Journal of Rural Studies 51 (2017) 28–36

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

Climate change transformations in Nordic agriculture?

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ARTICLE INFO

Article history:
Received 4 May 2016
Received in revised form
21 December 2016
Accepted 22 January 2017
Available online 3 February 2017

Keywords:
Agriculture
Vulnerability assessment
Adaptation
Climate change
Nordic

ABSTRACT

Climate change is expected to have negative impacts but also to bring potential opportunities for agriculture and crop productivity in the Nordic countries. Little research has been conducted at the farmer level to identify what adaptation measures are being considered or already taken and transformative these are. Based on semi-structured interviews with farmers and extension officers from two of the most fertile agricultural areas of Finland and Sweden, this study examines to what extent Nordic farmers are engaged in transforming their farming systems. The results show that some transformational changes are taking place already but most changes are incremental. Currently, agricultural policies and regulations are perceived as a greater adaptation challenge than climate change.

1. Introduction

Adaptation in various societal sectors to the impacts of climate change is now considered inevitable (IPCC, 2014; Pielke et al., 2007), and this also includes agriculture (Tripathi et al., 2016). The most recent assessment of the Intergovernmental Panel on Climate Change (IPCC) states that climate change will have considerable impacts on agricultural production (IPCC, 2014; Aaheim et al., 2012). Transformations in agriculture are considered crucial, if food production is to increase in terms of quantity, as well as stability (Rippke et al., 2016). More profound transformations are likely to be necessary in areas, where warming is higher (Challinor et al., 2014) but changes in farming practices are likely to be required everywhere.

Nordic agricultural production might gain in importance globally in the future, as predictions reveal more positive effects than elsewhere in the world (Olesen et al., 2011; Rötter et al., 2012). The changing climate and weather variability are expected to contribute to a longer growing season, providing an opportunity for Nordic agriculture to increase crop yield and production (Bindi and Olesen, 2011; Uleberg et al., 2014).

Agriculture as a sector is directly exposed to climate and weather changes, as well as indirectly through the global nature of agricultural markets, as climate impacts in one place affect market prices globally. Research so far has shown that non-climatic stimuli are important for famer decision-making (Uleberg et al., 2014) and that there is a myriad of reasons behind decisions, including attitudes, agricultural policy and market prices (Battershill and Gilg, 1997; Bergevoet et al., 2004). Overall, the study of vulnerability and adaptation of agricultural systems is highly context and place-specific, and as a system would be vulnerable to specific climatic and non-climatic stimuli and thus would adapt differently over time depending on its inherent characteristics and risks (Smit and Wandel, 2006).

At the moment, there is little empirical research on how farmers in the Nordic countries consider their vulnerability to climate change, whilst research on other drivers exists (Prestvik et al., 2013). Farmers' perceptions of climate change have been identified as an important factor for adaptation to take place (Abid et al., 2016; Feola et al., 2015; Marshall et al., 2013; Wheeler et al., 2013), as it triggers the necessary changes that are needed for action, in addition to other factors (Mugi-Ngenga et al., 2016). Adaptation in agricultural systems has so far been slow (Lyle, 2015). Thus, learning how farmers perceive themselves to be impacted by climate and other change factors, and understanding under which circumstances farmers are able to transform their farming systems is crucial for both agricultural and climate change policy.

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http://dx.doi.org/10.1016/j.jrurstud.2017.01.013
0743-0167/

In addition, there is little empirical examination of adaptation measures that Nordic farmers are considering or have already implemented, nor how they themselves perceive their vulnerability and the need to transform their farming systems. Elsewhere, studies on farmer adaptation have focused on modelling approaches (Rodriguez et al., 2014; Leclère et al., 2013; Lehmann et al., 2013) with little empirical research on the ground. Research has also been carried out through large-scale surveys (Antón et al., 2013; Below et al., 2012), through policy documents and expert surveys (Bizikova et al., 2014), or with a combination of the above (Claessens et al., 2012; Schaap et al., 2013).

Farmers' perceptions of vulnerability are a crucial driver for farm level adaptation to take place and this adaptation leads to different degrees of change in the farming system. An examination of this allows one to see to what extent the sector is adapting to climate change. This qualitative empirical study focuses on Nordic agriculture in the counties of Östergötland in Sweden and Uusimaa in Finland, with both regions possessing a significant agricultural tradition and one of the most fertile agricultural areas in their respective countries. The study addresses the following research question: Are Nordic farmers taking transformative adaptation measures? We answer this question by examining the perceptions of vulnerability and the actions Nordic farmers are taking through a qualitative case study of crop farmers.

2. Climate change and transformations in Nordic agriculture

When examining the role of climate change in Nordic agriculture, it is important to understand both the different dimensions of vulnerability, as well as any transformations that are taking place. In the following two sections, we present the theoretical underpinnings that guide our analysis in the results section.

2.1. Vulnerability of Nordic agriculture

Much of the impact of climate change on agricultural systems depends on complex interactions between physical factors, such as climate variability and climate change in ecosystems on the one hand and on socio-economic and cultural factors on the other (IPCC, 2014). Vulnerability[1] research encompasses a large array of studies from different disciplines and scientific communities and, more recently, vulnerability assessments have become more policy-driven, integrating more factors in the equation in order to inform and advise about feasible adaptation measures.

In this light, Smit and Wandel (2006) propose a stakeholder-focused vulnerability assessment that contributes to the understanding of the decision-making process in the context of practical adaptation to climate change and variability. The authors state that one characteristic of such an approach "is that the researcher does not presume to know the exposure and sensitivities that are pertinent to the community, nor does the research specify a priori determinants of adaptive capacity in the community. Rather, in this approach these are identified from the community itself" (Smit and Wandel, 2006, p. 288). This is in contrast to literature that focuses on systemic and often quantitative analyses of vulnerability of crops or the farming systems themselves (Eza et al., 2015; Bär et al., 2015).

Previous studies suggest that Nordic agricultural systems are predicted to be further exposed to increased temperature, especially during winter and to increased precipitation levels, as well as to an increase in temperature and precipitation variability and more frequent occurrence of extreme weather events, such as heat waves and heavy rainfalls (Bindi and Olesen, 2011; Olesen et al., 2011; Himanen et al., 2013; Uleberg et al., 2014). These changes are expected to have positive effects in terms of increased yield potential, introduction of new crops but also negative effects on Nordic agriculture (Bindi and Olesen, 2011; Olesen et al., 2011; Rötter et al., 2012; Uleberg et al., 2014).

With an increase in temperature, especially in the winter, and increased precipitation in the spring and summer, it is likely that the growing season enables more harvests and thus increasing the yield productivity (Fogelfors et al., 2009; Uleberg et al., 2014). However, these climatic changes can also bring an increase in pest attacks and diseases, difficult overwintering conditions and flooding, causing for instance difficult harvest conditions in autumn (Fogelfors et al., 2009; Uleberg et al., 2014).

In terms of sensitivity of Nordic agriculture, previous research has focused on crop yields and production levels in physical impact assessments (local or regional) farm/management/practical level, and (national or international) policy or sectorial level (Smit et al., 1996; Howden et al., 2007; Reidsma et al., 2010). The results have shown that there are sensitivities in terms of growing conditions for particular crops. Also, Iglesias et al. (2012, p. 165) state that "farming involves not only the production of crops and livestock, but also the management of people, supply chains, markets, building and transport infrastructure, and insurance. These indirect impacts of climate change in connected areas can have cumulative effects alongside the changes in crop productivity at farm level". Here, the role that global markets play in agriculture should not be ignored as significant driver of farmer decision-making. Impacts of climate change elsewhere can affect the markets and influence the decisions farmers make in other countries. In other words, farming should not be reduced to its crop and livestock productivity but it involves the subtle management of different farm factors and operations that are also sensitive to climate or weather changes and to non-climatic factors (Smit et al., 1996).

In addition to climatic factors, the agricultural sector is exposed to non-climate related factors, which can be significant (Smit et al., 1996, 2000; Smit and Skinner, 2002; Fogelfors et al., 2009; Rehman et al., 2014; Uleberg et al., 2014). As Rehman et al. state, agriculture "is influenced by market fluctuations, national and international policies, practices in management, trading terms, technology availability, biophysical factors, etc." (Rehman et al., 2014, p. 242). In the European context and relevant to this case study, the European Union (EU) Common Agricultural Policy (CAP) is one of the major policy instruments that influences agricultural trends with subsidies, financial support and rural development programs to drive for instance agriculture towards more organic practices (Bindi and Olesen, 2011). These non-climatic factors, socio-economic and institutional circumstances are constantly changing and the agricultural sector needs to adapt to these external systems, too (Smit and Skinner, 2002; Adger et al., 2005; Kvalvik et al., 2011; Himanen et al., 2013).

2.2. Adaptation and transformations in Nordic agriculture

Several adaptation practices have been identified that have the potential to reduce the vulnerability and enhance the adaptive capacity of the agricultural and farm systems in the context of Sweden and Finland (Fogelfors et al., 2009; Bindi and Olesen, 2011; Olesen et al., 2011; Himanen et al., 2013; Uleberg et al., 2014). Adaptation options, such as the introduction of new crop species

[1] Vulnerability is defined as a function of a system's exposure, sensitivity and adaptive capacity (Brooks, 2003; Füssel and Klein, 2006; Smit and Wandel, 2006), and can be understood as 'the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes' (IPCC, 2007, p. 883).

[2] Both regions have extensive coastline that also affects the agricultural activities in the region.