phase become the new normal through legislation, changing policies, norms and institutions. When this is achieved, the cycle starts over again with different and new issues.

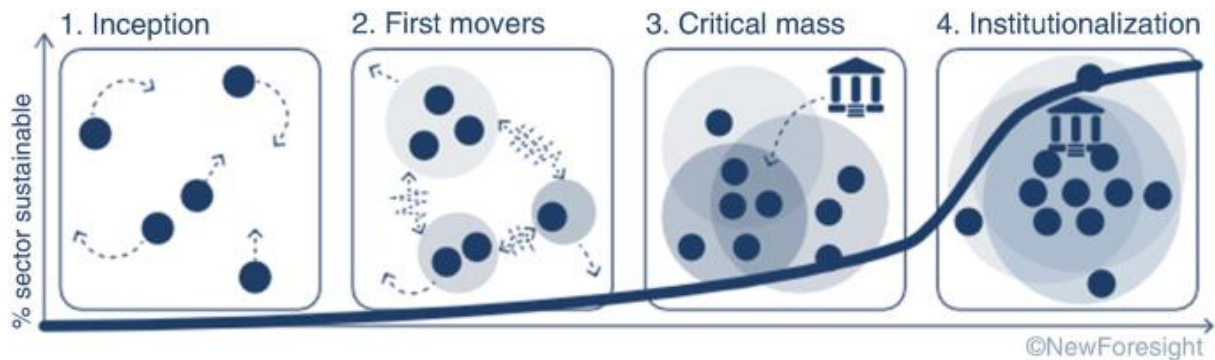


Figure 7: S-curve in transition model *Changing the Game* (Ter Haar & Simons, 2019)

The model also includes an S-curve to illustrate the progression of the transition. Initially, there is steady progress. Around phase 3, the transition generally gains more traction. It becomes more commonplace and an increasing number of stakeholders and citizens become involved with the issue. In phase 4, a significant acceleration is observed, where the transition becomes normalised and fully integrated into everyday life (Ter Haar & Simons, 2019). Concluding that *“The framework holds that market transformations towards higher levels of sustainability evolve through four successive phases, following an S-curve. The rationale behind the framework is that the imbalance of four, mutually interactive causal loops lead to sustainability issues on a market. Correspondingly, it is argued that by passing through the four phases of the framework sequentially, this imbalanced, lock-in situation will slowly be replaced with a balance of the causal loops, thereby solving the sustainability issues on the market”* (Nijhof et al., 2022, p. 359).

According to Simons (2017), five elements are necessary for a transition to be successful. Firstly, it is important to create transparency about everyone's role and contribution to the transition. Accountability and responsibility are very important. When there is strived towards a full sustainable market transformation, it is important that all market actors know and fulfil their individual responsibilities. Systems change is based on both action and reaction of every actor involved (Nijhof et al., 2022). Secondly, it is important to actively work towards a higher level of connectivity between actors. The network of actors will help these actors to make the transition in an effective way. Stakeholders need to agree on how the rules will be changed and what incentives, positive or negative, will be given during the transition. In this way it is possible to align the interests of individuals with the interests of the common good. That is the basis for system change. Then the overall vision becomes more important than everyone's own interests. Thirdly, incentives need to be provided for all actors to perform the right behaviour. Fourthly, it is important that there is adequate knowledge about the issue. Finally, material resources are also needed to start a transition.

There are several reasons why this model fits the research conducted. Firstly, there is a focus on the different stakeholders within this research. The role they play and the influence they have on both transitions. The 'Changing the Game' model really takes into account the different stakeholders. Secondly, the model initiates that all phases of the model are necessary. This is important when it comes to a transition. All phases need to be completed for a transition to be most successful. However, it is often the case that a transition consists of several sub-transitions. This is also true of the food transition, for example. The protein transition and the transition of upcycling are two examples of sub-transitions within the broader food transition. It is important to remember that these sub-transitions often progress through the phases at their own pace, which can influence the

overall transition process. Thirdly, the characteristics of the model are already more oriented towards indirect drivers compared to other models discussed in this chapter. As previously mentioned, the role of various stakeholders takes into account the interests of individuals with the interests of the common good. Moreover, incentives are recognized as a crucial component of the transition process - how to engage people, even if they may be indirectly inclined towards different outcomes. Finally, the model works towards a 'new' market or strategy. This research also focuses on the path to a new market for sustainable food. An additional stakeholder is added for this research, namely consumers. Consumers also play an important role in the food transition. As the consumer is not mentioned in the model, they will be researched separately through consumer research companies.

During this research, the four different phases, their progression through the S-curve, the five elements necessary for transition and the involvement of six different stakeholders play an important role. The interviews conducted were sampled according to the stakeholders identified in the model, including the consumers. In addition, the phases are used as indicators of the current progress of both sub-transitions. The development of the phases along the S-curve is used as a framework to guide further questions during the interviews. Lastly, the five necessary elements for transition provide a guideline to determine how a transition unfolds and what factors are important within it. As a result, the findings presented in chapter 8 bring the 'Changing the Game' transition model to life for both the transition of upcycling as well as the protein transition taking into account the four phases with the s-curve, the five elements for transition and the six different stakeholders.

5.2 Important theories and concepts

In this paragraph the most important theories and concepts of the research conducted will be explained so there is no confusion about definition.

5.2.1 Transition

'A transition' is a concept that is used a lot nowadays. Because the word is used in different forms and ways, it is important to assume one and the same definition for this research. For this research the following definition for 'transition' is used: *"Transition is the way people respond to change over time. People undergo transition when they need to adapt to new situations or circumstances in order to incorporate the change event into their lives"* (Kralik et al., 2006, p.320) and to add *"Transition occurs over time and entails change and adaptation, for example developmental, personal, relational, situational, societal or environmental change, but not all change engages transition. Reconstruction of a valued self-identity is essential to transition. Time is an essential element in transition and therefore longitudinal studies are required to explore the initial phase, midcourse experience and outcome of the transition experience"* (Kralik et al., 2006, p.320). When it comes to transition to a sustainable food system, it is important to bring supply and demand together. A transition is path leading to a known goal, unknown how to reach the destination with the path being characterised by chaos. Added to this, it is often the case that a transition consists of several sub-transitions. This is also true of the food transition, for example. The protein transition and the transition of upcycling are two examples of sub-transitions within the broader food transition. Both transitions lead to the common goal of the food system becoming more sustainable. However, within this overarching goal, they each have smaller goals that they aim to achieve. These smaller goals, in turn, contribute to the achievement of the overarching goal.

5.2.2 Sustainable Food System

To define a sustainable food system, the definition of the High Level Panel of Experts on Food Security and Nutrition (HLPE) is used. To start, the HLPE (2014) defines a food system the following: *"A food system gathers all the elements (environment, people, inputs, processes, infrastructures, institutions, etc.) and activities that relate to the production, processing, distribution, preparation and consumption of food, and the outputs of these activities, including socio-economic and environmental outcomes"* (p.12). A food system to be sustainable is therefore defined as followed: *"A sustainable food system is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised"* (HLPE, 2014, p.12). A sustainable food system is the eventual goal that both the transition of upcycling and the protein transition want to reach. In a sustainable food system, for example infectious diseases are reduced, but also the environmental footprint of the world is minimised and nutrition is promoted (Canavan et al., 2017). With the growing population of people there is also a growing demand for food. The growing demand for food led to an increase in production and consumption of meat. All of this together leads to a decrease in the availability of land available for agriculture and water (Canavan et al., 2017). A sustainable food system has the potential of nurturing human health and with that also supporting environmental sustainability. However, currently they are both under threat (Willett et al., 2019).

5.2.3 Upcycling

The concept of upcycling foods is already elaborated in paragraph 5.1, the critical literature analysis. When it comes to upcycling itself there are several definitions, because the concept is still relatively new. The definition used for this research is: *"Upcycling is the creation or modification of a product from used materials, components and products which is of equal or higher quality or value than the original."* (Sung, 2017, p.3).

5.3 Conceptual model

In the figure below (figure 8) the conceptual model of this research is displayed. On the left of the model is the protein transition from ten years ago until now. On the right is the current transition of upcycling. These two transitions are compared using the 'Changing the Game' transition model by Simons & Nijhof (2020). This transition model assumes five elements for a transition to take place and be successful. These elements are, as shown in the conceptual model (figure 8); knowledge, material resources, network, transparency and accountability, and incentives for right behaviour. The transition model 'Changing the Game' distinguishes 5 different stakeholders, and for this research the consumer is added, which makes six stakeholders. It also distinguishes four different phases a transition can be in. To determine how the protein transition has evolved from ten years ago to today, and where the transition of upcycling currently stands, the six different stakeholders are interviewed for both transitions, concerning the elements of the model and the four different phases. Based on the responses of the interviewees, the sub-transitions can be placed within their current phases, and for the protein transition an overview will be provided of the progress the transition has made since ten years ago. In order to move from the current food system to a sustainable food system in 2050, both the protein transition and the transition of upcycling are sub-transitions to get there. The model shows a number of variables that are required for a food system to be sustainable. These variables are further explained in paragraph 5.2.2. The main question of this research is the following: *What can the current transition of upcycling to food learn from the successes and risks that the protein transition experienced over the past ten years in creating a more sustainable food system in the Netherlands?* Once the different positions of the transitions have been determined, a comparison will be made. The comparison of the protein transition from ten years ago until now and the position of the transition of upcycling at the moment. This comparison will help to formulate an answer to the main question.

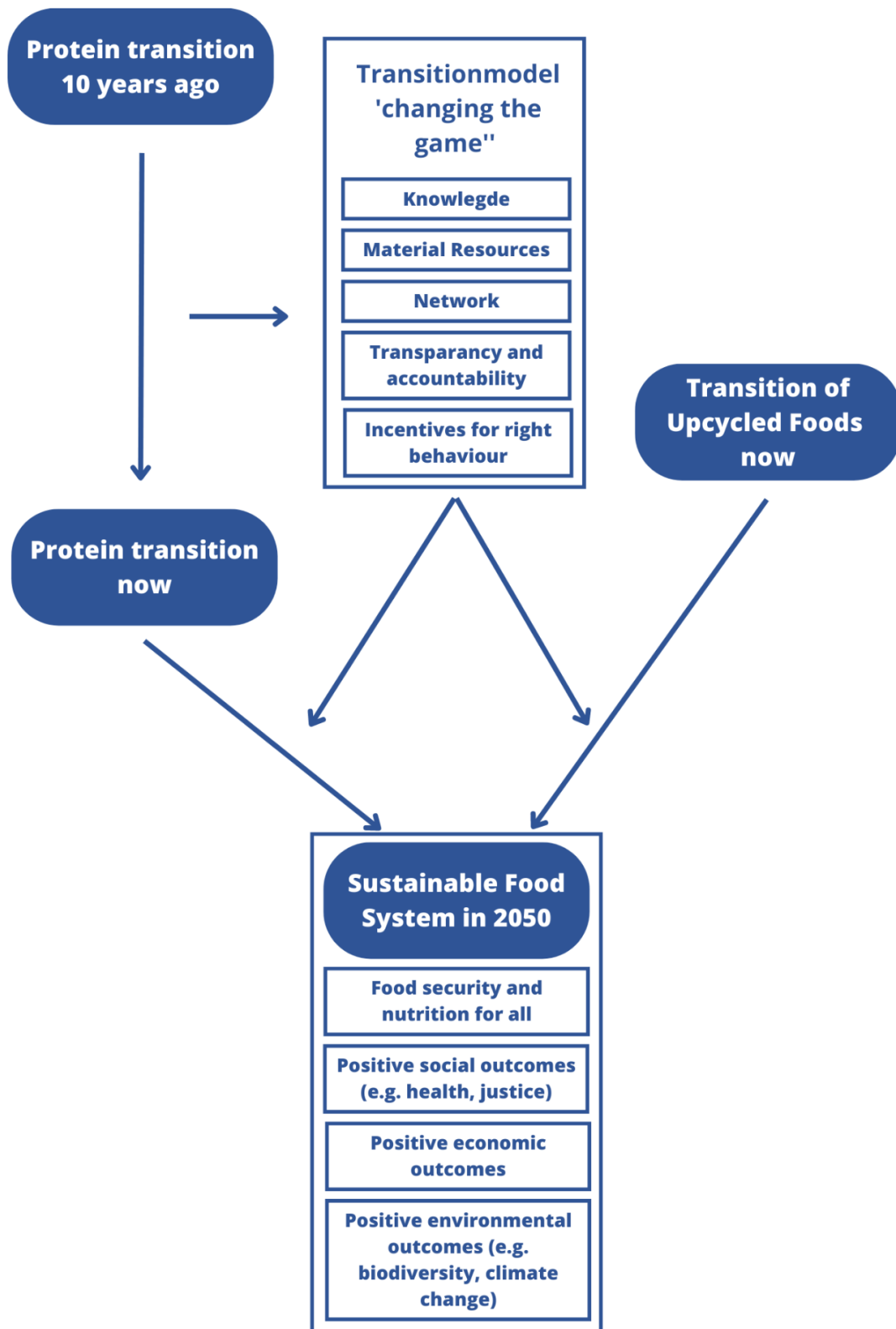


Figure 8: Conceptual model

6. Methodology

The research philosophy used for this research is critical theory. This means that the ontological and epistemological assumptions of this research are based on this paradigm. Critical theory has its aim focused on challenge, revealing conflict and oppression and last but not least, to bring change (Crotty 1998; Evely et al. 2008). Critical theory plays an important role in bringing about positive change, for example for oppressed people and minorities (Moon & Blackman, 2014). Climate change, sustainability and the shift to a more sustainable food system is an important transition that was not initially seen as so important. Today, there is a growing awareness of the urgency of this transition. The research that is being carried out looks at the role that stakeholders play in the transition from the current food system to a more sustainable food system. The ontology that is part of critical theory is historical realism. Historical realism means that a thing was formed over the years towards a certain structure, that now is reality (Guba & Lincoln, 1994). The protein transition has evolved over the last ten years into the structure that it is now. The term 'structure' refers to the manner in which alternative proteins are positioned in society, including the approaches adopted by different stakeholders in dealing with these proteins, the dietary changes associated with them, and their impact on the climate and social context. The research undertaken is a contribution to the process of upcycling learning from the most potentially useful parts of that structure. The epistemology of critical theory is that the investigator and the process/object being investigated are intertwined. The values of the investigator will influence the research (Guba & Lincoln, 1994). The same applies to this research, the research is influenced by the values of the researcher who is also trying to achieve a sustainable food system and who assumes that all stakeholders in the process have a role to play in this food system.

The research used the Netherlands as a case study. By focusing on a specific case, the actors involved in the process can be identified more precisely. Also, there is currently a lot that is unknown about upcycling, and within the framework of this master study it is too difficult to look at a larger situation. The advantage of focusing on a specific case is that the historical explanation of the current situation of protein conversion can be elaborated. This is also an advantage for the validity of the research (Bennett, 2004).

Triangulation was used in this research to gain additional insight. This method involved using multiple sources of data, such as literature reviews, document analysis and interviews, to cross-validate and corroborate findings, thereby increasing the overall reliability and comprehensiveness of the study. The literature review and document analysis was carried out at the beginning this research to find out what is already known about both the protein transition and the transition of upcycled foods. By carrying out a literature review and document analysis prior to the research, newer information was obtained and less duplicate information was obtained.

The methods of this research are also based on critical theory where dialogue is important. This dialogue should take place between the researcher and the 'subject' of the research. With this dialogue, ignorance and misunderstanding around the subject should change to a more informed awareness. Change has the potential to modify structure and generate actions that are proactive and lead to favourable outcomes (Guba & Lincoln, 1994). Change is important in this research because the ultimate goal is to provide the knowledge to change the food system. The world of plant-based protein has already changed a lot in recent years. By looking at its transition, the transition of upcycling gains knowledge to make the positive change as quickly as possible. Dialogue in this research is used for the interviews with different stakeholders involved in the transitions of upcycling and the protein transition. These interviews were used to start a conversation and dialogue with the

stakeholders and to get the best information for this research. A sampling strategy was used to identify the interviewees. For each sub-transition, both in terms of protein and upcycling, at least one person from each of the six different stakeholders identified in the 'Changing the Game' transition model was interviewed. The different interviewees per stakeholder can be found in table 1, chapter 8. The interviews conducted were semi-structured. An advantage of semi-structured interviews is that you can expand on the answers given by the interviewee. Each individual's thoughts and reasoning can be further explored (Adams, 2015). *"Semi-structured interviews are often considered 'the best of both worlds'. Combining elements of structured and unstructured interviews gives semi-structured interviews the advantages of both: comparable, reliable data, and the flexibility to ask follow-up questions"* (George, 2022, p.1).

Nevertheless, there is a risk that semi-structured interviews may reduce the validity of the research (Adams, 2015). Therefore, it is important that the stakeholders interviewed were chosen for a reason. By providing a clear rationale as to why certain stakeholders were interviewed, the research will be more valid. Using the transition model 'Changing the game', it makes sense to use semi-structured interviews for this research. The model has four phases. The different stakeholders gave information about which phase they were currently in and were able to elaborate and give reasons for this. By using open-ended questions, enough information is obtained and different phases can be distinguished for different stakeholders. The questions asks can be found in the interview guide, paragraph 13.1.

After the interviews, the data was analysed. The first step was to do a full transcription of the interviews. By transcribing the interviews, no data was lost. The second step was to analyse the transcribed interviews. Atlas.ti was used for this analysis. Atlas.ti is an online programme that identifies the most frequently used words and phrases. The frequency of some words is used to elaborate on why these words were used so often, and this led to conclusions about why they were considered important to the participants interviewed. Another important thing that was gained from the interviews is quotations. Quotes from participants are used throughout the research to support the conclusions that are drawn when answering the sub-questions and main question.

This research focuses on the Dutch case study. All stakeholders interviewed have knowledge of either the protein transition or the transition of upcycling in the Netherlands. It was important that this scope was clear during the interviews, as this makes the answers valid for the case study of this research.

7. Case study: Food transition in the Netherlands

This research focuses on the case study of the Netherlands. The transition for both protein and upcycling needs to happen on a global scale in order to change the current food system towards a more sustainable food system. For this Master's thesis, a global focus would be too broad and impossible within the time frame. So why the Netherlands? This research was carried out during an internship at Foodvalley NL. Foodvalley NL is an independent international foundation focused on creating a sustainable and healthy food system, based in Wageningen, the Netherlands. The foundation works with an international ecosystem of partners and encourages companies and organisations in that ecosystem to collaborate on different issues within innovation fields in the transition to a sustainable and healthy food system: circular agrifood, food and health and the protein transition. Although there is also a team specifically focused on global connections, this research is aimed at the ecosystem partners and network in the Netherlands.

When discussing the transition of upcycled foods at Foodvalley NL, it became clear that the United States of America (USA) is leading the way. They are one of the most developed countries when it comes to upcycling food, followed by Europe and Asia (Singapore). In the Netherlands the concept of upcycling is still new. As the transition is still in its beginnings, the Netherlands is an appropriate setting for this research since the Dutch government has food waste and food losses high on the political and policy agenda with the founding of the public-private Foundation Against Food Waste (Stichting Tegen Voedselverspilling) and since there is a Foodvalley Upcycling Community founded since 2022. The protein transition started in the Netherlands around 2008 (Hoogland, 2008). In this context, the Netherlands is a major global exporter of food and is connected to many different countries in the world in terms of consumer and production behaviour (Pyett, 2023). "*An increased production and consumption of plant-based proteins and a reduction of animal-based proteins in the Netherlands, are therefore transmitted through all these connections to other parts of the world*" (Pyett, 2023, p.533). Upcycling is becoming an increasingly popular concept in the Netherlands and there are already many innovative ideas. However, the national government, for example, is currently only focusing on valorising side streams from primary sectors, but not so much focussed on valorisation towards food. This creates an interesting relationship between the state, the market and civil society and it could be one of the bottlenecks for a successful transition of upcycling towards a more sustainable food system. This research therefore shows whether these bottlenecks are recognisable for the protein transition and how they have evolved.

The Netherlands has a population of about 17.8 million (CBS, 2023). The government of the country is made up of more than 1600 organisations and agencies. It includes the 12 ministries, the 12 provinces and the 342 municipalities. These are also the three levels of the Dutch national government (Overheid.nl, n.d.). National policy is decided by the so-called 'Tweede Kamer' and the 'Eerste Kamer'. These two groups of decision-makers are elected by the Dutch citizens. For the protein transition, the European Union has set itself the goal of becoming more self-sufficient and less dependent on imports, taking strategic food sovereignty into account. The European Union has asked all its member states to write a Protein Strategy according to this ambition. As a result, the Dutch Ministry of Agriculture, Nature and Food Quality published a National Protein Strategy in 2020 (LNV, 2020). "*The goal of this strategy is to increase self-sufficiency of plant proteins in the next five to ten years in a sustainable way that contributes to the health of humans, animals and the natural environment*" (Pyett, 2023, p.532). This strategy is a sign that the Netherlands is putting a more plant-based diet on the agenda.

Recently RIVM (n.d.) published a study, which shows that the total consumption of meat by people aged 7-65 has decreased by 18% between 2007 and 2021. The consumption of dairy products has also decreased, in this case by 14%. The decline of this magnitude shows a shift in consumers'

diet towards more plant-based proteins. (Semi-) vegetarianism is becoming increasingly popular in the western world (Fox & Ward, 2008). Two-thirds of the Dutch population would describe themselves as flexitarians. As consumers buy more and more plant-based products, demand continues to grow. Increased demand requires increased supply. *"Plant-based meat substitutes are gaining more shelf space in supermarkets and sales of plant-based proteins are increasing rapidly in the Netherlands, as in the rest of Europe"* (Pyett et al., 2023, p.513). The protein transition has seen a lot of investment in technological innovation in recent years (Pyett et al., 2023). With both supply and demand increasing, this shows that the protein transition has already begun in the Netherlands.

The transition to upcycling food should reduce food loss and waste. Because of the Sustainable Development Goals for 2030, countries are now taking more action to reach these targets. For example, food waste in Dutch supermarkets decreased between 2018 and 2020 (Pyett et al., 2023). However, there is still a lot of food waste in the Netherlands. *"All members of Dutch society must pitch in, not to correct a mere flaw, but to change the system itself"* (Pyett et al., 2023, p.328). The Netherlands still has a lot to learn, both on the transition of upcycled foods as well as on the protein transition.

8. Results

This chapter discusses the findings from the different interviews. The interviews are analysed using coding in atlas.ti. The coding was reviewed and these codes were analysed. The interviews will be used to answer the sub-questions and with these answers the main question will be answered in the conclusion (chapter 10). The results will be supported by quotations from the interviews. The table below gives an overview of the interviews that were conducted. It was strived to arrange interviews with an organisation or company within each stakeholder group on both the protein side and the upcycling side in order to get a clear and honest view of both transitions.

Table 1: Overview of respondents

	Upcycling	Protein
Consumers	Machiel Reinders - WUR	Sonja Vernooij - DVJ Insights
Industry	Carlos Cabrera - Greencore Alex van Kuilenburg - Milgro	Henk Schouten - Schouten Europe Henk Janknegt - Eiwitboeren
Government	Renze Brouwer - Ministry of Agriculture, Nature and Food Quality José van Gerven - Province of Gelderland	Renze Brouwer - Ministry of Agriculture, Nature and Food Quality Kees Pieters - Province of Gelderland
NGOs	Caroline Duivenvoorden - Foodvalley NL	Jeroen Willemsen - Foodvalley NL Corné van Dooren - WWF
Financial Institutions	Michiel Strijland - Invest NL	Mirjam Hilgeman - Rabobank
Research Institutions	Sanne Stroosnijder - WUR Harry te Riele - Transitiefocus	Hans Dagevos - WUR Harry te Riele - Transitiefocus Ingeborg Haagsma Boels - HAS

Source: Author

With the results from the interviews different sub-questions are answered. The following sub-questions were formulated:

- What are signs a transition towards a more sustainable food system is happening?
- What has the protein transition looked like from ten years ago until now?
- To what extent can the protein transition be considered successful?
- What are the key aspects that made the protein transition successful or created risks?
- Where does the transition of upcycling to food currently stand?
- What things can the different stakeholders learn about their role and the different phases of transition within the transition of upcycling from the example of the protein transition?

The sub-questions are answered in this chapter based on the responses of all the respondents. The research began with a literature review. From the beginning of the literature search, it was clear that there is much less knowledge about upcycling to food than there is about plant protein. Hans Dagevos confirmed this by saying that when it comes to upcycling to food, there

are not many studies yet. *"The studies that have been published so far are really still in the early stages"* (Hans Dagevos, personal communication, April 19, 2023). Within the organisations it was also more difficult to find someone with knowledge about upcycling than someone with knowledge about plant protein. This already shows a difference in where the transition of upcycling stands compared to the protein transition. With this in mind, the different parts of the interview guide (see appendices paragraph 13.1) will be taken apart and discussed in this chapter in order to answer the sub-questions.

8.1 Definition of Upcycling

"We have realised that the food system is actually one of the biggest threats to nature when it comes to deforestation, overfishing, land use and greenhouse gas emissions. So if you want to protect nature, you have to do something about the food system, both in terms of production and consumption" (Corné van Dooren, personal communication, April 25, 2023). Various stakeholders emphasised the importance of transforming the current food system into a more sustainable one. One of the things that emerged was the importance of having a common language. A language that is understood by all stakeholders, both experts and citizens. *"You also have to have a language and an approach for the transition, because explicitly almost the whole society has to go along with the time of social transition"* (Harry te Riele, personal communication, April 5, 2023).

For a transition to really get going, it is important that there is a common definition of the issue to work on. However, it is clear from several interviews that there is not yet a unified definition of upcycling that everyone uses and agrees on. Caroline Duivenvoorden (personal communication, March 28, 2023) indicated that the definition of upcycling is also something that is being worked on within The Upcycling Community.

Every stakeholder interviewed about upcycling to human food was asked to give a definition about this concept. With the knowledge of the experts that are interviewed, the most important parts of the definition of upcycling to human food are listed in figure 9.

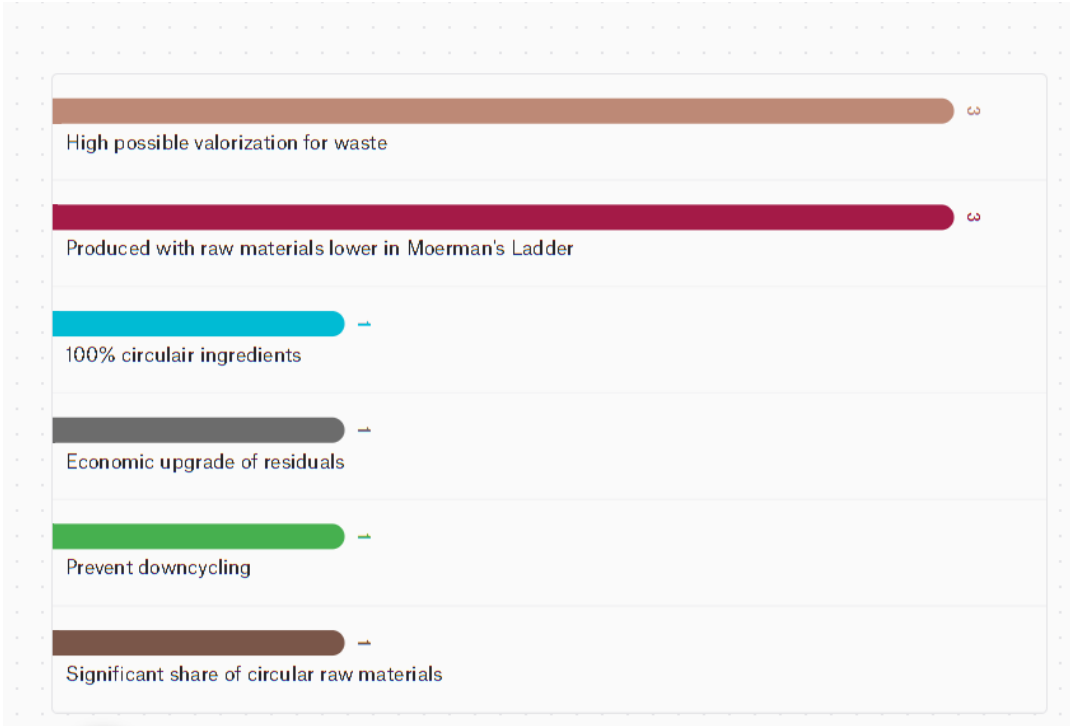


Figure 9: Definition of upcycling

A total of 10 answers were given on the question to define upcycling. During the interviews, interviewees often referred to the Ladder of Moerman, which was explained in paragraph 5.1.2. Most of the stakeholder definitions referred to the fact that for upcycled food it is also important that the raw materials used for the upcycled ingredients or upcycled products would otherwise have been wasted. A significant proportion of the product's ingredients should be upcycled when you want to communicate about the upcycled food claim. What constitutes a significant proportion is one of those questions being discussed within the Upcycling Community. Replacing some virgin ingredients in a product for upcycled ingredients can have a huge impact on the transition towards more upcycled food as well, also without claiming the upcycled product characteristic in the market or by making a claim for a 'mass balance' approach. According to Caroline Duivenvoorden (personal communication, March 28, 2023), in the USA and Canada there is already a private standard in place that has some strict definitions for using the upcycling ingredients and food claim. The value of such a private standard for upcycled ingredients and food is one of the developments that will be relevant to explore further. A common definition is still lacking. However, the results from figure 9 might be useful to finding a common definition that will lead to a common target.

8.2 Definition of plant-based protein

A more common definition exists for plant-based protein. Defining 'plant-based protein' stakeholders largely agreed that it was about 'protein crops for human consumption' and 'every protein not from animals', as shown in figure 10 below. A total of 18 answers were given. However, Ingeborg Haagsma Boels (personal communication, May 10, 2023) raises a valid question. What exactly do people mean when they talk about plant-based protein? Years ago, when people talked about plant-based protein, they really meant plant-based, such as from a lupin bean, a faba bean or a soybean. "I find that nowadays the transition from animal to plant-based is actually changing into a kind of transition from animal to alternative protein" (Ingeborg Haagsma-Boels, personal communication, May 10, 2023). When asked to define plant-based protein, several stakeholders also started to mention alternative proteins other than plant-based, such as proteins from fermentation, cultured meat or insects. This shows the confusion that is beginning to arise around the concept of 'plant-based protein', which is being confused with the concept of 'alternative proteins'. Sonja Vernooij (personal communication, 5 April 2002) also confirms this for consumers, pointing out that there is a lack of consumer knowledge about plant-based proteins.

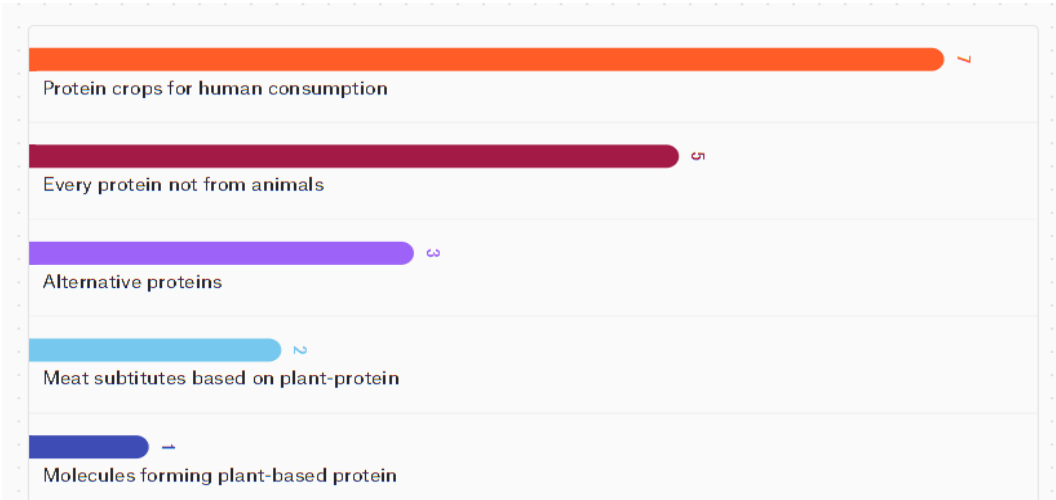


Figure 10: Definition of plant-based protein

8.3 Definition of sustainable food system

Both the protein transition as well as the transition of upcycling work towards a more sustainable food system. But what does 'a sustainable food system' mean to the stakeholders working on these themes? All interviewees were asked to give a definition of a sustainable food system. The answers of this question are shown in figure 11 down below.

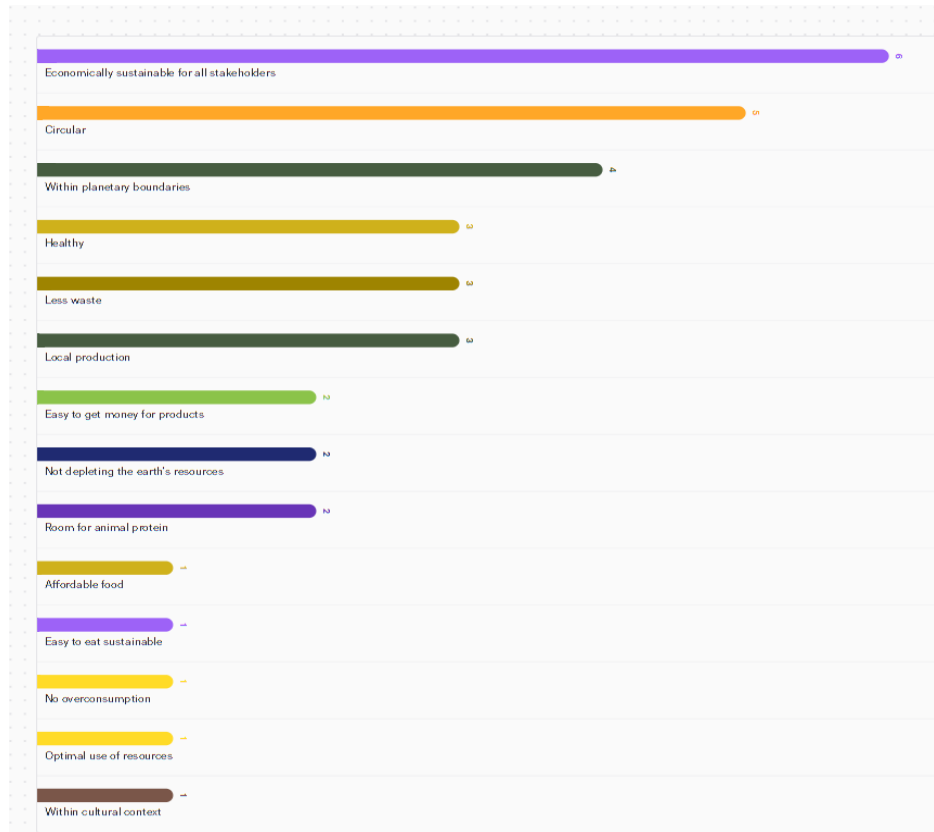


Figure 11: Definition of a sustainable food system

A total of 35 answers were given on the question to define a sustainable food system. The answers are quite varied. In summary, the food transition is a multifaceted transition with many components. This explains why the responses of different stakeholders can be very different. *"Carbon dioxide (CO₂) is relatively easy to measure; it started as a specific situation, and now it has changed. But the food transition is much broader than that. It includes aspects such as biodiversity, soil quality, the promotion of healthy food, health considerations and a significant component focused on animal welfare. It is therefore a comprehensive and far-reaching transition"* (Michiel Strijland, personal communication, May 31, 2023). Some of the most common responses will be highlighted. Many stakeholders agreed that a sustainable food system should be economically sustainable for all stakeholders. This means a healthy supply chain for the different links and stakeholders within the supply chain, from the farmer to the consumer. *"That we have a healthy profit model is not necessarily an economic profit model. Now, in this capitalist world, the economic earning model is the most important, or at least it seems to be. That is where certain routes are being cut off. Sustainability is already coming to the foreground in a different way, in a healthy way, as I call it. So everyone should be allowed to earn money from the sustainable food system"* (Ingeborg Haagsma-Boels, personal communication, May 10, 2023). In addition to a healthy supply chain, healthy food is seen as a necessary element of a sustainable food system. With a growing world population and more people to feed in the future, it is important that the food produced and

consumed is primarily healthy. Renze Brouwer (personal communication, April 20, 2023) says that sustainable and healthy cannot be considered separately when it comes to food. This healthy food should be grown and produced in a circular way within the planetary boundaries of this earth. In addition to the importance of planetary boundaries, it is also important that the sustainable food system fits into the cultural context of the local population and is affordable for everyone. In order to reduce emissions and create a fair and sustainable food system, local production and consumption cannot be forgotten. Henk Janknegt (personal communication, April 26, 2023) explains it as follows: "*Products that are produced and processed in the Netherlands should also be consumed in the Netherlands. In this way, a sustainable food system is also within reach.*" The last element to highlight is the fact that stakeholders mentioned that they also consider it important that there is still room for animal products in our sustainable food system. Livestock farming is an important part of the Dutch economy and it is inconceivable that it will disappear completely. Livestock are also important as they play a role in a balanced circular agrifood system.

To illustrate the transition to a more sustainable food system, the 'Changing the Game' transition model is used in this study. This model was explained in more detail in paragraph 5.1.5. A transition is an organic process and difficult to bring into visualisation. This model is used to try and show where both the protein transition and the transition of upcycling currently stand. The model has been used to try to simplify the complexity of both transitions. Often a transition is more complicated than a model suggests. During the interviews, stakeholders were asked to provide a critical view of the model. These critiques are included in the research to give a fairer picture of both transitions. Critiques were made on the elements, the actors and the phases of the transitions. These critiques will be elaborated shortly.

8.4 Critiques on transition model 'Changing the Game'

The main criticism on the Changing the Game transition model concerned the stakeholders it identifies. According to several respondents, it was indeed troubling that consumers were not included in the model. They also noted the absence of enabling organisations from the list of stakeholders. These organisations, such as Foodvalley NL, bring together different stakeholders and promote networking. Another stakeholder that was mentioned missing were the primary producers. "*The primary producers have the key to starting a transition*" (Henk Janknegt, personal communication, April 26, 2023). According to some stakeholders, primary producers could be included in the industry category. However, given their key role in the transition, it is suggested that they are recognised separately. Also some respondents argued that consumers, among others, were partly represented by the NGO stakeholder. However, this representation was considered insufficient by most of the interviewees. Enabling organisations were also placed in the category of NGOs when forced to choose, but it was suggested that it would be more appropriate for this group to form a separate stakeholder group in the model.

Another issue raised by respondents in relation to stakeholder distribution was that certain stakeholder groups were in fact too large and included an excessive number of stakeholders. This is partly related to the concern above. However, it is important to note that these companies and organisations were able to identify themselves within the model, but felt that the range of groups was too broad. For example, within the industry there are different segments of the value chain, each with different approaches to promoting sustainability in the food system. By bringing them together under a single stakeholder, there is a risk that some groups will not be adequately represented.

According to Lucas Simons' transition model, there are five necessary elements for a successful transition: Knowledge, Material Resources, Network, Transparency and Accountability, and Incentives for the Right Behaviour. These elements are discussed further in paragraph 5.1.5. During the interviews, two aspects were highlighted as missing components in relation to accelerating a transition. First, the role of policies and regulations was emphasised by most stakeholders as a crucial factor for a successful transition. While policies and regulations could be considered as part of the incentives for the right behaviour, most respondents felt that they warranted separate recognition. Second, public opinion was mentioned. *"I think public opinion ultimately serves as a trigger for the industry or manufacturers to say: 'Okay, now we will start addressing this issue and we will make sure that our supply is in line with this'"* (Sonja Vernooij, personal communication, April 5, 2023). Indeed, timing is crucial, and public opinion plays an important role in determining the appropriate timing for the introduction of products that can facilitate the transition. If products are introduced too early, they may languish on the shelves, resulting in limited business opportunities. On the other hand, there is also the risk of acting too late. In such cases, competitors may seize the opportunity and require a catch-up effort. Public opinion is therefore carefully monitored to determine the optimal time to launch products that can provide a timely boost to the transition. Public opinion, including people's perceptions of the behaviour of others, therefore plays a crucial role. If a transition is more accepted in the eyes of the public, it can proceed faster and more smoothly.

8.5 Signs of a transition towards a more sustainable food system

The various stakeholders interviewed were asked to identify signs that a transition in the right direction, in this case towards a more sustainable food system, is taking place. Everyone agrees that the protein transition and the transition of upcycling have already started. What are the signs that a transition is happening? According to Jeroen Willemsen (personal communication, April 17, 2023), there are two types of elements on which a transition happening can be based. There are clearly measurable elements and there are elements that can only be observed. An example of clear measurable elements are the figures published by RIVM (n.d.) earlier this year. Over the past 15 years, meat consumption in the Netherlands has fallen by 18% and dairy consumption by 14%. On the other hand, plant-based variations of meat, fish and dairy have increased by 30%. These are scientific figures that cannot be ignored and are based on facts. Jeroen Willemsen started working on the protein transition about ten years ago. From the beginning he said: *"We need to make the protein transition concrete, we need to put something measurable on it, that is also an important part of the transition"* (Jeroen Willemsen, personal communication, April 17, 2023). This shows the importance of measurable elements in order to be able to clearly see that a transition is taking place. Mirjam Hilgeman (personal communication, April 26, 2023) confirms this by saying that because of the protein transition becoming more concrete, more attention also goes to researching consumer behaviour. Subsequently, several studies showed that consumer behaviour has changed since the protein transition began. Today, consumers are asking for more plant-based protein and upcycled products. *"If you look at the past, some companies wanted to look at these innovations, but there was no market pool for it"* (Carlos Cabrera, personal communication, May 8, 2023). If consumers are not interested or involved, it is impossible for a transition to take place fully. Today, consumers feel more connected to food waste prevention and more sustainable options. With this willingness of consumers to focus more on these different issues, it helps companies to start implementing this more and more internally in their facilities.

One element that can be seen as a transition in the right direction is investment. When it comes to the transition of upcycling, for example, it can be seen in the last few years that companies are starting to invest more and more in it. Alex van Kuilenburg (personal communication, May 8, 2023) says that with a transition it can be seen that companies also dare to invest in more uncertain trajectories of things that are not yet common. As mentioned before, upcycling is still a relatively new topic. Investing in it can be uncertain. However, if a transition has already started, it shows that these investments are dared to be made *"And actually it can also cost something to be a sustainable leader or to have less ecological impact"* (Alex van Kuilenburg, personal communication, May 8, 2023). Ultimately, reducing environmental impact and waste will result in a return on investment. In some cases, however, the costs are incurred before the benefits can be obtained. Another element observed is that it is reflected in good management. *"Food resource use efficiency, will become part of good business practice"* (Sanne Stroosnijder, personal communication, 9 May 2023). Eventually, it should become something that when companies want to supply, indenture or tender for contracts have to take into account. What can be observed is that more and more companies are starting to look at resource efficiency. *"You can see that it is becoming something that is no longer part of a sustainability strategy, but part of their main business strategy"* (Sanne Stroosnijder, personal communication, May 9, 2023).

What can also be perceived subjectively is the improvement of the products. Most people agree that the vegetarian alternatives available today are better than the vegetarian alternatives available 10 to 15 years ago. A measurable element of this is the fact that vegetarian products are now more visible in supermarkets and more available on restaurant menus. *"The whole idea of reducing or even avoiding meat has increased tremendously in the last ten years"* (Hans Dagevos, personal communication, April 19, 2023). This shows that a standardisation of products or an idea in society is a sign that a transition is taking place. This is also confirmed by the 'Changing the Game' transition model used for this study.

In the end, a transition is made up of many different initiatives that work together creating tipping points, also seen in the s-curve in phase 4 in the transition model of 'Changing the Game'. It is difficult to say which part of the transition produced which result, but in the end the goal is achieved. This is where the theory of small wins comes in. When small wins are celebrated, it is ultimately easier to see the evolution of the transition and what is contributing to it.

8.6 The protein transition

Opinions differ on how long the protein transition has been going on and how successful it has been. Harry te Riele (personal communication, April 5, 2023) explained the evolution of the protein transition as follows: *"It has been a dispersion distributed throughout society, with all the particles clumping together, connecting the dots, and then slowly leading to a very long run-up period to a scaling up that now cannot be pushed away"*. Corné van Dooren (personal communication, April 25, 2023) described it as *"a transition that has been quite silent"*. The protein transition is happening, everyone agrees, but when and how did it get a boost?

According to Corné van Dooren (personal communication, April 25, 2023), the start-up phase of the protein transition was quite long. There was no lack of knowledge. The knowledge has been around for a long time, and in fact there was an ecological movement in the 1970s that said people should eat more plant-based foods. It was really a niche at that time. To turn that niche into a more landscape idea is a long way to go. *"Obviously it took us 60 years to double our meat consumption, but we do not have 60 years to halve it. It has to be done in 20 years or preferably even faster"* (Corné van Dooren, personal communication, April 25, 2023). Before the protein transition has really taken off, several events have taken place that show that the protein transition has already had a longer run-up. The emergence of vegetarianism in the Netherlands actually began around 1890. Within this

period, a clear mark was made in 1937, when Martine Wittop-Koning, a cookbook author, wrote a vegetarian cookbook for the Netherlands. This can be seen as the moment when the Dutch started to use cheese as a substitute for meat in their meals. Another moment is when Jan Juffermans said in the 1970s "one gram less meat, madam, and you know why". This is an awareness of what Little Earth was doing at the time to show the impact of meat consumption on our footprint. There are many more little markers that can be named like this. All these small milestones lead up to the boost we have seen in the protein transition in recent years. *"There are a lot of different actors, events, meetings, brochures and reports from the last few years, and somehow they have all helped to pave the way"* (Hans Dagevos, personal communication, April 19, 2023).

When it comes to sustainability issues in the Netherlands, there are about 10% of the population who can be described as 'front-runners'. These frontrunners are, for example, really convinced of the importance of switching to organic and plant-based food. They are quickly followed by another 30% of the population. These 30% also have the means, the knowledge and the money. The rest will gradually follow with the motto that everyone else is doing it and they cannot be left behind (Sonja Vernooij, personal communication, April 5, 2023). According to Mirjam Hilgeman (personal communication, April 26, 2023), the protein transition roughly followed the parabola of the Gardner Hype Cycle. After the early adopters are included, a huge peak can be seen in the growth curve. Expectations go through the roof and the media picks it up. With the protein transition, this happened around 2021. People tried the alternatives and there was a lot of discussion. In the end, however, developments in this rather young market cannot quite keep up with expectations. Then there is disappointment. Disappointment with someone who buys a product and is not satisfied with the taste, disappointment with an investor, disappointment in the market, and then some negative news in the media. 'Is the protein shift for real? 'Is it not a hype?'. There were a lot of messages like that in 2022. Then if looking at the growth curve, it seems like we are back at the very bottom. But the underlying growth continues, and ultimately creates what is called a steady base.

8.6.1 The protein transition ten years ago

This study covers a period of ten years. However, interviews with various stakeholders have revealed that the real boost to the protein transition may have occurred more recently. *"We have just reached the stage where protein is suddenly on everyone's radar. Ten years ago it was not talked about like that"* (Sonja Vernooij, personal communication, April 5, 2023). *"In my opinion, the protein transition has only really been going on for five years and it is not over yet, so there is still a lot to be done."* (Henk Janknegt, personal communication, April 26, 2023). To give an indication of where the protein transition was ten years ago, all stakeholders placed themselves in one of the phases of the transition model 'Changing the Game'. An overview of what phase the stakeholders indicated they were in ten years ago is shown in the figure (figure 12) down below. It shows that the stakeholders indicate that the protein transition was at the start of the transition as the all placed themselves in the first or second phase.

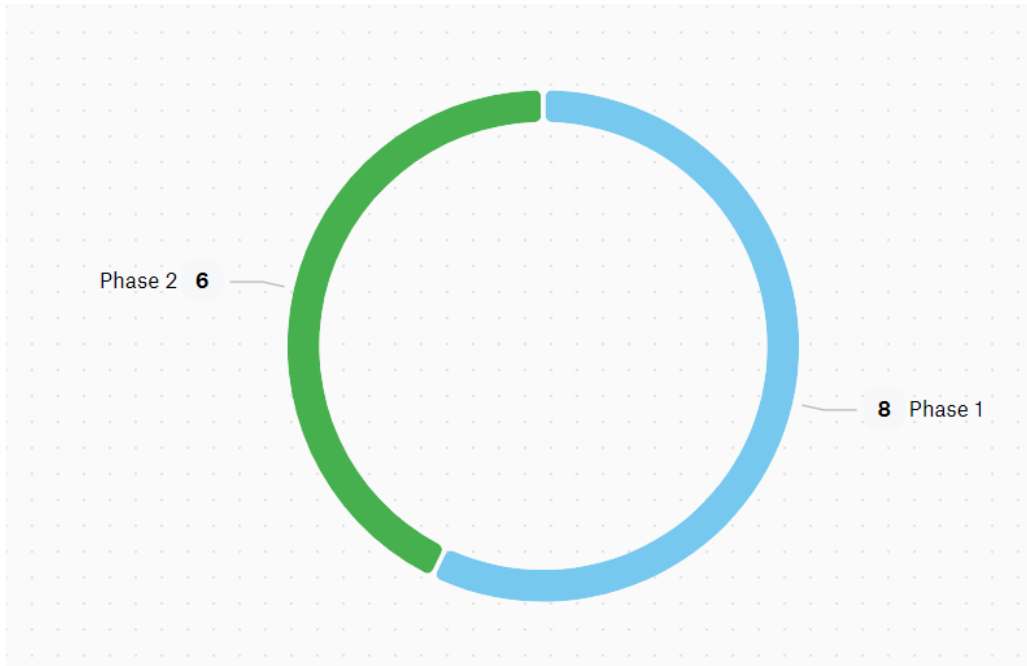


Figure 12: Phases protein transition 10 years ago according to the respondents

In figure 12 it can be seen that the answers of the stakeholders on where the protein transition was ten years ago differ. A total of fourteen different answers were given to this question. This does not correspond to the number of stakeholders interviewed about protein. This is because some stakeholders recognised the transition in two different phases. It can be seen that respondents answered 'Phase 1' eight times and 'Phase 2' six times. What stood out during the interviews was that many stakeholders recognised themselves in the bullet points within the transition model of both phase 1 and 2.

Hans Dagevos (personal communication, April 19, 2023) explains it as follows. 25 years ago there was an ecological realisation that the current meat consumption could not continue. It started with the environment, the impact on emissions, water and land use. As a result, people are looking at how this can be solved technologically, for example with new products. This can be seen as phase 2 ten years ago. Later on, people start to think that there should also be policies, companies have to be involved, and then it is thought that there are also people and society that need to be taken into account.

According to Sonja Vernooij (personal communication, April 5, 2023), it is clear that "*ten years ago, we were still in phase 1, or maybe not even there yet.*" She points out that at that time, it was a topic that occasionally came up among consumers and was discussed, but not in everyday conversations with most people.

Ten years ago, the national government started to explore the protein transition. As became clear in the interviews, stakeholders see policy and legislation as very important in the development of a transition. This is also the reason why it can be said that the national government has lagged behind in the protein transition. The national protein strategy was only adopted by the cabinet in 2020. This was partly due to the controversial nature of the protein strategy. The National Protein Strategy was declared controversial for a year. Rationally, there was very little to support it, but it happened anyway. Because the strategy was declared controversial, the whole implementation of the national protein strategy was delayed by two years (Kees Pieters, personal communication, May 11, 2023). In the opinion of several stakeholders interviewed, the national government's policy-making was lagging behind. The government did not use all the resources at its disposal. However,

with all due caution, the national government has manoeuvred towards the national protein strategy over the past 15 years. *"To this day, there is even an official policy target to get us to 50/50 by 2030. Anyone can say that this is happening much too slowly, that may all be true, but the important thing is that it is now all in writing"* (Hans Dagevos, personal communication, April 19, 2023).

Renze Brouwer (personal communication, April 20, 2023) explains the protein transition as *"an awareness process in society, coupled with political-administrative will, because everyone understands that something has to be done"*. There was a small group of Dutch citizens who actively demanded this transition to more plant-based protein ten years ago. Such groups are often too small for the industry to do anything with their demands commercially. *"At some point, the issue of sustainability and climate and everything around it became so important that there was also a slight unease among consumers that maybe they should start doing something about it"* (Sonja Vernooij, personal communication, April 5, 2023). Going back to the 10% of frontrunners mentioned earlier, this 10% of the population is really ready for a consensus. They find sustainability important enough to choose plant-based alternatives over meat, and they will not compare the two products one on one. These 10% accept that the product is different. It does not have to taste the same, it does not have to look the same, it does not have to be as tasty, it is just a different product. The group after these leaders is more critical. This group does not want to compromise on taste. So even if that part of the population starts to feel uncomfortable, they would still want the product to be somehow the same. *"Maybe it is a bit more expensive, but it should still taste good and fit into the daily routine"* (Sonja Vernooij, personal communication, April 5, 2023). According to Henk Schouten, we are currently in a phase of protein transition where there is still an expectation that taste and texture of plant-based will remain the same as the animal based version. However, it takes extra energy and several steps in the supply chain to make a meat substitute look like chicken, for example. This process is also very challenging. *"You can also choose not to do this and simply create products that do not resemble meat, that are tasty, have their own identity, while still providing nutritional value such as protein, iron and vitamin B12"* (Henk Schouten, personal communication, May 10, 2023). However, today, for a significant proportion of consumers, there is still a demand for meat substitutes to closely resemble the real thing. In order to achieve a more sustainable future, there is hope that they can move away from the idea that meat substitutes have to mimic meat exactly. That there is no longer the assumption that they are not tasty or of good quality if they do not resemble enough.

There is a perception that the food transition is from farm to fork. This means that the transition starts on the farm, with agriculture and farmers, and ends on the consumer's plate. However, Jeroen Willemsen (personal communication, April 17, 2023) says from experience that it is also important, if not more important, to look at it from the other side. Start with the market, the selling point of the food. Think the other way round and see what is needed in the links of the supply chain to meet market and consumer demand. An example of this is the protein transition. The key message is to eat less meat and more plant foods. It is all about the market and its demand for a transition to achieve the goals.

8.6.2 The protein transition now

To protein transition has developed over the years. In the figure below (figure 13) the answers on the question in which phase the protein transition currently is can be found.

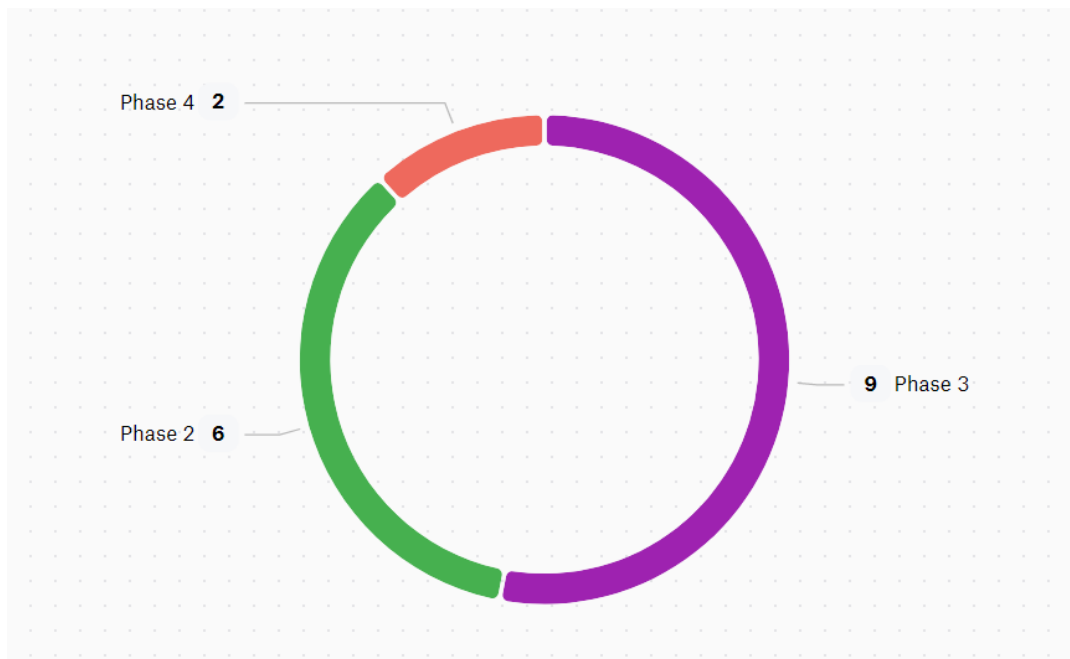


Figure 13: Phases of the current protein transition according to the respondents

The majority of respondents (nine) indicated that the protein transition is currently in phase 3. Also Kees Pieters (personal communication, May 11, 2023) thinks we are already in phase 3. For example, there has been talked about a meat tax, although, it has not been implemented yet. In that sense, there is still a lot of resistance within the system, whether it is within governments or within politics, to go that far. However, Pieters sees it as a positive sign that there is already a push for the 50/50 regulation. "So I think we're approaching the end of phase 3" says Pieters (personal communication, May 11, 2023). A further six respondents stated that the protein transition is in phase 2. "Currently, several groups have emerged, but the synchronisation between these groups is not yet fully established" explains Henk Janknegt (personal communication, April 26, 2023), referring to the fact that the protein transition is still in phase 2. There are even two stakeholders who even said that the protein transition is already currently in phase 4. Corné van Dooren (personal communication, April 25, 2023) explains that as an NGO, they are already engaged in lobbying efforts, which, according to the transition model Changing the Game, is clearly part of phase 4.

In total, seventeen responses were given. The same goes for the figure of the protein transitions ten years ago (figure 12). The total number of responses does not correspond to the number of stakeholders interviewed. This is because some stakeholders recognised the transition in two different phases. Several stakeholders also agreed that the protein transition is in transition from phase 2 to phase 3. Jeroen Willemsen (personal communication, April 17, 2023) gave the example of experts on transition. These experts will always say that a transition is still at the beginning of phase 2, just before take-off. It can be compared to asking a researcher what is still needed to make a difference, the answer will often be that more research is needed. When a transition expert is asked where a transition stands and what is needed for the transition to really take off, the answer will often be that the transition is at the beginning of phase 2 and that a lot needs to happen for the transition to really take-off. The different stakeholders were also placed in other phases by the interviewees. An example is given by Ingeborg Haagsma-Boels (personal communication, May 10, 2023): "If I just look at the research institutes, I would say phase 3, but industry for example I would not put them in phase 3 yet". Several stakeholders agreed that research institutes are ahead of other

stakeholders in the transition model in terms of phases. The knowledge is there and industry is a bit behind. One of the stakeholders identified by respondents as a latecomer is the retail sector. Retailers play a crucial role in the overall food transition, including the protein transition, by bringing products to consumers. They have the role and the tools to use marketing strategies to promote new products that are more environmentally friendly. Returning to the 'Changing the Game' model, this is about taking responsibility for the role someone has to play in a transition. Over the years, the protein transition has seen an increase in vegetarian products in stores. However, as respondents pointed out, this increase has been driven primarily by consumer demand rather than what is necessary for sustainability or the protein transition to accelerate.

According to most stakeholders, the protein transition is happening, but too slowly. However, as Renze Brouwer (personal communication, April 20, 2023) said: "*The protein transition is still in its infancy, but it can happen very quickly. For the first time in all these years, I see a lot of energy in society.*" There is energy in society, and with climate change becoming an increasingly hot topic, it is important that change happens. More and more people are realising that now. In a societal transition like this, it is crucial for the entire society to be involved. As mentioned earlier, the protein transition has developed significantly in recent years. Now, the question arises regarding the risks and successes that have contributed to boosting this transition.

8.6.3 The risks and successes of the protein transition

As explained earlier, the protein transition has experienced a boost in recent years. This boost has been caused by several things and some have had a significant impact on this. One of the things that was highlighted in the various interviews is the negative image of the impact of meat, which has increased in recent years. "*I think what has made the transition to plant-based really different is this negativity around meat in particular*" (Sonja Vernooij, personal communication, April 5, 2023). This negativity arose partly because of animal welfare and mainly because of the impact of the meat industry on the environment and nature. "*People did not even call a meat substitute a plant-based protein at first, but just an alternative to this negative perception around meat*" (Sonja Vernooij, personal communication, April 5, 2023). In addition to the negative image of meat, the fact that more and more is known about climate change has also boosted the protein transition. With resource scarcity and the ever-emerging topic of circular economy, it is hard not to be concerned about sustainable food. A generation is growing up where it is normal to be vegetarian and eat more plant-based foods. They are learning more about healthy and nutritious food. As a result, the new generation is more aware of what they eat and the impact food has on their bodies, the environment and society. The main influence on consumers has come from industry. From the moment the industry started to develop, the greater mass of consumers became involved in the protein transition. In fact, consumers do not see everything from the beginning of a transition in the same way as all stakeholders. "*Of course it starts with the fact that money is released, that research is done, that the government puts it high on the agenda and pays attention to it, but these are all relatively invisible processes for the consumer*" (Sonja Vernooij, personal communication, April 5, 2023).

"*It adds up. It is an awareness process in society, coupled with political administrative will, because everyone realises that something has to be done*" (Renze Brouwer, personal communication, April 20, 2023). Climate policy also played an important role in the protein transition. In particular, the European Union in Brussels played a major role with the Farm to Fork Strategy and the European Green Deal, which resulted in the Bean Deal with many stakeholders.

Overall, society is beginning to get used to change, with all the different transitions that are taking place today. *"The fact that society is starting to get used to the fact that things are no longer the same could turn out to be an advantage"* (Harry te Riele, personal communication, April 5, 2023). What are the next steps that can be taken in the protein transition to make this change even faster? It is no longer just a question of eating a bit more plant-based and less animal-based. Stakeholders today are more challenged to step back and look at the whole chain. Who produces what product? How and where are the products produced? What ingredients are used and where do they come from? The fact that stakeholders are more engaged with these questions ensures that the protein transition can also begin to accelerate. Initiatives such as the Bean Deal are also helping stakeholders to engage with these questions and set targets for themselves. It is difficult to look forward to what the transition will bring. Corné van Dooren (personal communication, April 25, 2023) confirms this by saying that in this case it is difficult for NGOs to choose a focus on an issue or part of a transition. It is difficult to determine where best to put energy. When the different stakeholders look back on the Protein Transition, would they say it was a successful transition?

The targets set for the protein transition are clear. The Dutch national government has set a target of a 50% vegetable and 50% animal protein diet by 2030. This target is unlikely to be met, as several stakeholders have pointed out. Can the protein transition be considered successful if national targets are unlikely to be met? Most respondents said that if you look beyond national targets, the protein transition has indeed been successful in recent years. For example, the number of flexitarians has increased in recent years. It has become more mainstream not to eat meat at least a few times a week. There is also a lot more on offer for flexitarians, vegetarians and vegans. *"The transition is clearly taking off, to meet the 2030 targets we have to raise the bar; it is no longer just about consumption, we now need to involve local protein farmers"* (Jeroen Willemsen, personal communication, April 17, 2023). Something has definitely changed. It is an issue that is on the agenda and is being researched a lot by different research institutions. As mentioned earlier, the evidence base that something needs to change is enormous, for many different reasons. Where the biggest change is still needed is in society. *"There is also a lot that is obviously still part of the "old world". The way the market is set up, the way supermarkets are set up, the way we eat, the way politics is made and the way companies are successful or not"* (Hans Dagevos, personal communication, April 19, 2023). These things are still fixed and have not been shaken in the last ten years. In that sense, it could be said that this still has to happen before the protein transition is successful.

What is hopeful is that it is in fact possible to change our diet. As Corné van Dooren (personal communication, April 25, 2023) says *"a change in our diet can indeed take place. We have also doubled meat consumption in the last 60 years."* With the right tools and motivation, the goals of the protein transition might be achieved and the protein transition may even surpass its existing level of success. Changes in consumers' diet and changes in society can also be seen within the transition of upcycling. Where does the transition of upcycling currently stand?

8.7 The transition of upcycling

Food losses and food waste has been an issue for years, but with the ever-growing world population, there is increasing pressure on our natural ecosystem. This also makes the significance and value of upcycling to foods increasingly clear for the market in recent years. *"Much knowledge and development has already taken place in the past that may now be accelerating as more attention has been paid to food waste as an issue in recent years"* (Caroline Duivenoorden, personal communication, March 28, 2023). With the value of upcycled food becoming clear to the market and

increasing awareness around ecological pressure, there may be an opportunity to revalue all the knowledge and technological developments that have already taken place in the past. This could lead to new business perspectives that have been figured out or were ready before, but for which society and the market were not yet ready. At some point, everyone has to realise that upcycling is simply necessary for a circular economy. As Michiel Strijland (personal communication, May 31, 2023) states: *"Upcycling is an essential part of a circular economy. So, if you do not do it in the right way, you can never achieve circularity and energy neutrality"*.

The challenge will be in the sourcing of your raw materials. Raw materials are central to everything right now. As Sanne Stroosnijder (personal communication, May 9, 2023) explained there is competition between food, feed and fuel, which are all competing over the same biomass. All these things are made from the bottom up and the same raw materials are needed. For the transition of upcycling to succeed it is very important that loss of raw material is limited. However, limiting waste and upcycling waste for human consumption is more complicated than some people might think. To illustrate, an example of the case of orange peels is considered by José van Gerven (personal communication, April 18, 2023). Theoretically, oranges can be entirely disassembled and each component can be used. However, the complexity lies in the fact that high-value valorisation often results in a low-value residual stream. In addition, within the existing regulatory framework, there are a lot of restrictions on the use of orange peels derived from consumers or restaurants. The main reason for this constraint is the lack of clarity regarding the origins and handling of these products. *"Not everything may be used to upcycle to consumers. There are already strict rules with animal food, it will be even stricter with human food"* (Renze Brouwer, personal communication, April 20, 2023). Secondly, it is almost impossible to avoid residual streams altogether. When you extract useful nutrients, new residual streams almost always come from that as well. Thus, that process can take a long time. Therefore, when upcycling side streams, it is important that the upcycling itself still outweighs the energy and money it costs to extract nutrients from the ever-new side streams. Finding a balance in this is important.

The concept of 'upcycling' and its inherent complexity, is something that has not yet landed with citizens. Hans Dagevos (personal communication, April 19, 2023) explained it as something still smaller than a niche. Consumers are not aware of the fact that they could see whether a product is upcycled or not. And if they do know, they often remain unfamiliar with the means to identify it. Machiel Reinders (personal communication, May 17, 2023) points out that based on the consumer research conducted so far on upcycling, it becomes evident that the added value of upcycling is not yet clear to consumers. When it is explained to them, they do recognise its benefits, but in short, they are not yet sufficiently familiar with it. It is plausible that individuals perceive the issue in terms of either minimising or eliminating food waste, such as by using products sparingly and minimising disposal. A practical example of this mindset can be seen in supermarkets where products nearing their expiration date are labelled with a 35% discount sticker, an initiative aimed at reducing waste. Although this represents a tangible step toward addressing food waste, it should be noted that it does not align directly with the concept of upcycling. Nevertheless, it could be a stepping stone for consumers understanding what upcycling actually is. According to Alex van Kuilenburg (personal communication, April 8, 2023) the foremost important part of the transition of upcycling is to create an efficient waste management; economically, ecological and operational. Subsequently, the focus extends to waste management in a broader sense: reduce the avoidable loss of raw materials to as little as possible. Ultimately, deploying all raw materials that are still used and upcycled in a circular or ecological neutral manner. In addition to effective waste management, other crucial components of the transition of upcycling include understanding, establishing a connection between supply and demand, and ensuring quality control of the resulting streams. Also, there is a lot of focus on food waste, but actually much of the food waste also comes from overconsumption. Excessive consumption surpasses recommended guidelines for optimal human health, contributing

substantially to the overall issue of food waste. It would be useful to also focus on how to reduce overconsumption in general.

8.7.1 The current transition of upcycling

In order to see where the current transition of upcycling stands, all stakeholders participating in the study were asked to provide their perspective on in which phase they would say upcycling is situated at the moment.

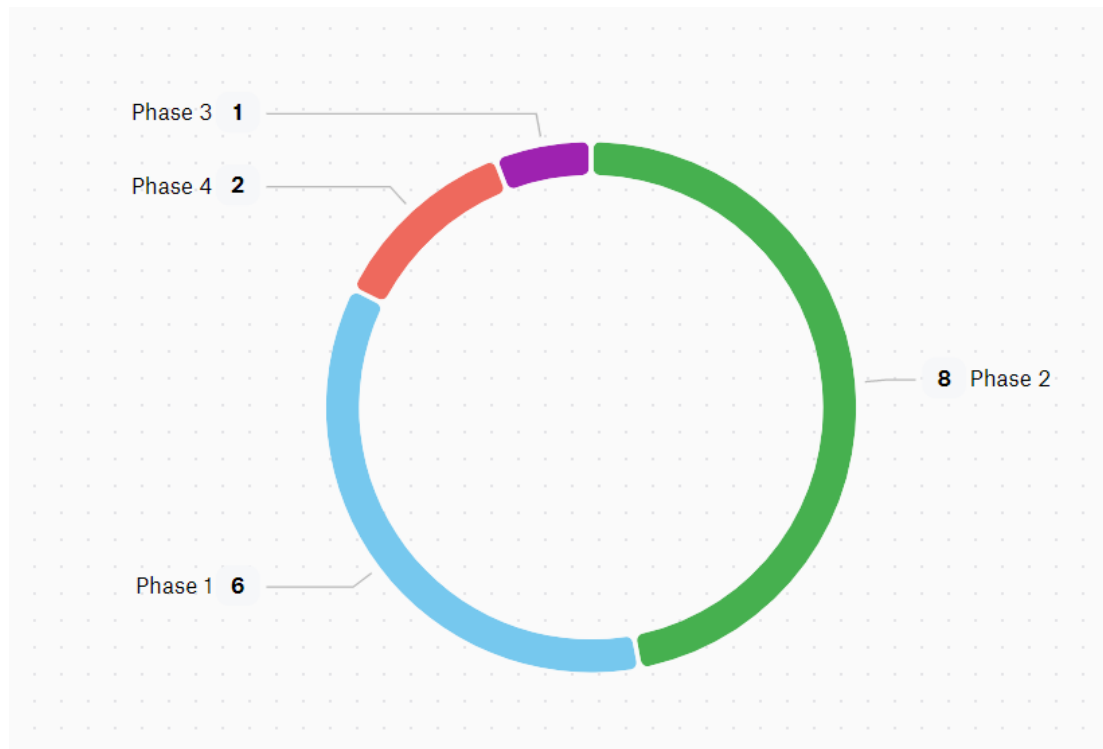


Figure 14: Phases current transition of upcycling according to the respondents

In figure 14 a diverse distribution of responses can be seen regarding the current position of the transition of upcycling across all four phases. Also in this figure the number of responses does not correspond with the number of interviewees. Some stakeholders recognized bullets from various phases and some distributed the different stakeholders of the model in different current phases. Caroline Duivenvoorden (personal communication, March 28, 2023) says *“it varies by part of the chain at what stage the transition of upcycling is now in”*. From a total of seventeen answers, six stakeholders explained that the transition of upcycling was mainly in phase 1. Caroline Duivenvoorden (personal communication, March 28, 2023) points out that part of the supply chain is still strategically orienting themselves, which is in line with phase 1. This includes retailers and food manufacturers, for example. Eight stakeholders said that the transition of upcycling currently is in phase 2. Carlos Cabrera (personal communication, May 8, 2023) argues this as follows: *“Labels have become a big thing, a big discussion. Like what should it be named and what should it be.”* In addition, he also mentioned that the value chain is quite fragmented, but people are finally coming together and are helping each other. *“So then the next step would be pre competitive collaboration (phase 3), but there is no strategy yet and there is no competitive agenda yet, so we are not there yet”* (Carlos Cabrera, personal communication, May 8, 2023). One respondent did think that the current transition of upcycling is already in phase 3. Even two respondents found at least one stakeholder already in phase 4. Caroline Duivenvoorden (personal communication, March 28, 2023)

demonstrates the variation in phases among stakeholders. In her interview, she highlights that NGOs, for instance, are progressing towards phase 3, while knowledge institutions may be moving closer to phase 4. Meanwhile, other stakeholders are lagging behind in their transition progress. With these total numbers it can be concluded that more than 50% of the respondents would say the transition of upcycling is still at the beginning of the transition. This shows that the transition of upcycling is indeed already happening, but there is still a lot to be still done. It is interesting to note that two stakeholders indicated that upcycling is not a new concept. For instance, in the past, potato peels were already used within households to create something new, and discarding them was not an option. Furthermore, Michiel Strijland (personal communication, May 31, 2023) states the following: *"Companies are always looking for revenue models, so they prefer not to waste anything. Therefore, there has always been an incentive to avoid disposal or incineration. The transition has been ongoing for quite some time, but it is only in recent years that there has been a real emphasis on not just getting rid of the waste to cows or other animals but finding higher value applications for it"*.

8.7.2 Important elements of the transition of upcycling

Throughout the interviews several key insights emerged regarding processes and elements that were seen as important for the stakeholders. These insights will briefly be highlighted to show the aspects that have already achieved success in the transition of upcycling and what aspects are still difficult or still need further attention for a boost to happen.

There is a big economic advantage that can be achieved for industries that are in the possession of a lot of side streams. The ingredients and products going to waste could generate a lot of money when they would be used for new food products. This represents a potential significant interest that at the moment is not in the market yet. The disposers of such residual streams find themselves sitting on a metaphorical gold mine, yet unable to harness its full potential on their own. The question arises who will take the risk of investing. There is a high probability that such an investment could yield substantial returns, although this is always in a way uncertain. The economic benefits of residual streams encompasses two sides. On the one hand, businesses are more prone to taking the risk associated with addressing such challenges or making an investment. On the other hand, it is crucial to establish the exact worth of the residual streams. What exactly does it provide when certain residual streams are upcycled? This aspect frequently remains lacking within the transition of upcycling. The added value of upcycling should also be communicated to consumers in a different way. *"When you talk about sustainability, etcetra, it is often quite abstract for many consumers"* says Machiel Reinders (personal communication, April 17, 2023). By framing the reduction of food loss and food waste as something necessary to ensure an adequate food supply for future generations, it can significantly change consumer awareness and perception.

Another aspect that could use attention when it comes to upcycling as a form of total use is seeing resource efficiency reflected in good management. *"Resource efficiency, when using food, is part of good business practice"* (Sanne Stroosnijder, personal communication, May 9, 2023). Eventually it should become something that is necessary to account for businesses wanting to supply, indenture or tender for contracts. What can be observed is that an increasing number of businesses are beginning to explore resource efficiency practices. According to Alex van Kuilenburg (personal communication, May 8, 2023), it is crucial to ensure proper registration of natural capital, which refers to the earth's resources used as raw materials. Such registration should constitute a fully-fledged department within a business, yet many enterprises have not yet established such a department. With the new EU directive, Corporate Sustainability Reporting Directive (CSRD), starting from 2024, companies will be required to report on the impact of their activities on society and the

environment. This directive is expected to contribute to accelerating the process of effectively capturing natural capital within a company.

Just like the definition of upcycling, there is not yet a national goal that needs to be made. Setting a sustainability-linked goal for upcycling will aid in accelerating the transition process. Legislation and policy are definitely elements that can contribute to accelerate the transition of upcycling. According to Sanne Stroosnijder (personal communication, May 9, 2023) the Netherlands faces certain constraints in this regard. While there is a strong desire for upcycling to further develop, there are considerable limitations on what can be implemented within the legislative framework of the EU. This situation poses a risk for the Netherlands, as it may lose its competitive edge in introducing innovative technologies due to European regulations. *“We call it changing the rules of the game, and that is certainly broader than just laws and regulations, because it is also very much about chain agreements and chain responsibility”* (Sanne Stroosnijder, personal communication, May 9, 2023). Renze Brouwer (personal communication, April 20, 2023) agrees on this by emphasising the necessity of adopting a chain-oriented approach throughout the entire process of upcycling. It is crucial to avoid only focusing on a single segment of the supply chain or a specific stakeholder.

The question also arises whether upcycling should be seen as a business-to-consumer (B2C) concept or a business-to-business (B2B) concept. On the one hand, it is crucial for companies and organisations to collaborate effectively and establish fair agreements. On the other hand it can be argued that consumers also need to embrace the consumption of upcycled products and ingredients. Unlike the protein transition, the transition of upcycling does not necessarily require consumers to undergo significant changes in their eating and cooking habits. The promotion of upcycling does not entail the creation of an entirely new market segment, as is the case with the protein transition where substitutes for meat and dairy actively replace the original products. In some cases, consumers may not even be aware of the fact that they are consuming upcycled products. Consequently, stakeholders have different options regarding the most effective approach for promoting upcycled foods: either prominently utilise the term “upcycling” for marketing and promotion or refrain from explicitly mentioning it.

As previously highlighted in this research, local food plays a pivotal role in fostering a sustainable food system. According to Harry te Riele (personal communication, April 5, 2023), upcycled food shows a tendency to align with local production. Te Riele states, *“Upcycling of food will once again reinforce local production, as it inherently involves smaller distances between sourcing raw materials, utilising waste from other food streams, the process of upcycling, subsequent repackaging, distribution, and consumption”*. Besides the potential tendency towards a local strategy, which is beneficial for the climate, there are also potential risks associated with upcycling. Due to the fact that in many cases additional process steps would be added, there is a requirement for increased energy consumption, transportation movements, and potentially additional distribution centres for collecting residual streams. It is essential to conduct an analysis to determine to what extent these factors offset the numerous advantages of upcycling in terms of sustainability and climate impact. According to Caroline Duivenvoorden (personal communication, March 28, 2023), it is therefore essential to examine these conflicting environmental issues surrounding upcycling on a case-to-case basis. Duivenvoorden states: *“At times, we find ourselves in a bit of a dilemma. Can we directly link this to our Sustainable Development Goals? There are indeed SDGs, and food loss and food waste are one aspect, but so are biodiversity, carbon footprint, and environmental impact. Moreover, there is a responsibility to do well in your local environment. All these factors can be influenced positively, neutrally, or negatively by upcycling.”* In addition to the conflicting challenges associated with upcycling that require careful consideration, stakeholders do believe that it is a transition that could develop rapidly. According to Hans Dagevos (personal communication, April 19, 2023) it could be said that the transition of upcycling is a so-called politically correct transition, it is

more reassuring. There is a consensus among individuals that food waste is undesirable. Given this shared agreement, it is possible that the transition of upcycling could advance quicker than the protein transition.

The protein transition and the transition of upcycling are both aimed at achieving a sustainable food system. The following paragraph will briefly outline the opinions of respondents of what the future of these transitions should look like. This will help give better guidance in the right direction of achieving a sustainable food system.

8.7.3 The future of transition

As discussed before in the literature review there are three main ways the protein transition and the transition of upcycling are linked to each other. Firstly, upcycled food can be derived from the by-products of plant-based proteins, such as transforming beet leaves into dairy alternatives. Secondly, upcycled ingredients can be generated and incorporated into the manufacturing of plant-based proteins, such as utilising brewer's spent grain in the production of meat analogues. Lastly, upcycling techniques can be employed to repurpose plant-based proteins themselves, such as using fibres to create pastries. Paragraph 5.1.3 illustrates this even further with a figure. These two transitions are developing both in conjunction with and independently of each other. There were several elements mentioned by interviewees that are important for the future of both transitions and their shared goal: the sustainable food system.

It is important for both transitions to continually seek out individuals who are genuinely committed to progress. As Mirjam Hilgeman (personal communication, April 26, 2023) put it: "*Form the coalition of the willing, so try to find those actors and parties who are willing to change, to take action. Bring them together and start working with them*". There are two types of companies entering the transition. In both the upcycling and plant-based protein sectors, there are existing food companies that eventually decide to expand into hybrid products or decide to start upcycling. These companies already have an established business and begin to incorporate upcycled or meat substitute products into their product range, moving away from their previous focus on meat production. In addition, both transitions also involve start-ups and scale-ups working primarily with ingredients. They are innovating and developing new concepts, such as extracting specific proteins from different sources, or creating a new business around upcycling, such as collecting orange peels. These ventures require a variety of tools and strategies. It is important to continue to look for those who are truly committed in both types of these companies. This approach is essential to drive change. Encouraging existing enterprises to embrace change is as important as encouraging the emergence of new start-ups. By motivating established companies to change their practices and supporting the creation of new companies, progress in the transition can be achieved.

It is important to consider the entire chain and ensure that all stakeholders are working towards a common goal. This common goal is for aligning efforts and ensuring that everyone is working towards the same outcome. It is equally important to set a realistic target. It should not be an unattainable utopia that makes everyone sceptical about its feasibility. Each link in the chain has its own role to play in achieving the goal. It is too simplistic to place the burden on just one stakeholder. "*Where we have made mistakes in the past is in relying solely on innovation. Innovation is a means, not a solution in itself*" (Corné van Dooren, personal communication, April 25, 2023). It is clear that it is important not to focus on just one aspect of the transition, namely innovation in this case. In the case of the food transition in particular, the question is whether to focus more on the ecological or the technological side. The technological side includes innovations such as cultured meat or genetically modified organisms (GMOs). The ecological side emphasises a return to nature and the use of earth's available resources. This debate can often be endless. Ultimately, a

combination of both approaches is needed. It is important to keep this in mind during the transition to avoid tunnel vision and fixation on one type of solution.

A transition is likely to progress faster when there is a sense of urgency. Respondents often referred to the example of the COVID-19 crisis to illustrate this point. When all attention is focused on solving a single problem, rapid progress can be made. The difference with climate-related issues is that their impact is less immediate, and those with the most power to make a difference often feel the least affected by them. Therefore, in both the protein transition and the transition of upcycling, it is crucial to increase the sense of urgency on a global scale. With increased urgency, it is hoped that everyone will be able to shift more quickly, thereby accelerating the transition process.

The final point to emphasise regarding transitions is the importance of continuous learning throughout the process. The future of any transition cannot be fully predicted or outlined in advance. As Renze Brouwer stated: "*It is always an ongoing learning journey, as I observe in the current circumstances we are talking about. Maybe in 3 years we will look at it very differently*" (personal communication, April 20, 2023). A transition can never be perfect because it involves moving towards something new and unfamiliar. However, lessons can be learned from past transitions to avoid repeating mistakes and to accelerate the replication of successful approaches.

9. Discussion

Over the course of this study, there were a number of things that were not included, even though they would have been beneficial for the study. There are also recommendations that would be a good addition to the current research.

For this study, Lucas Simons' transition model of 'Changing the Game' has been applied. In this model five different stakeholders are distinguished. Prior to the start of the research, there was a decision that consumers should also be part of the research. The research and interviews revealed the absence of several other stakeholders as well. One example is the enabling organisations, such as Foodvalley NL. It was therefore difficult to place them in the model, and the same applies to a number of other examples that are difficult to place. Some of the stakeholders in the model are also broadly represented within the generic term. Take industry, when it comes to producing sustainable food, the different types of organisations and companies within the industry all have their own specific roles, power and collaborations in the chain. Even within the collective name of industry, this is something that should be looked at separately. Another example is the government. The different levels of government in the Netherlands all have very specific roles. Lumping them all under one heading risks misrepresenting the government in this study. Because not all stakeholders were included, this can affect the results of the study. Some important stakeholders may have been forgotten in the results. It may also have influenced the respondents' answers. They may not have been able to position themselves in the model, but did so because they were asked to do so. Notwithstanding the current situation, it should be noted that not all stakeholders were represented by an equal number of respondents. This may lead to an imbalance in the generalisation of responses. This was largely due to time constraints (see reflections in chapter 11). For future research, it is recommended to have a wider range of stakeholders expanded than the transition model of 'Changing the Game' and that, for each stakeholder group, several respondents will be interviewed (corresponding to the number of respondents from other stakeholders).

Several stakeholders commented during the interviews on how it was possible to compare the transition of upcycling with the protein transition, as they are such different transitions. Plant-based is much more clustered than upcycling. For example, a brewer's spent grain is very different from a beet leaf, and they end up being different products. The discussion was even whether this could be subsumed under one term of upcycling. With plant-based, it is clearer that there is a movement from animal proteins to alternative proteins. The other big difference is that with plant-based products, products really have to replace other products from the market. This is not the case with upcycling. You want to replace certain ingredients and possibly create additional product options with them. However, both transitions are sub-transitions of the food transition, working towards the same goal. They both involve food and have many of the same actors in their supply chains. Therefore, the choice was made to compare the two transitions for this study. As one of the stakeholders mentioned in his interview, the current protein transition is also often compared to the energy transition. There are many differences in these transitions as well. However, they are both working towards a more sustainable world and both have the aim to make the inputs as small as possible and outputs as large as possible in a sustainable way. Because of this joint goal, it is definitely possible to learn from each other. For a next study, it might be a good idea to look more closely at the differences and similarities between the two transitions beforehand. This way, rather than looking at the whole picture, it would be possible to look more specifically at where one transition can learn from the other.

In discussing the definition of plant-based protein during the interviews, it became clear that the definition is still not entirely precise. The definition of plant-based proteins and alternative proteins is still sometimes confused. This was also the case during this study. The researcher did not become

aware of how the two definitions differed until at a certain point in the research. During the interviews, the two terms were sometimes confused by the stakeholders, but also by the researcher. For example, they sometimes talked about cultured meat. However, this is part of alternative proteins, not plant-based proteins. The difference between these two definitions is important because alternative proteins are broader than plant-based proteins. These differences may have led to some confusion between the two types of protein. The protein transition is not only about plant-based proteins, but also about the other available alternative proteins. This is also one of the reasons why the terms are easily confused in today's world. It is also possible that some stakeholders did not start talking about alternative proteins during their interview because they knew the clear definition of plant-based. As a result, answers may be missing or incomplete. For a follow-up study, it would be advisable to make a clear distinction in advance and to include the other alternative proteins in addition to plant-based from the beginning. In this way, the entire protein transition can be properly mapped.

One of the dangers of interviews is that the stakeholders are speaking from their own knowledge. They are being interviewed as stakeholders, but they are also individuals. They answer the questions from their own perspective and the role they have within an organisation/company. This can never be completely avoided. However, it is good to consider this when discussing and reading this study. After all, it means that if other people within the same organisation/company were interviewed, different answers might have been obtained. In addition, the researcher is also influenced by the internship involved in the research. In any organisation, there is a wide range of information and observations that come to one's attention. These inputs can shape personal perspectives and influence the way stakeholders are approached during interviews. It is inevitable to avoid such influences as the internship was a mandatory part of the research. Regardless of the location of the internship, the potential for some form of influence was always present. Who was interviewed was also determined on the basis of Foodvalley NL's network. They made suggestions for different stakeholders, so there is a risk of bias there. It is questionable whether the generalisation should be made for the whole of the Netherlands because of this bias. However, it is the case that the interviewed stakeholders were spread all over the Netherlands and not concentrated in one specific region. For a follow-up study, it would be good to look at a wider range of stakeholders than the Foodvalley NL network in order to get an even clearer picture of the Netherlands.

The final recommendation for further research is to go beyond consumer behaviour alone. In order to deepen the research, attention could also be directed towards the individual citizen. The behaviour around food consumption is strongly influenced by social norms, culinary skills, upbringing, and habitual patterns. Therefore, a broader approach is necessary, encompassing more than just the purchasing aspect. It is recommended that behaviour change is also considered, including education, role models and inspiration from restaurant menus, for example. A full understanding of this behaviour will provide a clearer picture of the business-to-consumer aspect of the transition. This research highlights the choices being made and attempts to provide an overview of the current status of both transitions. However, it would be beneficial to further investigate the reasons why individuals make certain choices in their dietary patterns. This would shed more light on how to accelerate both transitions even more.

10. Conclusion

The aim of this research was to find an answer to the following question: *What can the current transition of upcycling to food learn from the successes and risks that the protein transition experienced over the past ten years in creating a more sustainable food system in the Netherlands?* In order to adequately address this main question, several sub-questions were formulated:

- What are signs a transition towards a more sustainable food system is happening?
- What has the protein transition looked like from ten years ago until now?
- To what extent can the protein transition be considered successful?
- What are the key aspects that made the protein transition successful or created risks?
- Where does the transition of upcycling to food currently stand?
- What things can the different stakeholders learn about their role and the different phases of transition within the transition of upcycling from the example of the protein transition?

These sub-questions are answered in the results (chapter 8). Based on the answers to these sub-questions, a conclusion will be drawn in this chapter by addressing the main question. A total of six different stakeholders were interviewed for this research. Interviews were conducted for both the protein transition and the transition of upcycling. As the same types of stakeholders were interviewed for both transitions, a fair comparison can be made between them.

In fact, the protein transition has been underway for longer than the transition of upcycling. The concept of the protein transition has gained significant attention and development in recent years. Upcycling is a relatively new concept in the sustainability discourse. While the protein transition has seen considerable progress and implementation, the transition of upcycling is still in its early stages, with ongoing research and experimentation to explore its full potential. What is striking about the results is that stakeholders do not perceive a huge difference between the current status of the two transitions. They agree that the protein transition has indeed been going on for a longer time and has gained more recognition, even in common understanding. However, in terms of development, upcycling is not significantly behind, and there is an expectation that the transition of upcycling can progress at a faster pace than the protein transition. Looking at the figures in paragraphs 8.6.2 and 8.7.1 (figures 13 and 14), the difference in the current status of the two transitions is relatively small, with both transitions a lot of stakeholders recognized phase 2. In the case of the protein transition, the responses tend to be weighted towards the higher phases, with the most mentions of phase 3. Conversely, the transition of upcycling is much more frequently associated with phase 1 than the protein transition. Overall, according to the respondents, the transition of upcycling is more located around phase 2 and the protein transition more towards phase 3.

Looking at the stakeholders in the 'Changing the Game' transition model, there is one stakeholder that is perceived to be the biggest latecomer in the protein transition and is also experiencing a similar situation already in the transition of upcycling. This stakeholder is the national government. The effectiveness of the national government's involvement is difficult because it depends on the political party in power and its stance on the issue, as well as the regulations set by the EU. However, in the case of the protein transition, the national protein strategy was considered to have come too late. The same can already be said for the transition of upcycling. There are still many laws and regulations that hinder the progress of upcycled foods and no national targets have been set. Furthermore, the interviewees indicated that the national government is primarily focused on upcycling for animal feed, while other stakeholders have already moved beyond this stage and are actively involved in upcycling to food. Setting national targets on upcycling to food would provide a clear direction and facilitate a faster transition process by aligning efforts with the other

stakeholders. Efforts should be made to prevent further delay in setting national targets for upcycled foods. It would help to increase the pressure on the national government to take action.

One advantage of the transition of upcycling is that the alternative protein sources, that are part of the protein transition, have been on the market for a longer period of time. This means that people are already starting to used to dietary changes, which could potentially facilitate the transition of upcycling. This prior exposure to dietary changes may help individuals to be more open and receptive to trying innovative food options that are in line with sustainability goals, such as upcycled foods. In addition, there is a significant difference between the protein transition and the transition of upcycling in terms of dietary adaptation. In the protein transition, a whole new market segment is created, requiring people to buy different products and change their cooking habits. Dairy, meat and fish are challenged in the marketplace by substitutes. Upcycling, on the other hand, focuses largely on ingredient replacement. This may involve the introduction of entirely new products, but they compete within the same market segments rather than aiming to replace them entirely. Indeed, the fact that upcycled products can potentially be brought to market more easily and with less consumer resistance could be a valuable lesson for stakeholders. This suggests that the transition to upcycling can be accelerated by considering consumer acceptance and preferences from the product development of the protein transition.

One of the key aspects that upcycling must take into account when developing new products or ingredients is to ensure that the taste and texture of the products do not change too much. Currently sustainability is in a phase where consumers still expect the same level of quality, even if the products or ingredients are different. So this is an important aspect to consider. This trend can be seen in recent years with the change in proteins. In the beginning, for example, meat substitutes were of lower quality. This put some consumers off, even if they were willing to eat more vegetarian options for environmental reasons. It often takes time for them to give meat substitutes another chance. It would be unfortunate to lose these consumers during the transition period simply because of quality issues. Maintaining and ensuring the quality of products and ingredients is therefore a crucial aspect to focus on when upcycling to food.

One of the reasons for the success of the protein transition in recent years has been the negative perception of the meat industry. The negative impact of meat on the climate, animal welfare and human health through excessive meat consumption has contributed to this negative image. During the protein transition, this negative perception of meat has been used to shift the narrative to something that has a positive impact on consumers' use of alternative proteins. It is crucial to present this sort of information in a way that resonates with consumers. Describing food waste as 'bad for the climate' may seem distant to some people. But if they understand how much their food choices and food waste contribute to whether their children will have enough to eat in the future, they may be more inclined to make different choices. A lesson for the transition of upcycling could be to further quantify such statistics and communicate them to consumers in different ways.

There is a significant economic advantage to be gained by industries with abundant side streams. Utilising these wasted ingredients and products to create new food products has the potential to add significant financial value for companies, what is currently being discarded without further consideration or knowledge on its value. In the context of the protein transition, stakeholders have gained knowledge in recent years about the economic value associated with their products. It has even been observed that some consumers are now willing to pay a higher price for meat alternatives simply because of their preference for vegetarian diets. Therefore, for all stakeholders along the value chain, including consumers, investing in alternative proteins is considered a risk worth taking. However, the disposers of these residual streams find themselves in possession of a metaphorical gold mine, but unable to fully exploit its potential without external involvement. The key question is: who will take the risk of investing in upcycling? While there is a high probability that

such investments could yield substantial returns, there is always a degree of uncertainty. The economic benefits of upcycling are twofold. On the one hand, companies are more willing to take the risks and make the investments to address these challenges. On the other hand, it is crucial to determine the exact value of the residual streams and what they provide when they are upcycled before a risk is dared to be taken. So, another lesson that the transition of upcycling can learn from the successes of the protein transition, particularly in terms of price, is to establish economic value. Once the economic value of upcycled food is established, it will incentivise stakeholders to take greater risks and consequently increase supply.

Finally, it is important to emphasise that a transition is an evolving process. Everyone continuously learns during a transition, and goals often change during the process. A transition can never be perfect because it involves working towards something new and improved. This is true for both the transition of upcycling and the protein transition. Ultimately, the focus is on achieving the goals and learning from the successes and risks of others along the way, in order to work together to achieve a sustainable food system. Therefore, it is important that the transition of upcycling takes into account the key aspects of the risks and successes of the protein transition of recent years.

11. Reflection

Reflecting personally on the study conducted over the past few months, there are several aspects that may not have been entirely comprehensive or could have been improved due to time constraints and personal circumstances. Firstly, the preparation of my thesis has been challenging. My internship and therefore my dissertation process started on the 1st of February 2023. However, I had to undergo knee surgery in mid-December 2022 due to an injury. This procedure required a lot of energy and time for activities such as physiotherapy. As a result, the preparation of my thesis suffered at times, hindering the thorough examination of all theoretical aspects. With better preparation, I would have had more time to review the theory more thoroughly, which may have prevented certain problems. For example, the confusion arising from the distinction between the definitions of plant and alternative proteins, as discussed in chapter 9, could have been avoided. Proper preparation could have mitigated this confusion.

In addition, only one or two people from each stakeholder group were interviewed during the research. The research could have been broadened and have its validity increased by interviewing several respondents within each stakeholder group. This approach would have allowed for a wider range of stakeholder perspectives, making it easier to generalise the findings. However, due to the time constraints of writing the Master's thesis, it was decided to interview at least one person per stakeholder group. Given more time, it would have been preferable to interview more respondents from each stakeholder group.

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13. Appendices

13.1 Interviewguide

Introduction

Thank you very much for your time to have this interview with me. To start off, I will introduce myself. My name is Ellen and at the moment I'm studying Global Environment and Sustainability at Radboud University. To graduate I need to write my master thesis. In my master thesis I want to compare the transition of upcycled foods with the protein transition. As the transition of upcycling foods is still new I want to learn from the past 10 years of protein transition. During this research I specifically focus on the Netherlands, because of the timeframe for my master thesis. I will be interviewing different stakeholders that have been involved in either the protein transition or the transition of upcycling foods.

This is also the reason why I asked you to be one of the interviewees. You and your organisation both have a lot of knowledge about the protein transition/ the transition of upcycling. So thank you for your time in advance!

For your information: you can always interrupt or stop the interview if you in any sense feel uncomfortable.

Before we start the interview I have two questions:

- Is it okay if I record this interview?
- Would you like to stay anonymous when I mention this interview in my research, or may I use your name when for example I want to incorporate quotes?

To start this interview I will begin with some general questions about you, the organisation you work for and protein/upcycling. They will be followed by general questions about transition and lastly I will ask some questions about the transition of upcycling/the protein transition.

Do you have any questions before I start?

General

- Can you tell me something about your job and *the organisation you work for*?
- How is this organisation linked to upcycled foods/protein?
- How would you define upcycled foods/protein?
 - What are the key elements/aspects of upcycled foods/protein?

Transitions

Now I would like to ask you some questions about transition in general.

- Is your organisation focused on transition in itself?
- What would you say are signs that a transition in the right direction is happening?

For my research I use the transition model 'Changing the Game' by Lucas Simons. * (Show the model).* It distinguishes different stakeholders and different phases for a transition to happen.

- While looking at the model, what stakeholder group would you say your organisation belongs to?

Protein (in case interview is about protein)

As I mentioned before I will be comparing the protein transition with the transition of upcycled foods for my research. I will be interviewing different stakeholders (as you can see in the transition model) for both protein and upcycling and compare these with each other. You and your organisation are mainly focused on protein. To research where the transition of upcycled foods stands at the moment, I want to learn more about how the protein transition has developed over the past 10 years. So now I will ask you some specific questions about the protein transition and your organisation for the past couple of years.

Show transition model According to this transition model it is assumed that the following elements are necessary to create a successful transition: Knowledge, Material Resources, Network, Transparency and accountability, Incentives for right behaviour.

- Do you agree with this model?
 - Is it complete? What would you add?
- Which parts of knowledge, material resources, network, transparency and accountability, incentives for right behaviour would you say are important for a transition to be successful? Are there still some elements missing?
- What would you say the protein transition has looked like from 10 years ago until now?
- Do any particular events on the timeline of the transition in the past 10 years stand out?
- Would you say the protein transition has been successful the past 10 years?
- Where would you say the transition of upcycling stands at the moment, compared to the protein transition?
- Which stakeholders have, according to you, played an undeniable role in the transition, either positively or negatively?
 - Why?
- What role did the government play during the protein transition?
 - Were there any rules/regulations/laws that helped the transition?
 - Were there any policies that were important, helped or challenged the protein transition?
- In what phase do you think your organisation was 10 years ago, looking at the transition model of Changing the Game?
 - What are characteristics or elements that make you say this?
- In what phase of the model is your organisation at the moment?
 - What are characteristics or elements that make you say this?
- How would you define being successful in the transition towards a more sustainable food system? What does it mean to be sustainable?
- Has your organisation grown and developed towards a more sustainable food system over the past 10 years?
 - If yes, how did your organisation grow towards a more sustainable food system? How has the focus on the protein transition changed?
 - If not, is there any reason for this or why do you think your organisation has not grown towards a more sustainable food system?

- What role would you say your organisation had during the protein transition?
- Are there things your organisation could learn from the protein transition the past 10 years, what could be better next time?
- Are there things that went well that you would like to see repeated in other transitions?

Upcycling (in case interview is about upcycling)

As I mentioned before I will be comparing the protein transition with the transition of upcycled foods for my research. I will be interviewing different stakeholders (as you can see in the transition model) for both protein and upcycling and compare these with each other. You and your organisation are mainly focused on upcycled foods. To research where the transition of upcycling stands at the moment, I want to learn more about in what phase stakeholders currently are, when it comes to the transition of upcycling. So now I will ask you some specific questions about the transition of upcycling and your organisation.

Show transition model According to this transition model it is assumed that the following elements are necessary to create a successful transition: Knowledge, Material Resources, Network, Transparency and accountability, Incentives for right behaviour.

- Do you agree with this model?
- Is it complete? What would you add?
- Which parts of knowledge, material resources, network, transparency and accountability, incentives for right behaviour would you say are important for a transition to be successful? Are there still some elements missing?
- Would you say the transition of upcycled foods has already started?
 - If yes, when did it start? And how?
 - If not, when would you say a transition will start?
- Where does the transition of upcycled food stand at the moment, according to you?
- Where would you say the transition of upcycling stands at the moment compared to the protein transition?
- How would you define being successful in the transition towards a more sustainable food system? What does it mean to be sustainable?
- How would you say the transition to upcycled food can grow further towards a more sustainable food system in the future?
- What do you think the future for upcycled food looks like?
- Are there any stakeholders that you would say play an important role in this transition? Why?
 - If yes, are there also stakeholders that aren't moving fast enough?
 - What role does the government play at the moment within the transition on upcycled foods?
- In what phase of the model is your organisation at the moment?
 - What are characteristics or elements that make you say this?
- Is your organisation trying to move forward towards a more sustainable food system or change when it comes to upcycling food?
 - If yes, in what way?
 - If not, is there a reason for this?

Ending

To end this interview: Thank you so much for this interview, your insights and your time and effort.

- Are there things you'd like to add to the interview that I didn't ask?
- Is there anything else I should take away, including for subsequent interviews?
- Should I have any questions after this interview, could I reach out to you for this?
- Are you interested in receiving my final result/dissertation?
- Do you know a stakeholder that should be interviewed?