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Research paper

It's not right, but we do it. Exploring why and how Czech farmers become renewable energy producers

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ABSTRACT

The paper provides empirical evidence on emerging on-farm renewable energy enterprises in a post-communist space, namely in the Czech Republic. In addition to exploring farmers' individual motivations to adopt activities related to renewable energy production (biofuel crops growing, biomass production, operation of anaerobic digestion (AD) plants, and implementation of solar and wind energy projects), the study focuses on analysing regional and inter-firm variances in the level and types of adopted activities. A considerable discrepancy between stated personal attitudes of farmers (supporting the traditional view that farmers should only produce food) and actual practice of farms (dealing with renewable energy production for economic reasons) was detected. The extent and types of energy activities proved to be influenced both by geographical conditions and types of farm. While there are significant differences between the studied districts with different climatic and geographic conditions in the type and extent of energy crops and biomass cultivation, the expansion of AD plants and solar power systems was observed the same in both areas. The adoption of energy activities is positively correlated with company size and area of cultivated land, and negatively correlated with the degree of focus on livestock production. While growing biofuel crops is typical for large and medium-sized enterprises, individual farmers and small enterprises with less land area are more likely to produce biomass for combustion and use own grounds and roofs for implementing solar systems. Finally, the most common four types of currently adopted multipath renewable energy enterprises were identified.

1. Introduction

> "If subsidies for biogas energy were abolished, I would kill pigs and stop doing this business"
>
> (Manager of agricultural AD plant)

Agriculture has a dual role as an energy user and as an energy supplier, notably by producing biomass and bioenergy. This energy productive function has been recently highlighted and promoted – particularly within the European Union (EU) countries – as an opportunity for economic diversification and development of rural areas as well as for enhancing energy sustainability, energy security, and mitigating global climate changes [1,2].

As a result of regulations, production quotas and subsidies promoted under the EU's Common Agricultural Policy (CAP) and Energy Policy, many farmers have adopted new business models to diversify and stabilize their businesses, including organic farming, direct marketing, agro-tourism and renewable energy (RE) production activities [3]. Various crops are preferably cultivated to generate electricity and fuel cars, the energy from biogas produced in agricultural anaerobic digestion plants (hereinafter AD plants) became for many companies an essential additional source of income to keep the farming business going [4,5]. Thousands of hectares of quality farmland have been covered by solar panels, and farmers became owners of significant share of wind energy projects in some regions [6,7].

The policy support and development of agro-energy business has altered the land use dynamics, brought about new land use conflicts [8] and disconnections between policy makers and stakeholders [9,10]. Other unintended environmental and societal consequences include changes of landscape (e.g., visual intrusion by wind turbines and solar panels, landscape yellowfication due to the wide-spreading cultivation of oil seed rape), soil-erosion and deforestation [11], and concerns about food price increase and food insecurity [12].

While the literature is quite vast as concerns farmers' attitudes towards agricultural restructuring and diversification trends in general [13–17] or particularly as far as their willingness to grow

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energy crops and biomass [18–22] it seems to be much more limited as concerns other emerging RE enterprises. Only in recent years the first few studies investigated the scale of adoption of AD plants, solar and wind power technologies by farmers [23–25]. Majority of these studies (actually almost all come from the UK or the US) focused in particular on behavioural and cognitive factors, which affect the adoption (or potential adoption) of RE activities by farmers, their stated motivation factors and perceived barriers.

The contribution of this paper to the current knowledge about the diffusion and adoption of on-farm RE enterprises is represented by three aspects: (i) it is the first empirical evidence on the issue from the post-communist space, which is characterized by some specifics compared to the rest of Europe; (ii) it covers all forms of RE related activities run by farmers, including biofuel crops growing, biomass and biogas production, and solar and wind power plants; (iii) in addition to exploring farmers' individual attitudes to the transformation of agriculture and their motivation factors to adopt new technologies, we focus on analysing the regional and inter-firm variance in the extent and types of RE enterprises currently carried out by Czech farmers.

The research questions that drive the study were defined as follows:

- What are the attitudes of Czech farmers to the traditional productive role of agriculture and the development of on-farm RE enterprises?
- What is the current real rate of adoption and most common types of RE enterprises adopted by Czech farmers?
- Are the rate and forms of involvement in RE enterprises differentiated with respect to climatic and geographic conditions, and the type, size, and production focus of farms?
- What are main motivation factors and barriers affecting the adoption of RE enterprises as perceived by farmers?

Our study was not, however, aimed primarily at absolute numbers concerning the overall level of adoption of energy producing activities but rather at exploring specific relative indicators and relationships between factors.

2. Development of on-farm renewable energy enterprises: literature overview

In 1981, a new *Energy in Agriculture* journal was launched reflecting on new challenges in the context of ongoing technological and energy transitions [26]. Although the journal's primary focus has been on the effective use of energy IN agricultural production, the potential of agricultural sector FOR energy generation has been emphasized from the first issue. More than thirty years later, the agro-energy business developed into so many shapes and scales that then authors could hardly have imagined.

At the beginning of a new millennium, most papers [15,27–29] on farmers' willingness to diversify their activities in the context of CAP reforms have reported about prevailing conservative attitude, which claimed that farmers should only produce food and fibres. However, the more recent studies [23,24,30] detected a significant increase in the production of biomass and biofuel crops and in the adoption of other RE enterprises by farmers. This could have been caused by both the liberalization of farmers' opinions, intensifying competition in the market, and/or robust economic incentives to boost RE development.

According to a classical definition by Rogers [31] the innovation diffusion is a process by which an innovation is communicated through certain channels over time among the members of a social system. While the diffusion process takes place at the level of the social system, the innovation-adoption process takes place at the level of individuals or groups, and is linked with the decision-making process. The spatial diffusion of on-farm renewable energy innovations is not determined just by the optional or collective decisions by farmers; it has specific features and objective (geographical, technical or legislative) limits. A significant factor for on-farm RE development is also social acceptance of projects (particularly those with distinct impact on local landscape and life quality, such as wind turbines or biogas plants) by local communities [32,33].

Nevertheless, sometimes institutional interventions (directives, subsidies) and the human factor (individual motivation) may put over these limits. Recent studies on the 'solar business boom' in East-Central Europe [34–36] have detected that the spatial pattern of implementation of large photovoltaic plants in many countries does not correlate with the spatial distribution of solar resource potential. The result is that more PVs were constructed in regions with insufficient solar potential but with cheap land. This demonstrates that the energy policy and equal subsidies may be inefficient and that their design open the door to many individual investment decisions that are not necessarily in the best public or landscape interest. Similarly, the opponents of agro-energy development have stressed it is just a contrived, subsidy-driven business whose forms (e.g., the type and extent of cultivated crops) do not adequately respect geographic prerequisites and the need of sustainable soil cultivation and landscape stewardship.

A key influence of economic drivers was reflected in most studies on the potential for adoption of RE enterprises. Surveys on the adoption of solar, wind and AD plants in the UK [25,30], short-rotation coppice in Sweden [37] or biomass production in Greece [38] have come to similar results concerning the predisposition of farmers to run new enterprises. Potential adopters are more likely to have larger farm businesses, be owner occupiers, younger and better educated than non-adopters. Study on the potential of switchgrass production among Tennessee farmers [19] revealed that farmers with above average on-farm incomes were less enthusiastic to switchgrass production, while those with above average off-farm incomes were more ready to adopt the new crop.

A detailed analysis of the adoption of wind and solar energy technologies by Californian farmers [23] reported about significant differences in the types of farms adopting an off grid, small residential, small commercial or large commercial systems. A very distinct divide was found particularly between the adopters of commercial and non-commercial installations. They also underline the importance of evaluating the choice of the size (capacity) adopted in addition to the technology adoption choice. One study from the UK [30] analysed the diffusion of different RE enterprises in time. However, so far no study (if authors know) has analysed the influence of geographical factors on the extent and types of energy related activities run by farmers.

3. Geographical context of the study

Farming in the Czech Republic – as an example of post-communist countries - has experienced significant structural changes since the socio–political transition after the break of socialism in 1989 [39]. A centrally planned economy has changed to market economy with large consequences for agricultural sector, which had previously been one of the most supported branches of communist era, and during last two decades it has been facing a dynamic decline of its productionist focus [40]. Selected indicators of the agricultural transformation and expansion of technical crops and technologies used for renewable energy production are presented in Table 1.

As a result of historical development (the processes of expropriation of land and collectivization of farms during the communist era), the Czech agricultural sector is still characterized by specifics regarding the size structure of farms and the proportion of owned and leased land. While the average area of utilized land per holding