# Barriers to and Drivers of the Adoption of Energy Crops by Swedish Farmers: An Empirical Study

Anna C. Jonsson[1,*], Madelene Ostwald[1, 2], Therese Asplund[1], Victoria Wibeck[1]

[1] *Centre for Climate Science and Policy Research, Linköping University, Norrköping, Sweden*
[2] *Physical Resource Theory, Department of Energy and Environment, Chalmers University of Technology, Göteborg, Sweden*
** Corresponding author. Tel: +46 11 36 32 34, Fax: +46 1336 32 92, E-mail: anna.c.jonsson@liu.se*

**Abstract:** Since the Swedish government and the EU intend to encourage farmers to expand energy crop production, knowledge of the factors motivating adoption decisions is vital to policy success. Earlier studies have demonstrated that important barriers to farmer adoption of energy crops include converting from annual to perennial crops and from traditional crops or production systems to new ones. Economic motivations for changing production systems are strong, but factors such as values (e.g., aesthetics), knowledge (e.g., habits and knowledge of production methods), and legal conditions (e.g., cultivation licenses) are crucial for the change to energy crops. This paper helps fill gaps in the literature regarding why farmers decide to keep or change a production system. Based on a series of focus group interviews with Swedish farmers, the paper explores how farmers frame crop change decisions and what factors they consider most important. The main drivers of and barriers to growing energy crops, according to interviewees, are grouped and discussed in relation to four broad groups of motivational factors identified in the literature, i.e., values, legal conditions, knowledge, and economic factors. The paper ends by discussing whether some barriers could be overcome by policy changes at the national and European levels.

***Keywords:*** *Climate change, Energy crops, Farmers' incentives, Drivers, Barriers*

## 1. Introduction

The national goal of converting the Swedish energy supply from fossil fuel to renewable energy has been made more urgent by the climate change debate and a general emphasis on the sustainable development concept. As a member of the European Union (EU), since 2007 Sweden has been subject to an overall binding target of making its energy supply 20% renewable by 2020 [1]. Reducing total national emissions by producing more energy-related products or energy crops on traditionally agricultural land, i.e., "energy farming" [2], is one of the highlighted changes. At present, approximately 2% of Sweden's arable land is used for energy production [3]. Several studies indicate that energy crop production from the agricultural sector will play a more important role in the future [4,5]. The Swedish agricultural sector produced 1–1.5 terrawatt hours (TWh) of energy in 2006 [5, 6]. It has been calculated [7] that the agricultural sector could produce 15–30 TWh, depending on economic and political measures, and the Federation of Swedish Farmers (LRF) has committed to increasing energy production to at least 5 TWh in the near future [8]. A high potential for increased energy crop cultivation has also been identified at the European level [2,9]. At the same time, the problematique inherent in using limited land resources to produce renewable energy in a situation of high commodity prices and continuously growing world population should not be underestimated.

Currently, 13 energy crops are available to Swedish farmers [10], each with particular cultivation opportunities and restrictions and sets of drivers and barriers. The three most extensive energy crops currently produced in Sweden are straw (a by-product), oil crops, and wheat, each covering 15,000–25,000 ha [10]. Earlier studies of conditions for land use change at the Swedish and international levels have demonstrated the importance of economic incentives in encouraging individual actors to change production or land use [11,12]. In the Swedish case, economic evaluations of investment in energy crop production produce

contradictory results. Despite the potential profit, existing subsidies, and considerable farmer interest in energy crop cultivation [11], the extent of energy crop production in Swedish agriculture is limited [13,14]. Earlier studies have likely been too focused on purely economic incentives, which alone cannot explain farmer behaviour concerning the conversion to energy crop production. This leaves a knowledge gap regarding the involved social, cultural, institutional, and environmental issues, and how they are seen from the perspective of society and individual actors [9].

To address this knowledge gap, we had previously reviewed the scientific and gray literature dealing with *why* farmers decide to stay with or change a production system, and what motivational factors serve as drivers of or barriers to specific crops [10]. The review indicated that, although economic incentives to change the production system are strong, factors such as values (e.g., aesthetics), knowledge (e.g., habits and knowledge of production methods), and legal conditions (e.g., property rights and cultivation licensing) may also be crucial for production system change [10]. However, no empirical, explorative study of this matter has yet been carried out.

This paper builds on our earlier analysis of motivational factors as described in the literature, adding the findings of an empirical study of the conditions necessary for farmers to engage in energy crop production, which can serve both climate change mitigation and adaptation purposes. The specific research questions are: i) What drivers of and barriers to energy crop production, from the farmers' perspective, can be empirically identified? ii) How do these relate to the factors identified in the literature? The results will enhance our knowledge of *why* farmers choose to change their land use, including motivational factors. In terms of increasing energy crop production – a Swedish government goal – our analysis can provide a basis for policy decisions regarding enhancing drivers and removing barriers.

## 2. Motivational factors as drivers and barriers

Studies of the public understanding of environmental issues have identified a frequent gap between peoples' opinions and their actions – an "attitude–behaviour divide" (see, e.g., [15,16]). Even though actors may be knowledgeable regarding environmental issues, they may not always act in ways that contribute to environmental sustainability [17]. The reasons for this vary, but one possible explanation is that many environmental problems are characterized by complexity and uncertainty; they are often global in nature and their effects may be distant in time and space [16, 18].

Many studies focus on a single crop [19,20] or a particular aspect of energy farming [21]. Very few studies take a more integrated view of a wider range of crop alternatives and motivational factors relevant to the farmer considering energy farming. Rosenqvist et al. [19], for example, statistically analysed the characteristics of individual farmers who have adopted salix cultivation, and compared this group with a strategic sample of farmers who have not. The only more holistic study we found in the surveyed literature was that of Paulrud and Laitila [11], who use a methodologically strict and quantitative approach (i.e., a choice experiment) to investigate a limited number of motivational factors affecting a limited number of crops. Building a more comprehensive understanding of what affects farmers' adoption of energy crops calls for a more explorative and qualitative approach. Hence, it is important to contextualize attitudes, i.e., to analyze not only actors' stated opinions, but also the barriers preventing people from acting and the drivers encouraging them to do so [16,17].

To understand the contextual factors that restrain and enable farmers' actions, it might be useful to distinguish between *proximate causes* and *underlying driving forces* of individual land use change decisions [12,22]. Proximate causes are the motivational factors directly experienced by land users, such as an available market's increased demand for a product driving a change in land use or decreased dependence on subsistence farming due to off-farm income-generating activities. Underlying driving forces are indirect and more process oriented, such as climate change or expanding national/regional markets.

Our previous review of the literature dealing with the motivational factors guiding farmer decisions to engage in energy crop production identified four broad groups of motivations relating to values, legal conditions, knowledge, and economic factors [10]. Along with these, a variety of more specific factors was found that may serve as drivers of or barriers to individual farmers considering the adoption of certain energy crops. The analysis indicated that, although several studies have been undertaken, we still lack knowledge of the various groups of motivational factors and how they are assessed by individual farmers. More specifically, we lack knowledge of the direction of the motivational factors associated with various crops, the relative strengths of these factors, whether different strata of farmers assess motivational factors differently, and the precise identity of the proximate causes and underlying forces.

This paper represents a preliminary attempt to fill this knowledge gap. We aim to identify a wide variety of barriers and drivers discussed by Swedish farmers during four focus group interviews, dealing not with the adoption of specific crops, but with the motivational factors affecting whether or not one engages in "energy farming". These barriers and drivers will be discussed in relation to the four broad groups of motivational factors mentioned above, i.e., values, legal conditions, knowledge, and economic factors [10].

## 3. Methodology

This study builds on four focus group interviews involving 21 Swedish farmers, 20–70 years old, in 2010. A focus group is a group interview in which a small number of participants is brought together to discuss a specified issue under the guidance of a moderator who preferably assumes a low-key position [23]. The comparatively free form of discussion occurring in focus groups enables the researcher to uncover aspects of the chosen topic that were not anticipated but were spontaneously raised in the discussions and thereby proven to be important to the participants. Focus groups were chosen for this study since they offer a research method well suited to generating a rich understanding of participants' beliefs and experiences [24]. Moreover, focus group methodology enables analyses of what participants bring to the group; focus groups constitute "thinking societies in miniature" [25], in which the process of joint meaning-making may be studied in action [26]. Focus group methodology is well suited to studying socially shared knowledge as it is constructed, expressed, and negotiated in a group [27]. Nevertheless, like all research methods, focus groups have their limitations. Their purpose is not to draw statistical conclusions that are generalizable to a general population [28]. Instead, focus groups provide in-depth insight into particular topics, insight that can productively be combined, for example, with survey research.

Each interview started with a discussion of climate change and of the information sources used by the participating farmers to learn about this issue. This part of the interview is not analyzed here, but will be used for other purposes in the K3 project. The last 30–45 minutes of the focus group interview were designed as a participatory exercise in which farmers were asked to mention factors that they saw as facilitating or impeding their adoption of a certain

energy crop (one annual and one perennial). The factors were written down on cards, and participants were then asked to rank them in order of importance [29]. In the discussions, we used four example crops: wheat for energy production, hemp, salix, and hybrid aspen, of which two are annual (wheat and hemp) and two have a turnover time of more than 20 years (salix and hybrid aspen). Despite the use of specific example crops, the discussions were framed in general terms as dealing with the drivers of and barriers to energy farming.

## 4. Results

As shown in Table 3, the four groups of motivational factors mentioned by farmers during the focus group discussions include numerous aspects and conditions affecting decisions to begin growing energy crops. In Table 3, these are grouped into the four categories of motivational factors identified by Ostwald et al. [10]. In several cases, the same factor may serve as a driver of adopting an annual crop and a barrier to adopting a perennial crop, or vice versa.

## 5. Discussion, conclusions, and ideas for further research

Table 3 indicates that many of the factors identified in the literature review were mentioned in the focus groups. Legal factors, however, were not mentioned by the participating farmers as having any motivational impact. Knowledge factors, which were not mentioned that often, served mainly as barriers.

Value-driven motivational factors include environmental concerns, which seem to serve mostly as drivers of the adoption of both annual and perennial energy crops. The food versus energy antithesis and the heritage aspect served as very strong barriers to adopting perennial energy crops. This was particularly so in Group 1, comprising farmers in a forest area, who described adopting such crops as a “crossroads” choice that would undo the work of generations of ancestors who have striven to keep the fields clear to enable food production. To some extent, the food versus energy antithesis also served as a barrier to annual crop adoption, as it was seen as unethical to “burn food”. From this perspective, annual energy crops were slightly less bad than perennial crops, as they at least kept open the option of growing food crops in the near future. Moreover, lifestyle issues such as workload and curiosity served as drivers of the adoption of perennial energy crops.

Economic factors were, together with the value-related factors, those most often mentioned in the groups. In particular, the issue of flexibility was discussed thoroughly by all groups, mostly as a barrier to the adoption of perennial energy crops and a driver of annual crops. The inflexibility of the “crossroads” choice of perennial crops focused on the long turnover time of these crops as well as the difficulty of reconverting to annual crops after harvesting the perennial crop. The potential for better risk management by applying a portfolio perspective to the farm’s “crop basket” (identified by Berg et al. [4]) was also mentioned. Moreover, issues of profitability, subsidies, output value in relation to input costs, and other more straightforward economic aspects were also mentioned, particularly by Group 4, which consisted of relatively young farmers in an intensive farming area.

*Table 3. Empirically identified barriers, B, and drivers, D, for farmers adopting energy crop production. Each B or D indicates that a factor was mentioned at least once in each focus group.*

| Identified factors | <1 year turnover | >20 years turnover | Typology of factors |
|---|---|---|---|
| **VALUES** | | | |
| responsibility for nearby environment | D | B | environmental concerns |
| destroying nice views | D | B | |
| wildlife refuge (in open landscapes) | | D | |
| preserve cultural landscape | D | B[2] | |
| environmentally friendly | | D | |
| low negative environmental impact | | D | |
| grow food for the world | BB | B[2] | food vs. energy |
| potential food becomes energy | B | | |
| producing either food or energy | D | | |
| not usable for other purposes (food) | B | | |
| honour/dishonour ancestors | D | B | tradition/ heritage |
| "culture" = cultivation | D | B | |
| fun to try something new | | D | fun, curiosity |
| curiosity | | D[2] | |
| less work, more leisure time | | DDD[2] | work load |
| good timing with other crops | | D | |
| **KNOWLEDGE** | | | |
| too little knowledge | | BB | knowledge |
| well-known crop | D | | |
| not the optimal energy crop (input/input ratio) | B | | |
| **ECONOMY** | | | |
| flexibility | D | BBB | flexibility |
| destroys field drainage, etc. | DD | BBB[2] | |
| "crossroads" choice | D | B | |
| market flexibility (many buyers) | D | BD | |
| contract (if food wheat price goes up, you lose) | B | D | |
| unclear political ambitions + long-term perspective | D | B[2] | |
| lack of flexibility + too little knowledge | D | B | |
| not such a long turnover time | | D | |
| global wheat trade reduces the risk of unexplainable price price fluctuations | D | | |
| short term – easier to plan | D | | |
| if land is available/marginal land | B[1]D | DD | available land |
| no available land | BB[1] | B[2] | |
| unsuitable for soil type/intensive farming region | | B | |
| profitability | BB[1]DD | DD[2] | other factors |
| subsidies | D | D | |
| soil degradation | B | B[2] | |
| (no) need for special equipment | D | B | |
| rational production | | D | |
| low inputs (labour and agrochemicals) | B | D | |
| lower quality specifications compared with those of food wheat | D | | |

[1] Hemp
[2] Hybrid aspen

Moreover, our results have implications for policy formulation in general and for climate change communication and extension service to farmers in particular. In terms of the time and energy spent discussing the different types of motivational factors, value and economic factors were clearly regarded as the most important by participating farmers. In fact, value-related issues seemed to constitute the basis of individual identity – "what it is to be a farmer" – functioning as a filter or background for other factors, including economic ones, which were always assessed in relation to this identity. Hence, in discussing the potential for energy crop production, advisors and authorities must understand farmers' interpretative frames, i.e., what determines how they interpret and understand such messages, and in which agricultural setting they conduct there trade. There is also a clear divide between how various motivational factors serve as either drivers or barriers when annual or perennial energy crops are discussed. New policies to promote energy farming must take this into account, and design specific policy components for specific types of crop so that the overall policy package is coherent in terms of its motivational effects on farmers' decisions.

This paper has presented the results of a preliminary analysis of four focus group interviews of a planned sequence of eight. The following issues will be explored in an upcoming analysis of the present material, complemented by four additional focus groups to be held in 2011:

Firstly, the motivational factors identified here are mainly analyzed with regard to their direction, i.e., whether they serve as drivers of or barriers to the adoption of annual and perennial energy crops. Analyzing the ranking of the identified factors and any correlations between them to establish a hierarchy of importance would improve our qualitative understanding of what affects farmers' adoption of energy crops. Preliminary results indicate that value-related factors are at least as important as economic factors.

Secondly, the motivational factors discussed here were identified from the perspective of individual farmers and the decision contexts that face them when considering converting to energy crop cultivation. The factors all directly influence the outcome, but often they stem from trends and developments on a national or even global scale. The distinction between proximate and underlying forces [12] may sharpen the analysis considerably.

Finally, the increased cultivation of energy crops can be seen as a way society can adapt to climate change by reducing greenhouse gas emissions. Clearly, the opportunities created by increased national and global demand for energy crops enhance risk management and portfolio thinking for farmers, who can benefit from a wider choice of crops when deciding whether to stay in traditional food production or convert to energy crops. These and other adaptation possibilities for individual farmers also merit investigation.

Future quantitative studies, i.e. surveys, could productively explore the relative and absolute importance of various motivational factors to different strata of farmers (e.g., depending on age, type of land tenure, and location).

## Acknowledgements

The paper is part of the research project K3Jordbruk (www.cspr.se) funded by the Swedish Farmers' Foundation for Agricultural Research. The authors would like to thank the participants of the focus groups for their generosity, time, and willing participation. We are also grateful for the comments from two anonymous reviewers.

**References**

[1] European Commission. Renewable Energy Road Map Renewable energies in the 21st century: Building a more sustainable future. Communication from the Commission to the Council and the European Parliament. 2007;10.1.2007. COM(2006) 848 final.

[2] Faaij APC. Bio-energy in Europe: changing technology choices. Energy Policy 2006;34(3):322–342.

[3] Government of Sweden. Bioenergy from agriculture and forestry. 2008:Fact Sheet Ministry of Agriculture.

[4] Berg M, Bubholz M, Forsberg M, Myringer Å, Palm O, Rönnbäck M, et al. Förstudie-sammanställning och syntes av kunskap och erfarenheter om grödor från åker till energiproduktion. Värmeforsk, rapport 2007;1009.

[5] Swedish Government Official Reports. Bioenergi från jordbruket – en växande resurs. 2007;SOU 2007:36.

[6] Berndes G, Magnusson L. The future of bioenergy in Sweden. Background and summary of outstanding issues. 2006;2006:30.

[7] Swedish Government Official Reports. Sverige inför klimatförändringarna – hot och möjligheter. 2007;SOU 2007:60.

[8] The Federation of Swedish Farmers (LRF). De gröna näringarnas klimatlöfte. Available at: http://www.lrf.se/Miljo/Klimat/LRFs-klimatlofte/. Accessed 01/12, 2011.

[9] Domac J, Richards K, Risovic S. Socio–economic drivers in implementing bioenergy projects. Biomass Bioenergy 2005;28(2):97–106.

[10] Ostwald M, Jonsson A, Wibeck V, Asplund T. *Mapping energy crop cultivation and identifying motivational factors among Swedish farmers.*. Conditionally accepted in Biomass and Bioenergy .

[11] Paulrud S, Laitila T. Lantbrukarnas attityder till odling av energigrödor. Värderingsstudie med choice experiment. 2007;Miljöinstitutet, I.V.L.

[12] Ostwald M, Wibeck V, Stridbeck P. Proximate causes and underlying driving forces of land-use change among small-scale farmers–illustrations from the Loess Plateau, China. Journal of Land Use Science 2009;4(3):157–171.

[13] Swedish Board of Agriculture. Bioenergi- ny energi för jordbruket. 2006;2006:1.

[14] Lantz M, Svensson M, Björnsson L, Börjesson P. The prospects for an expansion of biogas systems in Sweden--Incentives, barriers and potentials. Energy Policy 2007;35(3):1830–1843.

[15] Grob A. A structural model of environmental attitudes and behaviour. J Environ Psychol 1995;15(3):209–220.

[16] Nicholson-Cole SA. Representing climate change futures: a critique on the use of images for visual communication. Comput , Environ Urban Syst 2005;29(3):255–273.

[17] Kollmuss A, Agyeman J. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environmental Education Research 2002;8(3):239–260.

[18] Moser SC, Dilling L. Making climate hot. Environment: Science and Policy for Sustainable Development 2004;46(10):32–46.

[19] Rosenqvist H, Roos A, Ling E, Hektor B. Willow growers in Sweden. Biomass Bioenergy 2000;18(2):137–145.

[20] Hillring B. Rural development and bioenergy--experiences from 20 years of development in Sweden. Biomass Bioenergy 2002;23(6):443–451.

[21] Skärbäck E, Becht P. Landscape perspective on energy forests. Biomass Bioenergy 2005;28(2):151–159.

[22] Geist HJ, Lambin EF. Proximate causes and underlying driving forces of tropical deforestation. Bioscience 2002;52(2):143–150.

[23] Litosseliti L. Using focus groups in research. London: Continuum Intl Pub Group; 2003.

[24] Morgan DL. The focus group guidebook. Thousand Oaks, Calif.; London: SAGE; 1998.

[25] Jovchelovitch S. *Contextualising focus groups: understanding groups and cultures*. 2001;Paper prepared for the V Meeting of the Group 'Conversation et language', Laboratoire Européen de Psychologie Social, Paris.

[26] Wibeck V, Dahlgren MA, Öberg G. Learning in focus groups. Qualitative Research 2007;7(2):249.

[27] Marková I, Linell P, Grossen M, Salazar Orvig A. Dialogue in focus groups : exploring socially shared knowledge. London: Equinox; 2007.

[28] Bauer MW, Gaskell G. Towards a paradigm for research on social representations. Journal for the Theory of Social Behaviour 1999 JUN;29(2):163.

[29] Jonsson A, Andersson L, Alkan-Olsson J, Johansson M. (accepted). Defining goals in participatory water management: merging local visions and expert judgements. Journal of Environmental Planning and Management 2011;September 54((6)):xx--yy.