

Barriers to Dedicated Energy Crop Cultivation in Poland

The Case of Willow in the Grudziądz Region

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Abstract

This research aims at finding out the barriers to dedicated energy crop cultivation from the perspective of farmers. The study focuses on the case of willow in the Grudziądz region in Poland.

Great potential in the long term has been identified for dedicated energy crops, especially in countries with large areas of agricultural land and the need for diversification of activities in rural areas. However, in Poland the development of these crops has not moved at the pace that was expected. So far, no research has been conducted on the farmers' level about barriers to dedicated energy crop growing.

During the on-the-ground study, primarily 29 farmers were interviewed about why they have not taken up willow cultivation and what they perceive as problems related to this crop. The main perceived barriers could be grouped into four main categories: financial, informational, technical and market related barriers. Other significant related factors influencing farmers' decision are the farm size and the suitability of soils in terms of water content.

Based on the perceptions gathered during the interviews from the Grudziądz region, it can be concluded that under present conditions willow cultivation is not profitable from the farmers' point of view. The main reason for willow being uncompetitive compared to traditional crops is the current subsidy system in Poland, where under the adopted EU CAP scheme dedicated energy crops do not qualify for aid. The removal of this barrier needs involvement on the policy-making level. However, one opportunity that has been discussed in this work to address the identified barriers was possible cooperation for biomass growing among the interested farmers.

Still, as a result of this research it remained somewhat unclear where the potential areas for willow cultivation exactly are located in this particular case and how much potential there actually is in this region. These issues would need further research. Since, this research focused only on the barriers to willow cultivation, it would be interesting to investigate the barriers to growing other dedicated energy crops, such as perennial energy grasses.

Executive Summary

This thesis investigates the barriers to dedicated energy crop cultivation from the perspective of farmers in Poland. The focus in this research is on a special variety of dedicated energy crops, namely, willow. The study was carried out in the Grudziądz region in the centre of Northern Poland.

The objective of this research was to find out why the Polish farmers have not taken up dedicated energy crop cultivation. This research set out to answer the following research questions:

1. *Why do the farmers not engage in willow cultivation?*
2. *How could willow development be aided in the Grudziądz region?*

Currently issues related to the reduction of greenhouse gas emissions and the mitigation of the climate change effect are on the agenda worldwide. The increasing geo-political risks and mounting threats to supply security are all among the drivers for the development of renewable energy. Holm-Nielsen et al. (2006) has stated that “biomass will be the primary energy source for the 21st century, like the fossils in the past”.

Poland, as a New EU Member State, has had to develop its legal system in line with the EU legislation. The introduced “green” electricity obligation acts as the main driver for bioenergy development for power and combined heat and power (CHP) plants (Jaworski, 2006; Nilsson, et al., 2006). However, at the moment, there is great competition for biomass resources. The energy sector is competing with the pulp and paper industry and the fibre board producers for wood supply. Also forest residues are largely used up by sawmills and other industries, therefore not guaranteeing a stable supply for the energy producers. The search for alternative biomass sources has been directed towards the agricultural sector. In Poland, there is an abundance of agricultural land and a need for extra income sources in rural areas. Two main biomass sources, agricultural residues and dedicated energy crops, should be considered. Straw is a readily available biofuel but has lower calorific value and part of it needs to be ploughed back into the field for agronomic considerations. In the long term, great potential has been identified for energy crops (Rodriguez, 2005).

Another reason for focusing on the barriers for farmers in Grudziądz region in regard to dedicated energy crop growing is the local energy producer, who has set out to fulfil the “green” electricity obligation by using willow supplied by local farmers. Since in the area there is no available land that the energy producer could use to establish its own plantations.

It was decided to focus on willow for several reasons. The main factor that makes willow attractive is the relatively higher calorific value compared to agricultural residues and the better combustion properties. The fact that willow is harvested during the coldest time of the year when it can be used right away for energy production adds another advantage. In the case location, the lowlands that are unsuitable for traditional crops (too wet) have been perceived as potential areas for willow. Also the future set-aside obligation is expected to create some opportunities for willow. The fact that the energy producer is especially interested in using willow as a biofuel in the future implies that the region could become a potential willow cultivation area.

This study focuses on the use of solid biofuels for electricity production and, therefore, any liquid biofuels for use in transportation are beyond the scope. The barriers were investigated mainly from the farmers’ perspective.

So far, energy crops have not developed as well as expected. Research has been conducted about the barriers to bioenergy on a more institutional level. However, in Poland, the technical solutions are already available; the problem lies rather with the shortage of biomass supply (Jaworski and Oniszk-Poplawska, 2005). Therefore, there is a need to identify the challenges for the potential crop producers. For this research it has been assumed that the farmers are the potential growers of dedicated energy crops. If the farmers are not interested in growing energy crops, then the subsequent energy crop chain loses its meaning. Up to date no on-the-ground study has been conducted about the barriers to farmers in regard to energy crop growing.

This research started out with a literature review on energy crops in Poland with an emphasis on the barriers for dedicated energy crop cultivation from the perspective of farmers. An exploratory visit to Poland was made in May. Before the trip preliminary research questions were formulated and refined further after the study visit. Based on the knowledge and insights from the first visit a semi-structured interview questionnaire was compiled to be used for the farmer interviews. In July, 29 individual farmers and 5 other actors in the Grudziądz region were interviewed about their perceptions of barriers to willow cultivation. The findings were analysed and discussed by comparing them to the ones found previously in the literature and how other actors in the region perceived the situation.

A number of perceived barriers were identified. The most frequently mentioned barriers could be divided into four main groups: **financial**, **informational**, **technical** and **market related barriers**. The establishment costs of willow plantations, as well as the low annual subsidies were mainly addressed under financial barriers. Comparing the current subsidies for traditional crops with subsidies for dedicated energy crops in Poland, the latter are not competitive. In addition, the establishment of a willow plantation entails extra costs. Based on these insights, it can be concluded, that financial barriers are the most significant ones and that under current conditions dedicated energy crop cultivation is not profitable for Polish farmers compared to other traditional food crops. Also issues related to the farm size were brought up. Small farmers were perceived to have less potential to become willow growers.

While conducting research in Poland, it was perceived that life in the rural areas is hard and farmers seem to base all their decisions simply on what is more profitable so that they can provide for their family. Therefore, they aim at reducing risks and would rather continue familiar activities than engage into something new and unknown.

The energy producer has decided to begin from using straw as a biofuel to start up “green” electricity production because straw is an already available biomass source and it will take time to establish willow plantations and about 4-6 years more before the plantations can be harvested for the first time.

Clearly, it is very difficult to convince farmers to take up dedicated energy crop growing unless these crops become competitive with other crops in terms of subsidies. Another barrier that needs involvement from external actors is the market related barrier – farmers need to feel confident that there will be a market once it is time to sell their harvest. Analysing the other barriers, it was noticed that these could be overcome if the farmers cooperated. Willow plantations that are larger than 50 ha can get an establishment subsidy from the Polish EcoFund. A farmers’ biomass cooperative could serve as a platform for knowledge and experience sharing and together they could solve the equipment related problems.

Since, establishing a well functioning cooperative is not easy, it has been suggested to do it within a demonstration project that would involve a number of actors to address the farm

related as well as other external barriers, and act as a capacity building project for other similar ventures in other areas in Poland.

Occasionally, farmers mentioned that their soils might be too dry for growing willow. However, the existence of suitable soils is a prerequisite for engaging in energy crop cultivation. As a result, it remained somewhat unclear where exactly the potential willow growing areas are located in the region. This could have been because of two limitations: the number of interviewed farmers was too small and not many different areas were visited. Therefore, for further research, it is suggested to increase the number of interviewed farmers with an emphasis on bigger farms and include different areas, e.g. the region on the western bank of the Vistula River. This would enable to identify the potential biomass growers in the region, so that afterwards efforts could be directed towards addressing their barriers. Since, this research only concentrated on willow, further research could also explore the barriers to herbaceous energy crop cultivation for farmers.

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1 Introduction

1.1 Background

Currently issues related to greenhouse gas (GHG) emissions and climate change are very high on the global agenda. The main objectives of the European Union (EU) energy policy are to develop renewable energy for reducing CO₂ emissions to the atmosphere, enhance sustainability and secure energy supply within the European Community (Commission of the European Communities, 2006). The need to break dependency on fossil fuels is another reason for the development of renewable energy sources.

In Poland, the main sources of energy are hard coal and lignite (Gierulski, 2002), the combustion of which contributes significantly to the carbon and sulphur emissions. Poland has signed the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol and is thus devoted to the reduction of GHG emissions (Nilsson, et al., 2006). Poland's commitment under the Kyoto Protocol is a 6% reduction of GHG emissions compared to 1990 that has already been fulfilled due to the restructuring of the Polish economy (Ignaciuk, et al., 2006). Any further reductions will benefit Poland in terms of revenues from the Emissions Trading Scheme.

Poland acceded to the European Union on the 1st of May 2004. As a result, Poland has had to implement a number of EC Directives. In the field of energy, this has brought along among other requirements, the obligation to produce a certain amount of electricity from renewable sources. The Polish national indicative target for "green" electricity sold to final customers has been set at 7.5% by 2010 (Council of Ministers, 2000). The *Development Strategy of Renewable Energy Sector* (2000) has identified that biomass is the most promising renewable energy source for Poland and should contribute to 4%¹ from all "green" electricity in Poland. Today, the "green" electricity obligation acts as the main driver for the development of bioenergy for the CHP and electricity producers (Jaworski, 2006; Nilsson, et al., 2006).

However, on the European level it has not been determined how much different bioenergy sources should contribute, the Biomass Action Plan (BAP) states that this decision should be taken on the local or regional level (Commission of the European Communities, 2005).

In Poland, the bioenergy sector faces serious competition for solid biomass resources. The competition for the use of wood is fierce between the energy sector and the industrial sector of pulp and paper; and furniture manufacturing (Jaworski and Poplawska, 2005). Forestry residues are mostly used up by wood processing industries (Bal, 2006) and, therefore, are not available for energy producers. Agricultural residues are available but have certain drawbacks such as lower calorific value and part of it needs to be ploughed back in the fields for agronomic considerations. Therefore, there is a need to find an alternative, Johansson et al. (1993) and Hall et al. (1993) have stated that biomass plantations have great potential in Europe for replacing food crops on agricultural land due to overproduction. In Poland, the additional beneficial factors supporting dedicated energy crop cultivation are the surplus of arable land, the relatively high unemployment rate in rural areas and consequently an opportunity to enhance rural development through engaging in biomass production. Farmers

¹ Report by the Polish Ministry of Economy and Labour on Promotion of Green Electricity in Poland for the years 2005-2014, August 2005 (as cited in Jaworski and Oniszk-Poplawska, 2005).

could also grow dedicated energy crops on unused lands and areas unsuitable for traditional agriculture.

Regardless of the perceived huge potential, energy production from dedicated energy crops has not developed as expected. As any other biomass source, dedicated energy crop cultivation has its drawbacks and problems starting from the policy-making level down to the growers' level. Research has been conducted, so far, on the barriers to bioenergy on a more institutional level and from different perspectives, except the farmers' point of view. However, Ericsson et al. (2006) has studied the economic viability of willow growing in Poland where the challenges for Polish farmers in regard to energy crop cultivation have been briefly touched upon. Also Alker et al. (2005) has covered the barriers to short rotation coppice (SRC) willow production during the implementation of such bioenergy systems among the members of the International Energy Agency (IEA).

However, farmers can play a crucial role as biomass suppliers in the energy crop supply chain. Consequently, if they are not interested in energy crop growing then the whole chain following the farmers loses its meaning. Therefore, finding out the barriers on farmers' level that prevent them from cultivating dedicated energy crops and that hinder the development of the whole supply chain is of great importance. Up-to-date no "on-the-ground" study about the perspective of farmers related to barriers for dedicated energy crop cultivation in Poland has been carried out.

The other reason for looking at barriers to dedicated energy crop, namely, willow, cultivation springs from the local energy producer in the case location. The energy producer needs to supply "green" electricity and has set out to achieve this in long term by using a dedicated energy crop, willow, as a solid biomass source.

On a broader level an intrinsic interest to gain insights into bioenergy barriers that affect farmers was put forward by the Bioenergy Network of Excellence (NoE)², which considers that the farmers' perspective on the cultivation of bioenergy crops has been insufficiently researched so far. As a result, the author was fortunate to carry out this research in Poland under the auspices of the NoE.

This research aims at filling in the research gap by finding out directly from the farmers why they do not engage in dedicated energy crop cultivation and what problems they relate to growing these crops. As a result, recommendations are made about how willow development could be aided in this region to overcome the identified barriers and who could contribute to this process.

1.2 Objectives

The purpose of this research is to find out why the Polish farmers do not grow dedicated energy crops. The identification of barriers will help to tackle the problems on the local level and set up energy production from dedicated energy crops. Furthermore, a firsthand understanding of the farmers' standpoint could be used further for steering the policy making process in Poland.

² The Bioenergy Network of Excellence (NoE) links together eight leading research institutes in Europe in the field of bioenergy. The aim of the network is to enhance the position of bioenergy on the European market through collaboration among these institutions. Bioenergy Network of Excellence. (2006). <http://www.bioenergy-noe.com/> [2006, August 16]

The results of this research will be of interest first of all to the academia and all the actors in the Grudziądz region but also to the decision-makers in Poland, not only on the local but also on the regional and national level; and to students interested in the field.

Therefore, this research aims at giving answers to the following research questions:

1. *Why do the farmers not engage in willow cultivation?*
2. *How could willow development be aided in the Grudziądz region?*

Assumptions

It should be noted that there are different ways of building up dedicated energy crop supply chains. One way would be to include farmers in the chain as growers, either individually or in some form of a cooperative. However, it is also possible to exclude the farmers by establishing commercial plantations operated by e.g. the energy producers themselves. Therefore, it is not obligatory to have farmers in the energy crop supply chain. However, based on the case study approach taken and insights gained from the case location from different actors, the author assumes for this research that in the Grudziądz region farmers must be involved in cultivating dedicated energy crops. The main argument behind this assumption is that the energy producer cannot establish its own plantations due to the unavailability of land (Bal, 2006), and needs to engage the local farmers into the supply chain.

1.3 Scope

This research will be looking at cultivating dedicated energy crops in Poland from the perspective of farmers. Due to the fact that Poland is a large country and that the cultivation of any crop is always highly dependent on the agro climatic conditions and other variables, such as market, etc, there is a need to focus on a specific area in order to be able to draw reliable conclusions. This study focuses geographically on the Grudziądz region located in the centre of Northern Poland. In the context of this research, Grudziądz “region” stands for the Grudziądz municipality and also some districts outside the southern borders of the municipality near the Vistula River.

In this research, the focus is on solid biofuels from dedicated energy crops for heat and electricity production. This research concentrates on a specific variety – on willow. This species has been chosen due to several reasons. The main advantage of willow is that it has a higher calorific value and also better combustion properties compared to agricultural residues such as straw. Also the fact that willow is harvested during the coldest period of the year eliminates the need for long-term storage and speaks in favour of willow. The wet areas in the Vistula Valley were perceived to be suitable areas for growing willow, especially since these provide low yields/profits for growing traditional food crops or are not suitable for these crops at all. Making use of these areas for willow cultivation would give the farmers an opportunity to earn extra income. Also in the future the set-aside obligation could create opportunities for willow in terms of increased competitiveness on arable land. The fact that the energy producer is especially interested in using willow as a biomass source in the long term, would create a market for willow in the future. No market was perceived for other dedicated energy crops in the region in the near future. It should also be noted that willow has reached rather large-scale cultivation in several countries in Europe, e.g. in Sweden (15 000 ha

in 2004³). Due to all these factors, it seems that this region could have potential as a willow growing region.

The cultivation of liquid fuel crops such as rapeseed, sugar beet or grain for use in e.g. transportation is beyond the scope of this study. However, the cultivation of rapeseed for bioenergy will briefly be touched upon in the discussion section in terms of a potential alternative activity in the farm that could compete for land with dedicated energy crops. In addition, the possibility of supplying agricultural residue - straw for energy purposes will be considered a primary solution to start up “green” energy production as quickly as possible.

This research mainly looks at barriers for farmers, the challenges related to the energy producer or the whole energy crop chain are mentioned only so far as these might have an influence on the barriers for the farmers.

1.4 Methodology, approach and limitations

The case study approach is used to conduct this research. The perspective is primarily that of regional farmers. The aim is to research which barriers affect the decision to engage in the cultivation of dedicated energy crops by farmers in Poland. During the first visit to Poland, in May 2006, it was realised that it is not possible to look at the farmers in isolation. The decisions of farmers seemed to be highly dependent on several factors, such as, the demand and prices for biomass in the region, etc. Therefore, it was decided that the perspective should be kept wider and put into the local context, which means also getting a brief insight into the views of other local actors related to energy crop growing including the standpoint of the local energy producer. As a result, the case study approach was chosen.

Figure 1-1 below presents the research design. Thereafter each step is briefly explained.

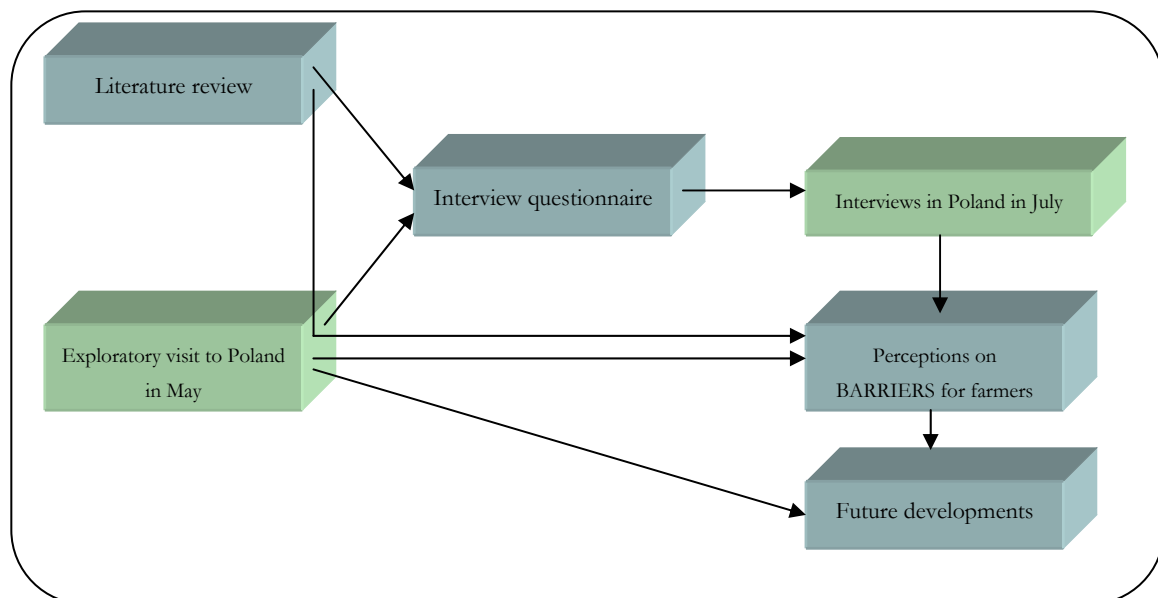


Figure 1-1 Research design.

³ Svebio. (2004). Energy crops – a resource for development. [Online] Available: <http://svebio.agriprim.com/attachments/33/120.pdf> [2006, May 14]

Data collection

Literature review

This research started out with *secondary data* collection from literature about the current status and drivers for bioenergy in terms of dedicated energy crops on the EU, as well as on the Polish level. Then the barriers to dedicated energy crop growing were investigated with an emphasis on the perspective of the farmers. The literature review created a background to and an understanding of the topic. The knowledge gained about the barriers from previous studies was used while constructing the questionnaire and later analysing the findings from the research in Poland. Most of the literature is available as journal articles and was obtained through the Lund University electronic database ELIN. For acquiring several up-to-date articles on the topic, the expertise of several researchers from IIIIEE as well as from the Polish research institute - EC Baltic Renewable Energy Centre (EC BREC) was used.

Exploratory visit to Poland in May 2006

Primary data has been collected using the interview method. The on-the-ground research has consisted of two stages: First, in May 2006 an initial visit to two locations in Poland, to Grudziądz and Elbląg, was made. These locations were identified as both suitable and relevant based on intensive discussions with the local experts in the bioenergy field in Poland at EC BREC. The aim of this visit was to investigate the general situation regarding energy crop cultivation in Poland and map the actors relevant to the cases. In addition to a panel discussion in Grudziądz, the mission to Poland included site visits to plantations of various types of dedicated energy crops. Before the trip, preliminary research questions were formulated, which were then further refined after the visit.

Based on the insights and experiences gained from the first visit, the author chose to focus the research on the Grudziądz case as it has perspective as a future dedicated energy crop growing region with the relevant interest from the energy producer.

Interview questionnaire

Before the second visit a semi-structured interview questionnaire (see Appendix I) was developed for the farmers and was also translated into Polish. The interviews with other key actors were adapted to the specific roles of these actors and, therefore, no questionnaire was used. All the actors were investigated about their perceptions regarding energy crops: the barriers for farmers for energy crop cultivation and about the future outlook of these crops in the region. The use of semi-structured interview questionnaires in case of farmers allowed being more organised and efficient during the interviews, however, the farmers were asked to give additional comments and explanations in order to get a deeper in-sight into the farmers' everyday life in this area and a comprehensive understanding into the underlying reasons for the farmers' to make certain kinds of decisions. Relevant and interesting issues were followed up whenever necessary and possible, e.g. sometimes, the farmers were additionally asked about their opinion on cooperation possibilities in the village and the relationships between people in the neighbourhood. The issue of rapeseed as a potential competitor for land was occasionally brought up.

As a part of the questionnaire, the farmers were asked to indicate in the order of priority what they perceive as the three most important strengths, weaknesses, opportunities and threats for their farm in terms of dedicated energy crop cultivation from a pre-prepared list. The aim of this task was to approach the barriers in a more systematic way and also test the relative

importance of the different statements found in literature and perceptions gathered during the first visit. The list was prepared based on the literature review and the experiences and information gained during the first visit to Poland. The farmers were given an opportunity to complement the list with their own alternatives to increase the validity of the results.

Interviews in Poland in July 2006

In July 2006, the second mission to Poland was made. The purpose of this trip was to gather relevant and specific *primary data* as well as to compare and clarify issues discussed during the first visit. The main emphasis was on meeting the farmers.

In Poland, interviews were conducted with 29 individual farmers and 1 representative of a farmers' cooperative in the Grudziądz region. All the farmer interviews were conducted individually face-to-face on their premises. Mainly the farmers were interviewed, however, on a few occasions also wives, mothers or fathers of the farmers were included in the interviews.

Additionally, four interviews with other relevant actors: the head of the municipality, the representative of the agricultural advisory board, the head of the farmers' union and the representative of the energy producer (OPEC Grudziądz), were conducted. Four of the farmer interviews were pre-arranged using contacts from OPEC Grudziądz, the remainder were picked randomly. The researchers went from farm to farm without previous appointments in three different geographical locations (north, east, south) in the region. This allowed limiting the bias related to the pre-selection of interviewees.

The researcher was accompanied by a staff member of EC BREC for the whole interview making period. This helped to clear out ambiguous responses given by farmers and to increase the general reliability of the interviews.

A possible limitation to this study is the language barrier and issues related to translation. In order to reduce this impact, the Polish version of the interview questionnaire was tested with Ms. Ewa Gańko from EC BREC who confirmed that the translation corresponded to the English one. All unclarities were followed up and discussed with the relevant experts at EC BREC in the end of the visit in Warsaw.

Analysis

Perceptions on barriers for farmers

This research was designed with the emphasis on the qualitative aspects and this was also how the questionnaire was constructed. Therefore, the analysis of the research results is carried out from the qualitative viewpoint.

The relatively small number of interviewed individual farmers (29) compared to the number of all the individual farmers in the region (1483)⁴, does not permit statistical analysis of the results or subsequent generalised conclusions. Despite the limited number of interviewed farmers, the fact that similar answers were provided implies that the findings could be generalised to some extent. However, it should be noted that there could be regional or other

⁴ Urban, A. (2004). Ziemia Grudziądzka. Grudziądz: Studio ART F. W.

variations that were not identified due to the size of the sample. Thus in order to make generalisations for all the farmers in the region, additional research may be warranted.

In order to give the analysis a framework and be able to emphasize prevailing perceptions, the identified barriers were grouped into financial, technical, informational, cultural, etc and based on the frequency of emergence in the interviews the relative importance of different groups was then brought out and analysed. The farmers were also divided into three groups according to the geographical location (north, south, and east) to see if there were any differences and similarities location-wise.

In the analysis part, the barriers were analysed by comparing the results from the field study to the relevant findings from the literature. The perceptions of the farmers were compared to the perceptions of other actors. In addition, it was checked how the responses to the interview questions corresponded to the strengths, weaknesses, opportunities and threats prioritised by the farmers. Thereafter, the implications of the findings were discussed.

No uniform statement can be made about the generalisability of results from this research. The barriers for energy crop cultivation can roughly be divided into two groups. The first group being the barriers related to a special location, such as water content in the soil or local biomass market. These barriers are rather location specific but could be related to other cases with similar conditions. The second group, covering financial issues like subsidies or establishment costs or problems with harvesting equipment, allows generalisability since these problems are common and applicable also elsewhere in Poland.

Due to the fact that some interviewees were unwilling to disclose their personal details – some farmers were promised complete confidentiality. Thus, during the coding and analysis process, all farmers are treated as anonymous. Since, this research looks at the region as a whole there is no need to relate any specific opinions back to specific individual farmers.

Future Developments

After discussing the reasons why the farmers do not engage in willow cultivation under current conditions, suggestions were given about how the development of this crop could be aided in the Grudziądz region in the light of the identified barriers.

1.5 Definitions

Biomass - “shall mean the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), forestry and related industries, as well as the biodegradable fraction of industrial and municipal waste“ (Council Directive 2001/77/EC).

Common agricultural policy (CAP) – “the set of legislation and practices adopted by the Member States of the EU in order to provide a common, unified policy on agriculture (under Article 33 of the EU Treaty). The CAP is the most integrated of the EU-wide policies implemented by the EU. It aims to ensure that agriculture can be maintained over the long-term at the heart of a living countryside. This means that the policy is targeted not just at agricultural producers but also at the wider rural population, consumers and society as a whole” (European Commission, 2004a).

Dedicated energy crops can be divided as follows: woody crops (such as Willow and Poplar), herbaceous crops (such as Reed Canary Grass, Miscanthus and Sida) and; oilseed and

sugar-containing crops that are sources of liquid biofuels (Venendaal, et al., 1997).

Set-aside land – land that is not used for producing agricultural crops. Set-aside requirement is set to reduce overproduction of food crops and sometimes is a prerequisite for farmers to apply for support (European Commission, 2004a). There is no set aside obligation under the SAPS for New Member States (GAIN, 2004a).

Single area payment scheme (SAPS) – a scheme developed for the 10 New Member States⁵ where all the direct payments are topped up and distributed to the farmers based on the number of hectares (European Commission, 2004a). However, this scheme does not include support for energy crops (GAIN, 2004a). This is a transitional scheme and valid only until 2009, when the New Member States have to adopt the Single Payment Scheme (European Commission, 2004c).

Single payment scheme (or single farm payment) SPS – is a scheme introduced after the CAP reform in 2003, where the direct aid payment is decoupled from the type of crop and size of production. The new system substituted most of the previous direct payment schemes (European Commission, 2004a). There are two methods for payment under this scheme:

“(1) SFP – based on an average of previous payments from 2000-2002 per farmer, referred to as the “historic payment,” and

(2) taking a region’s historic average of direct payments and then doling it out per farmer based on their hectares, referred to as the “flat-rate.” (GAIN, 2004b)”.

Willow (*Salix spp*) is a fast growing woody crop producing a great amount of biomass in a short time, suitable for cultivation in the northern part of Europe. Willow can be grown in cold and wet areas. From the environmental point of view, willow can be used to absorb excess nutrients from the soil and in this way preventing the runoff of nutrients to the water courses. The average life span of a willow plantation is approximately 25 years and willow can be harvested 4-6 years after planting and later every 3-4 years (Venendaal, et al., 1997; Helby, et al., 2006; Scottish Agricultural College, 2002).

1.6 Structure of the thesis

In *chapter 2* an overview of the drivers for and potential of dedicated energy crops on the EU as well as on the Polish level is given. Potential barriers for Polish farmers have been brought out based on existing research. Finally, issues regarding agricultural cooperation are presented.

In *chapter 3* first an introduction to the case location and the current situation regarding bioenergy and energy crops is made. Then the barriers perceived by the interviewees in Poland are presented. Lastly, the perceptions regarding cooperation for biomass are brought out.

In *chapter 4* the analysis and discussion of the research results has been carried out following the same structure as in the previous chapter. Furthermore, future developments in terms of a potential way to aid willow cultivation in the area are discussed and suggestions given about how the identified barriers could be addressed.

⁵ Only Slovenia and Malta from the 10 New Member States have adopted the SPS (European Commission, 2004b).

Finally, conclusions are drawn from the whole research and recommendations made for further research in the field.

2 Energy crops

This chapter aims at finding out the potential drivers and barriers for energy crop cultivation in Poland. For that, the relevant policies and requirements on the European level have been reviewed and then related to the implications in the Polish context. Special attention has been paid to the implementation of the Common Agricultural Policy (CAP) as one of the main sources of financial support for the agricultural community in the European Union (EU). The overview of the current status of the Polish agriculture is intended to give an insight into the importance and size of the sector. The potential barriers that can influence the decision of Polish farmers in regard to dedicated energy crop cultivation are presented based on literature review. Finally, biomass cooperatives to enhance biomass production have successfully been established in several countries, since this could be foreseen also for Poland, then literature on farmer cooperatives was investigated; their functions, benefits and some good practice examples as well as problems with cooperating have been presented.

2.1 Energy crops in EU

The development of energy crops as renewable energy sources involves several sectors, such as energy, environmental, agricultural as well as economic (McCormick, et al., 2006) and, therefore, the policies and requirements set forth in all of them have an impact on overall success of implementation.

There are three directives that are potential driving forces for bioenergy development in the context of the research are: *the Directive 2001/77/EC on the promotion of the electricity produced from the renewable energy sources in the internal energy market*, *the Directive 2001/80/EC on the limitation of emissions of certain pollutants into the air from large combustion plants* and *the directive 2003/30/EC on the promotion and use of biofuels or other renewable fuels for transport*. Since this research has been limited to the cultivation of dedicated energy crops for use as solid fuels for heat and electricity production, then the implications of the latter directive will not be discussed any further.

In the EU White Paper on Renewable Energy Sources (RES) goal has been set to double the share of renewable energy in gross energy consumption from 6% to 12% by 2010 in the European Union (European Commission, 1997). Special attention has been paid to electricity production from renewable sources striving to increase the share of “green” electricity from 14% to 22% of gross electricity consumption by 2010 in Europe (Council Directive, 2001/77/EC). This Directive leaves it up to the individual Member States to set national targets for “green” electricity based on indicative targets put forward in the Annex to the Directive. In the Biomass Action Plan for Europe it has been stated that this obligation will promote the development of biomass based energy, as commonly it is not possible to fulfil these targets without using increasing amounts of biomass (Commission of the European Communities, 2005). Johansson et al. (1993) and Hall et al. (1993) have argued that replacing food crops with biomass plantations for energy purposes in the European Community, since there is overproduction of food, holds great potential. Also Rodriguez (2005) has found out that energy crops do have long term potential. Holm-Nielsen et al., (2006) stated that “biomass will be the primary energy source for the 21st century”.

Biomass Action Plan (BAP)

The BAP aims at promoting the use of biomass for various energy purposes. The Action Plan points out that there is currently a gap in legislation regarding the promotion of renewable energy in heating but developments are expected during 2006. It also mentions in regard to the CAP and energy crop cultivation that the most appropriate level for determining the choice of an exact crop is either the local or the regional level (Commission of the European Communities, 2005). Johansson et al. (2002) argues that if subsidies were excluded, perennial crops would be the most competitive crops grown for energy purposes in Europe due to their modest labour requirements. Within the BAP framework, the European Commission plans to finance information dissemination projects to introduce energy crops and their benefits to the farmers as the perceived major suppliers of biomass. Especially the need to give solid arguments for short rotation forestry has been identified, since these crops require a long term commitment from the growers. However, the increase of biomass from agriculture is largely affected by the developments related to the Common Agricultural Policy (Commission of the European Communities, 2005).

Common Agricultural Policy (CAP)

CAP is an EU wide agricultural policy adopted by all its Member States (see the definition in chapter 1.5). In 2003 the CAP was reformed in terms of the support schemes provided to EU farmers. The CAP reform decoupled subsidies from the production volume and the type of crop cultivated. After the CAP reform farmers can produce according to the market needs, provided that it is profitable for the farmers in terms of knowledge, experience, availability of equipment and that the agro climatic conditions support it (European Commission, 2006a; GAIN, 2004b). Through an action plan presumably compiled during 2006 the CAP will be simplified further to reduce the related administrative burden, especially to the farmers (European Commission, 2006b).

With the accession of 10 New Member States to the European Union in 2004, the utilised agricultural area increased by 30%. It has been mentioned that the New Member States have a huge agricultural potential that has not been exploited to the fullest yet. The new agricultural policy is continuing to bring along significant modernisation and restructuring of farming to these states. Not all the CAP mechanisms entered into force immediately for the New Member States. On the one hand, farmers received immediate access to the EU single market but on the other hand the direct payments are only phased-in gradually over 10 years, having started from 25% of the EU rate in 2004 and reaching the same rate with the EU-15 countries in 2013. There is also a possibility to “top-up” the EU payments with complementary national payments under certain conditions in order to bridge the difference (European Commission, 2004b).

Under the CAP reform 2003, there are two methods for receiving support for energy crop cultivation by farmers. The first one is the energy crop aid which is additional to the Single Payment Scheme (SPS). The energy crop aid is 45 EUR per ha (with a maximum guaranteed area of 1 500 000 ha as a budgetary ceiling) for all crops produced for energy purposes on agricultural land. Secondly, the pre-reform system of receiving support for cultivating non-food crops on set-aside land within the SPS⁶ continues to operate (EU info sheet, 2005).

⁶ Only Slovenia and Malta from the 10 New Member States have adopted the SPS (European Commission, 2004b).

Support conditions and rates for energy crop cultivation currently differ for New Member States due to the adopted temporary payment schemes (e.g. Single Area Payment Scheme) and crop specific direct payments under CAP.

2.2 Energy crops in Poland

Today, most of Poland's energy needs are met by producing energy from fossil fuels, such as, hard coal and lignite (Gierulski, 2002; Nilsson, et al., 2006). In 2003, renewable energy use of primary energy use was about 4% and 95% of renewable energy was formed by bioenergy in Poland (Nilsson, et al., 2006).

In the Polish context the main driver for renewable energy is the EC directive on electricity from RES (2001/77/EC) and consequently the "green" electricity quota introduced by the Polish Government for utilities distributing electricity to the final consumer (Jaworski, 2006; Nilsson, et al., 2006). Based on the requirements set forth in the "green" electricity directive, the Polish Government has formulated an indicative target of 7.5% by 2010 of energy from renewable energy sources in the sales of electricity to final customers. The share of electricity from biomass is estimated to be more than a half of that by 2010. No specific target regarding different sources of biomass, including energy crops, has been set in Poland.

However, neither on the European nor on the Polish level is there a direct obligation for heat production from renewable energy sources. Yet, small and medium sized applications for generating heat seem to be promising in terms of biomass use in Poland (Nilsson, et al., 2006).

In Poland, there is now strong competition among different actors for biomass resources. Jaworski and Oniszk-Poplawska (2005) point out that there is fierce competition for the different uses of forest resources. The industrial sector of pulp and paper, fibre boards and furniture production is competing with the energy sector for wood supply for heat and electricity production. They indicate that bioenergy sector needs large amounts of fuel with moderate demands for quality. Also Bal (2006) emphasised that the different residues are used up by the industries themselves and there is no surplus. However, agricultural residues have great potential in terms of availability and low risk; they also entail drawbacks such as bad combustion properties and the need to plough a certain amount of straw back to the ground.

Therefore, there is a need for development of alternative sources of biomass such as for example, dedicated energy crops, for being able to fulfil the RE obligation at power and CHP plants in Poland. Although, in the short term, agricultural residues, forestry residues and forestry fuel wood have the highest potential, energy crops are estimated to gain significance in the mid and long term (Gierulski and Rogulska, 2003). However, immediate action to develop perennial energy crops should be taken, since the time from establishing a plantation and harvesting the first crop is considerable. For willow, the first harvest will happen 4-6 years after planting (Helby, et al., 2006).

In Poland, there is great technical potential for biomass from energy crops but at the moment the availability of energy crop resources is limited (Jaworski and Oniszk-Poplawska, 2005). Poland is especially suited to energy crop cultivation due to large areas of agricultural land, relatively high unemployment rate in rural areas and need for alternative sources of income. Gierulski and Rogulska (2003) have pointed out the following three main benefits of using local bioenergy sources for rural development as: "job creation, environmental improvement and diversification of agriculture". The number of jobs is estimated to increase as energy crop

cultivation needs extra labour force for growing, harvesting and trading (Oniszk-Poplawska, et al., 2003).

The co-firing of biomass and coal is eligible for “green electricity” production under Polish regulations (Jaworski and Oniszk-Poplawska, 2005). Currently, the cheapest option for electricity production from biomass is co-firing it with fossil fuels, like coal. However, in several regions in Poland the biomass supply is a limiting factor rather than the co-firing capacity. It is estimated that electricity produced from biomass in co-firing could reach 1,6-4,6% of the total electricity production by 2010. The benefits of biomass co-firing being the opportunity to establish an initial market for biomass, existing infrastructure and can serve as a bridging solution on the way to biomass-based solutions (Berggren, et al., 2006) Co-firing of coal and biomass would also be a solution for creating an initial market for energy crops and for handling the unstable supply (Ericsson, et al., 2006).

Agriculture and farms in Poland

In 2005, the area of agricultural land in use was 15.9 Mha (GUS, 2006a) constituting almost half of the total area (31 Mha (European Commission, 2002)). In Poland, about 18% of the population was employed in agriculture in 2002 (Polish Statistical Office, as cited in Ericsson, et al., 2006). In EU-15 the corresponding number was 4,3% in 2002 (European Commission, 2002). Therefore, agriculture forms a significant sector in Poland. There were about 2.9 million farms in Poland in 2001, 1.9 million of them being larger than 1 ha. The average farm size is about 8.4 ha without farms smaller than 1 ha (5.8 ha including farms under 1 ha) (Polish Statistical Office, as cited in Ericsson, et al., 2006). In 2000, 95% of all agricultural land was privately owned. Family farms constitute 88% of the 95%, while cooperatives and private companies are uncommon. In Poland the farm structure is fragmented, collective farms were not common in Poland during the Soviet time (Gańko, 2006). The productivity of agricultural land in Poland is rather low because of employing traditional farming methods and moderate use of machinery. The proportion of subsistence and semi-subsistence farming is relatively high still. The most widely grown crop in Poland is wheat, though Poland is the largest grower of rye and potatoes (Ericsson, et al., 2006).

The most suitable crops for energy purposes in Poland are *Salix* (willow), *Miscanthus* and *Sida* (Gańko, 2006). At the moment, the size of willow plantations reaches approximately 5000 ha. Willow growing areas are located mainly in eastern and northern Poland (Ericsson, et al., 2006). The interest in energy crops as a source of bioenergy is growing. In spite of this, the majority of plantations have been established for either R&D purposes or for producing cuttings (Nilsson, et al., 2006) and only few or no commercial bioenergy plantations are exploited at present (Bal, 2006; Gańko, 2006; Gumeniuk, 2006).

CAP and national support schemes in Poland

As a result of the EU accession negotiations, Poland has implemented a mixed CAP system which means that the agricultural sector will be eligible for support from the EU as well as from the Polish Government funds (GAIN, 2005). Poland has adopted the Single Area Payment Scheme (SAPS) and as a New Member State is eligible to the gradually increasing financial support from the EU (Ministry of Agriculture and Rural Development, 2005). Polish farmers can apply for SAPS support and Supplemental Direct Payments. Under SAPS all arable land (over 0.1 ha) is eligible for support of approximately € 55/ha (2005). However, this scheme does not include energy crops (GAIN, 2004a). Supplemental Direct Payment Scheme offers traditional crops (cereals, rapeseed, maize, sugar beets, etc) an extra support (71 €/ha), so that the total amount for cereals is 126 €/ha (2005). At the same time energy crops do not

receive any support under the same scheme (GAIN, 2005, Gańko, 2006). There is no set aside obligation in Poland at the moment and Polish farmers are currently not eligible for the € 45/ha support for growing energy crops on agricultural land (Gańko, 2006).

The following Figure 2-1 describes the support available for farmers in EU-15 and in Poland for growing dedicated energy crops under CAP.

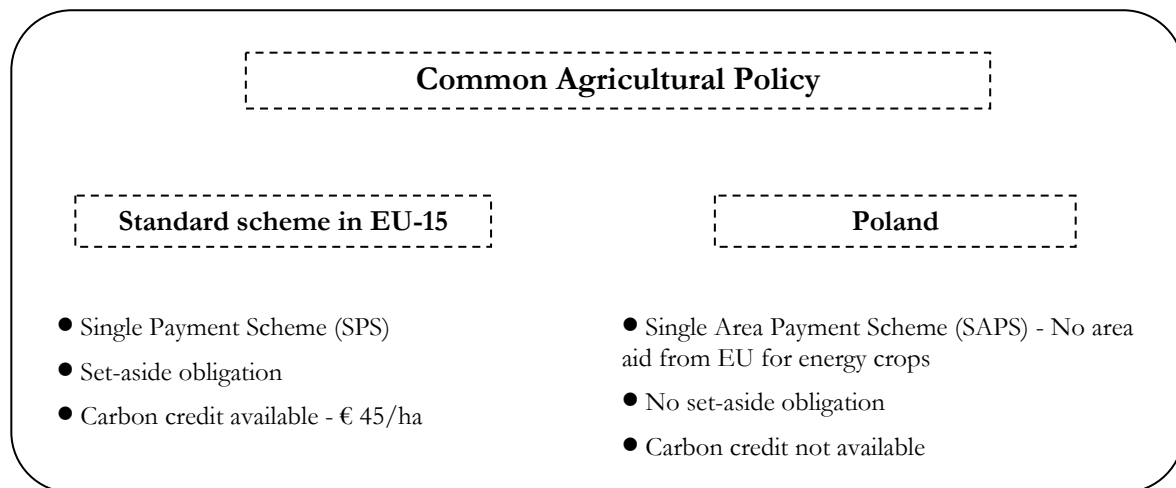


Figure 2-1 Comparison between support under CAP for EU-15 and Poland (Gańko, 2006 modified by Sinnison).

Since 2005, dedicated energy crops such as *Salix* and *Rosa Multiflora* are eligible to a support of € 55/ha from the national budget. Starting from 2007 also energy grasses will be included under the same scheme (Gańko, 2006). Additionally, there is an establishment subsidy available for plantations with a size over 50 ha from the Polish Ecofund for the eco-conversion of Polish debts (Gańko, 2006). Figure 2-2 presents the subsidies for traditional crops (cereals, rapeseed, maize, sugar beets, etc) and dedicated energy crops. As a result it can be seen, that although Poland holds great potential for dedicated energy crop growing, from the farmers' perspective the support mechanisms are so far still in favour of traditional crops, making the energy crops not competitive.

	Traditional crops	Dedicated energy crops
EU (CAP)	55 €/ha	0 €/ha
Polish Government	71 €/ha	55 €/ha*
	126 €/ha	55 €/ha

* Willow, *Rosa Multiflora* (from 2006) and energy grasses (from 2007) qualify for this aid.

Figure 2-2 Comparison of subsidies for traditional and dedicated energy crops in Poland.

Therefore, “the development of energy crops in Poland will depend strongly on CAP and resulting domestic policies” (Nilsson, et al., 2006).

It is believed that the situation with subsidies will improve once Poland needs to switch from the SAPS to the Single Payment Scheme that will grant Polish farmers with the same subsidies as the farmers in the EU-15 countries (Gańko, 2006). This will happen in 2009 at the latest.

2.3 Potential barriers

As mentioned in previous chapters Poland is required to increase the amount of energy produced from renewable sources and energy crops are believed to be a promising resources due to the availability of agricultural land and the need for an additional source of income among Polish farmers. However, so far energy crops have not developed at the pace that has been expected.

This chapter gives an overview of different aspects that can, depending on the particular situation, become barriers to dedicated energy crop growing. Herby, a broad perspective is kept and a number of different potential barriers are presented based on literature. Which of them exactly turn out to be barriers for Polish farmers will be presented in chapter 3. As mentioned in the first chapter, the focus is kept primarily on the challenges for the farmers. This information will give an implication about the direction this research could head to and later will serve as a standpoint for comparison with the barriers that the farmers themselves perceived and pointed out.

So far little research has been carried out in regard to the challenges related to energy crop growing for farmers. These have been touched upon mostly in two studies: by Ericsson et al. (2006) and Alker et al. (2005).

The study by Ericsson et al. (2006) investigating the agro-economic viability of willow cultivation in Poland touches upon challenges for farmers in course of adopting willow in Poland. Another study has been conducted about the technical and non-technical barriers to SRC-implementation (including the production phase) among the IEA (International Energy Agency) member countries by Alker et al. (2005).

However, it is also possible to relate indirectly the research of other scientists to the topic. Roos et al. (2000) has studied the farm related factors that have had an influence on the Swedish farmers' decision about taking up willow growing and modelled which of these have had a positive and which a negative impact. The factors being land use, geographical location, farm size and farm type.

Figure 2-3 describes the potential barriers brought forward in literature that can prevent farmers from engaging in dedicated energy crop cultivation. Each category of barriers will be explained briefly below.

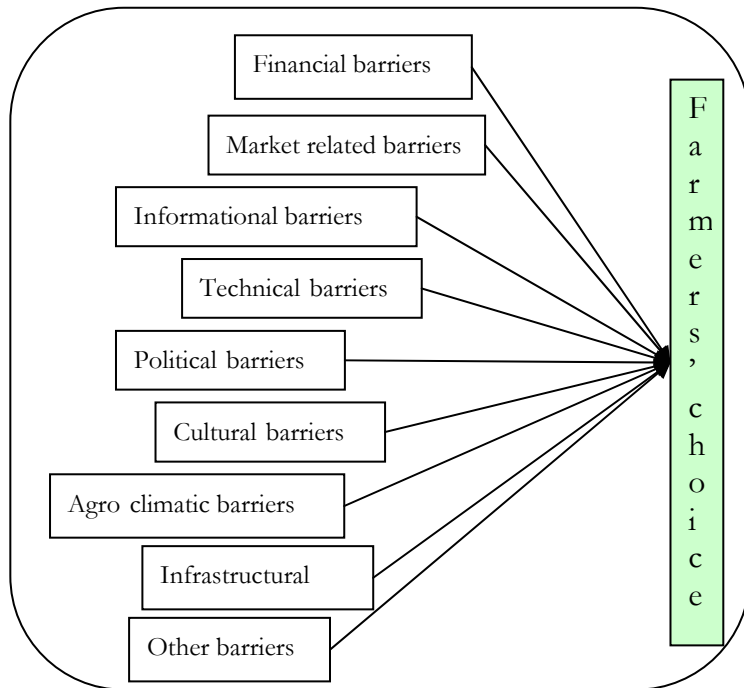


Figure 2-3 Potential barriers for farmers for energy crop cultivation (Sinnison, based on literature).

Financial barriers

Financial barriers include all problems related to economic aspects of dedicated energy crop growing. Willow has to be perceived as profitable as other traditional crops by farmers before they start growing it (Ericsson, et al., 2006). Alker et al. (2005) has identified the competition between SRC and other biomass and food crops as a problem. However, a study investigating the agro-economic viability of willow has reached the conclusion that in Poland willow can be economically viable⁷ compared to cereal crops like wheat and barley (since the latter compete more or less for the same land) (Ericsson, et al., 2006). Farmers also perceive a high economic risk with willow cultivation because of the high plantation establishment costs and then the lack of income from the plantation before the first harvest, since willow is a perennial crop and will yield no income before the fourth year (Alker, et al., 2005; Downing et al., 1998; Ericsson, et al., 2006; Helby, et al., 2006).

Market related barriers

A factor that has an effect on the decision about dedicated energy crop cultivation from the farmers' perspective is the existence of a stable market for willow (Ericsson, et al., 2006). In Poland there currently is a strong demand for biofuels but no markets still exist on the local or regional level (Gańko, 2006).

Informational barriers

Knowledge, awareness and experience related barriers are considered under the informational barriers. Farmers' awareness and familiarity with new crops, such as energy crops, their cultivation practices as well as subsidy conditions, can influence their choice. Farmers' lack of

⁷ However, it must be pointed out that the study by Ericsson, et al. (2006) is based on farms larger than 30 ha.

knowledge and experience with novel energy crops has an impact on the previously mentioned perception of economic risk and reluctance of taking up cultivation (Ericsson, et al., 2006; McCormick, et al., 2006). Lack of knowledge and the resulting misconceptions among farmers as well as advisors were identified to be the main barriers affecting the potential SRC producers to enter the market in the UK. Some misconceptions included beliefs that it is difficult to remove SRC and that the pests and diseases are uncontrollable (Alker et al., 2005). There is a need to disseminate experience gained from successful pilot projects to farmers and to the agricultural community as a whole (Ericsson, et al., 2006). A strong need for learning-by-doing and capacity building has been identified (Nilsson, et al., 2004; Venendaal, et al., 1997). There is a clear need to demonstrate in practice repeatedly the feasibility of biomass production and prove that the misconceptions are false “until the negative perceptions are erased” (Alker, et al., 2005).

Technical barriers

In the context of this research, problems related to planting and harvesting machinery, are meant by technical barriers. Ericsson et al. (2006) has mentioned that if the farmers switch to willow the use of existing machinery will be less efficient. Other than that, issues related to technical barriers have not been brought out in literature.

Cultural barriers

Traditions, perceptions and attitudes are grouped under cultural barriers. A general skepticism is common to new crops (Alker, et al., 2005). Misconceptions as mentioned by Alker et al., (2005) earlier can have a negative influence on farmers’ perceptions. Rösch and Kaltschmitt (1999) point out that “energy crops on set-aside land are not a competitive production alternative to food and fodder production and therefore are not responsible for the hunger in developing countries”. Also negative experiences from other projects are said to have a long-term negative effect. In UK, the failure of the ARBRE project⁸ has created strong negative feelings towards SRC because it left the farmers without a market for their crop (Alker, et al., 2005).

Political barriers

Although willow has also been proved to be economically viable, it would not reach large scale cultivation by farmers unless active support mechanisms are implemented and the policies on Polish as well as on European level have been stabilized (Ericsson, et al., 2006). Government policies can delay the implementation of bioenergy projects but on the other hand, if policies are changed too often, they again hinder the development by creating instability among the potential investors (Alker, et al., 2005).

Infrastructural barriers

Another factor influencing farmers’ choice of cultivating dedicated energy crops is the distance to the market. According to Bal (2006), it is due to transportation costs economically viable to grow energy crops in the radius of 60 km from the energy producer. Therefore, the farmers’ choice is highly dependent on the fuel needs of the energy producer in the region and the existing or planned infrastructure.

⁸ Reasons for failure of this bioenergy project were related to the technical aspects (Defra, 2005)

Agro climatic barriers

The success of growing a certain type of crop is dependent on agro climatic conditions as well as agricultural practices that the farmer applies. Agro climatic conditions include the climatic conditions in the geographical location where the crop is grown and the agricultural factors such as the quality of soils, the moisture content, etc (Rosenqvist, et al., 2000). Agricultural practices include the choice of raw materials, preparation of soil, irrigation, weed control, fertilization, etc. (Venendaal, et al., 1997). Helby et al., (2006) studied the reasons, why a number of Swedish farmers retreated or regretted starting willow cultivation. The main reasons were agronomic, economic barriers were mentioned less often. The farmers had often not followed best agricultural practices, willow had been planted on arid soils, there had been problems with weeds and frost, and sometimes the farmers had invested in poor quality cuttings.

Other barriers

Roos et al. (2000) and Rosenqvist et al. (2000) have both mentioned the following farm related factors like farm size, farm type, land use and age of the farmer that can have an effect on the farmers' decisions. Rosenqvist et al. (2000) has found out that in Sweden willow is cultivated on relatively larger farms, as the size allows the farmers to mitigate risks in terms of new crops and also these farmers are said to be more knowledgeable in terms of cultivation practices and available subsidies. Willow is an option for farm owners who do not actively engage in agriculture, since willow needs moderate input after planting. Also, willow is less often produced in farms that have specialised in animal production.

Roos et al. (2000) has concluded that land use at the farm has an influence on the farmers' potential of willow cultivation. Forest owners are said to take up willow cultivation more likely as they already have experience with tree-like crops but pasture owners usually keep it for their animals and for fodder production.

Farmers are increasingly interested in willow cultivation up to the age of about 65. It has been explained that younger farmers might be more interested in quicker cash flows and farmers over 65 are rather risk averse in terms of novel crops and long-term commitment (Helby, et al., 2006). Additionally, farmers at the age of about 50 often own relatively big farms and have reached certain stability and are consequently looking for new sources of income. It is believed that farmers under 35 years are more risk averse in terms of willow cultivation due to their tight economic situation (Roos, et al., 2000).

Generally, it should be pointed out that all these potential barriers are very interrelated and the way they are perceived together has the final effect. The combination of different factors related to SRCs, such as for example the long-term commitment, the unstable markets and government policies often represent too much risk for the farmers and make them prefer the more conventional crop production (Alker et al., 2005). From the farmers' perspective a strong need for capacity building, consensus and acceptance for energy crops, creating incentives and support schemes has been identified (Nilsson, et al., 2006).

The following case study in Poland offers insights into the barriers perceived by Polish farmers in the Grudziądz-region. As a result – while discounting country/region-specific characteristics – it is possible to compare these barriers to more general barriers found in literature.

2.4 Cooperation

Despite the fact that in the Eastern European countries the trend has been moving away from the agricultural cooperatives for some time as a reaction to the forced cooperation during the Soviet times, issues related to agricultural cooperation have become more important and interesting again recently. Since, cooperation might be a potential way of addressing a number of problems for farmers, the challenges and opportunities related to cooperation for biomass cultivation have been explored.

As a result of reviewing literature on agricultural cooperation and cooperatives it was noticed that there are different models and combining them there are even more options of how to organize a cooperative in terms of purpose, field of activity, functions, structure, scale, etc. Cooperatives can employ different strategies for achieving their goals and can range in size from 10 to 15 000 members (Co-operatives^{UK}, 2003).

The definition given by Cooperative Energy (2006) is that “Cooperatives are independent, democratically controlled enterprises. They are owned and governed by their members, with the aim of meeting common social, economic and environmental needs (Cooperative Energy, 2006)”. Cooperatives act according to a number of principles which are “based on the values of self-help, self-responsibility, democracy, equality, equity and solidarity” (International Co-operative Alliance, 2006).

The first agricultural cooperatives in the US had a simple structure and called to life essentially to assist farmers with their problems related to growing and marketing their products (Downing, et al., 2005). In time the cooperatives have become more complex and act more as networks with rather ambiguous borders within the whole supply chain tying together different actors (Fairbairn, 2003). In terms of bioenergy, it means that all the actors related to the bioenergy chain function as a system. Downing et al. (1998) has proposed a scheme where the members of a cooperative grow the crops, produce energy from it and then use the energy to fulfill the energy needs within the cooperative to process other goods. “The end product would then be a processed commodity, which could then be sold as an additional value added product (Downing, 1998)”. It has been stated that the cooperative makes a bigger margin if it offers the full service – produces heat and/or power, than just produces the crop and sells it to an energy producer. Though this venture is also on a larger scale and entails greater investment and risks (Co-operative Energy, 2006).

A successful example is the farmer owned district heating plant in the community of Kolback, Sweden, where the farmers supply solid biomass and also operate the district heating plant for the local community. This way guaranteeing a stable market for their harvest and the municipality gains from renewable source based energy (DTI Global Watch, 2004).

Another example of a more complicated collaboration in the field of SRC willow is Agrobränsle AB in Sweden. Agrobränsle is the subsidiary of the farmer owned cooperative Lantmännen that unites 49 000 farmers in Sweden. Through Agrobränsle AB the members of the cooperative benefit from the shared cost of a number of services from plant breeding till marketing of the crop (Agrobränsle, 2006; DTI Global Watch, 2004; Lantmännen, 2006).

The benefits from cooperation for farmers include processing and marketing the harvest (have more resources to dedicate to finding new markets), offering a consistent quality of supply, shared risks, possibility to buy and share agricultural equipment together and also the increased negotiation power (Downing, et al., 1998; McCormick, et al., 2006). For example in the case of Mureck, Austria the farmers have benefited from agricultural cooperation in terms of reduced and dispersed risk related to energy crop production which leads to more stable

income in the future perspective (Tomescu, 2006). Buyers are also interested in long-term, stable, high quality supply of biomass delivered to them in time. As a result energy producers find it more convenient to enter into business relations with one single contractor rather than have separate contracts with a number of farmers offering a limited supply of biomass. Contrarily, it has also been mentioned that diversification of supply for energy producers is a way to guarantee a reliable supply (Downing, et al., 2005; Rösch and Kaltschmitt, 1999). Downing et al. (1998) has put forward the idea that cooperatives have the potential to influence the policy making process in the areas of energy, environment and agriculture and therefore improve life in rural areas.

However, it is not easy to form and manage cooperatives. Cooperation entails transaction costs: the difficulties with reaching agreement, the low speed of decision making, etc. The DTI Global Watch report (2004) also pointed out referring to the Kolback case in Sweden that it is not easy to replicate a successful model. The reasons in this case were first of all financial - farmers did not want to mortgage their own farms for guaranteeing a loan for the cooperative. Also distributing the profits and sharing the responsibilities have constituted a problem, which has been related to the general culture of cooperating.

In the DTI Global Watch report (2004) about cooperatives for bioenergy, it was identified that there is strong need for government support to cooperative energy demonstration projects “enabling stakeholders to gain experience with different structures (DTI Global Watch, 2004)”. The same report stresses the importance of local authority’s participation in projects by guaranteeing for example infrastructure investments. In order for the joint ventures to become a success, serious effort should be put into finding and employing the people with right expertise to manage this demonstration project. Cooperation with experts from other countries that have faced the same barriers in terms of biomass cultivation and successfully overcome them should be sought for (Alker et al., 2005).

Regardless of the construction of a cooperative, the underlying reason for establishing cooperatives is still that together the members can achieve what they can’t accomplish individually. Therefore, they are moving towards the economies of scale and enjoying the consequent benefits (Downing et al., 1998).

3 Grudziądz case

In this chapter the case location is introduced and the current situation regarding bioenergy development from solid biomass resources in the region is described. Thereafter, the perceptions regarding the barriers to dedicated energy crop, namely, willow, cultivation from the farmers’ perspective are presented based on the field research carried out in Poland. The barriers have been structured similarly to the previous chapter. Finally, the perceptions related to cooperation issues among farmers are brought out. In parallel to the perceptions of farmers, the perceptions of other actors are presented.

3.1 Background

3.1.1 Grudziądz region

The town of Grudziądz is located in the municipality and county with the same name, in the Kujawsko-Pomorskie Voivodship in the centre of Northern Poland (see Figure 3-1). The research was carried out around the town of Grudziądz in the so called Grudziądz region. As explained earlier the borders of the Grudziądz “region” more or less coincide with the Grudziądz municipality borders but also include some districts outside the southern border of the municipality. In the west the municipality is bordered by River Vistula.



Figure 3-1 Location of the town of Grudziądz and the Grudziądz municipality (Source: UNDP, GRID-Arendal, 1998 and Urban, 2004).

The population in the Grudziądz municipality is 10 274 (GUS, 2005). Grudziądz municipality covers the area of 16 683 ha and about 65% is arable land. The average farm size is 5,82 ha and the number of farms was 1483 in 2004. Similarly to other parts of Poland, the number of small size farms is high. The distribution of farms according to farms size in the Kujawsko-Pomorskie Voivodship is presented on Figure 3-4 below. Most of the soils are from the IV, V

and VI class, only in some regions there are II and III class soils⁹. In the municipality smaller farms earn their income from tobacco, vegetables and orchards. Bigger farms cultivate crops, potatoes, sugar beet and fodder for animals. Farmers market their products in the town of Grudziądz mostly. In the municipality about 21% of the area is covered by forests and over 90% of the forest area is under protection. The water level changes considerably in the Vistula River during the year (Urban, 2004) causing floods during times of high water. Vistula River banks are under protection as a Natura 2000 site (Bal, 2006).



Figure 3-2 Distribution of farms according to size in the Kujawsko-Pomorskie Voivodship (GUS, 2002).

3.1.2 OPEC Grudziądz

In the municipality, OPEC Grudziądz is the major heat and only electricity producer. At the moment coal is used as the main fuel. So far, electricity has been produced mostly for own use and the surplus has been sold to the grid but electricity production is expected to increase in the future (Bal, 2006). Private households and farms mostly have their own boilers and produce heating themselves. The fuels used for heating farms are varied, though most commonly oil, gas and coal are used (Tesmer, 2006). OPEC Grudziądz is 100% owned by the town of Grudziądz (Bal, 2006). From other major potential competitors for biomass supply, a cellulose producer located across the river in Świecie that had been interested in buying willow from farmers near the southern border of the municipality a few years ago was mentioned.

The current situation regarding bioenergy from solid biomass sources has been presented on Figure 3-3 and will be explained below.

⁹ The bigger the number of the soil class, the lower the quality of soils. (Soil classes range from I – VI) (Gumieniuk, 2006).

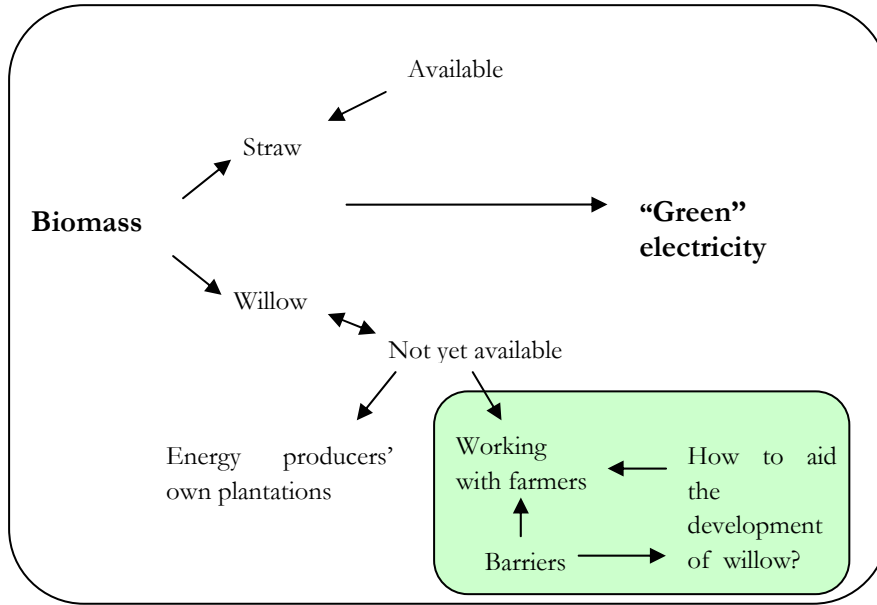


Figure 3-3 Current situation.

The “green” electricity obligation has acted as a driver for the energy producer in the Grudziądz region – OPEC Grudziądz needs to produce a certain amount of electricity from renewable sources. This obligation has made OPEC Grudziądz look for green energy sources since the company is not interested in buying the necessary guarantees of origin available on the market nor pay the penalties¹⁰ (Bal, 2006).

In the region there are no available forest fuels or forestry residues that the plant could use for energy purposes (Bal, 2006). The energy producer is planning to start from using agricultural residue – straw – as solid biofuel. Straw is an already available no risk biomass source from the point of view of farmers. The energy producer is planning to start up pellet production from rape straw (possibly also from sawdust) and using them in an existing boiler.

In long term, the energy producer has identified willow as the main source of biomass and is very interested in securing supply already today since there are no large-scale commercial plantations yet and it takes time till the plantations give the first yield. Willow has been chosen as having better combustion properties (much less aggressive for the boiler) than straw and other grasses (Gańko, 2006). The energy producer sees that willow could be grown on set aside land and lowlands in the vicinity of the Vistula River. However, for willow the energy producer needs to invest in a new boiler, since the high moisture content and other technological barriers do not allow co-firing with coal in the existing boilers.

“Green” electricity production is expected from the beginning of 2007. Since the pelletising machine is a substantial investment the energy producer is planning to have it working 24 h/day and also sell the overproduction of pellets.

Therefore, as mentioned earlier, straw is already available but willow plantations have not yet been established.

¹⁰ The penalty is 1,3 times the „buy-out fee” (Jaworski and Popławska, 2005)

From the energy producers' point of view there are two ways to supply willow: either to establish the plantations itself or rely on farmers for the biomass supply. In the Grudziądz case the energy producer cannot establish its own plantations since there is no available land in the region¹¹ that they could rent or buy. Therefore, OPEC has chosen the second option and is looking for farmers who would be interested in willow cultivation. Consequently the farmers become the decisive link in the chain for offering a reliable supply. The energy producer sees that engaging in biomass production would be an alternative activity for farmers who previously produced tobacco but have no market for it since the manufacturer of tobacco went bankrupt recently (Bal, 2006).

The interest among farmers towards willow cultivation has been moderate so far due to a number of barriers that will be presented in the next section.

OPEC Grudziądz is planning to establish a demonstration plantation the main aim of which is to show the farmers that it is possible and profitable to grow willow in Poland. The negotiations are ongoing for renting 60 ha of fields from a farmer in the neighbourhood. So far the energy producer has established a few small scale plantations to test different willow varieties in Polish conditions (Bal, 2006).

3.1.3 Interviewees

The Farmers

Among the 29 individual interviewed farmers the farm size ranges from 2,75 ha to 90 ha. Figure 3-4 below illustrates the distribution of farmers according to the farm size. The average farm size in the group of farmers who were interviewed was about 19 ha. Since one farm was 90 ha, then without this, the average was 16,5 ha. The farmers' cooperative uniting 29 farmers collectively owns 525 ha of agricultural land.

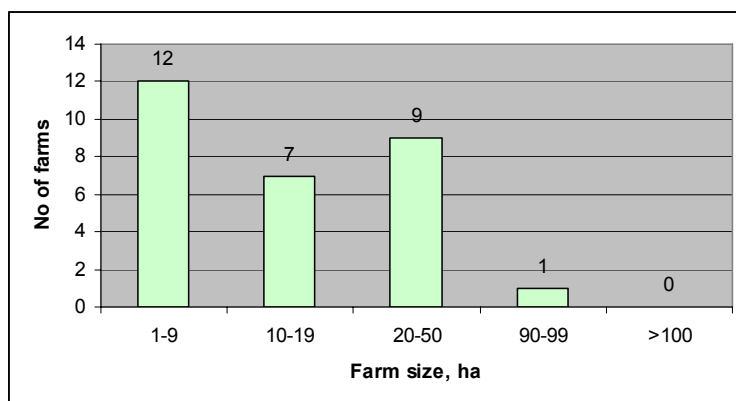


Figure 3-4 Distribution of farms according to farm size among the interviewed farmers.

Most of the farmers belonged to the age group born in the 1960s. The youngest farmer was 22 years old and the oldest farmer was 70 years old.

¹¹ Economically viable distance would be 60 km from the energy plant (Bal, 2006).

The distribution of farmers between three educational levels, obligatory, secondary and vocational training was more or less equal. There was only one farmer with higher education.

According to the findings of the interviews, the individual farms were dominantly semi-subsistence family farms engaging in different activities, including both animals and food crops. The activities in farms were versatile. The most common crops were wheat, barley, rye, buckwheat and rape. Farmers also engaged in potato, tobacco, vegetable, sugar beet and maize growing. Animal husbandry is also a very important activity: it determines the size of land that is dedicated to fodder and pastures. The most frequently mentioned animals were cows and pigs but also some birds such as ducks and chicken.

Other Key Actors

In addition to farmers, also a number of other actors were interviewed. The Agricultural Advisory Board is a state institution within the municipality of Grudziądz that works with issues related to agriculture in the municipality. They provide advisory and training to the farmers in the field of agriculture as well as administer the application process for subsidies (Kapuściorek, 2006). From the Municipality of Grudziądz, the Head of the Municipality, Jan Tesmer, was interviewed. The Agricultural Advisory Board was represented by Zdzisław Kapuściorek, the Manager of the Agricultural Advisory Board.

The Farmers' Union in Grudziądz represents the interests of farmers and takes their problems to a higher level in the institutional hierarchy. The personnel works on a voluntary basis and provides versatile assistance to the farmers, for example, helps finding marketing possibilities and filling in applications for financial support (Szlitkus, 2006). The Head of the Union in Grudziądz, Grzegorz Szlitkus, was interviewed.

3.2 Current situation

3.2.1 Experience

In the Grudziądz region dedicated energy crops are rather new and just in the beginning of development (Tesmer, 2006; Szlitkus, 2006). Exactly the same statement was made by some farmers. The interest towards the use of biomass is increasing also among the farmers; they are considering switching to biomass fuels in their farms since fossil fuels (e.g. coal) are becoming increasingly expensive (Tesmer, 2006; Jedrzejczak, 2006).

So far none of the interviewed farmers in the region has any practical experience with cultivating any dedicated energy crops. Farmers have long traditions with cultivating rapeseed but since they have no knowledge of what happens to it after selling it to a contractor then it is not possible to say if they have produced it for biodiesel.

According to the Head of the Municipality there are currently only a few test plantations of willow established by the energy producer where the growth of Swedish cuttings is tested in Polish conditions. To his knowledge there is no production of energy grasses in the region (Tesmer, 2006). However, the Head of the Farmers' Union has heard of some farmers who do grow willow but for their own use (Szlitkus, 2006). The farmers had mainly three kinds of opinions. More than 2/3 of the farmers did not know anyone who is currently cultivating energy crops in the region. Some farmers referred to the plantations established by the energy producer and others to some other farmers they had heard of.

3.2.2 Knowledge

Farmers were asked to evaluate their knowledge of energy crops¹² on the scale: good, average, and limited. Farmers in the northern parts of the region perceived their knowledge of energy crops mostly as average. At the same time, in the southern parts, the perception was towards limited knowledge. In the eastern part of the municipality the farmers evaluated their knowledge equally average and limited. Therefore, generally farmers evaluated their knowledge more or less equally limited and average. Only three farmers out of 29 claimed that their knowledge of energy crops is good. Moderate knowledge was often motivated by a statement that they have not been interested in the topic.

The perception of the representative of the Farmers' Union as well as the representative of the Agricultural Advisory Board is that the knowledge of energy crops among farmers is generally limited (Szlitkus, 2006; Kapuściorek, 2006).

The three most often mentioned sources of information among farmers were: television, OPEC Grudziądz and newspapers. OPEC Grudziądz has organised meetings together with the Agricultural Advisory Board for finding out the potential interest among farmers for willow cultivation. Some farmers had learned about energy crops from other farmers or from their family members.

Regarding the opportunities for receiving information about energy crops in case of interest the views of farmers differed. In the northern and southern part of the region, the prevailing view was that the opportunities are good. However, in the eastern part, the opportunities to receive information were considered equally good and limited. Some called the situation even "tragic". The opinion of the representative of the Farmers' Union was that the opportunities to get information are average but interested farmers can always get the information and usually read up themselves (Szlitkus, 2006). The Farmers' Union also issues a newspaper with an agricultural orientation together with the Agricultural Advisory Board. It is not free of charge and it is available only in the offices of these institutions in Grudziądz.

There have been seminars about energy crops at the Grudziądz Agricultural Advisory Board. Also OPEC has cooperated with the Board to hold joint meetings. It is also possible to get printed materials about energy crops from the Board (Kapuściorek, 2006).

3.2.3 Market

At the moment there is no market for any dedicated energy crops in the region because no one is growing it. When the farmers were asked if they knew where they could market their harvest in the future, about half of the interviewees mentioned OPEC Grudziądz as the future buyer. Some knew about the plans of OPEC more, others less, since they had not taken interest in the issue. The other prevailing answer was that farmers didn't know where they could sell energy crops since there is no market yet.

However, the farmers near the southern border of the municipality pointed to a celluloses company in Świecie, which had been interested in buying willow from farmers in the region in order to produce energy for their own use a few years ago. Afterwards, the farmers had not heard anything about any progress there.

¹² When talking about energy crops, farmers mostly related the term to dedicated crops such as willow and sometimes also energy grasses.

3.3 Barriers

The farmers were investigated in regard to the first research question about the reasons why they have not taken up energy crop cultivation so far and what problems they relate to energy crop growing.

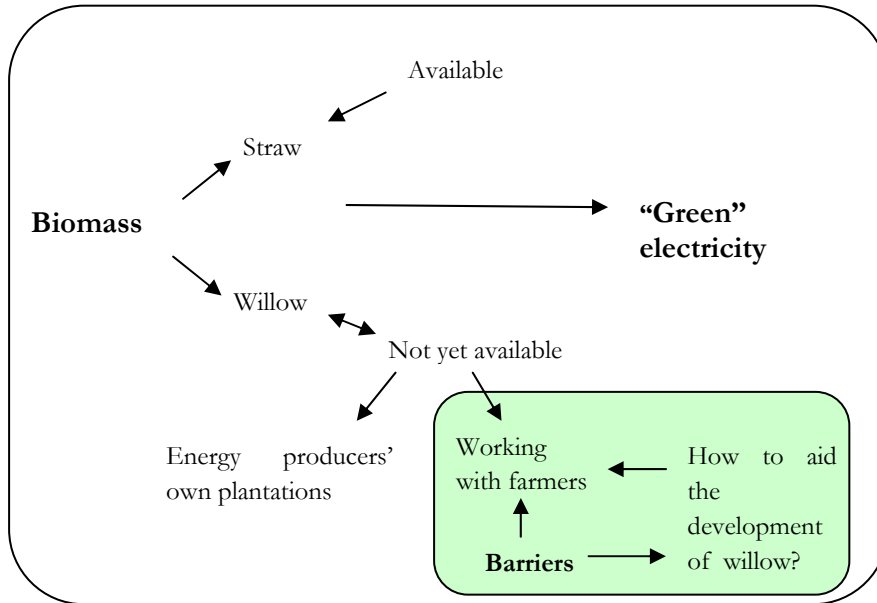


Figure 3-5 Barriers in the context of this research.

The answers were very versatile and it was rather difficult to group them but still the more often mentioned barriers could be divided similarly to the literature review section 2.3, into the following categories: financial, informational, technical, market related, cultural and other barriers.

Financial barriers

The most frequently mentioned barriers can be categorised as financial barriers.

The majority of the interviewed farmers stated that they have not engaged in energy crop cultivation so far because it is not profitable compared to other crops under current conditions. The representative of the Farmers' Union had the same perception but believes that it will change in the future (Szlitkus, 2006). However, among the farmers there are more people who believe that energy crops could become profitable in the future, than those who are pessimistic regarding the future profitability of willow.

The two main financial barriers mentioned by the farmers are the high willow plantation establishment cost and the long time till the first income from the plantation. Farmers perceive the high price of good quality (certified) cuttings as the biggest contributor to the establishment cost. The latter constitutes a major economic risk from the perspective of farmers, as mentioned by one farmer “if anything went wrong, we would go bankrupt”.

The Head of the Municipality, the representative of the energy producer and the representative of the Farmers' Union all claimed that at the moment the financial barriers constitute the biggest problem for the farmers (Tesmer, 2006; Bal, 2006; Szlitkus, 2006). The Head of the Municipality also mentioned the unclear situation with the subsidies does not benefit the situation (Tesmer, 2006).

It was pointed out that the situation is most difficult for small size farms, the costs would be the highest for them. The representative of the energy producer confirmed that by saying that farmers with 3-4 ha, would not be able to feed their families if they dedicated land to willow (Bal, 2006).

It should be mentioned that the representative of the energy producer and the Head of the Municipality also realised the weak negotiation position for individual farmers, who might not get the best conditions.

Informational barriers

The second often mentioned barriers were the lack of knowledge of and experience with energy crops: how to cultivate them, what kind of conditions they need and what the yields would be. Farmers seemed to value very highly learning from their peers. The fact that they have not seen nor heard of anyone in the region growing willow and succeeding was perceived as a barrier. Repeatedly, a need for demonstration plantations was expressed.

Farmers need very basic professional practical information about how to grow these crops, what conditions they need, available subsidies, etc. (Szlitkus, 2006).

Technical barriers

Farmers often emphasised that the equipment that is needed to cultivate willow will be a problem. Most often they talked about the costs related to harvesting equipment. Farmers do not own any suitable equipment for harvesting willow as a rule, therefore they need either to buy or rent it. Consequently, the issue related to the cost of renting the equipment was raised and that the venture should still be profitable from the farmers' point of view.

It was pointed out by a number of farmers and the representative of the Agricultural Advisory Board that it is not possible and even practical for small farms to buy equipment separately. The representative of the Agricultural Advisory Board sees harvesting as the biggest problem for the farmers (Kapuściorek, 2006). Problems with harvesting equipment were brought up also by the Head of the Municipality and the Farmers' Union. Also the energy producer recognised the difficulties related to harvesting equipment.

Market related barriers

Since willow is not grown in the region for commercial purposes, then currently there is no market for it. Based on their earlier negative experiences the farmers were sceptical if the future biomass buyer really would buy their harvest in 4-6 years after planting. The Manager of the Farmers' Cooperative as well as the Head of the Municipality referred to the unstable market for the same reasons mentioned previously (Jedrzejczak, 2006; Tesmer, 2006).

One farmer pointed out as a drawback of a small farm that if there was a middle man who purchases the harvest from the farmers and sells it to the final buyer then he would earn the most from the deal. This again refers to the weak position of an individual farmer in the negotiation process.

Cultural barriers

Cultural barriers in terms of willow being a new, unconventional crop were pointed to by the Head of the Municipality and the representative of the energy producer. They called these “barriers in farmers’ mind”. They explained that the nature of Polish farmers is sceptical and they treat new crops with great deal of precaution. They always need to see an example from the practical life, that someone is growing this crop and that it is possible and profitable (Bal, 2006; Tesmer, 2006). The energy producer stressed the seriousness of the negative effect from an unsuccessful plantation.

Agro climatic barriers

In the southern and northern parts of the municipality it was sometimes mentioned that the soil can become too dry for willow, especially with hot summer weather. A few farmers that had farms in the Vistula River valley stated that their soils are well suited for willow, since sometimes the fields become flooded. However, it should be noted that the river banks are under protection as Natura 2000 areas and there farmers are not allowed to plant any crops. In the eastern parts of the municipality the farmers claimed that their soils are suitable for willow and some farmers thought that their soils are even too good for growing energy crops.

Other barriers

Farmers sometimes pointed out the farm size, that their farms are too small, that there are no empty fields and there is no room for energy crops. This was especially noticed with farmers who raised cattle that all the land is needed for their own animals.

Some farmers as well as the representative of the Farmers’ Union pointed out the long-term commitment that is made while taking up perennial crop cultivation. Although farmers appreciate certain long-term stability; they feel that dedicating approximately 20-25 years to willow can be a problem. This period seems to them too long for not being able to use these fields for any other crop. Several farmers mentioned this inflexibility as a barrier for leaving the farm to the children who might have other plans for the farm.

3.3.1 Strengths, weaknesses, opportunities and threats

The aim of this exercise was to complement the semi-structured questionnaire as a supplementary way to gather perceptions. Farmers were asked to fill in a table about what they perceive would be the strengths, weaknesses, opportunities and threats in terms of their own farm if the were interested in willow cultivation.

Since, none of the interviewed farmers was yet growing any energy crops and often were not interested in doing it, they were asked to imagine themselves into a situation where they would be interested in this activity. They were asked to think about what the strengths, weaknesses, opportunities and threats of growing energy crops could be in that situation.

The table was constructed based on the knowledge about potential factors obtained from the literature review and the first exploratory visit to Poland in May. Meeting a number of different actors and hearing their claims enabled getting a rather comprehensive picture and, therefore, also served as a solid starting point for further research. Since, this was a pre-designed exercise the farmers were encouraged to give their own alternatives to go beyond the presented options and this way increase reliability.

For this research, strengths and weaknesses are interpreted as factors that influence the decision of farmers regarding willow cultivation from within the farm – the so called “internal” factors. Opportunities and threats, on the other hand, are understood as factors, that influence the farmers in regard to willow cultivation from outside – the so called “external” factors.

The responses have been analysed, compared and prioritised below based on a number of factors. First, the frequency of different responses was considered. Then, the statements were weighed according to their significance, the ones rated “number one” most frequently were considered relatively more significant compared to others that in total might have got a higher score. While marking the responses, the line, between more significant and less significant ones, was drawn by trying to distinguish clusters of more important statements that more or less clearly stood out compared to other. To some extent personal perceptions from the interviews might have had an effect on the prioritising activity as well.

In a few cases farmers found it difficult to pick three statements in the order of importance. As a result of all these factors, the figures in the following Table 3-1 are intended to give a relative indication of the priorities the farmers gave to different answers and should not be treated as absolute numbers.

Table 3-1. Strengths, weaknesses, opportunities and threats¹³.

STRENGTHS	1	2	3	total	WEAKNESSES	1	2	3	total
Suitable soil quality for energy crop growing	14	2	3	19	High establishment cost	13	3	3	19
Extra income in the long term	6	7	4	17	No income from the plantation before the first harvest	3	7	7	17
Suitable farm size for energy crop growing	4	5	3	12	Lack of knowledge, information and experience with energy crops	7	3	5	15
Little input – easy to grow	2	6	3	11	Lack of necessary equipment	1	9	5	15
Own necessary equipment for energy crop growing		4	7	11	Weak negotiation position for the price	1	3	3	7
Good knowledge of energy crop growing	2	1	3	6	No cooperation with other farmers	2		4	6
Diversification of activities – risk mitigation		1		1	Unknown crop yields	1	2	1	4
Other, e.g. ...					Less efficient use of machinery and labour		2		2

¹³ In the table, number 1 indicates the most important strength, weakness, opportunity and threat, and number 3 the third important one.

					Other, e.g. SOILS TOO DRY	1			1
OPPORTUNITIES	1	2	3	Total	THREATS	1	2	3	Total
Long-term contracts	5	6	5	16	Energy crops subsidised only by the Polish government – no EU subsidies	11	3	4	18
Demand for energy crops	9	4		13	No stable market for energy crops	4	7	8	19
Support, advice, training available		6	7	13	Changing policies, regulations, subsidy conditions	4	4	5	13
Favourable credits	3	7	2	12	Unsuccessful test plantations	1	4	7	12
Competitive prices with food crops	6	1	4	11	Energy crop prices are not competitive with food crop prices	5	5		10
Export market for energy crops	5	2	4	11	No set-aside obligation	3	1	1	5
National subsidies	1	3	1	5	Unclear application process	1	3		4
Necessary infrastructure present			2	2	Other, e.g.				
Successful pilot projects			1	1					
Other, e.g.									

Only one farmer used the opportunity to add a statement to the pre-designed list in the weakness section. To point out that the main weakness for his farm is the lack of water in the soils.

The results will be analysed, discussed and compared with the interview results in chapter 4.

The other actors were also asked about their perception of the strengths, weaknesses, opportunities and threats for the farmers to get their insight. The results are presented in a table in Appendix II and commented on in chapter 4.

3.4 Cooperation

The perceptions of different actors regarding potential cooperation for biomass are presented below in terms of the need for cooperation, perceived advantages, disadvantages of cooperation and willingness to cooperate.

3.4.1 Need for cooperation

The farmers were inquired about the need for cooperation for growing dedicated energy crops. All the farmers out of 29, with the exception of three farmers, who did not have an opinion in this question, and one who stated that there is no need for cooperation, argued that there is strong need for cooperation. It was mentioned that this necessity is bigger especially

for farmers with smaller farms since together they could make up a bigger area which would create several advantages.

One farmer also had tried to organise cooperation between neighbouring farmers in the north eastern part of the municipality a few years ago, they held several discussions and researched the opportunities but finally concluded that this venture would not be profitable at this point. The farmer that stated that there is no need for cooperation motivated it by saying that everyone should try to manage on their own.

The representative of the Farmers' Union sees the need for establishing biomass producer groups similar to the existing ones that today bring together the growers of a certain crop, such as tobacco, etc. (Szlitkus, 2006).

3.4.2 Benefits from cooperation

The main benefits that were mentioned were related to solving problems with the necessary equipment; knowledge and experience sharing and gaining a stronger position as a group.

Most often the farmers saw the opportunity to share the costs of buying equipment that is needed for willow planting/harvesting and thereafter share the equipment jointly.

Since the farmers have no experience with willow cultivation they would expect sharing of knowledge and experience among the members of the cooperative. Supporting and helping each other with harvesting, irrigation, etc were also often brought up.

Farmers believe that in a cooperative they would be more respected, could find buyers more easily (also on the export market) and have a better position for negotiating for the price of the harvest. In case of middle-men the farmers could skip them and go straight to the buyer and be able to make a better deal.

Only a few farmers knew that by cooperating they would be eligible for subsidies that they could not apply for alone.

On the other hand, the Head of the Municipality and the representative of the energy producer were rather hesitant about the feasibility of forming farmer cooperatives in the region. They anticipate great reluctance among the farmers due to the negative experience ("bad taste") with badly managed collective farms from the Soviet times (Bal, 2006; Tesmer, 2006). Neither does the representative of the Agricultural Advisory Board foresee farmers' cooperating.

Willingness to cooperate

24 out of 29 individual farmers answered that they are willing to cooperate with other farmers for dedicated energy crops cultivation. Sometimes the farmers were somewhat doubtful if there would be other farmers in the neighbourhood who would be interested in energy crops and cooperating for that matter. This was especially mentioned in the northern part of the municipality where the conditions for willow growing were perceived not to be so good, people engage often in cattle raising and vegetable growing. In this area, it was often mentioned that people are not used to working together and the mentality has so far been "everyone for oneself".

In a few occasions it was mentioned that farmers already do share equipment for different purposes among farmers.

4 Analysis and Discussion

This chapter analyses and discusses the results from the on-the-ground study conducted in Poland. First, the general situation in the case location is commented on and the representativeness of the sample of interviewed farmers is analysed and discussed. Secondly, the perceived barriers are analysed and discussed in relation to relevant literature. Since the purpose of the strengths, weaknesses, opportunities and threats exercise was to complement the interview questionnaire then the results from both are briefly compared. Thirdly, the issues related to cooperation have been looked at and finally, one possible way is presented about how the development of willow in this region could be aided in the future.

The similarities and differences between the perceptions of different actors have been analysed and discussed in relation to each issue.

4.1 Current situation

Biomass cultivation is very tightly related to the demand side. Since the cost of transportation limits the marketing opportunities, then mostly the growers depend on the interests and future plans of the local buyers, in this case on the local energy producer. That is why the perspective of the energy producer has been emphasised in this research in relation to the potential energy crop – willow.

Undoubtedly, if there was another biomass buyer involved or the same energy producer would prefer e.g. perennial energy grasses as a biomass source, then the research would have had different implications. However, today, energy grasses are even less competitive than willow since they do not even receive the subsidies that willow does (see section 2.2).

The energy producer has also investigated the availability of other biofuels, such as forest fuels and concluded that due to the shortage of supply, it would be very difficult to secure a stable stock. Looking at the forest resources in the region (see chapter 3.1), it can be seen that 90% of the forest is under conservation and cannot be used for economic purposes. Furthermore, wood is bulky and it is very costly to transport it from far away.

In literature, the co-firing of biomass in the existing fossil fuel fuelled boilers has been emphasised as a cost-efficient option for creating an initial market for biomass, starting out with biofuel use and softening the effects of unstable supply of biomass. However, in this case the energy producer has excluded this option due to technological difficulties that would make co-firing unreasonably expensive. Currently, coal is fired in the form of dust and the technology for producing dust from biomass is far too expensive.

At the moment the energy producer has decided to engage farmers in the biomass supply chain, since they have not been able to find available land in the region to establish their own plantations. Due to the transportation costs, it has been identified that willow needs to be produced in the radius of 60 km from the plant (Bal, 2006). Both approaches, working with the farmers as well as establishing own plantations, have their advantages and drawbacks depending on the perspective as well.

From the energy producers' and economic efficiency point of view, large scale plantations might be more profitable. In addition to the benefits from the economies of scale, large-scale plantations could guarantee a stable supply and uniform quality; consequently making the

energy producer more independent and avoid risks resulting from a number of small suppliers. This kind of biomass supply chain would probably be easier to administer as well.

Including farmers in the supply chain provides social benefits for the local community in terms of alternative income and employment¹⁴ in the rural areas. While conducting the interviews, it was noticed that the Polish farmers generally were barely making both ends meet and are struggling to support their families. Therefore, any additional income would help to tackle the low standard of living and make use of the agricultural lands that are currently unused or are used inefficiently.

The sample

The group of interviewed farmers does not exactly reflect the Polish average in terms of average farm size (16,5¹⁵ ha compared to 8,4ha¹⁶) nor the municipality average (16,5 ha compared to 5,82 ha). This could be expected, since the size of the sample was too limited (29 farmers out of the total 1483¹⁷ in the municipality) for such calculations. However, while looking at the distribution of farms according to the farm size, the biggest number of interviewed farmers still belong to the below 10 ha farm size group, which is characteristic to the Kujawsko-Pomorskie Voivodship, as can be seen from Figure 3-2 in section 3.1.1. Therefore, although the average is higher, the distribution still can give an indication of the barriers for farmers in a slightly wider context than just the interviewed sample.

The fact that in most cases the farm was the main source of income for the interviewed farmers and that they are not engaged in monoculture confirmed that Polish farms are still rather often subsistence or semi-subsistence family farms. The typical crops grown by the interviewed farmers reflected the dominating ones in Polish agriculture in general (see section 3.1.1). In terms of activities at the farm, north of the town of Grudziądz, more intensive cultivation of vegetables in green houses compared to other regions, was observed.

Although, the sample does not perfectly match the Polish or regional average in terms of farm size, it is still believed that it more or less indicates the perceptions of a typical Polish farmer and the results are credible considering the purpose of the study – to identify the prevailing barriers among Polish farmers from the qualitative aspect. The fact that majority of the farmers were picked randomly without previously arranging meetings, allowed getting a more unbiased sample. Although, the number of contacts forwarded by OPEC Grudziądz was small (4), it came forward that they tended to be slightly more positive towards dedicated energy crops and willow. When inquired about the future plans for the farm, one farmer even stated that willow is the future for their farm.

4.2 Barriers

When farmers were investigated about their perceptions of barriers, everyone had their own approach and way of giving an explanation. While trying to organise the barriers into groups, it was realised that barriers are often interrelated and it is quite difficult to divide them into clear-cut groups. Again the same structure as in the previous chapters was used.

¹⁴ In the Grudziądz county the unemployment rate was 29.6% in March, 2006 (GUS, 2006b).

¹⁵ This calculation does not include the 90ha farm, since it would have a significant impact on the average.

¹⁶ GUS Central Statistical Office as cited in Ericsson, et al., (2006)

¹⁷ Urban, A. (2004). Ziemia Grudziądzka. Grudziądz: Studio ART F. W.

However, some issues were still raised more frequently than others. Since, the number of interviewed farmers was limited; no significant patterns between different areas in the region in terms of barriers could be identified. To some extent, differences could be observed in relation to the soils and water content in the soils. Also the farmers owning land directly on the Vistula river banks shared the common problem of Natura 2000 areas where they are not allowed to grow crops.

In relation to every barrier, it has been discussed, whether it is possible to generalise these results from the willow case also to other dedicated energy crops and other regions or Poland as a whole.

Financial barriers

Based on the interviews, financial barriers are without a doubt perceived to be the most significant factors preventing farmers from growing dedicated energy crops.

Traditional crops are subsidised by the EU as well as the Polish Government but dedicated energy crops, willow and *Rosa Multiflora* at the moment; and herbaceous crops from 2007, receive support only from the Polish Government. Comparing the subsidies for traditional crops and dedicated energy crops, it can be concluded that the latter crops are not competitive from the start (see section 2.2). It should be noted that energy grasses, such as *Miscanthus* and *Sida* for example, are not eligible even for the Polish subsidies before 2007, this way making them at the moment even less competitive than willow and *Rosa Multiflora*. Moreover, the establishment costs of dedicated energy crop plantations are not comparable with traditional crops. Especially for perennial crops such as willow, the establishment costs are high and the first income is received 4-6 years from planting. Establishment subsidy is available only to plantations over 50 ha from the Polish Ecofund for the conversion of Polish debts; consequently smaller farms are not eligible. According to Gańko (2006) the limit is set at 50 ha in order to have a considerable effect in terms of CO₂ emission reductions.

These financial barriers have been emphasised in the previous studies: Ericsson et al. (2006) has mentioned the “perceived high economic risk” as the major barrier for Polish farmers including the high establishment costs as well as the long time till the first harvest e.g. the first income from the plantation. Alker et al. (2004) addressed the financial issues in terms of competitiveness with other crops. Since, the subsidy conditions are the same for all the regions and farmers in Poland, the financial challenges could be generalised over Poland. Furthermore, since the main competitive disadvantage for dedicated energy crops compared to food crops results from the Single Area Payment Scheme under the EU CAP, then this barrier could similarly be encountered in other EU New Member States that have adopted the same scheme.

As a result, it is clear, that dedicated energy crops cannot compete with food crops for arable land and since at the moment there is no set-aside obligation in Poland, then these crops do not have any resulting advantages either.

During the visit to Poland, it was observed that Polish farmers base their decisions simply on what enables them to support their family. It was noticed that commonly farmers engage in any activity that promises the most profit, assuming certainly that agro climatic conditions are in favour. Since, the farmers have not seen the profitability of dedicated energy crops in Poland in practice, they are rather cautious towards growing them. This can be related to the cautious nature and other barriers explained shortly.

Since, there is no commercial willow cultivation and consequently no market, then it is difficult to say anything about potential prices for willow harvest. In the article by Ericsson et al. (2006), the viability of willow is calculated based on the prices for wood chips from forestry residues. In Poland, now, it is difficult to estimate the revenue that the farmer could get for the harvest per hectare, especially compared to other crops, as it depends on several variables, such as the yield, which again can be dependent on e.g. the water availability and agricultural practices employed in cultivation, etc. Field tests are, therefore, needed to find out the yield in a region.

The fact that farmers mostly expect that willow could become profitable in the future, could be taken as an indication that the farmers generally have a positive attitude towards the crop and are hopeful.

Market related barriers

As already mentioned earlier by the farmers, the existence of a future biomass market is essential for starting growing any dedicated energy crops. At the moment there is no existing market but in the future the energy producer in the Grudziądz region is interested in purchasing willow from local farmers. OPEC Grudziądz has organised seminars for the farmers to introduce this crop and find out the interest among farmers. This explains why farmers mostly related willow to dedicated energy crops not energy grasses. During the visit, no indication about a potential energy grass market in the region was perceived.

The lack of an existing market and other similar factors only raises the uncertainty in the eyes of the farmers. The need for a stable market was also pointed out by Ericsson et al. (2006) and Alker et al. (2004) (see section 2.3).

In May, during a panel meeting, the fear related to not having a market was related to the fact that so far the energy producer does not have a boiler for burning wood chips from willow. This created the “chicken and egg” situation, where the farmers said they would plant willow if the energy producer had the boiler and vice versa, the energy producer is interested in securing the necessary supply first, before making any investments. The question is: who should be the one taking the risk here? For solving the problem, the energy producer is offering long-term contracts (20 years) to farmers as a form of a guarantee. Perhaps, the farmers also could have difficulties with grasping the long time period and based on previous experiences are not too sure about the value of such promises.

Farmers are afraid that there might be no market when it is time to sell the harvest or the prices are not what they had expected. Several farmers referred to incidents when they had given their rapeseed harvest to a contractor and were never paid for it. One farmer brought out the constantly changing meat prices as an example that a farmer may never be sure, what will happen the next day. These historical, market related events and uncertainty seem to have left a mark in the Polish farmers' minds.

When alternative new sources of income were investigated in the field of biomass production, then already during the visit in May, farmers stated that they are waiting for times when there would be demand for rapeseed for producing biodiesel. In June 2006 a biofuels regulation was issued in Poland which is in line with the EU Directive (Gańko, 2006) and therefore creates a driver for producing biomass for liquid biofuels for transportation. From the farmers' perspective rapeseed cultivation has several advantages over any dedicated energy crop cultivation. Farmers have already experience and knowledge with rapeseed, there are no high establishment costs involved, the equipment for harvesting is already existing and they can

always sell the harvest for food oil production. Rapeseed enjoys the same subsidies as other traditional crops regardless if it is cultivated for food oil or biodiesel. Also the representative of the Agricultural Advisory Board claimed that comparing the cultivation of rapeseed and dedicated energy crops; rapeseed would be more profitable from the perspective of farmers. He also mentioned that recently there has been interest towards the potential for supplying rapeseed from the Grudziądz region. Therefore, once there is real demand for rapeseed for biodiesel it might be much more difficult to make dedicated energy crop cultivation attractive and find farmers for growing it. However, the interviewed farmers did not mention that any interest had been shown by any potential future buyers of rapeseed for energy production purposes.

Issues related to the biomass market should be considered regional or local, since due to the costs it is not feasible to transport over long distances.

Informational barriers

Since the barriers are rather interrelated, knowledge related problems have to some extent already been discussed in regard to financial and market related barriers.

Perceived average and limited knowledge among the farmers could again be explained by the way of life of farmers in Poland. Farmers spend most of their time working in the farm; as a result, they do not have too much time to spend on learning about advancements in agriculture. They have to prioritise and usually take interest in and gather information about issues that seem to be profitable for their farm and do not go deeply into others that they have at some point out ruled. Some farmers simply stated that they have not really thought about any dedicated energy crops.

Poor knowledge of energy crops was mentioned by Alker et al. (2005) in regard to the UK. Both authors, Alker et al. (2005) and Ericsson et al. (2006) saw the limited knowledge as an underlying reason for scepticism and misconceptions sometimes widely spread among farmers. The same could also be concluded based on the insights from the interviews conducted in Poland. Some farmers thought that willow needs almost no input but as seen from the test plantations in Poland and also from the Swedish experience, underestimating the need for proper agricultural practices can have extremely sad consequences.

Generally farmers stated that in case someone is interested in getting information on dedicated energy crops, it is possible to get it. Those farmers who considered the opportunities to receive information limited or “tragic”, stated that it is difficult for them to access the information. The long distance to town to pick up the information from the authorities was considered a barrier. As a solution one farmer proposed that printed material be sent by regular mail to the farmers. The Head of the Farmers’ Union pointed out the price of the newspaper could be problem for some farmers. Based on the observations while visiting the farms in Poland having internet connection at home seemed to be extremely rare. This could also explain the significant role of media (radio, television, national newspapers) in the information dissemination process.

It was noticed that the meetings organised by OPEC had played a great role in raising awareness and even if farmers had not participated in the seminars, they had at least heard about them. Willow was seen as the potential energy crop for the region by farmers as well as all other actors because they had most knowledge about it. It could be speculated that if there was another actor promoting energy grasses, the outcome might be different.

So, the awareness among farmers depends on the future outlook for dedicated energy crops in a particular region and, therefore, can differ between regions.

Technical barriers

Although the farmers mostly perceived problems related to harvesting equipment as significant ones, these issues have not been discussed so explicitly in the literature. For 1-2 ha it is possible to harvest manually with a chain saw (Ganko, 2006). The cost of equipment is the main problem, especially since the machinery is in use only during times of planting and harvesting, which is approximately in every 3-4 years. Ericsson et al. (2006) has approached this from another angle, namely that if farmers switched to energy crops from cereal crops, the existing equipment would be used inefficiently. This point was never raised by the farmers during the interviews and it seemed that in the southern part of the region the farmers anyhow borrowed tractors and other equipment among themselves.

One farmer pointed out the difficulties with finding reliable labour force for her present tobacco plantation. It was stated that some workers prefer to take the support from the state instead and not work at all. From this viewpoint, the rather limited input needed for willow growing speaks in favour of switching to energy crop cultivation.

Cultural barriers

As already briefly touched upon under the market related barriers negative past experiences can have a harmful long term influence on farmers' behaviour and decisions diminishing their enthusiasm for undertaking new similar ventures. More than one farmer talked about negative past experiences with selling rape to contractors who never paid them for the harvest. That could also be seen as an explanation to why the farmers mentioned that they would take up energy crop cultivation only if they saw someone else doing it and being successful. To know the yields in this region, etc.

Sometimes, farmers pointed to keeping up farming traditions for their family as a reason for not engaging into something new. One farmer explained that he is raising cows because this is something that his father and grandfather have been doing before him and he has to continue. Based on observations, it seemed that the farms that raised cattle were often doing better and often were more hopeful and had a clearer vision for the future in terms of increasing the number of animals, buying more land and renovating/building new buildings, etc. It was perceived that Polish farmers are generally not willing to take risks and would rather prefer to keep to the activities they are familiar with.

Political barriers

With a few exceptions, the farmers hardly ever brought up policy related issues but stayed on the more practical farm level, which is closer to them and that they know best. This could indicate that the farmers did not perceive there to be any such barriers, but it could also be related to a lack of in-depth knowledge about how the political system or policies influence e.g. markets and agriculture. It could also be noted that the establishment or formation of markets can be directly related to policies such as subsidy schemes. Thus discussions on economic barriers are also highly relevant from a political perspective.

Agro climatic barriers

During the interviews it was noticed that issues related to suitable soils for willow growing are slightly complicated. It should be noted that in the context of this research the perception of the quality of soils for willow cultivation strongly depends on the farmers' knowledge about what kind of soils willow needs. A few farmers stated that they are actually not aware of the conditions for willow cultivation.

Occasionally farmers mentioned the lack of water in soils as a hindering factor preventing willow cultivation. This was also the main problem for the farmer owning the 90 ha farm in region. Sufficient water content is a prerequisite of engaging in willow cultivation, like also pointed out as the main strength of a farm that would be interested in willow cultivation. Since, it is not possible to overcome this barrier (irrigation would include extra costs), these farmers are not the potential willow growers in the region.

On the other hand, a group of farmers mentioned that their soils might be too good for willow. In May, the Grudziądz region as a whole was characterised as an area with good quality soils relevant for rapeseed, winter wheat and sugar beets, which are the most profitable crops. Therefore, the yield must be relatively high and together with the previously mentioned financial barriers willow could not compete with these crops for arable land in Grudziądz region. It is only logical that good soils are used first for food production.

As a result of investigation, it remained somewhat unclear where exactly in the region the potentially suitable soils for willow are located and how much potential there actually is. However, based on knowledge and insights gained during the research, areas with the most potential seemed to be the lowlands in the Vistula Valley that become flooded during high water.

Starting willow cultivation on the lowlands that are not suitable for other crops would allow making use of these lands and earning extra income. Thus, it should be noted, that willow should not be pushed to lands with too low quality, because this will have a negative effect on the yields. Since willow does not require to be harvested at a specific time, then if the area should not be accessible with harvesting machinery due to floods, then it could also be harvested at some other time, when it is accessible. On the other hand, this could cause problems with providing a steady supply to the energy producer. The Manager of the Farmers' cooperative saw the opportunities of putting willow on grasslands, other unused lands and fields that are not suitable for growing food crops (Jedrzejczak, 2006). The suitability of willow for unused grasslands with high water table was also stressed by the Head of the Farmers' Union (Szlitkus, 2006).

Up to date, no large scale plantations of willow are common, so it is difficult to really estimate the potential in this region. Further research should be carried out to estimate the real potential of willow in this region in terms of yields and suitable locations for cultivation.

Other barriers

Age. Due to the limited sample no dominant patterns between different age groups could be observed and it is not possible to relate any perceptions to specific age groups. The perceptions of farmers that were captured during interviews were that older farmers (roughly born in 1930-40s) were generally more sceptical regarding new crops and more pessimistic about the future of their farm and life in rural areas as a whole. At the same time younger

farmers were trying to keep an open mind even if they do not consider energy crops an option for their farm in the short or even in the longer term, they still acknowledge that there might be future for these crops.

Farm type. Generally, it was noticed that farms engaged in milk and meat production have a better living standard and are more interested in continuing with this activity and expanding. As also mentioned in the literature, since they need the land for fodder and pastures, they are less likely to engage in dedicated energy crop growing.

Long-term commitment. The fear of long term commitment to a perennial crop often pointed to in the literature was also confirmed by the farmers. In the Biomass Action Plan (see section 2.1) the long-term commitment was seen as a somewhat hindering factor inducing resistance in farmers' mind. Farmers constantly compare the profitability of different crops to find out the most profitable one and switch to that (Alker, et al., 2005). Although farmers appreciate certain long term stability; they feel that dedicating approximately 20-25 years to willow can be a problem. This period seems to them as a too long period for not being able to use these fields for any other crop. Several farmers mentioned the inflexibility of willow as a barrier for leaving the farm to the children. Even if agronomically it is possible to switch crops on the field, from the economic point of view it would not make much sense, since the investment costs have been significant and should be earned back from the plantation.

Farm size. It seems that one factor that can play a significant role in the decisions taken by the farmers in regard to energy crop cultivation is the farm size. As mentioned before, Ericsson et al. (2006) has proven economic viability of willow for farms larger than 30 ha. The Polish EcoFund has set 50 ha as a minimum for qualifying for the plantation establishment subsidy. Then again, according to Agrobränsle AB, the minimum economic planting of willow is already 4-5 ha (DTI Global Watch, 2004). The energy producer pointed out that farms of 3-4 ha, will not survive if they dedicated land to willow. As a result, it seems very difficult to determine where the line should be drawn in terms of the size of the farm – which farms have the most potential.

However, in general it seems that small farms are not able to afford to grow a monoculture, since the small farmers need to live off their land. As mentioned also in the literature and perceived from the interviews in Poland, farmers engaged in animal husbandry need the land for fodder production and therefore do not have any surplus land for willow. The insight acquired from the research, however, indicated greater potential for larger farms due to reduced risk, diversification of activities, etc.

Farmers compared to other actors

Comparing the perceptions of different key actors with the farmers' the range of barriers mentioned is always more or less the same. The three main issues: financial barriers, technical barriers and experience and knowledge related difficulties were always mentioned. In addition the other actors pointed to the "barriers in the farmers' mind" preventing them from engaging in new activities. They perceive farmers to be sceptical towards energy crops and believed that the farmers would rather stick to traditional crops. The other actors emphasised the importance of successful demonstration plantations.

4.2.1 Strengths, weaknesses, opportunities and threats

Looking at the results from the exercise (see section 3.3.1) it can be concluded that the strengths, weaknesses, opportunities and threats that were rated number one by farmers also

ended up more or less at the top of the list in total ranking. Therefore, these statements are unarguably weightily more significant.

It is possible to compare the weaknesses and threats to the interview results directly since the internal (in the farm) and external (influencing the farm from outside) barriers were investigated explicitly during the interviews. Strengths and opportunities can be compared more indirectly based on the perceptions that came forward during the interviews.

Comparing the results from farmer interviews in terms of barriers with the weaknesses and threats it can be concluded that these match very well: both list the financial, information related and equipment related barriers as the most important weaknesses. The fact that there is no market at the moment and the perceived instability of the future market were often mentioned in the interviews. The threat regarding the lack of EU subsidies for dedicated energy crops in Poland was put mentioned in the interviews in terms of uncompetitiveness with traditional crops (see section 3.3 on financial barriers).

Since the farmers were asked to prioritise the strengths, weaknesses, opportunities and threats in a situation where they were interested in energy crop growing, then they interpreted the strengths as “what would be the strengths” not “what are the strengths”. Therefore, they rated the existence of suitable soils as the most important strength, as a prerequisite for starting the cultivation at all. Secondly, the opportunity to earn extra income was mentioned. In the interviews farmers saw the main benefit of starting willow cultivation the opportunity to earn money which is only reasonable.

Here, the opportunities could not be prioritised so explicitly, however, the farmers perceived more often that the existence of a biomass market and long-term contracts would motivate them to take up energy crop cultivation. Tackling these external opportunities needs involvement from outside, there needs to be a buyer with a long term vision.

Perceptions of farmers compared to other actors

Comparing the strengths, weaknesses, opportunities and threats mentioned by the farmers with the ones pointed out by other actors, they seem to match well. Generally, it seems that the farmers and other actors perceive the situation fairly the same way. This could be explained for example by the fact that the Head of the Municipality as well as the Head of the Farmers’ Union and the Head of the Farmers’ Cooperative are all farmers and very well acquainted to the way of thinking of farmers.

It must be pointed out, that the strengths, weaknesses, opportunities and threats marked by the Manager of the Farmers’ Cooperative correspond relatively well to the farmers’ perceptions. This can be taken as an indication that the cooperative really does represent the views of the individual farmers.

Compared to other weaknesses the statement implying “less efficient use of machinery and labour” was considered less important. As mentioned earlier, farmers never addressed this issue and since the farms were mostly small size family farms, then the issues related to labour were not too much on the agenda because most work was done by the family members themselves.

Generally, it can be stated that the perceptions of different actors of the situation regarding energy crops did not vary considerably and no significant differences were identified.

In conclusion, due to the large number of various barriers those depending on their significance either individually or in a combination result in farmers currently not being interested in engaging in cultivating willow.

4.3 Cooperation

The biggest differ in opinion between the farmers and other actors appeared when the issues regarding cooperation were investigated.

In terms of willingness to cooperate the farmers stated very strong need and expressed willingness to cooperate. At the same time, the other interviewed actors, especially the representative of the energy producer and the Head of the Municipality, were both quite pessimistic and did not have great expectations in terms of cooperation. The main argument was that farmers in this region perceive any cooperation as something negative and relate it to the negative experiences from the times of badly managed collective farms in Poland and consequently would not be interested in cooperation.

Here the research proved the opposite - farmers stated willingness to cooperate for biomass production. Certainly, it can be speculated if in reality they would actually carry out their words when the time comes or still consider the risks too big. Certainly, a cooperative needs initiative and a motivated leader and perhaps the other actors looked at the issue from a wider perspective and see difficulties related to establishing and operating a cooperative.

Looking for similarities and differences among different areas in the region, it was noticed from the interviews that in the northern part of the region people were less willing to cooperate and often mentioned that there is no tradition of working together, while in the southern parts farmers sometimes claimed borrowing equipment during harvesting times. In the northern part they often mentioned the prevailing mentality that one must manage on one own.

In literature Downing et al. (1998) pointed out that energy producers would rather avoid doing business with a big number of small farmers. The representative of OPEC Grudziądz on the other hand did not see the farm size as a hindering factor. For the energy company the prerequisite in this case is that the farmers should be able to harvest their crop without expecting support from the energy producer, since they are not planning to take on any such kind of responsibilities (Bal, 2006).

The fact that the representative of the Farmers' Union saw the need for a cooperative and believed a biomass cooperative could function similarly to other product based cooperatives, adds confidence that forming a cooperative could be feasible.

4.4 Future Developments

Looking at the future prospects of bioenergy in the region, two possible perspectives should be considered: a short-term and a long-term perspective. The fact is that the energy producer needs to start producing "green" electricity as soon as possible. Considering the claims of different actors and evaluating the situation it seems that, from the farmers' as well as the energy producers' perspective, utilising agricultural residue – straw – would be the quickest way to start "green" energy production. At the moment straw is a no risk, already available source of biomass that the farmers could sell and earn extra income. From the energy producers' point of view straw would be an immediately available biofuel, however, the

calorific value would be lower compared to willow. The energy producer already has the boiler for burning straw pellets in place.

Considering the long-term perspective in this research, the future outlook is discussed in terms of aiding the development of willow in the region in the light of all the identified barriers perceived in Poland (see Figure 4-1). Taking immediate action is of immense importance since it will take time before the first willow harvest¹⁸.

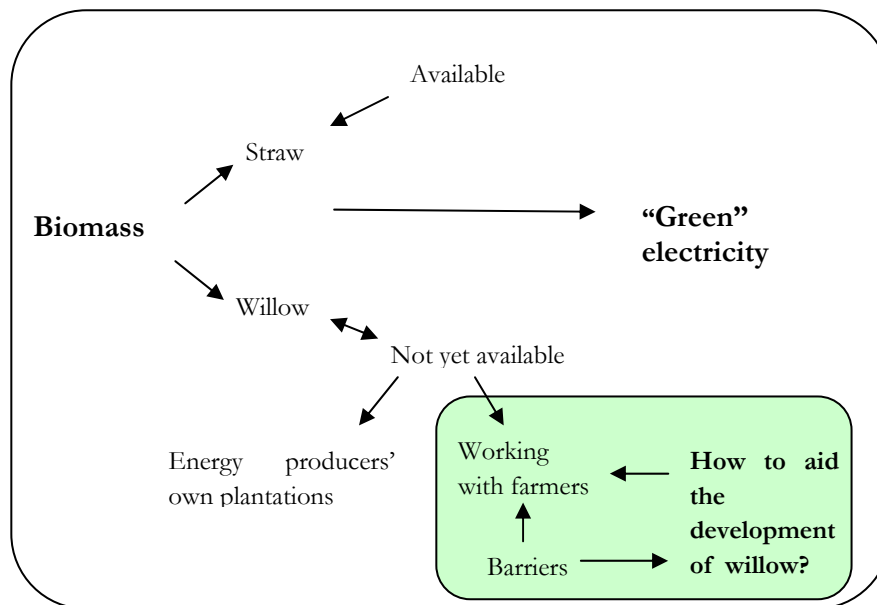


Figure 4-1 Future developments in the context of this research.

To motivate the farmers to engage in willow cultivation, the perceived barriers need to be addressed, i.e. it must be focused on eliminating the weaknesses and threats; and developing the strengths and opportunities. As was identified previously, the biggest barriers for farmers are financial, informational, technical and market related. The fact that energy crops are not competitive with other crops already from the beginning in terms of agricultural subsidies needs intervention on the Polish/EU level. Energy crops need to become eligible for support under the EU CAP scheme on equal grounds with other crops. However, the most often mentioned problem for farmers, the plantation establishment cost, could be addressed on the local or even on the farmers' level.

At the moment the problem is that farmers with farms smaller than 50 ha are not eligible for the establishment aid from the Polish EcoFound that provides support within the eco-conversion of Polish debts framework. Farmers have already taken agricultural loans and banks are reluctant to give them more loans. In the panel discussion it was pointed out that the financial institutions in Poland are not familiar with willow and the related risks and therefore are also unwilling to get involved in these projects.

In the interviews several farmers pointed out that they would expect help from the buyer or the energy producer who will buy their harvest. When the representative of the energy

¹⁸ Taking in account that it will take 4-6 years (Helby, et al., (2006)) before the first harvest then if the first plantations are established in 2007, the first willow could be harvested in 2011-2013.

producer was investigated about this future outlook, he explained that they *could* provide help in terms of buying cuttings for the farmers but rather would prefer not to do it. Some years ago OPEC Grudziądz had bought cuttings for farmers to be cultivated on their land but after some time the company had to hire people to take care of the plantation since the farmers had lost interest and expected that willow does not need any input in terms of labour. The energy producer commented that “farmers don’t realise that there is money growing on their fields¹⁹” (Bal, 2006). This case proved in practice that buying cuttings for the farmers is not a solution since then the farmers do not feel the accompanying responsibility. The energy producer has also stated that they are not interested in engaging into solving technical problems for the farmers. If OPEC had about 600 ha of their own plantations, they would consider buying harvesting equipment (Bal, 2006). Therefore, farmers should not expect help from the energy producer in terms of buying willow cuttings or harvesting machinery.

Looking at the farm size, most farms are small; it would be very difficult to find a farm that would dedicate 50 ha to willow individually. Therefore, one option to tackle undoubtedly the biggest problem of establishment costs would be through **cooperation**. By forming a cooperative the farmers could increase the size of the plantation and become eligible for the establishment support provided by the Polish EcoFound.

In addition to solving the problem with plantation establishment costs, forming a cooperative would create a number of other benefits. A cooperative aiming at supporting farmers with willow growing could offer support throughout the whole production chain from establishing the plantation, growing, harvesting, collecting, handling, transportation and storage till marketing.

At the same time, farmers could tackle also the informational and technical barriers. The cooperative would serve as a platform for sharing knowledge and experience among the members and they could buy and share (or subcontract) the necessary equipment also jointly. Cooperative has wider possibilities to look for new markets (export markets), since it has more resources at hand compared to individual farmers (Downing et al., 1998). Due to its size and supply volume the cooperative would have a stronger position for negotiating prices. From the practical point of view, members of the biomass cooperative could buy cuttings in bulk and get a discount, this way reducing the establishment costs.

Cooperative would also coordinate the supply streams which is very important for willow because there is no annual yield from the plantation. It has been suggested to plant willow over three consecutive years so that afterwards there will be an annual income (Downing et al., 1998). This kind of coordination would be important from the farmers’ (income) as well as from the energy producers’ (supply stability) point of view.

Engaging in a farmers’ cooperative for biomass cultivation, additionally, allows earning extra income in the long term and diversifying activities at the farm. New sources of income will create revenue for the local authorities and result in boosting rural development. Last but not least, growing willow has a number of environmental benefits. The energy producer would be guaranteed a necessary amount of biomass from one source, this way reducing the efforts to engage into business relationships with individual farmers.

In this research the assumption about the feasibility of forming a cooperative among the farmers in this region in Poland is based on two conclusions from the interviews. Firstly, the

¹⁹ In Polish: “Rolnicy nie zdają sobie sprawy że pieniądze rosną na ich ziemi” (Bal, 2006).

interviewed farmers perceived that there is a need for cooperation for biomass cultivation. Secondly, majority of the interviewed farmers expressed willingness to cooperate. The Head of the Farmers' Union stressed the need for a cooperative and also pointed out that a biomass cooperative could function similarly to the existing producer groups for other crops.

Based on the perceptions gathered during the research it is believed that cooperatives could have future among the new generation of farmers who seemingly are more open minded and although under present conditions they do not consider engaging in dedicated energy crop cultivation, they still keep an open mind and do not exclude it in the future perspective.

The Representative of the Agricultural Advisory Board and the Head of the Farmers' Union both stated that there is potential for energy crops in the future for the whole Poland (Kapuściorek, 2006; Szlitkus, 2006). These statements show that these actors recognise the future outlook of dedicated energy crops in the region.

As also mentioned by Alker et al. (2005) (see section 2.3) other countries have successfully managed to overcome barriers related to energy crop cultivation, so it should be also feasible for Poland.

4.4.1 Pilot project for a farmers' biomass cooperative

Further recommendations will not include detailed suggestions about how the cooperation should be organised exactly, since already the theory on agricultural cooperatives refers to a number of different structures and ways of organising a cooperative. The main objective of forming a cooperative is seen as a mean to overcome the identified barriers. However, it is recommended that the cooperative starts out with addressing the basic problems farmers face when taking up willow cultivation and in time move from focusing on the farmers' end of the supply chain to engaging in other related activities, such as producing their own cuttings, etc.

Establishing a well functioning cooperative is not easy as can be seen from section: Cooperation 2.4. In addition to striving towards solving the problems related to the actual cultivation of the crop, barriers related to forming a cooperative have to be kept in mind and avoided. This does not only constitute a problem for Poland but also has occurred in other countries that have long-term traditions with agricultural cooperatives and dedicated energy crops (see section 2.4).

As a result, a project based approach towards forming a cooperative is suggested. This venture could be seen as a capacity building project for the whole Poland in terms of establishing biomass cooperatives. It would have to be designed and managed carefully engaging top experts in the field in order to become a success and serve as a positive example motivating other similar ventures. Learning from the mistakes of other is of great importance. As could be seen from the ARBRE case in UK (see section: Cooperation 2.4), negative examples and experiences penetrate in peoples' minds for a long time and do not encourage activities in the same field. Careful planning is necessary also because of the long-term commitment (20-30 years) that a perennial crop such as willow demands. It should be noted, that the aim is not to get as many people as possible started with willow, but develop viable plantation that offer a good yield throughout its lifetime.

From the interview with the manager of an existing Farmers' Cooperative it came forward that regardless of the eligibility for the establishment subsidy and suitable lowlands, for them the biggest barrier is finding a market for their harvest (Jedrzejczak, 2006). Therefore, although a

cooperative has potential to solve the farm related “internal” problems; there still is a need for involvement of other actors for tackling the external issues such as the market for example.

A pilot project for setting up a biomass cooperative for the farmers would include a number of actors from the region. In addition to farmers the other actors who should certainly be involved are the energy producer, research institutions and local authorities. The roles of each one will be discussed below.

The energy producer would guarantee a market for the harvest by offering a long-term contract to the cooperative. This way creating the most important external opportunities that were perceived to motivate farmers to grow energy crops (see section 3.3.1).

The experience from the demonstration plantation that OPEC Grudziądz is about to launch (see section 3.2) could be disseminated through the cooperative to the farmers and this way the farmers could get practical information and advice relevant to their plantations since the demonstration will be in the vicinity and farmers can go and consult any time. Through the demonstration project the energy producer would contribute to raising awareness and addressing the information related barriers that were perceived from the interviews, as well as often pointed to in literature (see section 2.3).

Research institutions could contribute in several ways. Firstly, by developing cuttings²⁰ most suitable for the local conditions as well as having in mind the needs of the energy producer in terms of biofuel quality. Secondly, raise awareness among the farmers about the right agricultural practices to be able to harvest high yields of good quality biomass addressing the need for practical advice pointed to e.g. by the Head of the Farmers’ Union (see section 3.3).

Local authorities could have a supporting role in terms of guaranteeing loans for the cooperative to make investments, e.g. in equipment (see section 2.4), because as mentioned already earlier - individual farmers already have loans and they do not want to mortgage their homes for the cooperative. Thus, as mentioned in literature on cooperatives, the members do need to participate and be engaged in monetary terms, since this way the members will feel responsibility and also other actors are more willing to make investments. In Poland the district heating systems and sometimes CHP plants are owned by the local governments/authorities. According to Nilsson et al. (2004) local authorities are responsible for compiling local energy plans that determine the possible ways of using energy resources in the region. Since the CHP plant in Grudziądz is owned by the town of Grudziądz, they play a significant role in the development of local energy sources – develop biomass as a renewable source of energy. Bal (2006) stated that so far the owners have not taken interest or concern in how the company will be able to fulfil the “green” electricity obligation.

Also the Agricultural Advisory Board could take a more active role in disseminating information about subsidies and other support schemes in terms of biomass cultivation, so that the cooperative would serve as a platform for information sharing.

Problems related to administrative and managerial issues need to be tackled as well. The cooperative needs transparent management practices that would restore trust in cooperatives again. Forming a cooperative within a pilot project framework could help to implement solid management practices.

²⁰ The „gurus” in this field in Poland are prof. Tworkowski and prof. Szczukowski from Uniwersytet Wermiński-Mazurski in Olsztyn (Gańko, 2006).

In the future perspective, once the biomass cooperative is functioning well, it could perhaps also direct its efforts outside the cooperative in terms of representing the interests and addressing the problems of the members on the decision making level. As proposed by Downing et al. (1998) (see section: Cooperation 2.4) biomass cooperatives have the potential to influence policy making in the fields of agriculture, energy and environment. The cooperative could bring the uncompetitiveness of energy crops compared to other crops in terms of subsidies in the agenda.

5 Conclusions

As in Poland bioenergy production from dedicated energy crops has not developed at a pace that was expected, a need was identified to research the hindering barriers. The aim of this research was to find out directly from the Polish farmers what the barriers are for them for growing dedicated energy crops.

The initial plan in May was to complement the Grudziądz case study with insights from the other case location in Elbląg. However, as the research evolved the author decided, due to administrative as well as time constraints, to focus on the Grudziądz case and subsequently on willow. Grudziądz case suited very well with the objective of this research by providing a context and future potential in terms of supplying biomass by farmers to an energy producer in the region with the relevant interest.

During the on-the-ground research conducted in Poland the perceptions regarding the main barriers for willow cultivation for farmers in the region were gathered. The bottom-line for not engaging in willow cultivation is that at the moment willow is not competitive with other traditional crops. Especially on good quality soils winter wheat, rapeseed and sugar beet are most profitable. Thus soil quality is an important factor for energy crop implementation.

Undoubtedly, the most significant barriers for willow are the financial ones, they include **firstly** the plantation establishment costs and then the annual subsidies. The latter are especially important since willow as a perennial crop does not yield income every year. The fact that in Poland currently dedicated energy crops are not eligible for agricultural support under CAP SAPS, makes them uncompetitive compared to other crops already from the start. **Secondly**, the knowledge and experience related barriers were emphasised. The lack of information, tradition and experience with a novel crop such as willow was perceived as a factor hindering the development of energy crops and causing scepticism. Farmers often expressed the need for a demonstration project that would among other things also prove the yield level of willow. **Thirdly**, the farmers stated that equipment for cultivating willow, especially harvesting equipment, is a great problem. The equipment is expensive especially for farmers who have small farms and there is no sense in owning the equipment individually. **Fourthly**, the market related issues came forward in the interviews; farmers need to feel secure that there will be a market once it is time to sell the harvest and that they would get a reasonable price for their product.

The comparison of perceptions about the barriers from farmers themselves and other interviewed actors indicates that there are no significant differences. Most of the barriers have implications in literature and are consistent with Ericsson et al. (2006) study touching upon barriers in Poland and Alker et al. (2005) study about barriers in the IEA member countries. However, in literature the problems related to harvesting equipment were not emphasised as strongly as they were perceived by the actors in this research. This is a barrier related to the very practical aspects of willow cultivation that farmers related to in the first order. As the life in rural areas in Poland is hard, then the first priority for the farmers is to make both ends meet for their families and avoid taking extra risks.

However, based on the insights from the first meeting in May, it was anticipated that the farmers are most likely to be against agricultural cooperation but the research results show that the farmers on the contrary did express the need and willingness to cooperate.

Based on the identified barriers among the interviewed farmers in the region, recommendations, about how the development of willow could be aided in the future, have been given. For tackling the barrier related to the competitiveness of energy crops compared to other crops in terms of subsidies needs involvement from the national/EU level. There is a need to make energy crops eligible to support under CAP similarly to EU-15 countries. This is expected to happen in 2009 at the latest when Poland has to adopt the SPS under CAP. The other major concern, the high establishment costs of biomass plantations, could be solved through cooperation between farmers, so that together the farmers increase the size of the fields and become eligible for the establishment support for plantations over 50 ha available from Ekofund. In fact, forming a cooperative enables to address a number of other identified barriers simultaneously. A cooperative could serve as a platform for information and experience sharing. Most of the farmers saw the major benefit of a cooperative in the opportunity to solve the problem with necessary equipment. In addition, a cooperative would have better opportunities for finding a market and negotiating for better conditions with the buyer of the harvest.

Starting up a successful and well functioning cooperative has proven to be difficult even in countries that have long-term experience with dedicated energy crops and an existing culture of cooperation. In such a situation it has been suggested to establish and implement a pilot project for forming a farmers' biomass cooperative. This project could simultaneously serve as a demonstration and capacity building project for similar initiatives in other locations in Poland. In addition to farmers, the project could bring together a number of related actors such as the energy producer, local authorities and research institutions in order to provide relevant support. Farmers in Poland were perceived to be greatly influenced by experiences of others and especially the negative cases made farmers cautious and had a long term effect on them. Therefore, in order to avoid setbacks for the bioenergy sector as a whole, careful planning and implementation of the pilot project is essential. This means that resources should be invested in involving experts in the field and proper management to guarantee success.

Considering the knowledge and perceptions gained during the research, it is not entirely clear where the potential areas for willow cultivation in the area are, since sometimes the interviewed farmers mentioned having too dry soils or that the suitable areas are on the banks of Vistula River that are protected under Natura 2000. This could potentially be explained by two factors: the sample of farmers was too small and the geographical locations were limited.

Therefore, for further research it is suggested to:

1. interview a higher number of farmers with a special focus on larger farms, which should be less risk aware for new type of crops such as willow;
2. expand the research to other areas, including areas on the others side of the Vistula River; and
3. research the barriers to other dedicated energy crops, such as permanent grasses, which have the advantage of using the conventional straw harvesting machinery.

Expanding the area of research will allow drawing more extensive conclusions about which locations are suitable for willow cultivation in terms of soils, since these conditions are the prerequisites of engaging into willow cultivation in the first place. As a result the target audience among the farmers could be identified more explicitly and the further efforts directed their way.

Bibliography

- Berggren, M., Ljunggren, E., Johnsson, F. (2006). Biomass co-firing potentials for electricity generation in Poland: Matching supply and co-firing opportunities. *Biomass and Bioenergy*, In press.
- Downing, M., Dementer, D., Braster, M., Hanson, C., Larson, G., Volk, T. (1998). Agricultural Cooperatives and Marketing Bioenergy Crops: Case Studies of Emerging Cooperative Development for Agriculture and Energy. In: *BioEnergy '98: Expanding Bioenergy Partnerships*, Madison, Wisconsin, October 4-8, 1998
- Downing, M., Volk, T. A., Schmidt, D. A. (2005). Development of new generation cooperatives in agriculture for renewable energy research, development, and demonstration projects. *Biomass and Bioenergy*, 28, 425-434.
- Ericsson, K., Rosenqvist, H., Gańko, E., Pisarek, M., Nilsson, L. (2006). An agro-economic analysis of willow cultivation in Poland. *Biomass and Bioenergy*, 30, 16-27.
- Fairbairn, B. (2003). The role of farmers in the future economy. [Online]. Available: <http://coop-studies.usask.ca/pdf-files/RoleFarmers.pdf> [2006, July 25]
- Gierulski, K. (2002). Polish national strategy for the development of renewable energy sector. [Online]. Available: <http://www.world-council-for-renewable-energy.org/downloads/WCRE-Gierulsky.pdf> [2006, May 17]
- Gierulski, K., Rogulska, M. (2003). Policy and legal framework for wider implementation of biomass CHP in Poland. (EC Baltic Renewable Energy Centre (EC BREC), RECEPOL and POLBIOM). Warsaw, Poland.
- Hall, D. O., Rosillo-Calle, F., Williams, R. H., Woods, J. (1993). Biomass for energy: Supply Prospects. In: Edited by Johansson, TB. et al. *Renewable energy: Sources for fuels and electricity*. (595-651). Washington DC: Island Press.
- Helby, P., Rosenqvist, H., Roos, A. (2006). Retreat from Salix – Swedish experience with energy crops in the 1990s. *Biomass and Bioenergy*, 30, 422-427
- Holm-Neilsen, J.B., Madsen, M., Popiel, P.O. (2006). Predicted energy crop potentials for bioenergy, worldwide and for EU-25. In: *World Bioenergy 2006. Conference and Exhibition on Biomass for Energy*, Jönköping, Sweden, 30 May- 1 June, 2006.
- Ignaciuk, A., Vöhringer, F., Ruijs, A., van Ierland, E.C. (2006). Competition between biomass and food production in the presence of energy policies: a partial equilibrium analysis. *Energy Policy*, 34, 1127-1138
- Johansson, B., Börjesson, P., Ericsson, K., Nilsson, L., Svenningsson, P. (2002). The use of biomass for energy in Sweden: Critical Factors and Lessons Learned. Lund University. [Online]. Available: <http://www.miljo.lth.se/svenska/publikationer/visaInfo.asp?ID=168> [2006, June 26].
- Johansson, T. B., Kelly, H., Reddy, A. K. N., Williams, R. H. (1993). Renewable fuels and electricity for a growing world economy: Defining and achieving the potential. In: Edited by Johansson, TB. et al. *Renewable energy: Sources for fuels and electricity*. (1-74). Washington DC: Island Press.
- Nilsson, L., Pisarek, M., Buriak, J., Oniszk-Poplawska, A., Bućko, P., Ericsson, K. (2004). Bioenergy policy and strategies for Poland. In: *Proceedings of the 2nd Biomass World Conference & Technology Exhibition on Biomass for Energy Industry & Climate Protection*, Rome, 10-14 May 2004.
- McCormick, K., Nilsson, H., Tomescu, M. (2006). Energy Crops and the Common Agricultural Policy. In: *World Bioenergy 2006. Conference and Exhibition on Biomass for Energy*, Jönköping, Sweden, 30 May- 1 June, 2006.
- Nilsson, L., Pisarek, M., Buriak, J., Oniszk-Poplawska, A., Bućko, P., Ericsson, K., Jaworski, L. (2006). Energy policy and the role of bioenergy in Poland. *Energy Policy*, 34, 2236-2278.
- Oniszk-Poplawska, A., Rogulska, M., Wiśniewski, G. (2003). Renewable-energy developments in Poland to 2020. *Applied Energy*, 76, 101-110.
- Rodriguez, A. (2005). *Key factors in the potential of biomass for energy purposes*. Lund: Lund University.
- Roos, A., Rosenqvist, H., Ling, E., Hector, B. (2000). Farm-related factors influencing the adoption of short-rotation willow coppice production among Swedish farmers. *Acta Agric. Scand., Sect. B, Soil and Plant Sci.* 50, 28-34.
- Rosenqvist, H., Roos, A., Ling, E., Hektor, B. (2000). Willow growers in Sweden. *Biomass and Bioenergy*, 18, 137-145.

Rösch, C., Kaltschmitt, M. (1999). Energy from biomass – do non-technical barriers prevent an increased use? *Biomass and Bioenergy*, 16, 347-356.

Urban, A. (2004). *Ziemia Grudziądzka*. Grudziądz: Studio ART F. W.

Tomescu, M. (2006). Synergistic and socio-economic effects of bioenergy systems: The Mureck Bio-Energy Cycle. In: *World Bioenergy 2006. Conference and Exhibition on Biomass for Energy*, Jönköping, Sweden, 30 May- 1 June, 2006.

Venendaal, R., Jørgensen, U., Foster, C. A. (1997). European Energy Crops: A Synthesis. *Biomass and Bioenergy* Vol. 13, No 3. p. 147-185.

EU Documents

Directive 2001/77/EC of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market. OJ L 283, 27.10.2001, p.33.

Directive 2003/30/EC of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport. OJ L 123, 17. 05. 2003, p. 42.

Directive 2001/80/EC of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants. OJ L 309, 27. 11. 2001, p. 1.

Commission of the European Communities. (2006). *Green Paper: A European Strategy for sustainable, competitive and secure energy*. COM (2006) 105 final. [Online]. Available: http://ec.europa.eu/energy/res/legislation/index_en.htm [2006, June 21]

European Commission. (1997). *Energy for the future: Renewable sources of energy. White Paper for a Community Strategy and Action Plan*. COM (97) 599 final. [Online]. Available: http://ec.europa.eu/energy/res/legislation/index_en.htm [2006, June 21]

European Commission. (2002). *Agricultural Situation in the Candidate Countries. Country report on Poland*. [Online]. Available: <http://ec.europa.eu/agriculture/external/enlarge/publi/countryrep/poland.pdf>. [2006, August 19]

European Commission. (2004a). *Enlargement and Agriculture: Glossary*. [Online]. Available: http://ec.europa.eu/agriculture/publi/enlarge/gloss_en.pdf [2006, June 22]

European Commission (2004b). *Enlargement and Agriculture*. [Online]. Available: http://ec.europa.eu/agriculture/publi/enlarge/text_en.pdf [2006, June 22]

European Commission (2004c). *New Common Agricultural Policy in place on 1 January 2005* [Online]. Available: <http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/04/1540&format=HTML&ag> [2006, August 26] Press Release. December 2004.

European Commission. (2005). *Biomass Action Plan*. [Online]. Available: http://ec.europa.eu/energy/res/legislation/index_en.htm [2006, June 21]

European Commission. (2006a). *CAP reform – a long-term perspective for sustainable agriculture*. [Online]. Available: http://ec.europa.eu/agriculture/capreform/index_en.htm [2006, June 24]

European Commission. (2006b). *Simplification of the Common Agricultural Policy*. Luxembourg: Official Publications of the European Communities.

EU INFO SHEET. (2005). *Energy crops*. [Online]. Available: http://ec.europa.eu/agriculture/capreform/infosheets/energy_en.pdf [2006, June 22]

Reports

Alker, G., Bruton, C., Richards, K. (2005). Full-scale implementation of SRC-systems: Assessment of Technical and Non-Technical Barriers. [Online]. Available: http://www.shortrotationcrops.com/PDFs/IEA%20HPA3%20Barriers%20Report%202005_05_05.doc [2006, August 8]

Co-operatives^{UK}. (2003). Energy: the future generation. Co-operative opportunities. [Online]. Available: http://www.gandp.org.uk/live/images/cme_resources/Users/Nick/Energy_2003-report.pdf [2006, August 9]

Council of Ministers. (2000). *Development strategy of renewable energy sector*. Warsaw: Council of Ministers

DTI Global Watch. (2004). Co-operative energy: lessons from Denmark and Sweden [Online]. Available: http://www.gandp.org.uk/live/images/cme_resources/Users/Nick/DTI%20mission%20report_co-operative%20energy.pdf. [2006 August, 8]

GAIN. (2004a). Agricultural situation. Enlargement of the Common Agricultural Policy. [Online]. Available: <http://www.fas.usda.gov/gainfiles/200404/146106177.pdf#search=%22Enlargement%20of%20the%20Common%20Agricultural%20Policy%20GAIN%22> [2006, August 20]

GAIN. (2004b). Cap Reform 2003 – Deconstructing Decoupling. [Online]. Available: <http://www.fas.usda.gov/gainfiles/200408/146107107.pdf> [2006, June 24]

GAIN. (2005). Poland's CAP Implementation. [Online]. Available: <http://www.fas.usda.gov/gainfiles/200501/146118421.pdf> [2006, June 24]

GUS (Central Statistical Office). (2002). *Agricultural Census 2002*. [Online]. Available: http://www.stat.gov.pl/english/dane_spol-gosp/nsp/spis_rol/raport.htm [2006, September 13]

GUS (Central Statistical Office). (2005). *Population by sex, voivodship, powiats and gminas in 2005*. [Online]. Available: http://www.stat.gov.pl/dane_spol-gosp/ludnosc/stan_struk_teryt/2005/31_12/tablica8.xls [2006, August 19]

GUS (Central Statistical Office). (2006a). *Agriculture in 2005*. [Online]. Available: http://www.stat.gov.pl/english/dane_spol-gosp/rolnic_lesnict_srodowi/rolnictwo/2005/2005/index.htm [2006, August 19]

GUS (Central Statistical Office). (2006b). Unemployment rate by voivodships, subregions and powiats (I quarter 2006). [Online]. Available: http://www.stat.gov.pl/english/dane_spol-gosp/praca_ludnosc/bezrobocie_rejestrowane/2006/1quarter/index.htm [2006, September 2]

Ministry of Agriculture and Rural Development. (2005). *Agriculture and Food Economy in Poland*. [Online]. Available: http://www.minrol.gov.pl/FileRepozytory/FileRepozytoryShowImage.aspx?item_id=14707 [2006, June 22]

Internet Homepages

Agrobränsle AB. (2006). [Online]. Available: <http://www.agrobransle.se/index1,0.htm> [2006, July 20]

Bioenergy Network of Excellence. (2006). [Online]. Available: <http://www.bioenergy-noe.com/> [2006, August 16]

Co-operative Energy. (2006). [Online]. Available: <http://www.cooperatives-uk.coop/live/welcome.asp?id=0> [2006, August 10]

Defra. (2005). [Online]. Available: <http://www.defra.gov.uk/farm/crops/industrial/energy/biomass-taskforce/pdf/concl-recommend.pdf> [2006, August 16]

International Co-operative Alliance. (2006). [Online]. Available: <http://www.ica.coop/coop/principles.html> [2006, August 8].

Lantmännen. (2006). [Online]. Available: <http://www.lantmannen.com/Default.aspx> [2006, July 20]

Scottish Agricultural College. (2002). [Online]. Available: <http://www1.sac.ac.uk/envsci/External/WillowPower/#Introdn> [2006, June 20]

Svebio. (2004). Energy crops – a resource for development. [Online] Available: <http://svebio.agriprim.com/attachments/33/120.pdf> [2006, May 14]

UNDP GRID-Arendal. (1998). Map of Poland. [Online] Available:
http://maps.grida.no/go/graphic/poland_topographic_map[2006, July 20]

PowerPoint Presentations

Gańko, E. (2006). *Energy crops state of art: Regional opportunities for Salix growing for energy*. PowerPoint Presentation. EC BREC. 22 May 2006, Warsaw, Poland.

Gumieniuk, A., Gańko, E. (2006). *Salix competitiveness in Grudziądz county*. PowerPoint Presentation. EC BREC. 22 May 2006, Warsaw, Poland.

Jaworski, L., Oniszk-Popławska, A. (2005). *Implementation of the Directive 2001/77/EC in Poland – consequences for biomass use in electricity production sector*. EC BREC. 28-29 November 2005. Warsaw, Poland.

Personal interviews

Gańko, E. (2006 July 14). Personal Interview.

Jaworski, L. (2006, July 14). Personal Interview.

Kapuściorek, Z. (2006 July 4). Personal Interview.

Tesmer, J. (2006 July 4). Personal Interview.

Szlitkus, G. (2006 July 4). Personal Interview.

Bal, R. (2006 July 4). Personal Interview.

Jedrzejczak, S. (2006 July 6). Personal Interview.

29 personal farmer interviews²¹.

²¹ Since a number of interviewed farmers were promised complete confidentiality, then no personal details of any individual farmers are disclosed in this thesis.

Abbreviations

BAP	Biomass Action Plan
CAP	Common Agricultural Policy
CHP	Combined heat-and-power
EC	European Commission
EC BREC	EC Baltic Renewable Energy Centre
EU	European Union
IEA	International Energy Agency
IIIEE	International Institute for Industrial Environmental Economics
SAPS	Single Area Payment Scheme
SPS	Single Payment Scheme
SRC	Short Rotation Coppice

Appendix I

Interview questionnaire for Polish farmers.

Interview Questionnaire

Ankieta

1. General information / *Informacje ogólne*

1. Farm name/ <i>Nazwa gospodarstwa</i>	
2. Farmer name/ <i>Imię i nazwisko właściciela</i>	
3. Name of the person being interviewed (if different)/ <i>Imię i nazwisko osoby ankietowanej (jeśli jest to inna osoba)</i>	

2. Farm information / *Dane o gospodarstwie*

1. Farm size/ <i>Rozmiar gospodarstwa</i>	
2. Activities/ <i>Działalność</i>	
3. Main source of income/ <i>Główne źródło dochodu</i>	
4. Types of crops grown/ <i>Rodzaje upraw</i>	
5. Quality of soils/ <i>Jakość gleb</i>	

3. Energy crops / *Uprawy energetyczne*

1. What is your experience with energy crops? Do you have any experience with energy crops?/ <i>Jakie jest Państwa doświadczenie z uprawami energetycznymi? Czy mają Państwo doświadczenie z takimi uprawami?</i>	
2. How would you evaluate your knowledge of energy crops?/ <i>Jak Pan/i ocenia swoją</i>	<input type="checkbox"/> Good/ <i>Dobra</i>

<p><i>wiedzę na temat upraw energetycznych?</i></p>	<input type="checkbox"/> Average/Średnia <input type="checkbox"/> Limited/Ograniczona
<p>3. Where and from whom did you learn about energy crops? / <i>Gdzie i od kogo dowiedzieli się Państwo o uprawach energetycznych?</i></p>	
<p>4. How would you evaluate opportunities to receive information regarding energy crops? / <i>Jak oceniają państwo dostęp do informacji na temat upraw energetycznych?</i></p>	<input type="checkbox"/> Good/Dobry <input type="checkbox"/> Average/Średni <input type="checkbox"/> Limited/Ograniczony
<p>5. Which energy crop would you potentially grow? / <i>Uprawą jakich roślin energetycznych byłoby Państwo potencjalnie zainteresowani?</i></p> <p>Why? / <i>Dlaczego?</i></p>	
<p>6. Do you know of anyone who is currently growing energy crops in this region? / <i>Czy wiezją Państwo o kims kto zajmuje się uprawami energetycznymi w tym rejonie?</i></p>	

4. Identification of factors / Rozpoznanie czynników

<p>1. Why have you/have you not taken up energy crop growing? / <i>Dlaczego podjęli (nie podjęli) się Państwo upraw roślin energetycznych?</i></p>	
<p>2. What are the problems for you with energy crop growing? / <i>Jakie są dla Państwa problemy z prowadzeniem upraw energetycznych?</i></p>	

<p>3. What do you see as benefits of energy crop growing for you? / <i>Jakie korzyści przewidują Państwo z prowadzenia upraw energetycznych?</i></p>	
<p>4. How would you characterize your soils in regards to energy crop growing? / <i>Jak oceniają Państwo jakość swoich gruntów w stosunku do wymagań upraw energetycznych?</i></p>	
<p>5. Do you know where you could market energy crops in the region? / <i>Czy wiedzą Państwo gdzie w regionie można sprzedawać uprawy energetyczne?</i></p>	
<p>6. How would you characterize the profitability of energy crop growing? / <i>Jak oceniają państwo opłacalność prowadzenia upraw energetycznych?</i></p>	

5. Identification of activities and actors / *Blizsza analiza osób oraz podjętych działań*

<p>1. What kind of help would you need to grow energy crops? (grants, technical support, training, advice, etc) / <i>Jakiego rodzaju pomocy potrzebują/ potrzebowałyby Państwo do prowadzenia upraw energetycznych (dofinansowanie, wsparcie techniczne, szkolenia, doradztwo itp.)</i></p>	
<p>2. Who do you think could provide this help? / <i>Kto Państwa zdaniem może dostarczyć takiej pomocy?</i></p>	
<p>3. Would there be need for cooperation with other farmers? / <i>Czy potrzebna byłaby współpraca z innymi rolnikami?</i></p>	

4. What would the benefits from cooperation be for you? / <i>Jakie byłyby korzyści dla Państwa ze współpracy z innymi rolnikami?</i>	
5. Would you be willing to cooperate with other farmers? / <i>Czy wyrażają państwo chęć współpracy z innymi rolnikami?</i>	
6. Under which conditions would you cooperate with other farmers? / <i>Pod jakimi warunkami byłoby Państwo skłonni podjąć współpracę z innymi rolnikami?</i>	

What are your plans for the future in your farm? / <i>Jakie są Państwa plany odnośnie rozwoju gospodarstwa?</i>	
What is your personal opinion about energy crops? / <i>Co Państwo sądzą na temat upraw energetycznych?</i>	

6. Strengths, weaknesses, opportunities and threats (SWOT)/ *Analiza SWOT*

Objective: To find out the potential of Polish farmers for growing energy crops/CEL: *Ustalenie potencjału produkcyjnego upraw energetycznych w Polsce*

What are the most important advantages within your farm that would motivate you to grow energy crops?/Jakie są największe zalety Państwa gospodarstwa uzasadniające podjęcie upraw energetycznych?

Please indicate **3** most important *STRENGTHS* of your farm in the order of priority:/ *Proszę o zaznaczenie trzech naszących się do Państwa gospodarstwa:*

(1 – *most important*; 2 – *second important*, and 3 – *third important*)/ (1 – *najważniejsze*; 2 – *mniej ważne*, oraz 3 – *najmniej ważne*)

- Suitable soil quality for energy crop growing/*Odporownia jakość gleby dla upraw energetycznych*
- Suitable farm size for energy crop growing/*Odporownia wielkość gospodarstwa dla upraw energetycznych*
- Extra income in the long term/*Dodatkowy przychód w perspektywie czasu*
- Diversification of activities – risk mitigation/*Dywersyfikacja upraw – rozproszenie ryzyka*
- Little input – easy to grow/*Niewielkie nakłady – łatwa uprawa*
- Good knowledge of energy crop growing/*Duża wiedza o uprawach energetycznych*
- Own necessary equipment for energy crop growing/*Posiadanie niezbędnego sprzętu do prowadzenia upraw energetycznych*
- Other, e.g./ *Inne np.*

What are the most important obstacles within your farm that would prevent you from growing energy crops?/Jakie są największe przeszkody w Państwa gospodarstwie uniemożliwiające podjęcie upraw energetycznych?

Please indicate **3** most important *WEAKNESSES* of your farm in the order of priority:/ *Proszę o zaznaczenie trzech najsłabszych stron Państwa gospodarstwa:*

(1 – *most important*; 2 – *second important*, and 3 – *third important*)/ (1 – *najważniejsze*; 2 – *mniej ważne*, oraz 3 – *najmniej ważne*)

- High establishment cost/*Wysokie koszty założenia plantacji*
- No income from the plantation before the first harvest/*Brak dochodu przed pierwszymi zbiorami*
- Lack of knowledge, information and experience with energy crops/*Brak wiedzy, informacji i doświadczenia w prowadzeniu plantacji energetycznych*
- Less efficient use of machinery and labour/*Mniej wydajne wykorzystanie maszyn rolniczych i pracy*
- Lack of necessary equipment/*Brak niezbędnego sprzętu*
- Unknown crop yields/*Nieznana wydajność upraw*
- No cooperation with other farmers/*Brak współpracy z innymi rolnikami*
- Weak negotiation position for the price/*Słaba pozycja do negocjacji cen*
- Other, e.g./ *Inne np.*

What are the most important external incentives that would motivate you to grow energy crops?/Jakie są dla Państwa najważniejsze czynniki zewnętrzne zachęcające do podjęcia upraw energetycznych?

Please indicate **3** most important *OPPORTUNITIES* for your farm in the order of priority:/Proszę o zaznaczenie trzech najważniejszych dla Państwa czynników według wagi:

(1 – most important; 2 – second important, and 3 – third important)/ (1 – najważniejsze; 2 – mniej ważne, oraz 3 – najmniej ważne)

- Competitive prices with food crops/*Konkurencyjne ceny w stosunku do upraw spożywczych*
- Export market for energy crops/*Rynek eksportu dla upraw energetycznych*
- National subsidies/*Subwencje państwowe*
- Favourable credits/*Korzystne kredyty*
- Demand for energy crops/*Zapotrzebowanie na uprawy energetyczne*
- Necessary infrastructure present/*Obecność niezbędnej infrastruktury*
- Long-term contracts/*Umowy długoterminowe*
- Support, advice, training available/*Dostępność wsparcia, szkoleń, doradztwa*
- Successful pilot projects/*Projekty pilotowe zakończone sukcesem*
- Other, e.g./*Inne np.*

What are the most important external risks that would prevent you from growing energy crops?/Jakie są dla Państwa najważniejsze czynniki zewnętrzne powstrzymujące przed prowadzeniem plantacji energetycznych?

Please indicate **3** most important *THREATS* for your farm in the order of priority:/Proszę o zaznaczenie trzech najważniejszych zagrożeń według wagi:

(1 – most important; 2 – second important, and 3 – third important)/ (1 – najważniejsze; 2 – mniej ważne, oraz 3 – najmniej ważne)

- Energy crop prices are not competitive with food crop prices/*Niekonkurencyjne ceny upraw energetycznych w stosunku do spożywczych*
- Energy crops subsidised only by the Polish government – no EU subsidies/*Dofinansowanie jedynie przez rząd polski – brak dopłat unijnych*
- No set-aside obligation/*Brak uregulowań prawnych*
- Changing policies, regulations, subsidy conditions/*Zmieniające się warunki prawne, dofinansowania*
- Unclear application process/*Niejasny proces aplikacji o subsydia*
- No stable market for energy crops/*Niestabilny rynek dla upraw energetycznych*
- Unsuccessful test plantations/*Uprawy próbne zakończone niepowodzeniem*
- Other, e.g./*Inne np.*

7. Farmer information/ Informacje O Rolniku

1. Date of Birth (Year)/ <i>Rok urodzenia</i>	
2. Current occupation/ <i>Obecny zawód</i>	
3. Previous occupation/ <i>Poprzedni zawód</i>	
4. Education/ <i>Wykształcenie</i>	<input type="checkbox"/> Obligatory school (Primary school, secondary school, etc) / <i>Podstawowe</i> <input type="checkbox"/> Vocational training/ <i>Zawodowe</i> <input type="checkbox"/> Technical college/ <i>Średnie</i> <input type="checkbox"/> University/ <i>Wyższe</i>

8. Contact details/ Dane kontaktowe

1. Telephone number/ <i>Numer telefonu</i>	
2. Postal address/ <i>Adres pocztowy</i>	
3. E-mail address/ <i>Adres e-mail</i>	

Are you satisfied with the interview?/ <i>Czy jest Pan/i zadowolony/a z przeprowadzonej ankiety?</i>	<input type="checkbox"/> Yes/ TAK <input type="checkbox"/> No/ NIE
Why not?/ <i>Dlaczego nie?</i>	
Additional comments/ <i>Dodatkový komentarz</i>	

Thank You!/ Dziękuję!

Appendix II

This table presents the most important strengths, weaknesses, opportunities and threats perceived by the key actors for farmers in terms of dedicated energy crop cultivation.

	The Manager of the Farmers' Cooperative	The Head of the Farmers' Union	The energy producer	The Head of the Municipality	The representative of the Agricultural Advisory Board
Strength	Extra income in the long term	Suitable soil quality for energy crop growing	Extra income in the long term	Diversification of activities – risk mitigation	Suitable soil quality for energy crop growing
Weakness	High establishment cost	High establishment cost	No income from the plantation before the first harvest	High establishment cost	High establishment cost
Opportunity	Long-term contracts	Export market for energy crops	Long-term contracts	Long-term contracts	Competitive prices with food crops
Threat	Energy crops subsidised only by the Polish government – no EU subsidies	Energy crops subsidised only by the Polish government – no EU subsidies	Energy crops subsidised only by the Polish government – no EU subsidies	Energy crop prices are not competitive with food crop prices	No stable market for energy crops