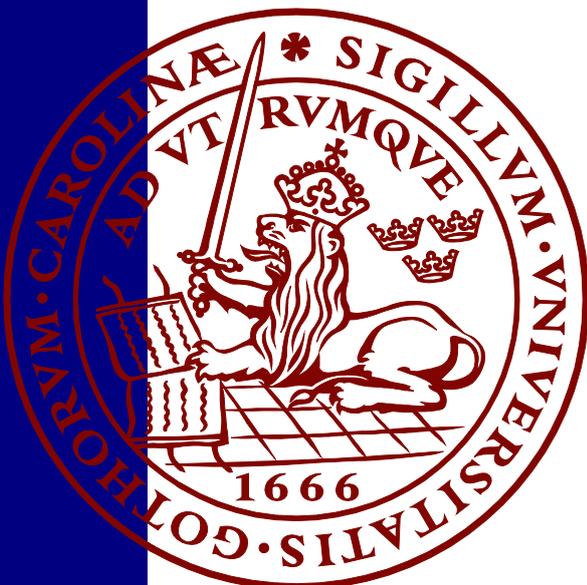


Sustainable Corporate Decision Making in Complex Realities – A General Approach and An Illustration in The German Food Vs. Fuel Conflict

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Abstract

This thesis suggests *Comprehensive Understanding* as an alternative approach of sustainable corporate decision making. It shows how sustainability becomes the intrinsic rationale of corporate decision making in complex realities. The approach of Comprehensive Understanding is based on a synthesis of different concepts of sustainability science. As methods, a review of academic literature, a dialogue with practitioners and academics as well as own reflections have been applied.

Modern disciplinary understanding can only provide a limited perspective on complex realities through its focus on deep analysis. I argue for a more Comprehensive Understanding that covers the impacts of a corporate decision made within complexity of reality. For such understanding, the integration of diverse, rational as well as emotional perspectives is the basic guideline. In contrast to other concept of sustainable decision making, it fulfills two basic requirements to achieve that. First, it is practical for daily corporate decision making practices in complex realities. Second, its application lies in the self-interest of the decision maker.

The functioning of the approach will be illustrated by an exemplary corporate decision from the German food vs. fuel conflict. Besides other alternatives of mitigation, this thesis will evaluate the option of importing food from a country with a high theoretical potential of production increase; such as Ukraine. It will be shown that a Comprehensive Understanding is necessary to understand the complexity of the issue and to make sustainable decisions within such complex environment.

Key words

Sustainability, Decision making, Bioenergy, Agriculture, Business, Ukraine

Word count:

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Reflection

The point of departure of the thesis journey was the profound intuitive feeling that sustainability is in fact not just an imaginary paradise that everybody acknowledges its beauty but most people do not see it in their intrinsic individual interest contributing for. Instead, I felt that sustainability is the common good whose achievement lies in each of our individual interests. During the journey of the thesis, this feeling has been conceptualized. I hope you enjoy the journey report and it can help you on your way.

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1 Introduction

1.1 Background

Sustainability issues are seen as complex realities (Jerneck et al. 2011; Ostrom 2009). In terms of sustainability, it is crucial how decision makers understand these complex realities, based on that understanding act within this context and cause impacts on sustainability. Because of the high sustainability impacts of the business sector, especially corporations need research and action for a more sustainable ways of decision making. The currently dominant way of decision making, which is based especially on academic disciplinary backgrounds, reason and the thinking of modernity, has fundamental problems in providing a sufficient understanding of such complex realities (UNEP 2007; Millennium Ecosystem Assessment 2005).

In contrast to this conventional conception, diverse concepts have been created in order to minimize the impacts on human and natural systems within these complex realities. Part of approaches such as transdisciplinarity (e.g. Max-Neef 2005; Thompson Klein 2004), holism (Esfeld 2003; Nagel 1972) or Habermasian communicative rationality (Habermas 1981) is to theoretically resolve sustainability problems. Decision-support tools for sustainability such as certification (van Dam et al. 2008; Scarlet & Dallemand 2011), sustainability impact assessment (Gibson 2006) or environmental management systems such as ISO 14000 (Martin 1998) or EMAS (European Parliament and Council 2009) have been established in practice.

However, in terms of sustainable development, theoretical as well as applied approaches have two main shortcomings. First, their implementation is not practical enough for an application for the small and quick decisions in everyday decision making in complex realities. There is a lack of operationalization and application for such decisions, because decision makers are not willing or able to invest sufficient resources to pay the relatively high transaction costs of the mentioned decision-support tools. Second, their application is usually not seen as lying within the intrinsic self-interest of the applicant. Above all the more theoretical concepts show how a decision can contribute to sustainability in the sense of a common good for environment, society and economy on the long-run. However, those general benefits do not necessarily correspond to the decisive individual benefits of the decision maker. However, for a transition towards more sustainable business practices, sustainability must not only be constrained to normative decisions for the common good of sustainability, but must also be integrated into daily organizational decision making. To put it as a metaphor, it must not be constrained to the nicely painted external skin, but has to be the essence of the whole body underneath. This is the challenge for this thesis.

The first part of the thesis introduces a conceptual framework for sustainable corporate decision making in complex realities, which, first, is easily applicable for any decision in complex realities and, second, whose application lies in the intrinsic self-interest of the applicant.

The second part of the thesis illustrates the approach to show how sustainability can be the intrinsic rationale of corporate decision making in complex realities. The illustration is based on a question from a German decision maker out of his daily activities within the complex realities of the bioenergy sector. It is the assessment of food importation from Ukraine to Germany as one option to mitigate

the German food vs. fuel conflict. In Germany approximately 2 Million ha of agricultural land (BMU 2011; FNR 2011) are currently used for bioenergy feedstock production. Moreover, the German government has shown ambitious goals in order to further increase bioenergy production and use (BMELV & BMU 2010). This can lead to further negative impacts on Germany's food supply. In times of international agricultural trade, substitution for this decreasing production might come from other countries. A region with a relatively low productivity and high portion of fallow land is Eastern Europe (FAO 2012); and an example of that is the country of Ukraine. This thesis will analyze, besides other options for mitigation, the role of increasingly importing food from Ukraine in reducing the food vs. fuel conflict in Germany.

1.2 Research questions

The overall research question of the conceptual part is:

1. How can sustainability become the intrinsic rationale of corporate decision making in complex realities?

Sub-research questions are:

- 1.1. How can a sustainable corporate decision, besides benefiting long-term general environmental, social or economic factors, simultaneously bring individual benefit to the decision maker?
- 1.2. Based on the concepts of transdisciplinarity, communicative rationality, holism, sustainability impact assessment, certification and environmental management systems; what is a practical common guideline for sustainable corporate decision making in complex realities?

The overall question of the illustrative example is:

2. What can be the role of importing food from Ukraine in mitigating the food vs. fuel conflict in Germany?

The contribution of food importation from Ukraine in relations to other options for mitigation is conceptualized as the role of this option.

Sub-research questions are:

- 2.1 What options for mitigating the food vs. fuel conflict exist?
- 2.2 To what extent can Ukraine be a stable exporter to Germany?

This part of the thesis will, first, not be a sustainability assessment of the Ukrainian agriculture or German bioenergy production and use, second, not make suggestions for a more sustainable development of the Ukrainian agriculture, nor, third, be the basis for investment into Ukrainian agriculture by the energy company Vattenfall Europe New Energy, who was initiator of that question.

The thesis is structured in the following way. Part two will describe the methodology used in the research. The third section will present the conceptual approach followed by the illustrative example. Finally, the contributions of the concept as well as the example will be discussed.

2 Methodology

2.1 Critical realism as epistemological basis

The epistemological basis of the work is based on critical realism. In this part, I present main relevant ideas of critical realism and extract from them some points, which are useful for the way it is understood here.

An epistemology used for conceptualizing socio-ecological system, which lies in the focus of sustainability science (Ostrom 2009; Clark & Dickson 2003; Kates et al. 2001; Anderies; Janssen & Ostrom 2004), has to acknowledge physically existing realities of the natural system as well as the socially constructiveness of natural and social realities. However, neither the in natural science dominant positivism, nor the in social science used constructivism are suitable for that. On the one hand, social constructivism focuses on the social dimension of realities and claim that they are constructed and not objectively real (Flick 2010; Berger & Luckmann 1969; Schirmer 2009). Problematic for investigating socio-ecological systems is that it is not fully suitable for analyzing natural processes that occur physically and cannot be seen as socially constructed (for example global warming, death, etc.). Positivism, on the other hand, argues that reality can objectively be measured and explained (Bryman 2008). It is the dominant paradigm of natural science. However, with that focus it does not allow investigating social realities that entail social constructions, perceptions as well as different paradigms or disciplines.

Considering these fundamental limitations, I opt for critical realism, which has the advantages of both: social constructivism and positivism, without their concrete impediments in conceptualizing socio-ecological systems. The basic ideas of critical realism used in this thesis are based on Potter & López' (2005) as well as Collier's work (1994). Under that reading, in critical realism there is a reality existing, which is complex and independent from human's perception and thinking. Transferred to sustainability science this means that physical processes, such as measurable global warming, are objectively happening. However, we cannot fully have access to that reality, but only approach it through our mental models. There are different ways of perceiving reality, understanding it and acting upon such understanding.

The consequences of this for my work are first, we can access reality and create our understanding based on different perspectives such as personal experience, academic investigation or professional know-how. Second, one can come 'closer' to reality, by having more models better adjusted to reality. Third, there are different understandings of the same reality possible. Fourth, decision makers have to consider these both forms of reality (factually existing and constructed). Fifth, there is the possibility for a synthesis based on the essence of perspectives that all approach the same reality in order to achieve a more accurate model of reality. Sixth, such synthesis is an inter-subjective, shared truth, instead of a universally accepted objective truth.

2.2 Research strategy

As part of a transdisciplinary and mode 2 research process (Gibbons 1994; Etzkowitz & Leydesdorff 2000), the thesis has been developed within its field of application. Crucial in the whole research process has been the co-operation with the company Vattenfall Europe New Energy, which was a forum for dialogue with practitioners. Participating in the research context limits bias and provides a more comprehensive insights than, for example, by single interviews (Girtler 2001; Lamnek 2010). The participation has provided me with insights into the company's structure and its decision making rationales. The link between sustainability theory and business practice has been a challenging but also very inspiring environment. This is especially true for an energy company which is mainly based on fossil fuels (Vattenfall 2010). The illustrative example focuses on the bioenergy activities of Vattenfall Europe New Energy.

The research strategy of this thesis is based on transdisciplinary. It draws from diverse forms of knowledge, not being constrained to disciplinary boundaries and also considering non-academic sources of knowledge (Max-Neef 2005, Lawrence 2004). In this thesis, I synthesize different concepts that are used in sustainability science and the field research experience under a common theme under the research question. The idea of the synthesis is to extract the essence of each of those approaches and integrate them into a new approach that addresses the research aims and questions more directly. For that, ideas that have been already discussed in other approaches are conceptualized in the logic of the Comprehensive Understanding approach. Since within the limited space of the thesis many different ideas have to be presented, the work is written in a rather condense manner.

The participatory aspect of the research has not only been a source of inspiration, but also the basis for a reflexive research. In academia, there are more and more discussions on researchers giving something back to their research field, as being agents of change. These discussions can be located, for example, in action research (Nichols 1997; Reason & Bradbury 2001; Biott 1996) or within the transdisciplinarity literature (Scholz et al. 2006). The applicability of the research approach as well as the illustration of the case has been an essential research objective. Furthermore, besides academics, practitioners are a vital part of the audience of the thesis. The thesis has been written in a way that it can be useful for this broad audience.

2.3 Research process and methods

For the research, triangulation of research methods has been used. This means to access the same research objects through different methods in order to increase the validity of the research (Lamnek 2010). Such approach corresponds to the basic idea of my research. The main methods applied are further presented here. While the research strategy has been identical for both and there have been some inter-relations, the main part of the research process with its applied methods has been distinct for the conceptual and the example part. In order to be transparent, the part is presented separately.

Methods applied in conceptual part

As methods of the conceptual part, literature review, reflections and an intense dialogue with practitioners have been used as research methods.

The literature review is based on the sustainability science discourse. It is a broad literature review that includes academic books and articles. Works that have been used directly are referenced; some three or four times more works have been consulted. The selection was based on the relevance of the work towards the research topic (Kromrey 2006) which changed during the research process. Mostly, the literature derives from the approaches mentioned above in the introduction.

To the ideas express in this literature, new ideas have been added, combined in different ways and new logics have been created through my individual reflection and discussion with other persons. My reflection and contemplation have extended over about one a half years. It has been an iterative, process between theoretical and practical reflections (Schirmer 2009; Flick 2010), which has gone along with the reformulation of the approach and synthesis of many initial ideas into the present approach. In the first stage it was more a case study (Yin 2009) for the energy company Vattenfall Europe New Energy aiming at conceptualizing their approach and linking it to sustainability. However, then, the synthesis of many different academic approach was added. Through its basis on the theoretical discourse, it became emancipated from the concrete case and more generalizable for corporate decision making in complex realities. However, the research field has always inspired the development of the approach and the illustrative example in the second part of the thesis derives from the research field.

Interactions within the participatory frame have had various forms. I conducted semi-structured interviews (Lamnek 2010; Bogner, Littig & Menz 2009) on the sustainability and bioenergy activities as well as public perception of the company and the project development department I worked in. Furthermore, I organized three presentations and discussions along the research process. This helped me to present the state of the work, get feedback and created a forum for learning for both sides. Besides this direct link to practitioners, there has been a constant dialogue with academia in order to check the approach for coherence, scientific robustness and to get inspirations. Such dialogues included professors, such as the supervisors, fellow students as well as a presentation of the approach at the academic conference ‘Sustainability Summit 2012’ in Lüneburg.

An overview on the methods used for each research question can be found in table 1.

Table 1: Research questions and methodology

Research question	Section	Aim	Methods
1. How can sustainable decision making become the intrinsic rationale of corporate decision making in complex realities?			
1.1. Sustainability as self-interest	3.3.3.	Sustainable corporate decisions as self-interest in complex realities	Academic literature review, reflections
1.2. Guideline	3.3.4.	Guideline for sustainable corporate decision making in complex realities	Academic literature review, reflections

2. What can be the role of importing food from Ukraine in mitigating the food vs. fuel conflict in Germany?

2.1. Options for mitigating food vs. fuel	4.2.	Present different options that are discussed in academic literature on mitigating the food vs. fuel conflict	Academic literature review, reflections
2.2. Stable exports from Ukraine	4.3.	Assess the potential of Ukraine of exporting food to Germany in a stable manner	Academic literature review, discussions, interviews, document analysis

Methods applied in example

A number of methods were used for the illustrative example. First, expert interviews were applied (Lamnek 1995; Bogner, Littig & Menz 2009). Through purposive sampling (Bryman 2008), relevant and available persons were consulted during the investigations. The aim was to gather diverse insights on the Ukrainian agricultural system and the German relations to it. Access to interviews was limited by language and availability of interviewees. However, ten about 30 minutes' long interviews were conducted. I interviewed mostly agricultural experts of the Ukrainian system (Ukrainian and German) as well as Ukrainian citizens, whom I had contact with. All interview partners could contribute a lot through their perspective on the agricultural system and general social and political developments in Ukraine. The interviews were guided by the research questions and aimed at revealing the interviewee's mental models of the Ukrainian agricultural system and the relations to Germany. The beginning of the research process was a more explorative phase. Therefore, more open interviews were used (Punch 2005) in order to discover the relevant aspects of the issue. Then, after the creation of a first draft of the model, semi-structured interviews (Flick 2010) helped to check and validate the model.

Second, a review of academic literature provided an overview on the relevant aspects and their representation in that concrete case. In the academic literature, basically disciplinary perspectives on the issue were consulted. Such perspectives were deep analysis on specific aspects and their inter-relations with other aspects on the issue. They provided a basis for the later synthesis into a Comprehensive Understanding. Most of the works consulted are cited here; however, some more have been consulted during the research process. Besides peer-reviewed journals, also publications from non peer-reviewed sources such as research institutes have been used. This has been important to also include their perspective on the matter and to complement the academic literature that was accessible for me in English. However, especially in those cases, the content had to be assessed critically according to the positions and interests of the author (Wolff 2008).

This holds as well for the analysis of newspapers that have been an important source of current information and a non-academic and also critical perspective on the system. Various newspaper articles of Ukrainian newspapers that publish in English have been consulted. Studied newspapers were the 'Kyiv Post' as well as 'The Day Weekly Digest'. Also these sources were analyzed, looking for relevant aspects and their inter-relations.

A fourth main source of information has been official statistics. Quantitative information has been important in relation to aspects such as production or cultivated area. The official data of the Ukrainian government has been used, because it has been found most reliable and above all complete in contrast to other possible sources. However, the possibility of the transferability of such data to my research has been critically assessed (Bryman 2008, Punch 2005). As for other aspect, it is argued that the essence of each source is more important than their detailed exactness. In that way, exact definition of the data was less important than the more or less level of productivity, cultivated land as well as their development over time.

The analysis of those sources has been conducted until the point where the information on the issue seemed saturated and not so much new perspective were added by each interview. At that point the model was seen as sufficiently robust and valid.

2.4 Research tools

The conceptual framework of DPSIR (Drivers-Pressures-State-Impacts-Responses) has been used as a framing tool for the illustrative example. Before presenting why and how I applied DPSIR in this thesis, I have to mention that it is one of many tools that can be used for the Comprehensive Understanding approach. Decision making concepts such as sustainability impact assessment, certifications or environmental management systems can be used as tools of the Comprehensive Understanding concept as well. They are presented later in this thesis.

The DPSIR framework is an approach based on system thinking. It helps to understand complex issues by breaking complexity down into distinct aspects of the issue (Ness et al. 2010; Bidone and Lacerda 2004). Then, it supports in establishing interrelations and hierarchies among those factors. Based on system thinking, such inter-relations are conceptualized as causes and effects. In its logic of analyzing an issue, it starts with an impact, defined as problem and tracing its causes back; first, to the state level, then basic pressures and fundamental driving forces (Carr et al. 2007). It is usually used for environmental issues. Wording such as 'state' (of the environment), and pressures on it show that. Besides its application in environmental issues, in sustainability science, there is a frequent use in socio-ecological systems (e.g. UNEP 2007). DPSIR is usually also used to evaluate the effectiveness of responses to problems, depending on the level (drivers, pressures, state or impacts) they are directed at (EEA Report 1999). Here, the analysis of responses is not in the focus, just the strength of the framework in synthesizing complex issues is used.

For the decision making process in this illustration, DPSIR is used as a tool, because time resources allowed so. The basic approach of sustainable decision making could also be reduced to 'just' integrate diverse perspective. However, the use of an accepted framework makes the discussion more robust. DPSIR it is not only possible tool to create Comprehensive Understanding (e.g. sustainability impact assessments), but with its essence of framing complex issues, by breaking them down into relevant aspects, establishing interrelations and hierarchies it is best suitable for merging different perspectives and to create a Comprehensive Understanding. Furthermore, in order to conduct a profound assessment of the case, the ability of DPSIR to reveal fundamental driving forces and long-term processes is of special interest.

As other tools, also DPSIR implies certain limitations. Above all, it provides a rigid frame within that reality has to be put in. It is an artificial set up of four, (or with responses five) levels. Since in reality,

an issue might have more layers than that, cause and effect relationships have to be put on the same level. However, the framework has been flexible enough to be used in the assessment. The DPSIR framework is used according to the logic presented above and is populated through the findings of the research process described.

2.5 Challenges

There have been various challenges in the research process. Those challenges arise when, within the constraints of research reality, I had to stick to criteria of good research (e.g. Swedish Research Council 2006). In order to be transparent about the process (Bryman 2008), I discuss the main challenges that I have encountered in my research.

Position of researcher

The first main aspect is the position as a researcher in the field. Within the field of Ukraine, I have been non-native, coming from another country and not speaking the language of the field. These are similar difficulties that are faced by many researchers (Girtler 2001). Related problems are that the pre-defined understandings of the research about the research field are usually not very accurate. Another problem is to access crucial information; how do people present their situation towards the researcher coming from outside. In order to mitigate the bias possibly involved in such problems, a triangulation of research methods has been used in order to access each aspect from various perspectives.

Field visit in Ukraine

In order to have access to a diversity of perspective, which can be integrated into the Comprehensive Understanding, a field visit can help to get closer contact to reality (Girtler 2001, Lamnek 2010). The experience of local expert can be an important source of information in the establishment and validation of the model. However, for this study, no field visit has been conducted due to the following reasoning. First, according to critical realism, reality can also be approached from another perspective. In that way, the perspective from the persons possibly interviewed in Ukraine could also be partially covered by desktop research. Second, considering the limited resources of the decision maker in time and money as well as of the planet in energy, it is important to show how valid research can be conducted without travelling. The gap between theoretical sustainable patterns and research practice is often high, due to long distance travelling by the researcher. In this work, I wanted to show one example where such gap is not so high. Third, my question that focuses on the general national agricultural system does not require so much specific perspectives from the local context. Main relevant information could also be accessed via desktop research and telephone interviews.

However, there are some perspectives that are usually marginalized in academic research as well as in newspaper articles or official reports from the government. Considering that no field visit was conducted, it was especially important to look for perspectives that are marginalized in those means of access. I had to select typical cases for the research (Kromrey 2006). In that way, the perspective of economically poorer people as for example small-scale farmers has been included explicitly in some interviews and the analysis of documents. Moreover, some local knowledge has been included through the interview conducted by one of my contacts in Ukraine. As a Ukrainian she had better

access to local information and trust by the interviewee.

Ethical considerations

The first ethical concern related to the work is the impact of the research in the field of application. This is a consideration essentially linked to the core of action research as a research practice that explicitly aims to have an impact in the field (Greenwood 1998; Reason & Bradbury 2001). In this case, the fundamental value of such impact was sustainability. In theory, sustainability aims to be good for everyone on the long-term. However, it cannot be neglected that in its practical application, there can be especially short-term winners and losers. As a researcher of sustainability science I accept this implication considering the potential positive contributions made by the evaluation of that case as well as the general approach for sustainable decision making.

A second concern is related to the research process itself with the relation to the interviewees. It is a basic element of good research practice (Kvale 1996) to be transparent about the aims and purpose of the research. This is especially important, when it comes to action research. In such research practice, the impacts of the research are also based on the contribution of each interviewee. In that way, interviewees have been informed about the background and aims of the study as well as the purposes of the interview. After the completion of the work, the thesis is sent to them in order to create transparency.

3 Comprehensive Understanding as theoretical approach

Based on this research, I have developed an approach of sustainable corporate decision making that is presented in the following sections. In short, the approach has the following argumentation: Considering complex realities of sustainability related issues, a Comprehensive Understanding is necessary in order to make decisions with more sustainable impacts.

3.1 Complex realities

The focus of this section is to clarify for which situations the approach is useful. The aim is not to assume a simplified reality, but to take complex realities as they are in sustainability challenges.

Sustainability Science has emerged to, amongst other things, address these realities in sustainability challenges. Such realities are marked by a multitude of aspects coming from nature as well as society, which interplay in a socio-ecological system (Ostrom 2007; Ostrom 2009). Furthermore, such aspects can be located on different scales and levels. Multi-level governance systems of such socio-ecological systems indicate that (Scott 2011). Moreover, such systems are dynamic (Grunwald 2007), there is a constant change inherent in them. This is shown by major changes in almost all major ecosystem indicators (Millennium Ecosystem Assessment 2005). However, such change is not always linear, there are ecological tipping points (UNEP 2007; IPCC 2007), or for example social or political revolutions.

Business activities are increasingly connected to such sustainability challenges. By acting within such complex realities, a decision made necessarily implies diverse impacts. Most important big strategic decision one make might be located on such realities. However, they are especially relevant for sustainability when they touch general social and environmental concerns, critical social and ecological resources. In those cases, for sustainability it is crucial that such impacts promote sustainability.

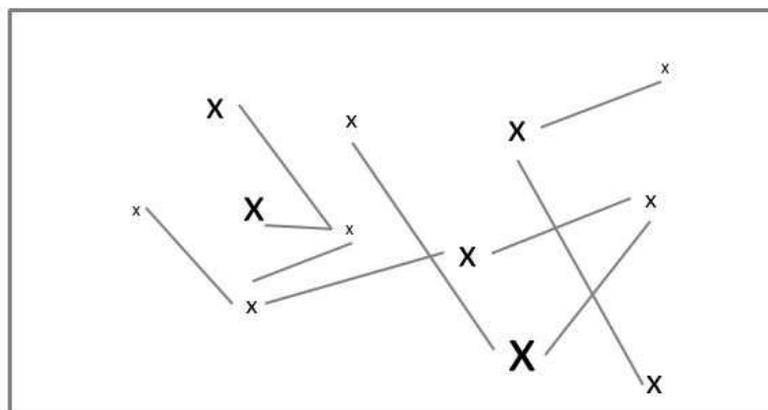


Figure 1: Complex reality

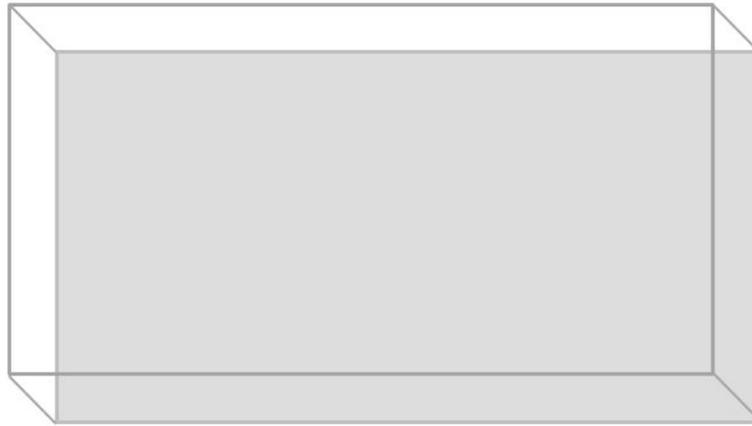


Figure 2: Veil of ignorance

The development of the framework is continuously conceptualized by these schematic representations. Figure 1 represents complexity of realities showing a multitude of diverse aspects being interrelated (dynamic, non-linear changes or location on different scales cannot be displayed here; however, they remain in the argumentation). Figure 2 shows, based on critical realism, that we these realities are on another level than on the human understanding of them. Without knowing about such reality, there is a 'veil of ignorance' above them. This veil can be lifted through experiencing, studying or feeling. Different ways of understanding such realities and which consequences that implies for sustainability is presented in the following sections.

3.2 Modern disciplinary understanding

I describe two ideal types of understanding. As all ideal types, they do not exist exactly like this in reality; however, a certain applied understanding always might show some traits of one of them. It is important to present shortcomings of the counterpart of the later developed approach in order to justify the development of an alternative approach.

3.2.1 Construction of understanding

The first ideal type based on the history and traits of modernity, which also gave birth to the way academic disciplines existing nowadays. Since the later presented Comprehensive Understanding is mainly based on transdisciplinarity and sustainability science literature, also this type of understanding is based on the same sources. It is the explicit or implicit mentioned counterpart of a more sustainable, Comprehensive Understanding in its various different forms. The main idea of such understanding is that disciplines and modernity have led to an understanding that provides a limited perspective on reality. Through the specialization of knowledge, complexity is reduced to a few variables.

The contested and widely discussed concept of modernity is used under the following ideas. A first founding stone of modernity is the importance of reason (Callinicos 2007; Schaal & Heidenriech 2009). Through the era of enlightenment, rational thought, founded in the Newton physics (Gibbons 1994) and oriented by a natural science approach has been used in order to explain social and natural reality. Reason has been used for detailed analysis. Such analysis is often conducted in a dialectic

manner, which in one of its first forms; Hegel (Callinicos 2007) suggests dividing reality into two opposing parts; thesis and antithesis. Part of dialectical thinking would also be to synthesize the analyzed parts; however, modernity has focused more on the specialization of knowledge and deep analysis.

The process of specialization in society and economy has been described by Smith (1776). The idea was to be more efficient through dividing the whole into single parts and concentrating one's activities on them. In the same way, in academia, more and more disciplines have been created having their own research objects and methodology to investigate them. A type of academic disciplines has been created that is labeled 'mode 1' science by Gibbons et al. (1994). With such term they describe the conventional, academic way of doing science. I translate some of their ideas on mode 1 science into my conceptualization. Mode 1 looks at a part of reality. Others might say that they construct their focus area (e.g. political system for political science, technology for engineering ...). Part of the complexity is that categories such as of 'natural', 'economic' are artificially compartmenting realities that possess by default, many interrelations and interactions among all those factors. Scientists who are educated at universities get specialized in one of those segments of reality. Being specialized in one field, the communication with other segments of the same reality is not necessarily possible. One reason is that the same issues are conceptualized in a distinct way by different disciplines. In these academic disciplines, practitioners are educated to apply their specialized methodology of their discipline in order to understand and act within the realities they face. Many important, especially technological and economic, achievements are ascribed to such mode. However, in literature (e.g. Max-Neef 2005; Lawrence 2004), there is doubt about its suitability to understand complex sustainability challenges and to act within such realities. I present the general problems of such thought for sustainability in the following section.

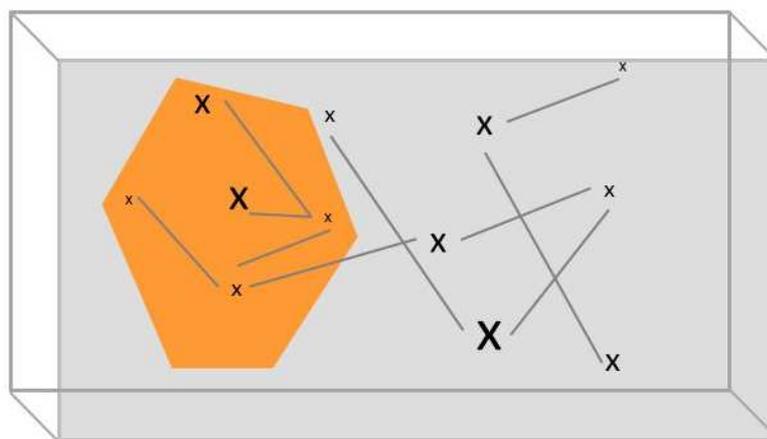


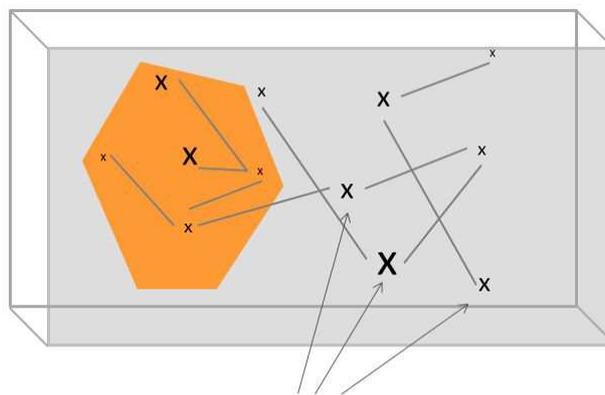
Figure 3: Modern disciplinary understanding

In the schematic representation (figure 3), this modern disciplinary understanding provides a partial understanding of overall reality. In this thesis I do not only focus on academic perspective; but also on other kinds of perspectives one can have on a certain issue. This can be personal experience, emotions but also rational knowledge.

3.2.2 Sustainability impacts

The basic problem of specialized knowledge within complex realities generates the two following types of problems.

The first problem is called problem of limited understandings (figure 4). Through focusing on a part of the system, one gains a profound insight into some aspects, as for example the research area of the discipline (political system for political scientist, etc.). However, these aspects are only one part of realities. They are artificially constructed segments, which provide a limited understanding of the overall reality. Other aspects, which lie out of the own perspective, are not taken into account. In that way, occurring impacts of an action, positive as well as negative, within such reality are not considered.

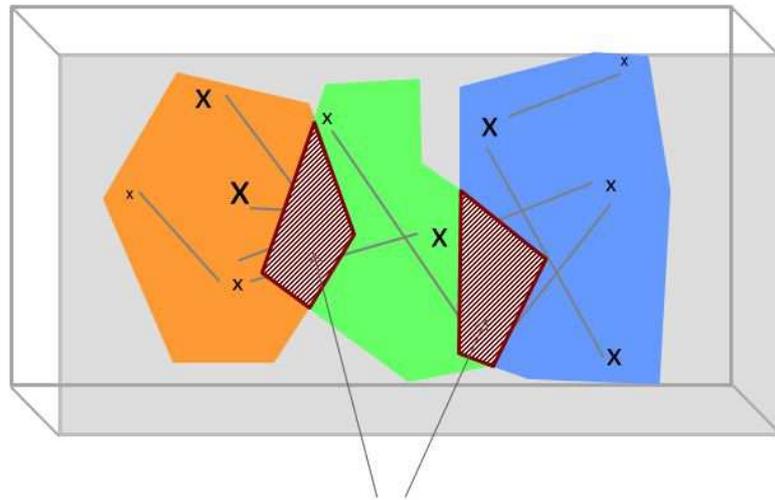


I. Problem of limited understanding

Figure 4: I. Problem: Limited understanding

This creates especially problems with the following traits of reality. For example, socio-ecological systems are divided and often understood in distinct disciplines. Natural and social science create often opposing constructions with distinct institutions and methodologies. However, the studied socio-ecological system remains the same and important aspects and relations are missed. Furthermore, modern disciplinary thought often assumes linearity. This conflicts with the non-linear changing trait of sustainability challenges' realities. In that way, modern disciplinary understandings have fundamental problems in providing a sufficient basis for understanding and acting within complex realities.

The second main problem is the problem of conflicting understandings (figure 5). This problem is created in cases when the same reality is analyzed from different disciplinary perspectives, different assumptions and methodologies, etc. Often, each perspective has a specialized focus; nevertheless, there are overlaps, which are analyzed by various perspectives. In that way, processes can be analyzed for example from a political science, economist or sociologist stand point. These are latent conflicting understandings that can create from misunderstandings or even conflicts about which perspective is correct. The problem is, however, that by having each of them a different perspective and way of thought, communication and reconciling these conflicts is not always easy.



II. Problem of limited understanding

Figure 5: II. Problem: Conflicting understandings

3.3 Comprehensive Understanding

3.3.1 Theoretical basis for the concept

Here, I present relevant aspects from basic sustainability science concepts. The approach of Comprehensive Understanding is based on a synthesis of the commonalities of those different approaches.

Transdisciplinarity

This thesis has been inspired a lot by the literature on transdisciplinarity (Max-Neef 2005; Lawrence 2004; Nicolescu 2010; Thompson Klein 2004; Hadorn et al. 2006; Scholz et al. 2006); however is not the only source of inspiration.

Transdisciplinarity is an approach that addresses problems lying within complex realities (Nelson 2000; Scheringer, Jäger, and Esfeld 2000). Such problems are defined jointly with practitioners or civil society. In that way, transdisciplinarity aims to contribute to the solution of 'real world' problems instead of tackling purely academic questions. Its method is the integration of different disciplinary understandings as well as non-academic forms of knowledge. It is seen as a core element of sustainability science. However, it also finds application in many other cases.

Communicative rationality

A more theoretical concept that has been a basis for this thesis is the concept of communicative rationality developed by Habermas (1981). Habermas conceptualizes problems of modernity arising from tensions between the system and lifeworld. Lifeworld is the realm of society, culture or arts. Within it, understanding is created via communicative rationality. Such rationality integrates different perspectives and interests in an ideal speech situation into an intersubjective understanding. In contrast to this, the system is the realm of economy and administration. The

dominant rationality within this realm is instrumental rationality, for example efficiency. The problem in the era of modernity is that the lifeworld is colonized by the system's instrumental rationality. As a consequence, communicative rationality with its positive effects is undermined. The solution to this is to strengthen communicative rationality (Habermas 1981). There have been attempts to connect his thinking to the sustainability concept that became important after he published his main works. In the concept of communicative sustainability (Wironen 2007), the basic embeddedness of the lifeworld and the system in environment should be recognized. Through such recognition, sustainability will get part of the discourse and become an intersubjective truth.

Holism and reductionism

Besides of Habermas' theoretical ideas, there are basic ideas of holism, which are similar to my argumentation. Holism argues that complex systems cannot be understood through reductionism that perceives the whole through its division into its part (Esfeld 2003). A problem of such reductionism is the emergence of events that cannot be explained by the understanding of the single parts. Therefore, proponents of holism argue for understanding the whole system in an integrated perspective.

Decision-support tools

Sustainability impacts assessments, certification environmental management are widely applied tools of sustainable decision-support. Sustainability impact assessment focuses on the sustainability impacts of any kind of rather single project (Gibson 2006; Ness et al. 2007). Certification methods focus more on creating transparency about the sustainability impacts of a certain product that is often reproduced (van Dam et al. 2008; Lewandowski & Faaij 2006). Environmental management systems such as ISO 14000 (Martin 1998) or EMAS (European Parliament and Council 2009) focus on minimizing negative environmental impacts of organizations by establishing a certified environmental management scheme for the organization. All three have their general methodology in common. The joint aim of such approaches is to contribute in a way or another to sustainability. They have often an implicit or explicit understanding of sustainability that they operationalize by defining relevant variables that the measure. Mostly, these variables lie in a broad number of dimensions, such as the social, legal, technological, economic or ecological (Scarlat & Dallemand 2011). If the defined requirements are met, the assessed object receives the label sustainable; or if they are not met, it is not sustainable (van Dam et al. 2008).

3.3.2 Construction of Comprehensive Understanding

The aim should be to develop an understanding that embraces complexity in order to prevent 2 problems mentioned above. Such understanding should, first, cover all relevant aspects that lie in nature and society, different levels and changing on the long-run. Second, such understanding should create a shared understanding of the same reality. Furthermore, it should incorporate its operationalization in order to be applied by practitioners. Having such understanding, sustainability impacts of one's decisions and actions should be optimized by mitigating negative and promoting positive impacts. I argue that the key for achieving this lies in synthesizing diverse perspectives.

Considering the complexity of reality with its multitude of aspects, the diversity of specialized perspective provides a first basis in covering all aspects of complex realities. In today's world,

information and knowledge is omnipresent as never before (Nesseldreher 2006). However, knowledge is not the only way of accessing reality, also emotional ways such as intuition or imagination are fundamental part of how human access and understand reality (Max-Neef 2005). It is for example very different to know about injustice, hunger or love or to have felt them. Therefore, including emotional perspectives is an essential part of creating a Comprehensive Understanding.

Considering all this, holistic argumentations show (Esfeld 2003) that the whole system is more than the sum of its parts. The method should not be to sum all these different perspective up. This would only create a more complicated and complex understanding of a complex reality. However, a more comprehensive, accurate understanding of complex realities does not necessarily have to be more complicated. In an ideal case all different perspectives have to be synthesized into a Comprehensive Understanding.

In the case of over-lapping conflicting understanding, a dialogue is carried out in order to create an inter-subjective understanding. This dialogue can be facilitated through different ways. Through discussing a specific topic, theoretical pre-understandings can be deconstructed and a consensus, based on the jointly perceived reality can be generated. Furthermore, in such ideal dialogue, an ideal speech situation of rationally arguing participations that are open to other logics and willing to accept the better arguments (Habermas 1981) favors the creation of a consensus. In that way, different single, segmented perspectives merge in an ideal dialogue about a specific reality into a shared, inter-subjective understanding. This understanding that benefits from all the single contributions and reconciles pre-existing conflicts among them.

The result of such synthesis is a Comprehensive Understanding that covers all relevant aspects of reality (problem 1), their interrelations and changes over time, on the long-term. Additionally, it is a shared understanding that reconciles conflicting understandings (problem 2).

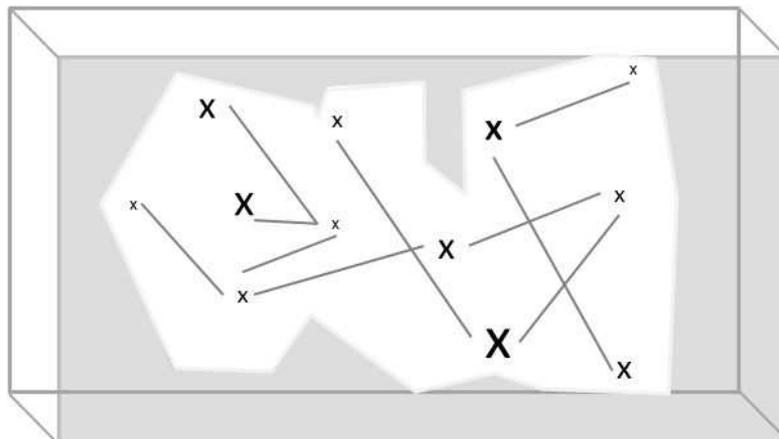


Figure 6: Comprehensive Understanding

In the schematic representation (figure 6), this synthesis of limited understandings is represented by the merging of such perspective into a single understanding that provides a more comprehensive and accurate model of the same complex reality.

3.3.3 Sustainability impacts

In this chapter, I link the approach to the concept of sustainability. I show how the approach promotes sustainability and discuss its use as intrinsic rationale for decision making.

Concepts of sustainability

In order to link it to the sustainability concept, I go to the basic discussion on what sustainability and sustainability development are. Generally spoken, there is no consensus on how to understand sustainability or sustainable development. However, some conceptualizations have been widely used and accepted. I present some general ideas of those coming from different schools.

First, based on the work of Solow (1993), there is an understanding labeled ‘weak sustainable development’. Under this understanding, sustainable development is a development that sustains human welfare while developing the total stock of capital. Solow (1993) puts emphasis on including environmental, besides social and economic forms of capital into the total accounting of capitals. It is called a ‘weak’ form, because natural capital can be substituted for other forms of capital, as long as the total stock does not diminish. In contrast to this, there is a school, known as ‘strong sustainability’, which argues for the non-substitutability of ecological resources. Daly (1996, 2008) lays emphasis on the complementarity, the vital role of ecological resources in economy and society. In that way, also strong sustainable development is anthropocentric focusing on human welfare. Between these two schools, many currently used conceptualizations can be located under the branch of ‘critical sustainable development’. In that branch, they argue for the non-substitutability of essential environmental resources. Some environmental resources might be substituted for the development of other forms of capitals. Some understandings of sustainability are, for example:

Cash et al. (2003, 8086): “challenge of meeting human development needs while protecting the earth’s life support systems”

Clark & Dickson (2003, 8059): “sustainable development is the reconciliation of society’s development goals with the planet’s environmental limits over the long term”

However, the main contribution of that perspective is the emphasis on the long-term character of such development. In writings on sustainable development, such as from Carter (2007), there is an idea of sustainable development as a metafix, as a concept that should reconcile societal and environmental conflicts. Furthermore, Carter (2007) argues that sustainable development is not only the goal, but also the means of development in an inclusive development process. In the concept’s application, such general definitions have been operationalized into different dimensions. In those understandings, something sustainable should contribute positively to the environmental, social and economic areas.

The common characteristic of these definitions and applications is their broad scoping of considering and optimizing all kind of aspects on the long-run, while preserving essential stocks that are responsible for such development. Their achievement lies in a shared process of all striving for the common good of sustainability. In that sense, the ideal form of sustainable development as goal and means is very similar to the ideal form of Comprehensive Understanding presented above. It has been conceptualized as an understanding that covers all relevant aspects of reality with their

interrelations and changes over time by integrating different perspectives into a shared understanding. The remaining question is to make clear, whether this understanding is not only comprehensive, but also contributes to general sustainability; and, why someone should strive for such Comprehensive Understanding facing complex realities? This question is clarified in the following section.

Integrating sustainability as intrinsic rationale for decision making

It is well known that sustainability is something positive and that all will benefit from it on the long-run. However, there is often a tension between the common good of sustainability and particular, often short term interests. In the words of Habermas (1981), nowadays, sustainability is not yet the intrinsic logic of the system. It is often more a supplement to business as usual modern disciplinary decision making. However, in order to make sustainability really the means and the ends, it has to become the intrinsic decision making rationale that merges particular interests with the common good.

It can be assumed that individual businesses are at least interested in mitigating negative and promoting positive impacts on themselves. If they do so on the long-term, this has an individual notion of sustainability (e.g. corporate sustainability, sustainability of a project). Nevertheless, as discussed above, realities are complex and individual action interconnected with others. Actions have impacts on many aspects and other stakeholders through interrelations and can have repercussion on one's own interests. Many aspects that have repercussion are not understood with modern understanding. However, they have impacts on one own and on the broader context including the social and natural environment. Such impacts can be understood and mitigated through a Comprehensive Understanding. Such understanding does not only optimize the individual sustainability, but merge different individual perspectives into a shared understanding. Such a common good mitigates negative impacts on the environment and society and at the same time promotes positive effects. It reconciles conflicts amongst its participants and considered aspects; and consequently, it optimizes the benefits for all. And not only that, since all participants' individual interests have merged into the shared common good, the application of a Comprehensive Understanding and therefore sustainability development lies in the vital interest of each participant. In that way, it can be integrated as the intrinsic rationale for decision making.

'Merging individual interest and the common good of sustainability' sounds almost too nice to be true. 'Unfortunately', social reality does not equal to the ideal types discussed by an academic. However, realities have always traits of such ideal cases. In the following section, I discuss the scope of contribution of such Comprehensive Understanding to general sustainability.

Scope of sustainability achieved in practice

The key to the question whether the sustainable development lies in the particular interest is basically decided by whether and to what extent impacts of decision maker's action really have repercussion on the decision maker.

Generally, realities have become more complex. Inter-relations and impacts factually happen. However, decisive for creating the repercussions of impacts back to the decision maker are mechanisms of internalization. Their effectiveness depends on the context. There are various types approached by the broad governance literature. Three types are briefly presented here. The first type stated here is a critical public. A critical public or civil society can criticize the decision maker for negative impacts he or she is responsible for. The public can create awareness and also affect the

reputation, and by doing that, it can touch the self-interest of the actor. A second type of internalization mechanisms are values or norms (Therborn 2002). It does not always need external critique. In many cases the decision maker already prevents negative impacts on others, although they do not have direct repercussions on the decision maker. Like the other mechanisms, also their effect is limited; however, this is usually the area where sustainability is located. Conscious consumption is one example of that, where consumer pay more money in order to buy products that are in line with their normative understanding. A third type is policy instruments (Carter 2007; Delmas and Young 2009). Such mechanisms are mostly applied by the government in order to internalized general concerns into societal or economic behavior. They set a frame for economic and societal life. Policies can prohibit certain actions or incentivize others.

The idea of internalization mechanisms is broadly accepted in sustainability science literature. Barriers for the metafix of sustainable development, or here the Comprehensive Understanding is individual seeking for maximization of interest. Internalization mechanisms are needed to prevent such individual maximization by internalizing externalities and order to aspire to the common good.

It is important to mention, that not all kinds of creation of repercussion contribute to sustainability. It is about the internalization of general sustainability impacts and effects; especially on essential societal and environmental resources. There are many complex environments in the world, where a Comprehensive Understanding might help to make a more sustainable decision for the decision maker, but, not necessarily for wider environmental and societal concerns.

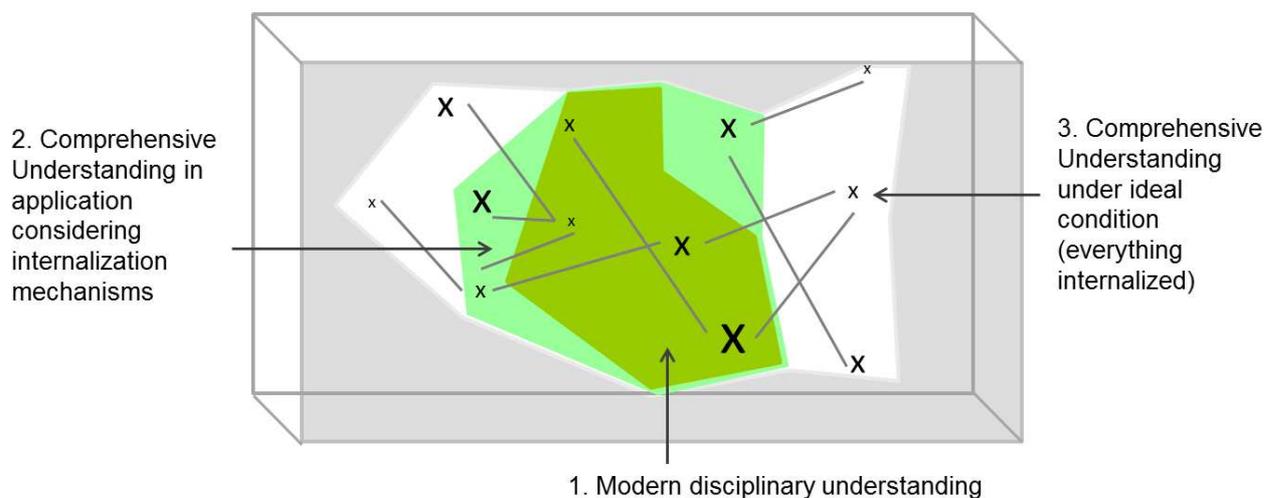


Figure 7: Internalization mechanisms

In figure 7, main ideas of that section are concluded. In complex realities, a modern disciplinary understanding is insufficient to understand all impacts of action. Furthermore, it is not suitable to optimize the impacts for the individual and general benefit, since negative impacts, which factually happen, are not considered. The optimization of impacts, through the application of a Comprehensive Understanding is within the internalized impacts in the self-interest of each. Where such internalization mechanisms do not exist, real impacts occur, but do not have repercussions to the decision maker. Especially in these domains, action is needed in order to create internalization mechanisms such as policies or an active civil society. However, it remains also the domain where sustainability always can be promoted by normative actions towards sustainability.

3.3.4 Guidelines towards a Comprehensive Understanding

As it has been shown, the core of such sustainable corporate decision making is the integration of diverse perspectives into a Comprehensive Understanding. This is in the self-interest of the decision maker considering the repercussions of his or her actions in a complex reality. In order to construct such Comprehensive Understanding, some basic guidelines can be followed (figure 8).

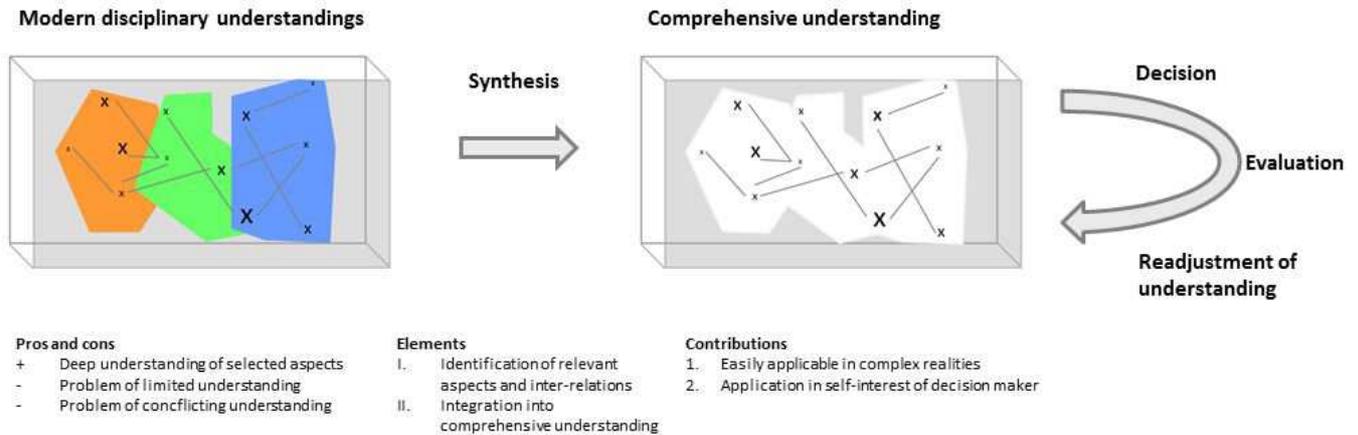


Figure 8: Process of Comprehensive Understanding

The first element is the gathering of diverse perspectives on relevant aspects. This is done in a dialogue and confrontation of pre-understandings with the concrete case. Rational as well as emotional perspectives are important. Sources of such perspectives can be academic literature, the internet, other forms of literature, newspapers, discussions, dialogue, personal experience or reflections. The second element is the synthesis of the aspects identified as relevant into a Comprehensive Understanding. In order to do so, interrelations between the different variables have to be determined. Again, the dialogue with others and the practice is crucial for that. Furthermore, openness, availability of resources as well as power relations must be considered. After creating such synthesis, a decision is made. However, this third element is not the end, because it is crucial to evaluate the decisions impacts, reconsider and adjust the understanding and the decisions made in an iterative process. Following such guidelines, the impacts on sustainability of such decision are optimized; sustainability is therefore promoted.

4 Illustrative example

The structure of that part will be the following. First, different options for mitigating the conflict will be stated. Second, the option of food import with the example of Ukraine will be assessed. And finally, the role of that option in the mitigation of the German food vs. fuel conflict will be concluded.

4.1 Applicability and application of Comprehensive Understanding

The Ukrainian agricultural system encompasses many aspects from the natural (e.g. soils, temperature, and precipitation) as well as broad social dimensions (e.g. property rights and structure, agricultural knowledge and practices, access to financial capital). Such factors can be located on different spatial and temporal levels, from local practices, over national policies, to global development such as climate change. An example for the (non-linear) change in the system is the deep transformation of Ukrainian agriculture, economy and society since 1990 (Gorton et al. 2002). Also before that, there have been major changes such as the shift towards the socialist agricultural system in the first half of the 20th century. Such major changes have occurred in a non-linear, very abrupt way. Since the occurrence of such events, there has been no straight process of modernization, but an unsteady transformation process of society, economy and agriculture (Wandel et al. 2011).

The research process is framed by using the different elements of the approach of sustainability decision making developed above. The first element is the gathering of diverse perspective on the relevant aspects. Then, secondly, a synthesis of such diverse perspectives is established. As a tool for doing that, the DPSIR framework has been used here. This is one framework out of other possible tools, which helps in the selection of the most relevant variables and the construction of inter-relations among those aspects. The framework allowed the integration of different perspectives into a Comprehensive Understanding. Based on that synthesis, a conclusion will be drawn. Such conclusion can then be the basis for a sustainable decision as well as, after that, its evaluation and readjustments. Since sufficient resources have been available, DPSIR has been used as a decision-support tool. As shown previously, the approach is also applicable for decisions for which less resources are available. In any decisions holds the basic idea: through the integration of more perspectives, the sustainability impacts of the decision will be optimized.

4.2 Options for mitigating the food vs. fuel conflict

The previously presented food vs. fuel conflict can be mitigated by various different manners. In this section, I provide a general overview on some of them. Such overview is not complete; however, it is supposed to provide an idea that the conflict can be tackled from various perspectives, before assessing one further in detail. The overview is based on a review of related literature. The different options have been categorized according to both their target they have been directed at (food or fuel); as well as the way in which they reduce the conflict between food and fuel (table 2).

Table 2: General options for mitigation regional food vs. fuel conflicts

Food	Vs.	Fuel
Supplying already existing demands on areas without competition		
Agricultural Zoning: Prioritization of food production		Marginal lands: Growth of fuel feedstock on marginal lands 2nd and 3rd generation bioenergy: New bioenergy technologies not competing with food production
Sufficiency: Decreasing total demand		
Diet: Consumption of less land intense food; especially meat		Absolute energy consumption: Reduction of absolute energy consumption, e.g. use of Information and Communication Technology, fossil fuels
Efficiency: More efficiently meeting current demand		
Waste: Reduction of food wastes		Energy Efficiency: Increase of efficient use of energy
Regional conflict mitigations		
Import: Import of food		Import: Import of fuel

First, there are means to supply the already existing demand on areas that raise competition between food and fuel. In that way, food cultivation can be prioritized through land-use planning on the most fertile soils (Corees 2002). Furthermore, bioenergy feedstock can be grown on marginal lands that are not directly used for food production. Examples for such second generation forms of bioenergies are short rotation plantations (McElory & Dawson 1986; Evans, Strezov & Evans 2010) as well as jatropha cultivations (Achten et al. 2008; Koh & Mohd. Ghazi 2011). Second, through means of sufficiency, the total need for food or fuel can be reduced. Concerning food, there can be dietary changes towards a decrease in meat consumption that demands relatively high portions of land (Goodland 1997). Regarding the energy side, the absolute demand for biofuels can be reduced by increasingly using information and communication technology that can substitute travel (Fuchs 2005). Another possible option to decrease biofuel use would be to increase the use of fossil fuels as a substitute. Third, the efficiency of the food or fuel use can be increased. In order to do so, food wastes can be decreased. In Germany, a current report (BMELV 2012) stated that about 81.6 kg of food per capita and year are wasted without being used. Concerning energy, energy efficiency can be improved through ways such as more energy efficient motors, insulation of buildings (Jollands et al. 2010) or more efficient power plants. Forth, regional food vs. fuel conflicts can be mitigated through the importations. The trade of food and energy has increased substantially in the last decades (FAO 2012). In the following chapter I further discuss the option of food import.

As part of a transdisciplinary work, this question did not come from academia, but the field of practitioners. It comes from a practitioner within the German bioenergy sector who aims to

understand the impacts of the possible increase in bioenergy production in Germany and potential ways to mitigate negative effects. The study will focus on observing what probably will happen in Ukraine as a country that has big theoretical potentials of productivity increases. The question seems furthermore interesting because of a lack of research since the other options have been already more widely covered. Based on the discussion, decision may be made in the German bioenergy sector. I address the question by using the previously developed approach of sustainable decision making. Besides answering the specific question, it will help to illustrate the functioning of the approach. As any other case, this example cannot illustrate completely the ideal case of the approach; nevertheless, the essence of the approach can be shown.

4.3 Comprehensive Understanding of the Ukrainian agricultural system

Based on my research, I construct a Comprehensive Understanding of the Ukrainian agricultural system with wheat as the most relevant crop as an example. The DPSIR framework is a tool in order to create such understanding. The model helps to comprehend the system and to answer the research question 2.2 on the stability of possible Ukrainian exports.

4.3.1 Impact

In my unconventional use of the DPSIR framework that focuses on its strength in modeling complex system, I define the research question as the impact. Whether Ukraine will be a stable exporter of wheat will basically depend on the underlying system of wheat production that will be revealed in the following discussion. Until now, there is a trade of wheat between Ukraine and Germany. FAO statistics (2012) show that the wheat trade between both countries has been relatively low in the recent years. The lowest amount was in 2009 with 428 tons in comparison to the highest amount in 2002 of 31609 tons (FAO 2012). Between 2002 and 2009 on the average, 0.74% of German wheat imports came from Ukraine and 0.23% of Ukrainian wheat exports went to Germany (own calculations based on FAO 2012).

4.3.2 State

The direct causes of stable exports are production, consisting of productivity and area harvested, as well as export contracts.

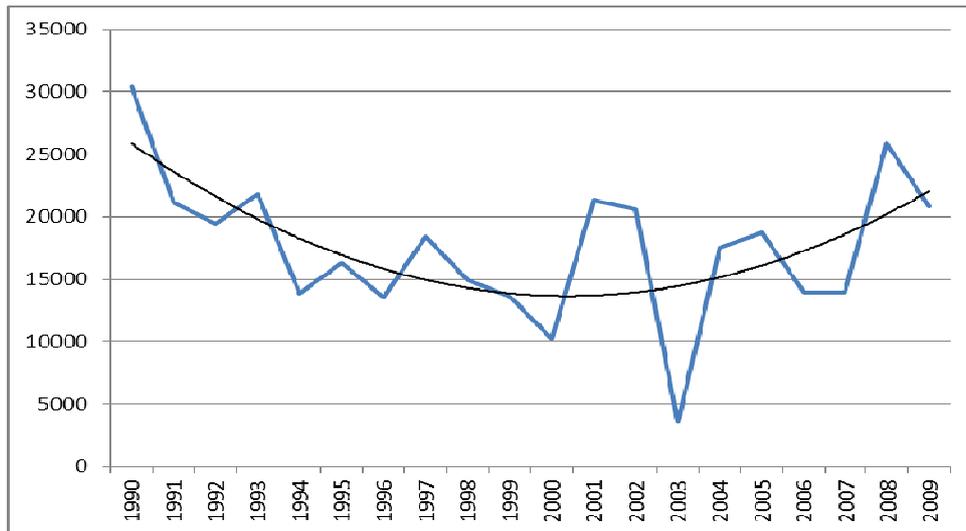


Figure 9: Ukrainian wheat production (in 1000 t)

The Ukrainian wheat production has reached 20886 thousand tons in 2009 (DerzhKomStat 2012). The production trend (figure 9) shows a U-shape. After the 1990 the trend goes downwards. In the 2000's the trend shows rather upwards. The production can be further analyzed by productivity and land area harvested.

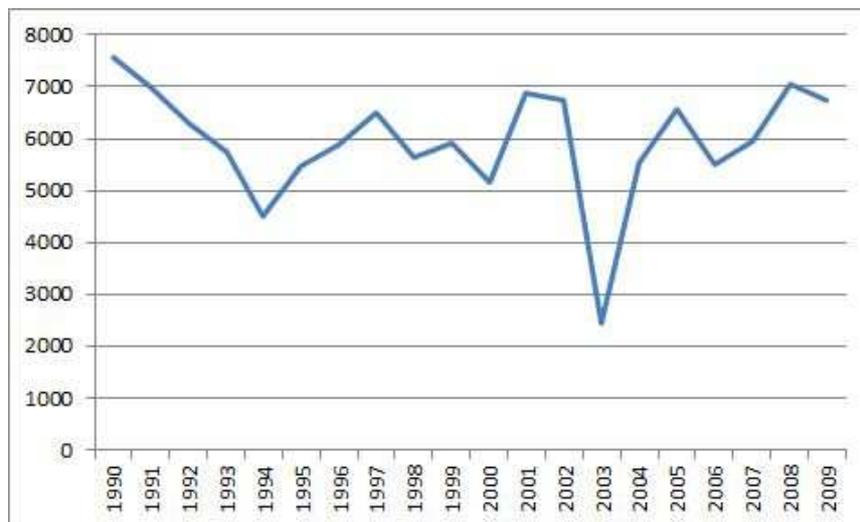


Figure 10: Area cultivated with wheat (in 1000 ha)

The total agricultural used land in Ukraine was 41276 thousand hectares in 2009 (1000 Ha) (FAO 2012). 24% of that total amount (6753 thousand hectares) have been cultivated by wheat (DerzhKomStat 2012) (figure 10). In the post-transition period, big parts of land were abandoned. In Western Ukraine Baumann et al. (2011) estimated that about 30% of the formerly cultivated land was unused. Currently, the area of fallow land in Ukraine has been 1523 thousand hectares in 2009 in comparison to 2712 thousand hectares in 2001 (FAO 2012). Especially fertile areas have been taken under cultivation (Interviewee 13).

Concerning productivity, the comparison to a country of similar harvested area¹ and climate conditions (temperate climate) can serve as an indicator for further potentials (figure 11). For 2009, Ukraine had an average yield of 3.1 tons per hectare (DerzhKomStat 2012), in comparison to 7.4 tons per hectare in France (FAO 2012).

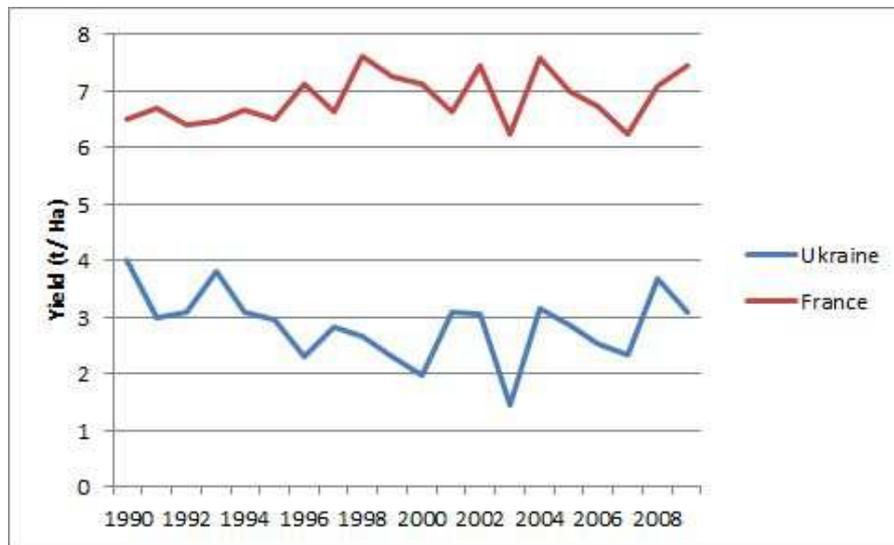


Figure 11: Yields in Ukraine and France

Because of the confidentiality, no official statistics on export contracts have been found. As an indicator for that, the current export statistics, which were previously presented, can provide an idea of the current trade.

However, the research question is directed to the future. Further insights, whether this numbers may increase in the future is provided through the discussion of the Ukrainian agricultural system in the next section.

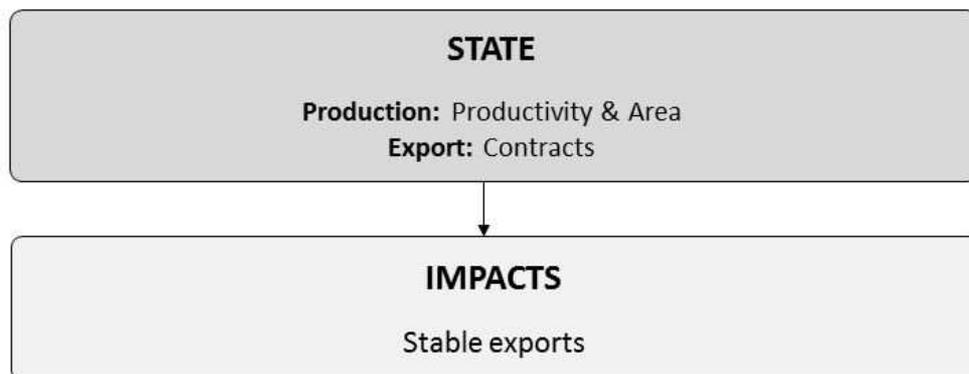


Figure 12: Impact and state of the Ukrainian agricultural export system

¹ Average from 1992 – 2009: France 5,1 x 10⁶ ha; Ukraine 5,8 x 10⁶ ha (own calculations based on FAO 2012)

According to the discussion, the DPSIR framework is continuously built up. Here, the relation of impacts with the state of production and exports is displayed (figure 12).

4.3.3 Pressures

Within the broad and complex agricultural system, most relevant factors are discussed. Such factors are categorized depending on whether they impact on productivity, land-use or export contracts.

Productivity

Concerning productivity, the physical **input factors** for plant's growth are an important aspect. Generally, there are various factors (including solar radiation, temperature and CO₂). However, the most relevant ones in the case of Ukraine are water and fertilizers. The use of fertilizers has been described as generally low; especially, after the fall of the socialist agricultural system (de Wit et al. 2011). Above all, small-scale farmers lack access to such means of production. **Water** is especially in the south-east of Ukraine a limiting factor. In this region, on the average, only 300 mm/year in contrast to 700 mm/year in the Western Ukraine can be registered (Cramon-Taubadel & Nivyesky 2008). The input of water is crucial mainly during the growth period from March to May. Due to the lack of irrigation systems, particularly small-scale farmers are vulnerable to lacks of precipitation.

Von Cramon-Taubadel & Nivyesky (2008) describe the general lack of **skills** in the work force as a major problem. One reason of that is the low social status of farmers. Many young, especially well educated professionals prefer moving to the city to working in the agricultural sector. Furthermore, outdated **management practices** from the Soviet era often prevail. They are a major barrier for adapting towards a new economic and social environment. In some cases, these shortcomings have been recognized and agricultural companies conduct trainings for their employees. Furthermore, the state of agricultural **technology** is relatively low. Since the transformation phase, many, especially small farmers have lacked access to adequate agriculture technologies (de Wit et al. 2011). Particularly irrigation systems as well as harvesting machines are not available. This lack of adequate technology prevents farmers to cultivate at the same productivity level as their colleagues in other European countries.

Besides those factors, the **political support** has been comparably low in Ukraine. In the former socialist system, the state provided missing skills and technologies. After the fall of socialism and the rise of liberalization paradigm, state support to agriculture has been very little (de Wit et al. 2011). As an indicator serves the nominal rate of assistance² to agriculture, which was -11 from 2000 to 2003 and -2 from 2004 to 2007 (Anderson and Swinnen 2009). This is a factual taxation of agricultural sector that has to be competitive against highly subsidies counterparts in the European Union. Besides the state, **financial capital** to famers could be provided by private institutions. However, in Ukraine, particularly for small and medium scale farmers, the interest rates on this market are very high (Cramon-Taubadel & Oleg Nivyesky 2008; Interviewee 15).

The described picture of access to input factors, skills, political support or credits differs highly among the sizes of farms. There are two main sections within the agricultural system. First, there are

² Increase in farmer's income, including non-production related subsidies. Usually paid by government

big agricultural companies, called agro-holdings. Their financial capital often derives from non-agricultural sectors. They concentrate on leasing big plots of land for cultivating cash crops with a quick return on investment. Therefore, on the one hand they bring necessary capital into the system and are responsible for main increases in productivity. On the other hand, there is an important question to the sustainability of their model of farming practices. Second, there is a high number of small-scale and subsistence farmers. They hardly produce cereals (Interviewee 12). However, they are responsible for big parts of the national production of meat and vegetables. Their biggest challenge is the deficient access to financial capital (Kniazhansky 2003), technology or fertilizers. However, they are of high importance when it comes to rural income and culture.

Input in terms of know-how or technologies could possibly come from **foreign investors**. Foreign investors encounter various barriers from political instability, corruption and the ban on land purchase (Strubenhoff & Nivyevskiy 2008). Historically, foreign investment in Ukrainian agriculture is relatively low in comparison to other sectors (Gorton et al. 2002; UCAB report 2009). However, there has been an increase in the recent years. Recognizing the problems investors face in Ukraine, a governmental agency has been created to accompany investors and help them with bureaucracy (Invest Ukraine 2012). In relation to sustainability, also for foreign investors with the focus on the return on investment, there is a general concern on the sustainability of their business model. Nevertheless, in Ukraine the number is still relatively low, especially because of the ban on land purchase in Ukraine.

Cultivated area

Concerning the area cultivated, the **land market** and especially the issue of **property rights** have been identified as essential variable. After the transformation from public cooperative (de Wit et al. 2011) to privately owned land (Wandel et al. 2011), the regulations of the land market are still in the current debate in Ukraine. At present, much land is allocated to people who do not use it. However, no land purchases or sales are possible. Therefore, in terms of wheat production, the land cannot come to the ones who would cultivate it (Demyanenko 2008). Furthermore, in many cases the property rights are unclear (Krasnozhon 2011). There has been a big controversy on lifting of the moratorium on land sales. Such lifting could create an economically efficient land market (Nehryc 2008). However, there are crucial political and social questions related, as for example to prevent concentration of property and guarantee to the population their access to land.

A very favorable factor for agriculture in Ukraine is the **soil quality**. Most of Ukraine possesses high fertile black soils with excellent regulation of nutrients and water. One reasons for the development of such good soils is the accumulation of loess³ as one basis for humus rich soils (Catt 2001). However, also these soils need good management to provide the lacking input factors to the plant.

Trade

Concerning the **regulations of trade**, there are some important factors to be mentioned. On the one hand there is the accession to the WTO in 2008 as well as a free-trade agreement with the European Union that aims at attaching Ukraine to the European domestic market (Interfax-Ukraine 2011). However, on the other hand, the Ukrainian government has established export quota and duties on wheat. Based on the low harvests, it has been a political decision aiming at increasing food security in

³ Aeloian sediment

Ukraine. The effects of such measure are controversially discussed. It is criticized by neo-liberal economics (Institute for Economic Research and Policy Consulting 2007); however, there the political objective of increasing food security.

Regarding the **relations between Ukraine and Germany**, some historical aspects have to be taken into consideration. Those factors have a very important emotional dimension and thereby exemplify the importance considering such aspects. In the fight between German Nazis and Soviets, many crimes have been committed the Ukrainian ground. The possible effects this past might have today are important to consider. According to the interviews the past has not been forgotten, but nowadays for the Ukrainians, there are other, more pressing problems than sad past memories. Actually, they often have a good image of the Germans. Therefore, from the Ukrainian side, no barriers for a future trade have been identified in that respect. On the contrary, current agricultural trade in especially rapeseed shows that trade between the two countries is indeed possible.

From the German side, two aspects have to be discussed concerning trade relations. The first factors are the German historical relations to Eastern European countries. In the interviews and documents analyzed, there has been no major indication that the past could pose a problem today. Instead, Germans are interested in foreign investment in the agricultural sector in Ukraine. Second, increasing bioenergy production and imports of food could threaten the German self-reliance in food production. Especially for basic crops such as wheat this might be a problem. In the German food system, trade is already present in every dimension. Furthermore, the increase in bioenergy is not so high to put food self-reliance in danger. Moreover, consumers do not know where the wheat for their bread comes from. However, there is a political consensus not to be too dependent on food imports (Interview 17). Yet, taking all factors into account, the development of a critical discourse on some wheat imports from Ukraine might be improbable and therefore, the potential impact of the German-Ukrainian relations on a potential trade has been assessed to be rather low.

The following figure 13 integrates the now discussed agricultural system in the DPSIR framework.

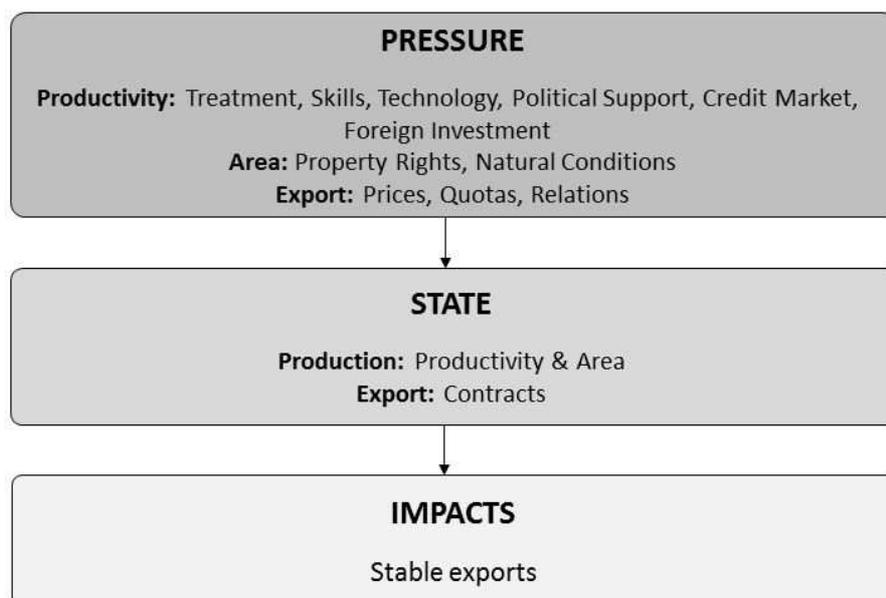


Figure 13: Pressures, state and impacts in the Ukrainian agricultural system

4.3.4 Drivers

The agricultural system itself is embedded into more general processes in the Ukrainian societal and environmental system. Main aspects are briefly discussed here.

Political instability & corruption

Additionally to the low political support for agriculture, the high **political instability** is a major barrier for stable conditions for farmers. In the last 20 years, the transformation phase has been marked by various changes in governments, ministries and policies (Crowther 2011). Such instable conditions make it hard for farmers and agricultural companies to act and invest within the sector. Another important factor is the high level of **corruption** affecting the everyday practices (Gorobets 2008, Tregub 2011). According to Transparency International (2011), Ukraine is the 134th of 178 countries in the corruption ranking. Especially small scale farmers and foreign investors suffer under these conditions. Bigger farmers or agricultural enterprises often have means to navigate within that context (Interview 14).

Climate change & Erosion

Climate change is probable to have mixed impacts on agricultural production in Ukraine. Basically climate change is affecting temperature and water on the long-term. In Ukraine, less cold winters could have a positive effect on reducing the winter kill⁴ of winter wheat (Giorgi et al. 2004). In contrast to this, hotter summers could damage crops. Concerning water, the projections show less precipitation (Olesen et al. 2011). This entails especially major effects for already water scarce south-eastern parts of Ukraine. Yet, the main impact might be increasing variability of temperature and precipitation (Olesen et al. 2011). The major drought in 2010 that lowered wheat production significantly has already indicated that. Furthermore, climate change is besides farming practices a reason for **erosion**. Medvedev and Bulygin (1997) stated that about 12.1 million hectares, 30% of agriculturally used land were affected by erosion in the 90's. They estimated that up to 80000 ha eroded each year.

The complete model is shown in figure 14. It shows how the impacts of stable exports can be understood in their context of production and export developments, trends in the agricultural and more general societal and environmental system.

⁴ Loss of winter wheat due to low temperatures in the winter

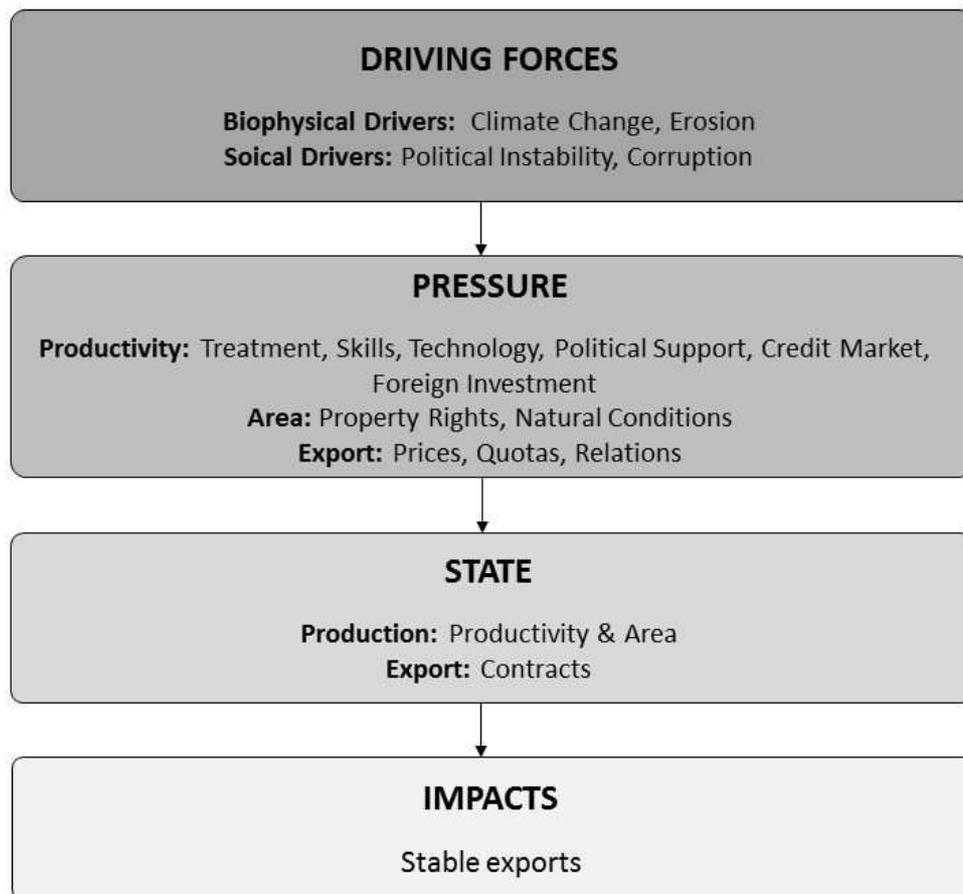


Figure 14: Driving forces, pressures, state and impacts in the Ukrainian agricultural system

4.4 Ukraine's potential role

The overall research question was aimed at evaluation the potential role that imports from Ukraine can play in mitigating the German food vs. fuel conflict. Here, it has been shown that such role can be a small contribution besides other ways of mitigating such a complex problem.

Ukraine has generally a high potential for production increases. However, there are many problems in the agricultural and general societal and environmental system. Positive developments, in relation to a wheat production increase, have been identified such as the investments by agro-holdings or foreigners. In that way, a productivity increase has been observed and is probable to continue, being based on relatively stable developments. However, many factors show that the development will be non-linear and very dynamic. Such factors are the general political instability, effects of climate change, and the general political and societal will to produce more food for export.

Considering the general positive but slow trend and the high uncertainty in the system, it should not be taken for granted that the production potential is met and fallow land is used for food production. Such uncertainty and general positive trend is probably similar in other countries of the region with similar traits; as for example in south-west Russia; Romania or Moldavia.

What does this mean for Germany and its food vs. fuel conflict? Global land-use conflicts among food, fuel, biodiversity or residential claims are probable to continue. German's fuel industry is not the only sector that has an increasing demand. International trade based on local productivity

increases such as the food import from Ukraine can alleviate the problem, but not resolve the conflict. From a sustainability point of view, the aims should be the following. Priority should be given to the basic human need for food. Nevertheless, sustainable forms of energy are also important. Bioenergy has potentials and can provide many positive impacts. In order to mitigate its negative impacts, various options are needed. There should not be reliance on one promising option that solves the whole problem. Instead, all possible options for mitigation should be used, while accepting general limitations of the bio-physical system. To do so, various actors are needed and responsible for providing their contribution in mitigating the problem. From the side of the company that has started the investigation on this issue, contribution have already made and can further be provided by cultivating bioenergy feedstock on marginal lands and work on efficiency as well as sufficiency. However, also governments through framing policies and every citizen can assume responsibility by reconsidering their energy and food consumption patterns. Complex sustainability problems do not have simple solutions, but need Comprehensive Understandings and ways of acting.

5 Discussion

5.1 Contributions of the Comprehensive Understanding concept

This thesis was not meant to add to existing approaches, but to synthesize them while preserving their strengths and reducing their weaknesses. Concerning its contribution the approach was not conventional by, to put it as a metaphor, adding a little stone to the house of sustainability science. The resulting building does not necessary have to be coherent. Therefore, the thesis aimed at reconsidering the design of parts of the house and suggesting an alternative one.

The main contribution is a coherent business approach based on sustainability science concepts. This approach is easily applicable in complex realities, optimizes sustainability impacts and its application lies in the partial self-interest of the applicant. The thesis has focused on corporate decision maker. However, considering that also others are facing complex sustainability challenges, the approach might be applicable more broadly.

Independent approach

Many ideas that are contained in this work have already been expressed in literature; however, I synthesized them in coherent approach together with new ideas and the aim of suitability for complex realities. The approach links basic ideas of transdisciplinarity, sustainability, Habermasian communicative rationality, holism as well as sustainability decision making tools such as sustainability impact analysis or certification.

Applicability

In order to achieve easy applicability of the approach, as common theme of the mentioned approach, the integration of diverse, rational as well as emotional perspectives have been found as a common theme. To follow this as a guideline towards sustainable decision making is a simplification of more complicated rules of other approaches. This guideline can easily be integrated in complex contexts. This also holds partially, by integrating some further perspectives, according to the availability of resources. However, it requires a mental reframing, towards a more Comprehensive Understanding, against the segmentation and detailedness of a modern disciplinary understanding. Furthermore, the more perspectives are integrated, on a general level, the more sustainability is promoted. Through such integration of diverse perspectives, a Comprehensive Understanding for complex realities is created. Its formation and application lies in the self-interest of the applicant. In the ideal case, the self-interest merges completely into the common good, sustainability that is then the intrinsic rationale for sustainable corporate decision making. However, in social reality not all externalities are internalized. Therefore, the approach helps to make sustainable decision for the applicant, where its impacts are internalized. Where this is not the case, internalization, based on a benevolent decision is still possible to integrate more aspects.

Effect

As effect, the application of the approach helps to optimize sustainability impacts. This is especially clear in comparison to a decision making based on a modern disciplinary understanding that does not consider many occurring impacts. The Comprehensive Understanding in its ideal form merges

individual and common interests. Therefore, in the concept itself lies the reason for more sustainable action and practices.

However, the thesis' implication goes even further than that. By applying the Comprehensive Understanding approach, businesses can reframe their role. From being a main causer of negative impacts they can become an agent of sustainable change. The Comprehensive Understanding integrates broad dimensions of complex realities, including not only the economic perspective, but also the social, ecological or cultural. In the ideal case, businesses would turn into organizations which optimize their sustainability impacts through their activities and are financially independent at the same time. In that way, through the approach of Comprehensive Understanding, businesses can canalize their power and potentials towards being an effective agent of change towards sustainability.

5.1.1 Contrast to other approaches of sustainable decision making

In this sections, the here developed approach is contrasted to other approaches. This approach has been inspired by some theoretical and practical approaches. Ideas from them have been synthesized into the present work. The synthesis was necessary, because none of the initial approaches fulfills two main requirements for a broad application: to be easily implementable and with the application lying in the self-interest of the applicant in corporate decision making. However, it is important to recognize their contribution to the thesis' approach and discuss the contribution of the Comprehensive Understanding approach. To do so, I always, first, present related ideas for the other approaches and; second, discuss the relation to my approach.

Transdisciplinarity

The thesis has been inspired a lot by the transdisciplinarity approach. The concept of Comprehensive Understanding shares the core idea and methodology with transdisciplinarity. However, to my knowledge, there is no transdisciplinarity approach that fulfills the two requirements of sustainable decision making. Many related ideas are implicit in the transdisciplinarity literature, but are not made explicit in an approach for sustainable corporate decision making in complex realities. Especially for the mentioned small and quick decisions, there was a lack for a more comprehensive approach. This is also the contribution of the Comprehensive Understanding concept to the literature of transdisciplinarity.

Habermasian Communicative rationality

The approach of Comprehensive Understanding has been inspired by Habermas. Above all, what I expressed in the creation of Comprehensive Understanding with integrating and synthesizing different forms of perspectives resembles communicative rationality. Its result, a Comprehensive Understanding, is quite similar to the idea of an intersubjective understanding. However, there are some differences. First, there is the explicit link to the sustainability discourse that is more encompassing than the more social and economic problems discussed by Habermas. Second, the here presented approach is probably more easily applicable than Habermas' concept that are more embedded into the philosophical academic discourse. Besides that, Habermas does not argue that communicative rationality could also be in the self-interest of the system. Neither in the concept of communicative sustainability can this be found. This concept stays on the level of suggesting a

theoretical concept that is able to resolve problems; however, which does not entail the argumentation why this concept should be applied by those who generate the problems. In my view, this has to be shown in order not only to picture a nice world of sustainability, but actually achieve such ideas in practice. In that why I suggested that in cases where impacts are already internalized, Comprehensive Understanding can contribute to sustainability and its application lies in the self-interest. For other cases I agree with the others that call for the creation of more internalization mechanisms, such as strengthening communicative rationality, in order to resolve problems and conflicts.

Holism and reductionism

However, also as in the communicative rationality concept, in holism the argumentation is often missing why its application lies in the self-interest of the individual. Furthermore, holism is not the only realm of ideas, which I draw from. The concept of Comprehensive Understanding links together many other approaches such as Habermasian communicative rationality or transdisciplinarity. I synthesize them into consistent framework that aims to be easily applicable, generates an understanding of complex realities, and its application contributes to mitigating sustainability impacts.

Decision-support tools

The advantage of approaches such as certification, sustainability impact assessment and environmental management systems is above all, that they are already applied in a broad range of different contexts and create positive effects for sustainability. Therefore, they can already build on trust, experience and accepted institutional settings. However, they have various shortcomings that are an obstacle for a broader application. First, they are only with difficulties applicable for a broad range of different context. Coming with their general criteria, they often have problems with the specific context. In addition to the general diversity of each context, their dynamic change poses difficulties to the general requirements of such approaches. Second, their application implies high costs, especially for measuring and communicating (Nebel et al. 2005). Above all for small decisions or people with little resources, the application of such tools is not under reach. Third, they are usually used as a supplement to the general decision making process and not as the intrinsic decision making rationale.

In contrast to this, also my approach entails the idea of integrating all different kinds of aspects in order to assess sustainability as well as the stakeholder integration in their set-up. However, it does not entail the costly methodology. Therefore, my approach is more general and can be used in a more easy and flexible way in a broader context of application, including small as well as big corporate decisions. However, the Comprehensive Understanding approach has not to be seen in conflict with Sustainability impact assessment or certification. Since the basic idea is the same, the approaches can be a practice tool of the also more theoretical based Comprehensive Understanding approach. On the other hand, all approaches mentioned can be complemented the others and inspire their further development.

5.1.2 Limitations

The approach of Comprehensive Understanding entails limitations in theory as well as in practice.

Theoretically, of course, this approach is no panacea that resolves all kind of sustainability problems. As Ostrom also argues, panacea, solutions resolving all the problems, do not exist (Ostrom, Janssen & Anderies 2007; Ostrom 2009). However, as other approaches, the here presented approach can make possible contributions. Yet, one limitation is set by the reach of understanding in the whole process of practices and their impacts. Since enlightenment we know that reasoning alone is not enough. Understanding is not the only element of sustainable action and its outcomes (Kollmuss & Agyeman 2002). There are other internal as well as external factors confining a process of understanding such as values or the social institutional system.

Furthermore, Comprehensive Understanding is an ideal case. In the real world application some aspects such as internalization mechanisms, power, will or resources have to be considered. The first point in that has already been mentioned. For achieving full sustainability, full internalization of externalities would be needed. This can be done through hard mechanisms such as policies, regulations and incentives; or softer ones such as values and benevolent action. However, the call for benevolent contributions to the common long-term good of sustainability is where sustainability action is often located. I have conceptualized this and for the contexts where an internalization already exists, I have shown the contributions of a Comprehensive Understanding in contrast to the modern disciplinary understanding. There is research and more importantly action needed to internalize general concern in order to align individual interest to the common good of sustainability. Governance literature is doing a lot in that way.

Secondly, aspects such as power, openness of the decision maker and its resources have to be discussed. First, power is a fundamental constituent of social realities that enables and prevents actions. The understanding creation process in its ideal model is free from such things such as power, which prevent the free merging of different understandings by giving more importance to one perspective. However, power is unequally distributed in the decision making process itself. Yet, responsibilities are that as well. Often there is one person who has the most power in the process but often also the biggest responsibility for the caused impacts. Considering the benefits of a Comprehensive Understanding it is especially in the self-interest of those powerful to strive for an ideal form of Comprehensive Understanding that optimizes the impacts of their action. In order to do that, they have to be especially cautious to be open and to communicate. They will benefit most from the optimization of impacts of the decision.

Another possible limitation is the availability of resources for the decision maker to integrate all sorts of different perspectives. The question is how the decision maker can have access to all that information and views of actors. Here it is beneficial that nowadays more information is available than ever (Nesseldreher 2006). Above all, the internet is a rich source of information and knowledge. However, it stays crucial to synthesize such information into an understanding of the issue.

Further limitations are inherent in the person creating a Comprehensive Understanding. First, everyone is different, has his own perspective on things and cannot cover all aspects. Therefore, it is essential to create a functioning team with a good communication. In that way a real synthesis out of the individual contributions can be created. Second, a decision maker might prefer his conventional modes of understanding, although the alternative of a more Comprehensive Understanding might have better arguments. Here, it is important to mention that there is no black or white, but that through integrating more perspective, one can always do a little step towards a more Comprehensive Understanding. Third, we often make pre-assumption of the other's understanding thinking often

that the other understands reality in the same way we do. Therefore, it is important, as argued here, to enter in a more integrative dialogue to learn about other rationales and to integrate other arguments into one’s understanding. Fourth, there are not always enough resources such as time to resolve conflicting understanding. In those cases it is important that sometimes people have to cease and accept the other’s opinion instead of integrating all into an ideal form of Comprehensive Understanding.

For all those aspects mentioned, further research is necessary in order to integrate them better into the approach.

5.2 Contribution of illustrative example

In this section, I discuss the contribution of this assessment to sustainability. I base the reasoning on the general argumentation of the approach of sustainable decision making.

I started by showing how the complexity of the issue made it a good example to illustrate how the approach functions. The contribution to sustainability comes out of the difference between the distinct ways of understanding that could have been constructed on that issue. The question that came from practitioners aimed at extending their understanding of the impacts of the German bioenergy sector. Modern disciplinary understanding could never have covered all relevant aspects of such a complex matter (figure 15). It would have missed crucial aspects and created conflicts with other understandings. In that way, it would have been insufficient to see only the economic, political, natural or historical aspects of the issue. For example, based on natural indicators such as soil fertility, Ukraine shows best conditions for agriculture and an increasing production would seem a logic consequence. However, looking only of political indicators, such as political instability, political support or corruption, the situation seems quite grim.

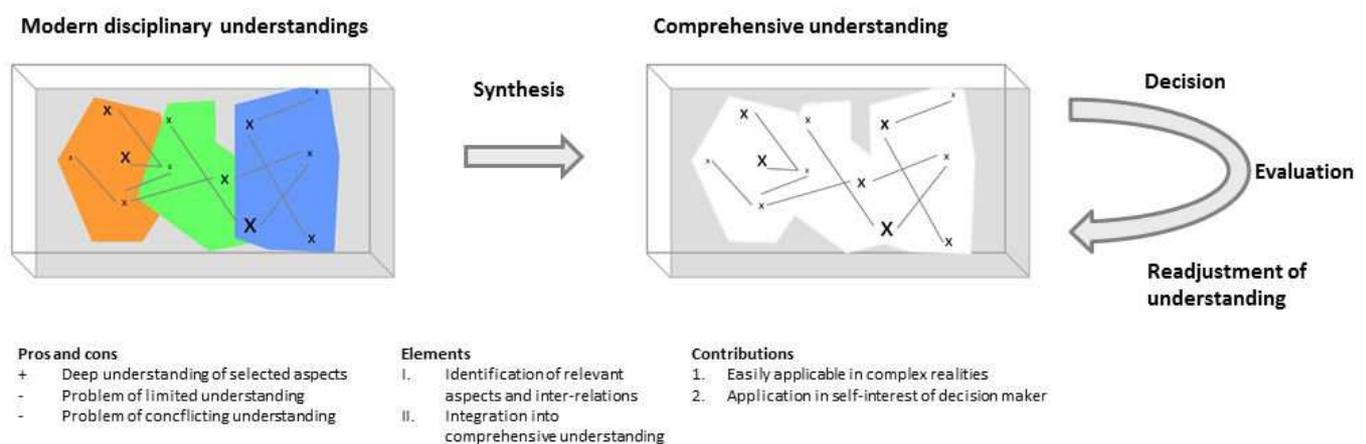


Figure 15: Process of Comprehensive Understanding in the Ukrainian case

It was the synthesis of all relevant understandings through DPSIR that provided a more accurate Comprehensive Understanding. Such understanding can be the basis for various decisions for the company that requested this research. As theoretically shown in the first part of the thesis, such decision will generate more positive impacts on sustainability and is in the self-interest of the corporate decision maker because of mitigating negative impacts on the decision maker as well as

promoting own positive impacts. Furthermore, the integration of diverse perspectives is a practical for everyday decision making by integrating different, already existing, perspectives.

6 Conclusion

This thesis has demonstrated a way how sustainability can become the intrinsic rationale of corporate decision making. Through the theoretical discussion and the illustrative example, it has created the approach of Comprehensive Understanding which fulfils two basic requirements for an integration of sustainability as intrinsic decision making rationale. First, the approach is practical for everyday corporate decision making in complex realities and, second, its application lies in the explicit self-interest of the decision maker.

In the theoretical and applied part it has been shown that sustainability is more than just normative, but actually can also be the intrinsic rationale for our thinking and action. Above all in the case it has become clear that a sustainable understanding does not require new detailed knowledge. Instead, it can be based on a synthesis on already existing understandings, including emotional perspectives.

In any case, there is more research and above all action needed in order to foster that approach further.

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Appendix: Table with interviews

Focus on interviewees from various perspectives

	Discipline	Nationality	Related experience	Contact
Vattenfall; Practitioners in Bioenergies				
Interviewee 1	Agricultural Science	German	Head of project development; Bioenergy	Supervisor, project responsible, often discussions within dialogue
Interviewee 2	Environmental Engineer	German	Project developer; waste-, and biogas energy	Often discussions
Interviewee 3	Mechanical Engineer	German	Renewable energies	Often discussions
Interviewee 4	Engineer	German	Biogas	Often discussions
Interviewee 5	Engineer	German (married with Ukrainian)	Biomass & Ukraine focus	Often discussions, interview
Interviewee 6	Forestry Management	German	Bioenergy procurement, sourcing	Interview, discussions, field visit
Interviewee 7	Political Science	German	Communication	Interview
Contacts Ukrainian Agriculture				
Interviewee 8	Agricultural Management	German	Experience in Eastern Europe	Interview
Interviewee 9	Forestry management of Eastern Europe	German	Research in Eastern Europe	Interview
Interviewee 10	Student, sustainability science	Ukrainian	Ukrainian	Interview and discussions

Interviewee 11	N.A.	Ukrainian, Western Ukraine (L'viv oblast')	Retired, previously head of company (fertilizers production)	One interview, via Ukrainian contact
Interviewee 12	MSc Accounting and Audit	in Ukrainian	Association Agribusiness Director of the Agency 'AgriSurvey'	Ukrainian Club, Agency Interview
Interviewee 13	Ph.D. Agricultural Economics and Applied Statistics	Ukrainian	Executive team leader of the project 'German- Ukrainian Policy Dialogue in Agriculture', Head of the Centre for Agriculture, Food and Renewable Energy Studies Institute for Economic Research and Policy Consulting (IER), Kiev	Interview
Interviewee 14	Accounting	Ukrainian	Ukrainian, having family in country side, agriculture, living for 20 years in Germany	Interview
Interviewee 15	Agricultural economics	German, intense research in Ukraine	Johan Heinrich von Thünen Institute; research focus: Profitability of arable farming in Ukraine; PhD candidate; researcher of Ukrainian agriculture, (Interview in German)	Interview
Interviewee 16	N.A.	Russians	Representatives of Russian regions on fair 'green week' in 2012 Berlin	Interviews
Interviewee 17	N.A.	German	Representatives from big Ukrainian agricultural company	Interview

Science, University

Interviewee 18	Sustainability Science	USA, Swede	Sustainability Science	Academic supervisor, often discussion
Interviewee 19	Environmental Science	USA	Sustainability Science, Modeling of CC production	Discussions, one paper
Interviewee 20	Geography PhD	Swede, German	Biomass	One discussion
Interviewee 21	Social Science	Iranian	Social Science	One discussion
Interviewee 22	Social, economic Geography	Swede	Sustainability science	One paper
Interviewee 23	Sustainability Science	German	Sustainability Science	One discussion
Interviewee 24	Sustainability Science	Swede	Sustainability Science	One paper
Fellow students				
Interviewee 25	Sustainability Science	Iranian/ Canadian	Sustainability Science	Discussions
Interviewee 26	Sustainability Science	Ecuadorian	Sustainability Science	Discussions
Interviewee 27	Sustainability Science	Canadian	Sustainability Science	Discussions