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Reducing the land use of EU pork production: where there's swill, there's a way

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ABSTRACT

Livestock production occupies approximately 75% of agricultural land, consumes 35% of the world's grain, and produces 14.5% of anthropogenic greenhouse gas emissions. With demand for meat and dairy products forecast to increase 60% by 2050, there is a pressing need to reduce the footprint of livestock farming. Food wastes have a long history as a source of environmentally benign animal feed, but their inclusion in feed is currently banned in the EU because of disease control concerns. A number of East Asian states have in the last 20 years, however, introduced regulated, centralised systems for safely recycling food wastes into animal feed. This study quantifies the land use savings that could be realised by changing EU legislation to promote the use of food wastes as animal feed and reviews the policy, public, and industry barriers to the use of food waste as feed. Our results suggest that the application of existing technologies could reduce the land use of EU pork (20% of world production) by one fifth, potentially saving 1.8 million hectares of agricultural land. While swill presents a low-cost, low-impact animal feed, widespread adoption would require efforts to address consumer and farmer concerns over food safety and disease control.

Introduction

Livestock production has a large and growing environmental impact. While providing one-third of all protein consumed by mankind (Herrero et al., 2009), livestock production occupies 75% of agricultural land (Foley et al., 2011), contributes 14.5% of anthropogenic greenhouse gas emissions (Gerber et al., 2013), and drives agricultural expansion in the tropics through the global trade in animal feed (Karstensen et al., 2013; Nepstad et al., 2006). With demand for meat and dairy products forecast to increase 60% by 2050 (Alexandratos and Bruinsma, 2012), there is growing recognition of the need to reduce the environmental impact of meat and dairy production.

Three principal strategies have been proposed to reduce the environmental impact of livestock: (1) reducing demand (Bajželj et al., 2014; Eisler et al., 2014; Fairlie, 2010; zu Ermgassen et al., 2014), principally in the developed world where meat and dairy consumption makes up a high proportion of food intake (Bonhommeau et al., 2013); (2) increasing efficiency, i.e. reducing the quantity of feed required per kg of meat or dairy produced (Garnett, 2013); and (3) changing animal diets to low-impact alternatives. Proposed novel, low-impact animal feeds include insects (Makkar et al., 2014), legumes (Jezierny et al., 2010), algae (Holman and Malau-Aduli, 2013), and bacteria (Byrne, 2014).

Low-impact animal feeds need not, however, be novel. Food waste has historically been recycled as livestock feed, particularly for pigs – cooked food waste fed to pigs is colloquially known as "swill". Pigs are a monogastric species whose digestive system is well adapted for the conversion of food waste into animal protein (Westendorf, 2000a); food waste produced in early human settlements is thought to have attracted wild pigs, leading to their domestication around 10,000 years ago (Fairlie, 2010). Swill can be a high-quality animal feed that requires no additional land to be brought into production, and hence has minimal or even positive environmental impact (food waste otherwise posing a disposal challenge). However, the use of swill is controversial in some countries and there is marked geographic variation in its acceptance and regulation. Though the recycling of food waste as swill is actively promoted in many nations, including South Korea, Japan, Taiwan, and Thailand (Menikpura et al., 2013), it was banned in the European Union (EU) in 2002 after the UK foot-and-mouth disease epidemic, which is thought to have been started by the illegal feeding of uncooked food waste to pigs. Proponents claim that swill is a cheap, environmentally benign animal feed (Fairlie, 2010; Stuart, 2009; Wadhwa and Bakshi, 2013), but critics claim

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that it is unsafe and produces pork of poor quality (Garcia et al., 2005; House of Lords, 2014).

In this paper we address some of the controversies surrounding the recycling of food waste as animal feed and quantify the potential for food waste to replace conventional animal feed and reduce the environmental impact of meat production. First, we provide an overview of the history and regulation of swill feeding, focusing on the contrasting approaches taken by the EU and two East Asian states: Japan and South Korea. Second, we consider the role that swill can play in reducing the land required for meat production, through a quantitative case-study of pork production in the EU. We then discuss the impact of swill on other environmental impacts, including greenhouse gas emissions, before reviewing the barriers to swill feeding in Europe. We focus on the potential concerns of pig producers, the public, and policy makers. To finish, we briefly discuss the legal status of swill in other parts of the world, focussing on the world's two largest pork producers: the USA and China.

Swill in the EU, Japan, and South Korea

Although it is the archetypal pig feed, swill has been in and out of fashion in Europe. Swill was the prevalent pig feed in the early 20th century and was actively promoted by the UK government during the Second World War as a means of attaining food security (Fairlie, 2010). The popularity of swill feeding decreased in the late 20th century as the availability of abundant cheap grains led the pig industry to focus on increasing production efficiencies through grain- and soybean-based diets. The risks of uncooked swill were demonstrated in 2001 when a UK farmer illegally fed uncooked food waste to pigs, precipitating the 2001 foot-and-mouth disease outbreak, which cost the UK economy £8 billion (UK House of Commons report, 2002). In response, swill feeding was banned in the UK in 2001, with the ban extended across the EU the following year (EC, 2002). The ban still permits the feeding of some food wastes where it can be demonstrated that there is no risk of contamination with meat products, but this represents only a small proportion of all EU food waste (see Appendix A for further details of EU regulation and food waste recycling).

Today, the EU produces more than 20% of world pork, 34 kg of pork meat/person/year (FAO, 2014a), and relies on grain- and soybean-based feed, which has a sizeable environmental footprint. A life cycle assessment (LCA) of European pork production found that pork production causes €1.9 of damage to the environment (from eutrophication, acidification, land use, and greenhouse gas emissions) per kg of pork produced – in comparison, it costs the farmer on average €1.4 to produce each kg of pork (Nguyen et al., 2012). Most (75.4%) of this environmental burden stems from feed production – in particular, the farming of soybean meal. The expansion of soybean farming in South America to meet international demand for animal feed poses a significant threat to biodiversity and is a large source of carbon emissions from deforestation (Godar et al., 2015; Karstensen et al., 2013; Nepstad et al., 2006; Richards et al., 2014).

Not all modern pig production is reliant on grain and soybean feed. In the same year that the UK banned swill, the Japanese government introduced the opposite policy, promoting the inclusion of food waste in animal feed (Takata et al., 2012). South Korea and Taiwan have introduced similar food waste recycling systems (in 1997 and 2003, respectively). While the feeding of uncooked meat wastes to pigs can transmit diseases including foot-and-mouth and classical swine fever, appropriate heat treatment deactivates these viruses and renders food waste safe for animal feed (Edwards, 2000; Garcia et al., 2005; OIE, 2009). In these countries, the industry is tightly regulated: the heat treatment of food waste is carried out by registered "Ecofeed" manufacturers (see Appendix B for details of food waste recycling practices in Japan and South Korea). Where Japan and South Korea formerly sent substantial quantities of food waste to landfill, in 2006–07 they respectively recycled 35.9% and 42.5% of food waste as animal feed (Fig. 1) (Kim and Kim, 2010; MAFF, 2012a, 2011).

The potential for swill to reduce the land use of EU pork

To estimate the potential land use saving of a change in EU regulation to promote the recycling of food waste as animal feed, we performed three complementary analyses. (a) We estimated the current land use of EU pork production; (b) we used data from feed trials comparing food waste and conventional diets to determine how the incorporation of food waste in pig diets affects the amount of feed and land required for pig production; and (c) we estimated the availability of food waste suitable for pig feed in the EU. We then combined these results to estimate the potential impact of promoting swill on the land use of EU pork production.

In this analysis we use land use as a footprint metric to assess the potential environmental benefits of the re-legalisation and promotion of swill in the EU. While measuring land use alone does not capture all of the environmental impacts of meat production, we consider land use an informative (though incomplete) metric for this analysis because (a) land use represents the majority (55%) of the environmental costs of European pork production (Nguyen et al., 2012); and (b) land use is a valuable indicator of the biodiversity impacts of products (Mattila et al., 2011). While other biodiversity metrics have been used in life cycle assessment (LCA), there remains no consensus on their relative validity (Souza et al., 2015).

The land use of EU pork production

To estimate the land use of EU pork, we calculated the land required across the entire lifecycle of pork production (breeding sows, piglets, and young and mature slaughter pigs) to grow the feed necessary to produce the 21.5 million tonnes of pork (live weight) which is produced in modern, large-scale pig production systems in the EU each year (for more details see Appendix C). The calculation was based upon weighted mean values of EU production statistics (e.g. the number of piglets weaned per sow per year, piglet mortality rates) and representative diets from the five leading producers of pork in the EU: Germany, Spain, Denmark, France, and Poland. These member states together represent >64% of EU pork production (Appendix C, Fig. A3).

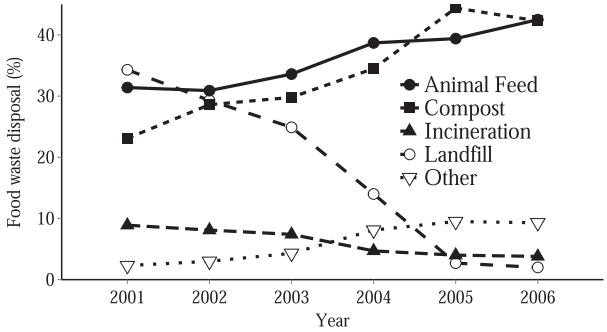

Fig. 1. The end-uses of food waste in South Korea 2001–06, the most recent available data (Kim and Kim, 2010). After the introduction of food waste recycling legislation in 1997, South Korea achieved substantial increases in food waste recycling. The recycling of food waste for animal feed is shown as a solid line.