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Let the cows graze: An empirical investigation on the trade-off between efficiency and farm animal welfare in milk production

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ABSTRACT

To investigate whether farm animal welfare comes at the cost of dairy farm performance, and the role that pasture-access thereby plays, we analyse a rich sample of 45 dairy farms in Germany with a scientific measure of farm animal welfare. Based on directional efficiency measure that acknowledges sequential preferences such that farm animal welfare becomes relevant after technical efficiency, we cannot find a trade-off between farm animal welfare and technical milk efficiency. Pasture-based production systems can be at least as efficient or even more efficient compared to confinement systems, despite lower milk yields. Neglecting sequential preferences would bias efficiency in provision of farm animal welfare by pasture-systems. Farms from all types of dairy systems determine the efficient frontier, where efficiency increases with herd size, and is linked with higher profits. We conclude that pasture-access may help but does not guarantee higher levels of animal welfare. These results question governmental support for pasture access regarding the provision of farm animal welfare.

1. Introduction

Farm animal welfare (FAW) has gained considerable attention in recent decades, with a notable influence on consumers' food choices (Lagerkvist and Hess, 2011). The majority of studies reveal that consumers' willingness to pay (WTP) increases with higher standards of farm animal welfare (e.g., Kehlbacher et al., 2012; Napolitano et al., 2008). Interestingly, this also holds true for dairy products produced in pasture-based systems. Consumers perceive pasture access as a positive contributor to welfare (Cardoso et al., 2016; Ellis et al., 2009) and even use it as a criterion to assess the level of FAW of the production system (Schuppli et al., 2014). Access to pasture is in fact used as an important sales argument (Weinrich et al., 2014), although the specific role of pasture access on dairy cow welfare is not that straightforward (Arnott et al., 2017). Contrarily, Lusk and Norwood (2011) argue that FAW directly relates to the husbandry system. Based upon their argumentation, in complex production systems such as dairy, the most profitable milk yield, as a measure of productivity, does not accompany optimal levels of FAW. Against the backdrop that many consumers find existing husbandry practices inacceptable (Roosen et al., 2016), several policy measures to incentivise production at higher levels of FAW, including pasture access for cows, have emerged (Ingenbleek et al., 2012; Veissier et al., 2008). The idea is that farms receive compensation since pasture access requires sacrificing (milk) productivity and thus profitability to provide higher levels of FAW. The question whether simply providing pasture-access warrant payments because farms have to sacrifice milk yield and profitability to increase dairy cows' welfare, however, remains open.

From animal science perspective, most animals prefer to stay on pasture, if cows are given the choice between pasture or confinement in an experimental setting (Charlton et al., 2011; Legrand et al., 2009; Motupalli et al., 2014). Studies in the field of animal science, however,

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report mixed findings concerning specific health and welfare effects of pasture access. Benefits result from more space, and easily accessible lying opportunities, which increases the lying times of cows, leading to lower levels of aggression (e.g., Burow et al., 2011). Furthermore, reduced integument alterations, hair loss, lesions and swellings have been reported for cows with pasture access (Burow et al., 2013). While some authors report positive health effects related to reduced lameness (Barker et al., 2010; Chapinal et al., 2013; de Vries et al., 2015), others could not determine any effects on claw health (Baird et al., 2009; Chapinal et al., 2010). Moreover, high-yielding cows might suffer from insufficient energy intake with pasture feeding, which in turn leads to nutritional and metabolic stress, with a negative impact on welfare (Vance et al., 2012). Beyond this, parasites that accompany grazing might also reduce positive impacts on FAW (Bennema et al., 2011; Vanderstichel et al., 2012).

From production economics perspective, dairy farm performance has often been examined using technical, economic and environmental efficiency (cf. among others Breustedt et al., 2011; Wettemann and Latacz-Lohmann, 2017). Only few studies directly relate farm (technical) efficiency to cow health status, as one aspect of welfare, and report a positive relationship (e.g., Barnes et al., 2011; Lawson et al., 2004a). The specific role of pasture access in this regard has thus far received only little attention. The study of Allendorf and Wettemann (2015) forms one exception and does not support any relationship between dairy cow welfare, pasture access and performance. These studies, however, rely on lameness or somatic cell counts as simplistic proxies for dairy cows' welfare and thus neglect the high complexity and multi-dimensionality of animal welfare. Furthermore, these studies do not consider FAW as a central part of the production process, as is argued by McInerney (2004), and simply relate efficiency scores to health status or pasture access indicators. In a recent study Henningsen et al. (2018) acknowledge that animal welfare can in fact positively impact the production process and its performance, though their empirical analysis reveals only a weak relationship between welfare and performance for Danish pig farmers. Evidence for the dairy sector that acknowledges the complexity of farm animal welfare and peculiarities under pasture-access is thus far not available.

Our study aims to close this gap by empirically investigating the relationship between dairy farm performance, pasture access of dairy cows and their welfare status. The objectives are twofold. Firstly, we empirically investigate the potential trade-off between dairy farm performance and FAW. Secondly, we analyse whether this potential trade-off differs systematically due to pasture access. We refer to technical efficiency as one major dimension of performance besides economic efficiency, productivity and effectiveness.[1] Our study relies on a rich dataset of 45 dairy farms located in north-western Germany, where in addition to all dairy branch-specific costs, a sophisticated measure to assess dairy cow welfare based on the Welfare Quality® Protocol (WQP) for cattle (Welfare Quality®, 2012) is available. Our study directly relates to research by Gocsik et al. (2016), who used the WQP-index in their analysis on the cost-efficiency of improvements in broiler welfare. In contrast and following Asmild and Hougaard (2006), we refer to a directional efficiency measure that acknowledges behavioural patterns of farm managers with sequential preferences: improvements in pure technical efficiency might be the primary goal of the farm and after having achieved the desired level of efficiency, farm animal welfare might become the next relevant focus. Therefore, in this study, we consider farm animal welfare as a second output alongside milk and are the first to use the multi-disciplinary scientific animal welfare measure within an efficiency analysis framework. To cross-validate the assumption of sequential preferences we further provide results of a standard efficiency approach. Our study will help to inform the discussion on whether policy support for pasture access can be justified by improved animal welfare, and whether pasture-based systems can efficiently provide farm animal welfare.

The remainder of this paper is structured as follows: first, we review the relevant literature and present the analytical framework (Section 2). Then, we describe the dataset and how farm animal welfare is measured based on the WQP (Section 3). In Section 4, we present the empirical strategy and in Section 5, we present and discuss the results. In the final section, we conclude.

2. Background, related literature and research framework

The percentage of dairy farms in Europe with pasture access dropped from 52% in 2008 to 35% in 2012 (Reijs et al., 2013). This trend contradicts consumers' increased interest in pasture-based systems but is the result of higher economic pressure induced by less stable and lower output prices, as well as the EU's milk market policy, which features reduced market support. Cost pressure might lead to changes in feeding strategies with tendencies to more maize-based rations given the higher energy yield per hectare compared to grassland. In addition, benefits of higher technical efficiency in milk production on specialized farms have been reported (e.g., Pieralli et al., 2017). Farms with larger herds might also benefit from economies of scale. Trends for larger herds and more specialization might partly explain the trend in pasture use in Western Europe since providing pasture access for larger herds can be more demanding on the grassland itself (given a confined grazing area). Against this backdrop, several policy schemes of the second pillar of the EU's Common Agricultural Policy have been devoted to counteract the trends in grassland and pasture-use. These measures target at keeping grassland in production to maintain landscapes, functioning of ecosystems, but also enhancing biological diversity and farm animal welfare. The latter programmes' success is often hampered by low acceptance rates among farmers. Schreiner and Hess (2017) argue that the high personal animal welfare standards of farmers are often mismatched with the design of such programmes. Farmers might fear disutility from participation, for instance, by suffering a loss of autonomy. This, however, does not necessarily imply that farmers do not include farm animal welfare in their goal setting. Hansson and Lagerkvist (2015) distinguish in this context between use and non-use. Use values are directly related to productivity and denote the necessity of animal well-being to ensure productivity, while non-use values include the remaining issues that provide utility to the farmer, although they are not directly related to productivity or even countervailing. For decision makers with high non-use values, it is reasonable to allocate inputs towards animal health and well-being although such actions neither directly nor indirectly correspond to increased productivity. The question remains whether such investments in FAW come at the cost of productivity or may even ensure economic efficiency or both.

Another strand of research has emerged analysing the direct contribution of FAW towards productivity. For instance, Lawson et al. (2004b) found no relationship between milk production, technical efficiency and reproductive disorders, as did Hansson and Öhlmér (2008). Contrary to this, higher technical efficiency could be proven to be associated with a lower frequency of milk fever but also with a higher rate of digestive disorders (Lawson et al., 2004a). In addition, Barnes et al. (2011) found healthier herds with fewer incidences of lameness were correlated with higher levels of technical efficiency. As Lawson et al. (2004a) emphasise, the choice of variables to measure animal welfare may influence empirical evidence given the complex nature of farm animal welfare, where health is just one dimension. Resulting relationships between productivity and animal welfare are therefore

[1] Technical efficiency is one major dimension of performance besides economic efficiency, productivity and effectiveness. While productivity usually describes the relationships between all inputs and outputs at the farm level, efficiency is a normative measure of specific input-output relations. Effectiveness is also a normative measure used to capture whether an intended output level is produced, irrespective of the current efficiency level.