



FEEDING SURPLUS FOOD TO PIGS SAFELY

A win-win for farmers and
the environment

**FEED
BACK**

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SUMMARY FOR POLICY MAKERS

Feedback urges the UK government to legislate for the safe collection and processing of unused food from retail, manufacturing and commercial catering to feed omnivorous livestock such as pigs and chickens.

Feeding pigs using our surplus food isn't a new idea. For thousands of years, humans have fed pigs on food waste, using up leftovers and agricultural by-products to produce tasty pork. But today, despite the 12.7 million tonnes of food waste generated per year in the UK (WRAP 2018; Quinn 2017b), omnivorous livestock like pigs and chickens are primarily fed on pulses, oilseed and cereal crops, using up valuable resources including land in the precious Amazon.

This practice is not only wasteful, it is also expensive. In 2017, UK pig feed costs accounted for 62% of total pig production costs (AHDB 2018), with UK pig producers battling exceptionally tight margins (AHDB 2017, 5). Sourcing alternative feeds for livestock is a significant economic and environmental opportunity for the UK, with substantial ongoing investment in research and development. Nearly two decades since the 2001 Foot and Mouth outbreak which led to the ban on feeding certain types of food waste to pigs, we now have the opportunity and the evidence to put in place safe, economically and environmentally attractive ways to reintroduce the use of surplus food as feed.

The case for change is compelling. Feeding more surplus food to pigs and chickens could yield substantial benefits, including improving the profitability of pig and chicken farming by taking pressure off feed costs. A recent survey of the pig farming industry found strong support (>75% of those surveyed) for the “relegalisation of swill among both pig farmers and other stakeholders” (zu Ermgassen et al. 2018), provided disease risk was adequately managed.

Japan provides a relevant comparison: a thriving Japanese industry collects surplus food from catering, supermarkets and manufacturing for treatment in licensed, well-regulated treatment plants, and feeds them to pigs as “eco-feed” at about half of the cost of conventional feed (Takahashi et al. 2012; Takahashi 2018). 52% of surplus from the Japanese food industry is now used as livestock feed (FAO 2017). Moreover, Japanese consumers choose to pay a premium for these meat products seeing them as healthier and more environmentally friendly (Kurishima et al. 2011). Although context-specific safety measures would be required for the UK and Europe, Japan provides a model for how this system could work in practice.

A new UK ‘surplus food-to-feed’ industry would create jobs and new business opportunities. This would be in addition to reducing industry costs and potentially freeing up savings to be reinvested in high animal welfare standards and reduced antibiotic use. Using all possible surplus food as feed would strengthen the UK food supply, by safeguarding against increasing competition for livestock feed from other parts of the world, such as China, and global feed crop price hikes. According to Feedback's estimates, if the surplus food to pig feed ban was lifted, a combined total of 2.5 million tonnes of surplus food from manufacturing, retail and commercial catering could potentially be fed to pigs – 20% of the UK's total estimated food waste. At this stage we propose to exclude leftovers from households.

The current ban on feeding surplus food containing meat came about as a response to the largely unregulated use of surplus food as animal feed which led to the 2001 Foot and Mouth outbreak. It is now time to revisit this ban in the light of new evidence and a new approach. In 2017, veterinary epidemiologists, microbiologists and pig nutritionists from the

Universities of Leeds, Cambridge and Wageningen, APHA-DEFRA and an expert from the European Food Standards Agency FEEDAP committee reviewed existing evidence and the Japanese model of feeding treated surplus food to pigs. These experts agreed that from a technical point of view it is possible to produce safe feed from surplus food through heat treatment, potentially complemented with acidification (fermentation or adding lactic acid for example) (Luyckx 2018). To ensure safety within the European and UK context, it will be necessary to limit the treatment of feed to licensed plants that are located separately from farm premises, and which apply sound biosecurity measures (Luyckx 2018, 2).

Feedback do not advocate a return to the pre-2001 system where there were substantial risks of disease outbreak. Instead, this report makes the case for a modern, well-managed system to deliver substantial benefits for farmers, consumers and the environment. We call for the UK government to:

- Lift the ban on feeding of commercial catering waste and surplus food containing meat from retail and manufacturing to omnivorous non-ruminant livestock and replace it with robust regulation that allows for the feeding of safe heat-treated surplus food with adequate biosecurity and monitoring
- Set up a pilot surplus food treatment facility to compare proven disease inactivation methods to determine which combination of temperature, acidity and time is better in terms of maximising nutritional values and cost and energy efficiency
- Incentivise the food use hierarchy so that food businesses prioritise prevention over redistribution, redistribution to humans over livestock feed, and the use of livestock feed over anaerobic digestion and composting

This move could cement the UK's global leadership in competitive, sustainable and high-welfare livestock production. Using surplus food that cannot be eaten by humans as animal feed is a necessary step towards a more sustainable food system. The United Nations estimates that if farmers all around the world fed their livestock on the food we currently waste and on agricultural by-products, enough grain would be freed to feed an extra three billion people, more than the additional number expected to be sharing our planet by 2050 (UNEP 2009). Furthermore, calculations at EU level show that using heat-treated surplus food as animal feed at rates similar to Japan, would result in a 21.5 % reduction in the current land use of large-scale EU pork production (zu Ermgassen et al. 2016), saving an area of global agricultural land the size of Wales. Feeding meat-containing surplus to pigs also could reduce demand for up to 268,000 hectares of soybean production (zu Ermgassen et al. 2016) reducing soy expansion in the Amazon and other high biodiversity regions of South America such as the Cerrado and Gran Chaco which continue to be particularly vulnerable to high rates of deforestation (TRAISE 2018).

This report considers the economic case, food safety implications and options, food waste reduction and environmental costs and benefits of feeding pigs on our leftovers, as well as exploring Japan's surplus food to feed industry as a case study. We hope it opens a healthy debate on the possibility of bringing this traditional practice into the 21st century.

HISTORY OF THE PIG IDEA

•2013: Tristram Stuart and Thomasina Miers co-found the Pig Idea.

•2013: Numerous chefs, celebrities, farmers and organisations back the campaign, including Hugh Fearnley-Whittingstall, and Compassion in World Farming.

•November 2013: The Pig Idea Feast in Trafalgar Square feeds over 5000 portions of pork to the public. All the pork served, from nose to tail, came from pigs reared on food waste by the team at Stepney City Farm. The feast achieved considerable media coverage, including in BBC News and the Telegraph.

•2014: Through the FoodSave project, the Pig Idea helps link London businesses with food wastes like surplus food like grains and whey with pig farmers who feed them to their pigs. This saves an estimated 1,200 tonnes of food from going to waste.

•2015-17: Feedback goes into an intense period of research, to prove that food waste can be fed to pigs safely, and build the economic and environmental case. Feedback start collaboration with EU project REFRESH.

•2016-17: As part of REFRESH, Feedback develop Animal Feed Tool to clarify which foods are currently legal to feed to pigs, to help businesses navigate current regulations and use more food waste as feed.

•November 2017: Feedback collaborates with EU REFRESH to convene a panel of experts .

•February 2018: EU REFRESH report concludes that from a technical point of view it is possible to produce safe feed from food waste through heat treatment.

•July 2018: The Pig Idea relauches in the Brexit context, as the UK now has the opportunity to reform the law directly rather than indirectly through EU law.

1. INTRODUCTION



Pigs can be a highly effective recycling system, with the potential to turn a massive problem of food waste into a delicious solution. Now that we know it can be done safely, it's mad not to.



Hugh Fearnley-Whittingstall

WHAT SURPLUS FOOD IS CURRENTLY ILLEGAL TO FEED TO PIGS?

- All unused food from restaurants, catering facilities and kitchens, including central kitchens and household kitchens (except for vegan household kitchens)
- Unused food containing meat, fish, raw eggs or dairy, or ruminant gelatine or collagen
- Any other food which may have come into contact with the above prohibited animal by-products.

WHAT SURPLUS FOOD IS IT CURRENTLY LEGAL TO FEED TO PIGS?

- Plant-based surplus food from primary production, manufacturing or retail which can be kept fully segregated from meat and other prohibited products
- Food and farming businesses interested in exploring the increased use of currently permissible surplus food in feed can use the REFRESH Animal Feed Tool <http://www.refreshcoe.eu/animal-feed-tool/> and read the Guidelines for the Feed Use of Food No Longer Intended for Human Consumption (European Commission 2018a).

The Foot and Mouth outbreak at the start of the millennium took surplus food containing meat off the menu for omnivorous livestock such as pigs and chickens. While the ban on feeding meat to ruminants to prevent Transmissible Spongiform Encephalopathies (TSE) is entirely justified and should remain in place, Feedback believes that the time has come to reconsider the ban for non-ruminants, because keeping surplus food in the food supply chain as feed is an indispensable part of building a sustainable food system (see Feedback's model). This report shows that using surplus food that has been rendered safe in modern treatment plants can both reduce the environmental impact of livestock farming and stop unused food from being wasted.

Feedback is not alone in this view. For example, to reduce the environmental impact of livestock, the Food and Agriculture Organisation (FAO) recommends increasing the feeding to livestock of by-products or waste that humans cannot eat. Regulatory frameworks should be reviewed "to consider the sanitary and technical requirements for including... waste from households or the food service industry into livestock feed rations", (FAO 2017, 6). The FAO cite the positive example of Japan where "52% of waste from the food industry is now used as livestock feed".

Likewise, the European Parliament's Committee on the Environment, Public Health and Food Safety published an own-initiative report (Borzan 2017) calling on the Commission "to analyse legal barriers to the use of former foodstuffs in feed production and to promote research in this area" whilst minimising food safety risk. It notes "the potential for optimisation of use of food unavoidably lost or discarded and by-products from the food chain, in particular those of animal origin, in feed production".

The Defra research report Recycling of catering & food waste (2013) concluded that existing regulations could be "relatively easily adapted to allow the recycling of more categories of food waste into animal feed, particularly those categories that were temporarily banned under the current regulations" (Defra 2013, 23), as long as the UK gathers "scientific evidence required to demonstrate that the procedures introduced would be safe" (Defra 2013, 24).

2. POLICY ASKS

2.1 Review the current ban on feeding certain types of surplus food to pigs:

Feedback calls on the UK to lift the current ban on using commercial catering waste and surplus food containing meat from retail and manufacturing as feed for omnivorous non-ruminant livestock, such as pigs and chickens. We propose that this ban is replaced with robust legislation regulating the treatment of this surplus food in off-farm licensed processing facilities so that it can be safely fed to omnivorous livestock. The following EU regulations would need reviewing when they are transposed into UK law, or updated directly in UK law post-Brexit:

- Regulation (EC) 999/2001 which bans using animal protein in animal feed (specifically amendments 1923/2006 and 56/2013 which extend this ban to non-ruminant omnivorous livestock)

- Regulation (EC) 1069/2009 and implementing Regulation (EC) 142/2011 which ban using kitchen left-overs and catering waste for feed

In the UK, these regulations are currently enforced through:

- The Animal By-Products (Enforcement) (England) Regulations 2013 (UK Government 2013 Part 2, 4.)

2.2 Research:

Further research is needed by government and industry as follows:

- Model the most effective and energy-efficient combination of temperature, acidity, pressure and time to inactivate dangerous pathogens such as Foot and Mouth Disease and African Swine Fever.
- As there is significant demand for soya in chicken feed, research the specific safety measures necessary to ensure new regulations can also incentivise the use of treated food surplus in chicken feed
- Lead the development of a PAS – Publicly Available Standard for a new surplus-food-to-feed industry building on the experience of the PAS for anaerobic digestion plants (WRAP and BSI 2014) and the legal framework setting out treatment, biosecurity and monitoring criteria for processing animal by-products such as Method 7 in EC Reg 142/2001 (European Commission 2011 Annex IV, Chapter III, G).
- Further research the health and nutrition benefits of liquid treated and fermented leftovers to be used as animal feed, given that “fermented liquid feed may strengthen the role of the stomach as the first line of defence against possible pathogenic infections by lowering the pH in the gastrointestinal tract thereby helping to exclude enteropathogens” (Missotten et al. 2015).

2.3 Set up a pilot facility:

The feed cost pressures on farmers, and the environmental impact of conventional feed, means that there should be no delay in regulating the treatment and safe feeding of surplus food based on existing evidence and experience. At the same time, we call on the UK government to encourage the establishment of a pilot processing facility to compare proven disease inactivation methods so that feed nutritional values and cost and energy efficiency can be maximised. Current legislation does not prohibit the building and testing of a fully functioning pilot processing facility, if the resultant feed is not fed to livestock, but such a facility could showcase the advantages of the model and iron out any difficulties to ensure swift uptake by the industry once the law is reformed. It could be funded through either direct government funding or encouraging investment from other institutions like the rendering industry, feed manufacturers, former foodstuff processors, venture capitalists, research institutions or universities – or some collaborative combination of these.



In Japan surplus-fed pigs are sold at a premium; they call it eco-pork. We know that feeding pigs soy grown in South America is one of the largest contributors to rainforest destruction. We also know that pigs are the most efficient converters of food waste. Thanks to research conducted by Feedback we now know that feeding pigs properly processed surplus food is completely safe. The only question that remains is how quickly we can make this happen



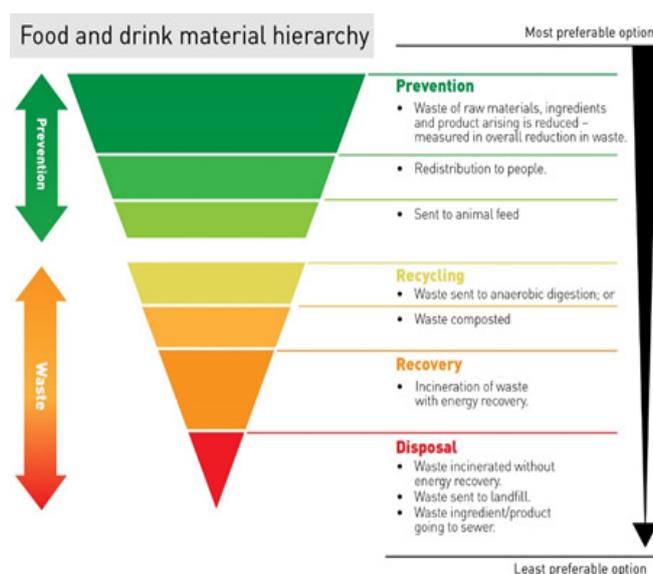
Thomasina Miers, founder of Wahaca and co-founder of the Pig Idea campaign

2.4 Reward environmentally friendly farming practices

Feedback backs a “public money for public goods” approach to farm subsidies, as proposed by Defra (2018a). Farming needs to be at the frontline of the UK’s efforts to tackle climate change and environmental degradation. Reducing the environmental impact of food waste and of conventional animal feed are both public goods which should be incentivised. For instance, the Rural Development Programme for England currently provides money for projects to improve agriculture, the environment and rural life (UK Government 2018). Farmers who feed safe, treated food waste to their pigs and chickens, purchased from licensed surplus food processors, could be offered additional subsidy support for the public goods which arise from the environmental benefits of using treated food waste. Subsidies to farmers feeding their pigs and chickens on treated surplus food would not be necessary for these feeds to be economically viable, but could speed its uptake, particularly during the early phases of transition.

2.5 Incentivise the food use hierarchy:

The UK’s main actions on food waste are currently prioritised according to the food waste hierarchy. Waste and Resources Action Programme (WRAP) have adapted the EU Waste Framework Directive’s waste hierarchy (European Commission n.d.) specifically to food:



(WRAP 2014)

All use of surplus food as animal feed should occur within the framework of this food use hierarchy, so it is vital to prioritise prevention of food waste or feeding unused food to humans over feeding it to livestock feed, and to prioritise diversion of surplus food to livestock feed over anaerobic digestion (AD) or composting. Feedback calls on the UK government to create fiscal incentives which move food up the food use hierarchy. This would be a constructive policy to introduce regardless of additional legal reform on omnivorous livestock feed. In line with WRAP’s (2016) findings, the National Pig Association (2018) notes how currently permissible former foodstuffs which are adequate for feeding to pigs are currently diverted down the food use hierarchy to anaerobic digestion. Current fiscal measures incentivise the movement of food waste away from landfill through Landfill Tax, for which the standard rate is currently £86.10/tonne (GOV.UK 2017), and towards anaerobic digestion, which is incentivised through various subsidies such as feed-in tariffs (NNFCC 2018).

In contrast, there are no subsidies to prevent food waste occurring in the first place, redistribution to feed people, or diversion to animal feed, which are higher up the food use hierarchy and more economically and environmentally valuable. This leads to a significantly suboptimal use of food waste at lower stages of the food use hierarchy. The House of Lords Counting the Cost of Food Waste report recommends that the government review incentives for anaerobic digestion to ensure they do not distort the food use hierarchy (House of Lords EU Committee 2013, 48). We encourage the government to review which combination of fiscal incentives would be most effective at moving food up the food use hierarchy:

- Penalties/additional taxes: Introduce a “Pay as you throw” system, with higher charges for lower stages of the food use hierarchy, like anaerobic digestion and landfill. This should ideally be the priority, because the Landfill Tax has proved immensely successful, it removes possible incentives to overproduce, and charges could be used to finance food waste reduction initiatives for consumers and businesses.
- Subsidies/tax relief: Subsidies or tax relief could be used as an incentive to move food waste up the food use hierarchy, with priority being given to prevention, redistribution to people and ,potentially, animal feed. Subsidies to lower stages of the hierarchy such as anaerobic digestion should be phased out or removed completely. If subsidies or tax relief are introduced for stages of the hierarchy other than prevention of food waste, care should be taken that government support for redistribution or animal feed does not encourage overproduction or act as a disincentive to the prevention of food waste.



3. THE ECONOMIC CASE

In the UK in October 2017, feed costs were at 62% of total production costs (AHDB 2018). More widely in Europe, high volatility in feed prices resulting in high prices for both cereals and compound feeding stuffs has created a difficult situation forcing an important number of pig farmers to cease production (EUROSTAT 2017a). UK pig producers are currently battling exceptionally tight margins - the UK reference price for pork in 2016 was £1.27 per kg with the average costs of production being £1.26 per kg, of which feed costs made up £0.75 per kg (AHDB 2017, 5). In the past decade, the net margins for the UK pig industry overall were often negative – ranging from a net £10/head loss to a £18/head profit in different years between 2007-2017 (AHDB 2017, 11).

In Japan, however, industrial food-to-feed recycling plants deliver surplus food-based feed at half of the cost of conventional feed (Takahashi et al. 2012, JFEC 2015). The production of Ecofeed in Japan has more than doubled from 0.48 million tonnes in 2003 to 1.19 million tonnes in 2016 (Japan Ministry of Agriculture, Forestry and Fisheries, 2018). There are already businesses in Europe developing business plans to expand the use of currently legal food waste feeds, such as NOSHAN (Gillman 2018).

3.1 Pig nutrition and Conversion Ratios:

A recent study of the Japanese model calculated that even if a diet containing 50% heat-treated surplus food produces 13% lower pig growth rates, as long as feed costs are 70% or less of conventional feed, overall production costs would be lower and profitability improved (zu Ermgassen et al. 2016).

Feedback and its expert research partners of the EU project REFRESH (2018) are currently engaged in Life Cycle Costing studies to assess the economic viability of feed ingredients made from surplus food in specialist licenced treatment plants. Due to be published in 2019, this research will involve estimating processing plant energy and running costs using data of existing plants in Japan. We will also look at comparable industries in Europe such as the pet food, rendering and former foodstuff industries (Luyckx 2018). This research will also factor in feed conversion ratios by looking at the cost of feed required to yield 1kg of pig weight gain, and building upon an existing body of research comparing the nutritional content of conventional feeds and food waste feeds (Garcia et al. 2005; Esteban et al. 2007; Westendorf, Dong, and Schoknecht 1998; Myer, Brendemuhl, and Johnson 1999). We will also further research the advantages and disadvantages of dry and wet feed made from treated surplus food and consider scenarios of price hikes in global agricultural commodities.

In terms of meat quality, a review of 18 studies on the effect of surplus food feeds on the quality and nutrition of pork, including blinded taste trials, found that increasing the proportion of surplus food in pig diets had no overall effect on overall palatability, flavour, colour and fat composition, among other traits (zu Ermgassen et al. 2016).

3.2 Effect on exports:

It is unlikely that the EU would ban imports of pork from pigs fed on surplus food on safety grounds, because the EU currently allows pork imports from Japan, the US and New Zealand, where the practice is permitted. Several EU countries, including France, Spain, Italy, Poland and Ireland, imported pork products from Japan in the past 4 years, and the UK has imported pork from the US every year between 1996 and 2018 (European Commission 2018b).

4. FEEDING TREATED SURPLUS FOOD SAFELY IN THE UK AND EUROPE

4.1 The Foot and Mouth Outbreak:

Any discussion of what can be safely fed to pigs must take into consideration the need to avoid a disease outbreak like the 2001 Foot and Mouth outbreak, which cost the UK economy £8 billion, led to the slaughter of over six million animals (Bourn 2002) and was traumatic to the farming community.

The cause of the UK Foot and Mouth Disease outbreak was primarily a problem of the failed enforcement of a law that was difficult to apply, asking farmers to boil surplus food for at least 60 minutes and asking inspectors to monitor large numbers of farmers to make sure this was done adequately. Extremely unhygienic conditions were found during inspections of the farm where the outbreak is thought to have started, but the State Veterinary Inspector only offered informal warnings and did not report the problem or conduct more thorough inspections which should have found containers with unprocessed swill (Parliamentary and Health Service Ombudsman 2007, 35–36). Between 1995-2001 the farm was only ever visited by one and the same inspector (Parliamentary and Health Service Ombudsman 2007, 34), although complaints had been made about the farm repeatedly by concerned individuals to



Newcastle Trading Standards officers, environmental health inspectors, the local branch of Ministry of Agriculture, Fisheries and Food and the Royal Society for the Prevention of Cruelty to Animals (Cook 2001, 13).

CONTAINMENT OF DISEASE OUTBREAK:

The infection was discovered on 19th February 2001 and confirmed by the Pirbright Institute one day later. A second test took until the 23rd February to confirm the case and introduce national livestock movement restrictions. One estimate indicates that if a ban on livestock movement had been in place on 20th February the extent of the epidemic would have been a third to one half of what it became (Anderson 2002, 60). Furthermore, the slaughter of animals to prevent further contagion was conducted in a piecemeal and erratic way which was unsupported by any clear scientific basis and often “not in proportion to the nature of the risks” (Anderson 2008, 56).

The EU permitted the UK to use emergency vaccination in some regions, but despite this, the UK did not actually carry out any vaccination because of industry concerns that retailers, exporters and the public might not buy food products from vaccinated animals (Anderson 2002, 125–29). The NPA are still opposed to vaccination on the grounds that it would harm British exports and animals infected shortly after vaccination can still spread disease without showing symptoms (National Pig Association 2013). In contrast, Uruguay brought its own 2001 Foot and Mouth outbreak under control in nearly half the time as the UK (European Commission 2001, 24 para 8), and the cost was estimated at \$13.6m, compared to a cost to the UK economy of £8 billion (Bourn 2002, 13). Uruguay responded very rapidly with livestock movement restrictions through road blocks and the vaccination of all cattle within a 10 km radius of affected farms followed by mass vaccination some days later (European Commission 2001 para 5.3.2). Although no pigs or sheep were vaccinated, probably because of their small numbers, the comprehensive vaccination of cattle proved effective.

4.2 Replacing the ban with a well-regulated system

The immediate ban on feeding surplus food, treated or not, following the UK Foot and Mouth outbreak was understandable, because of the need to send a strong signal to farmers and the public that an outbreak would never occur again. However, the real problem was not the type of feed fed to pigs, but rather one of a poorly designed regulatory framework and of lax enforcement. If we are to reintroduce meat-containing surplus food in feed for omnivorous livestock, we need a robustly regulated system that can be properly enforced.

4.3 Treating surplus food to make it disease-free

Catering and retail surplus food is fed to non-ruminants, especially pigs, in Japan, New Zealand and around half the states of the USA (Leib et al. 2016), after treatment to ensure its safety. In Japan, any by-products and former foodstuffs containing Animal Origin Protein, and all catering and kitchen waste, must undergo heat treatment to inactivate pathogens (30 minutes or more at 70 °C or for 3 minutes or more at 80 °C) (MAFF 2006). In the US, surplus must be heated throughout by boiling (212 °F or 100 °C at sea level) for 30 minutes before being fed to swine (US Department of Agriculture 2009).

ELIMINATING DISEASE WITH HEAT TREATMENT AND ACIDIFICATION

AFRICAN SWINE FEVER (ASF) African swine fever affects pigs and wild boar and can remain active for over four months in some meats and for years in frozen carcasses (National Pig Association 2013). African Swine Fever has been spreading from Russia (Kolbasov et al. 2018) to Eastern Europe with wild boar eating untreated food waste as a cause of transmission. However, ASF is inactivated if kept over 60°C for 20 minutes (OIE and World Organisation for Animal Health 2013a, see also Adkin et al. 2014).

FOOT AND MOUTH DISEASE (FMD)

The movement of infected animals is the most important contagion route for FMD, which is one of the most contagious diseases affecting livestock. FMD can also spread through air over distances up to 60km over land and much more over sea (OIE and World Organisation for Animal Health 2013b) and can be contagious shortly before the disease becomes clinically apparent. As with all other diseases, any feed given to livestock must be free from FMD. Heating meat to a minimum core temperature of 70°C for at least 30 minutes inactivates the virus as does bringing the acidity below pH6 through fermentation or adding lactic acid for example (commercial yoghurt has a pH of 4.5) (OIE and World Organisation for Animal Health 2013b).

REFRESH is currently researching the most energy efficient combination of heat, acidity, pressure and particle size that is effective at inactivating all diseases of concern in line with existing legal requirements for animal by-product processing. This will be done in reference to the legal framework for the processing of Animal By-Products where the operator must demonstrate “the capacity of the processing method to reduce [identified] hazards to a level which does not pose any significant risks to public or animal health” (European Commission 2011 Annex IV, Chapter III, G). A more extensive list of diseases and how they can be inactivated can be found in the REFRESH expert panel report (Luyckx 2018).

In 2017, as part of the REFRESH food waste research partnership, Feedback convened veterinary epidemiologists, microbiologists and pig nutritionists from the Universities of Leeds, Cambridge and Wageningen, APHA-DEFRA and an expert from the European Food Standards Agency FEEDAP committee to review existing evidence and the Japanese model of feeding treated surplus food to pigs. These experts agreed that from a technical point of view it is possible to produce safe feed from surplus food through heat treatment, potentially complemented with acidification (fermentation or adding lactic acid for example) (Luyckx 2018). While import controls are important to prevent illegal imports of contaminated meat (Hayrapetyan, Nierop Groot, and Zwietering 2017), we must assume some illegal imports may happen and thus heat treatment has to be effective.

4.4 Preventing cross-contamination between treated and untreated surplus food:

A DEFRA-APHA study confirms the effectiveness of heat-treatment to inactivate dangerous pathogens but highlights the risks from potential errors in transport, storage or manufacturing that could allow for the re-introduction of pathogens through cross-contamination between treated and untreated product (Adkin et al. 2014). Similarly, the REFRESH Expert panel (Luyckx 2018, 4) emphasizes “the importance of sound system design to prevent cross-contamination using biosecurity measures and proven logistical and Hazard Analysis and Critical Control Point measures for segregation in storage and transport” such as zoning, one directional process flows and dedicated sealed storage. Given the fact that the Foot and Mouth outbreak was linked to lax monitoring of on-farm biosecurity, in the European context it will be necessary to limit the production of feed from surplus food to licensed treatment plants that are located separately from any farm premises.

The actual technical requirements on biosecurity can be adapted from those applicable to the animal by-product rendering industry. Commission Regulation (EU) No 142/2011 lays out comprehensive safety requirements for processing plants – for example:

- One directional process flows such as a “a conveyer system” with “separate entrances, reception bays, equipment and exits”
- Careful monitoring of heat-treatment such as “measuring equipment to monitor temperature against time” and “recording devices to record continuously the results of these measurements in a way so that they remain accessible for the purpose of checks and official controls”
- Zoning, through “clear separation between the area of the plant where incoming material for processing is unloaded and the areas set aside for the processing of that product and the storage of the derived product”

4.5 Management of additional risks such as plastics and dioxins:

Additional risks such as plastics or dioxins must be managed as is done in the existing feed industry. Paul Featherstone of UK former foodstuff processor Sugarich noted that they “are currently evaluating optical sorting technology that can show up bright colours and the reflective properties of metalite packaging to screen for any packaging residues. It is a bit

like the technology used to check for discolouration of product in a chip or crisp factory” (Byrne 2017). Surplus food treated to become feed must meet the same requirements as conventional feed, see for example the legislation on mycotoxin and dioxin testing in feedstuffs (Walker 2017). In the context of REFRESH, Feedback is also partnering with global traceability and barcoding expert GS1 to develop recommendations on traceability, building on the JFEC experience where surplus food collection and input into the treatment system is barcoded (see case study in section 6).

4.6 Transmissible spongiform encephalopathies (TSEs) or prion diseases:

According to the EC Scientific Steering Committee (1999, 4) “no scientific evidence exists to demonstrate the natural occurrence of Transmissible Spongiform Encephalopathy in farmed pigs, poultry and fish, which may create a basis for an intra-species progression of a TSE infection due to intra-species recycling”. This was re-affirmed by the European Food Safety Authority (2007), stating “no naturally occurring TSE, including BSE, have been detected so far in pigs”. UK scientists have done very thorough research to establish whether pigs can contract TSE but have found “no infectivity” (Wells 2003).

However, although the known risks are low, the REFRESH expert panel report still highlights the need for robust disease monitoring systems especially on farms feeding surplus food and early crisis management plans to be vigilant of “unknown unknowns” (Luyckx 2018, 6). This is important because intensive large-scale livestock farming carries additional disease risk as highly concentrated numbers of animals with little genetic diversity are both more susceptible to infection, and increased risk of the emergence of more virulent disease strains (Garner, Hess, and Yang 2006; Gilchrist et al. 2007; Mennerat et al. 2010; Drew 2011; Jones et al. 2013).

4.7 Intra-Species Recycling – pigs eating food containing scraps of pork:

Feeding pigs surplus food from catering sources or feeds containing meat may lead to pigs eating surplus food feeds which could contain pork scraps.

Safety: The Japanese and US models do not have an intra-species recycling ban for non-ruminants which means that traces of pork may be found in some of the treated feed. Animals eating feed that contains traces of meat from their own species does increase the risks of animals contracting diseases that can be caught within their species – for this reason it is especially important that pathogens be inactivated through treatment and measures are put in place to prevent cross-contamination. It is also essential to ensure strict segregation between ruminant and non-ruminant feed, as is currently legislated in Japan (Ministry of Agriculture, Forestry and Fisheries, 2003).

Ethics: We must do all we can to prevent stress-induced forms of cannibalism such as the savaging of piglets by first litter gilts (young female pigs) which may account for up to 3% in piglet mortality (The Pig Site 2018; NADIS - National Animal Disease Information Service 2018) and tail- and ear-biting. See the section on animal welfare in Part 11 (p. 23) on how the feeding of meat-containing surplus food could contribute to a reduction in these stress-induced behaviours.



Wild boar eating meat - photo credit: Thimindu Goonatillake



Stepney City Farm pig eating a porridge of spent brewers' grains, whey and fruit leftovers

Zoologist Bill Schutt has brought together evidence on the evolutionary and biological role of intraspecies recycling, showing that in many cases it is perfectly natural (Schutt 2017). Similarly, pig nutritionists, veterinarians and animal welfare specialists have informally told Feedback that they see no concern from an animal welfare or health perspective, provided heat treatment and biosecurity measures are applied to inactivate pathogens.

Reducing intra-species recycling: Adequate treatment and biosecurity measures remove the need for an intra-species recycling ban for omnivorous livestock thereby ensuring significant additional quantities of surplus food can be used in feed. However, voluntary common-sense measures could be taken to reduce the proportion of pork that goes into pig feed, for example by ensuring that the processed animal proteins from single species rendering plants go to other species (ie chicken to pig and vice versa). And it may be desirable to treat surplus food in batches dedicated to specific species, for example, leftovers from restaurants primarily serving chicken could go to pig feed, and surplus from a pork pie factory could go to chicken feed.

5. ENFORCEMENT

The NPA have rightly raised the concern that whereas Japan has "a culture of regulatory compliance", the same may not be said for European countries like the UK (National Pig Association 2013), and so extra precautions may be needed.

5.1 Inspection of treatment plants:

In the European context it will be necessary to limit the production of feed from surplus food to licensed treatment plants that are located separately from farm premises" (Luyckx 2018, 2). For instance, in the UK there are currently around 17 rendering plants (Fabra UK 2018), which means regular comprehensive inspections are possible. Licensing fees could contribute to the cost of inspections. A new industry could develop a Publicly Available Standard, adapted from standards developed for similar industries, like PAS110:2014, which is currently used for anaerobic digestion plants (WRAP and BSI 2014), and the Japanese Ecofeed certification standard. PAS110 is a voluntary, industry-led specification which ensures that digestates are of consistent quality and fit for purpose - it sets requirements, input materials, process management controls and monitoring, and digestate sampling, testing, validation checks, and information for end users. In the case of a new surplus-food-to-feed industry, such a PAS would need to be set within the legal framework setting out treatment criteria for animal by-products: possibly Method 7 in EC Regulation 142/2001 (European Commission 2011 Annex IV, Chapter III, G) or similar UK legislation.

5.2 Inspection of farms:

Currently, the National Feed Audit examines random samples of animal feeds across the UK every year to assess compliance with the feed ban and prevent disease. All types of premises are visited, including a full detailed site inspection, and between April 2016-March 2017, nearly 5,000 samples were examined (APHA 2017b).

Inspections under the National Feed Audit could be updated to ensure only surplus-food-based feeds from licenced treatment plants are used. Farms using fishmeal in pig feed rations are currently more likely to be visited due to higher risks – this could be extended to premises using surplus food as pig feed. Farms could also be required to hold a license to use surplus food feeds for their pigs and have inspections confirm compliance. Existing farm inspections – for instance, for animal welfare standards – should already be checking that farms are not feeding untreated unlicensed food waste to pigs, or feed that is at risk of cross-contamination.

ADDRESSING POTENTIAL CONFUSION BETWEEN SAFE TREATED SURPLUS FOOD AND UNSAFE UNTREATED FOOD WASTE:

Communication about the requirement that only meat-containing surplus food from licenced treatment plants can be fed to pigs and chickens will be important to ensure households or small-scale farmers do not misinterpret the change in legislation as a green light to start feeding pigs and chickens unprocessed meat-containing food waste, a concern expressed by The National Pig Association (National Pig Association 2013). Effective communication could provide a positive note on the use of treated surplus food in the ongoing awareness raising campaigns by the National Pig Association, AHDB Pork, the Animal and Plant Health Agency and others regarding the illegal nature and risks related to feeding untreated meat to pigs and chickens (APHA 2017a; Driver 2017).

6. CASE STUDY: THE “ODAKYU SYSTEM” IN JAPAN

In Japan, there are currently 360 eco-feed producers, of which 47 process surplus food from retailers and 29 specialise in the processing of meat-containing surplus food (Japan Ministry of Agriculture, Forestry and Fisheries 2018).

Odakyu Food Ecology Centre: The Odakyu Group is a Japanese company operating a chain of department stores, hotels, restaurants and rail transport. They deliver unused food, including meat, from their supermarkets, restaurants and train lines - but not from households - to the Japan Food Ecology Centre (JFEC) factory to be turned into pig feed, and they buy back the pork to sell as a premium-quality eco-product in its own stores. JFEC takes in 35 tonnes of surplus food per day to produce 40 tonnes of eco-feed (JFEC 2015; K. Takahashi 2018). Due to the high disposal costs introduced with the Food Recycling Law, JFEC can charge customers for disposal of their unused food. JFEC receives no capital assistance from the government, although their customers and suppliers may receive some subsidies for involvement in eco-feed.

Unused food is separated (carbs, fish, vegetables, etc) before it gets to the factory. When the bins arrive at the factory, the bins' barcodes are scanned and weighed to record the surplus food composition and ensure traceability. Some of the favourite foods for the pigs are rice, bread, noodles, cooking scraps, delicatessen, vegetables, tofu, milk, fruit and used tea leaves. The surplus food is then checked for contamination (less than 0.1% of the mix is likely to be non-food, e.g. plastic bags) and the food is broken up using a power hose.

Surplus food waste is heated to 80 degrees Celsius in 10-ton tanks, then cooled to 40 degrees. Lactic acid fermentation is used for approximately 6 to 8 hours, with a pH between 3.7 - 4.2, using formic acid and lactobacillus (a bacterium similar to that used to turn milk into yoghurt, and the same bacteria is used in Yakult), which preserves the liquid feed and enhances its nutritional value. This process also inactivates disease pathogens of concern. For example, African Swine Fever cannot survive in temperatures above 70 degrees, whereas Foot and Mouth Disease cannot survive in pH lower than 6.

Farmers are able to feed their pigs 100% eco-feed because JFEC can guarantee a protein content of 15 to 17 per cent through computerised composition monitoring and the addition of a very small amount of soya (about 1% of total feed) as well as some synthetic lysine and calcium-vitamin premix. The resultant liquid feed is about 20% dry matter and has a shelf-life of about 10-14 days at room temperature. Finally, the feed is sold at half the cost of conventional feed, to around 15 medium-sized pig farmers (300 to 2,000 pigs each) within 150 km of the plant. Farmers can sell their pork at a premium as consumers appreciate the environmental value of the product (Kurishima et al. 2011). The pork is sold under a green label as "Yoghurt-pig" which claims to have "10 per cent more unsaturated fatty acids and 20 per cent less cholesterol" and be "tender, delicious, and juicy" (Stuart 2009, 278-81).

Takashi Kamei, a Japanese pig breeder who feeds his pigs on processed feed from JFEC, said "compared to the cost of my old feed, this environmentally friendly product costs me half as much. It's also better for the environment, so it's better for everyone" (Lemaire 2011).



Key steps to safe and nutritious feed

1. Collection

Collection from food businesses in dedicated bins to a reception bay strictly segregated from the rest of the plant. For perishable foods, transport is refrigerated.



2. Traceability

Each bin is barcoded for full traceability back to source.



5. Preventing contamination

One directional process flows and zoning are used to ensure there is no cross-contamination between treated and untreated feeds.

4. Sorting

Foreign objects (forks, plastic bags) are removed through a mix of automated techniques like magnets and manual sorting.



3. Nutrition

The surplus food is put into the bins in broad categories (carbohydrates, vegetables, meat, etc) and weighed to calculate the nutritional content of each batch.



6. Shredding

Surplus food is shredded and water is added to ensure that heat-treatment is thoroughly and uniformly effective.



7. Heat treatment

Heat treatment combined with acidification; through fermentation or adding lactic acid which inactivates disease pathogens. Low pH also increases shelf life.



8. Monitoring

Feed samples are tested to ensure safety and absence of contaminants. Processing plants must be licenced and regularly inspected.



9. Transport

The feed is then transported to licenced pig farms. Feed processing factories must be off-farm to ensure pigs or other livestock cannot access the untreated surplus food.

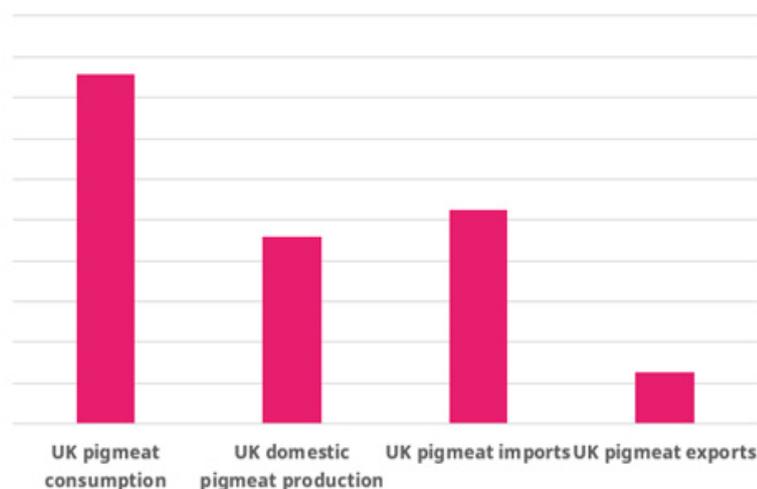


7. PIG FARMING IN THE UK

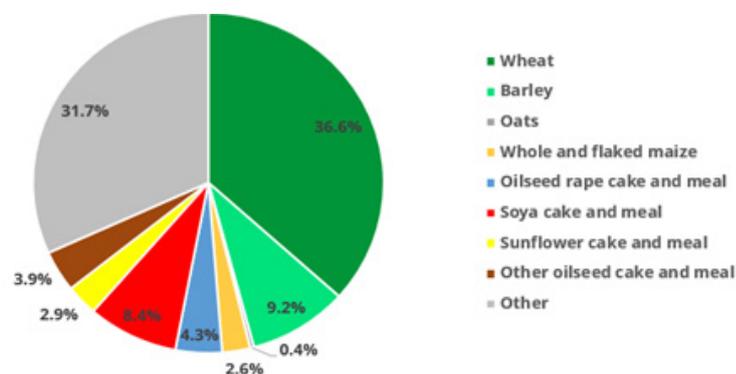
Current UK Pig and Pig feed Production:

In 2016, the UK slaughtered 10,990,000 pigs (AHDB 2017, 16), 4% of the approximately 257 million pigs slaughtered in the EU (EUROSTAT 2017b). 26kg of pork was consumed per person in the UK in 2016 (AHDB 2017, 16).

VOLUMES OF UK PIGMEAT PRODUCTION, CONSUMPTION, IMPORTS AND EXPORTS IN 2016 (TONNES)



(Defra 2018b Figure 2).



Of the UK's total animal feed consumption in 2017 (Defra 2018b Figure 2):

The UK produced 1,825,000 tonnes of pig feed, 13.2% of the UK's total animal feed production. Defra does not publish feed compositions for separate species, but assuming that pig feed uses roughly the average proportions of feed for the UK animal feed industry as a whole – BPEX claimed that pig feed is 8% soya (BPEX 2014, 3) – this would imply that pig feed in the UK used roughly 143,000 tonnes of soya cake and meal in 2017. Chickens need around 20 % of protein-rich soy in their feeds (PoultryHub 2018; Burley 2008). With a total of 6,244,000 tonnes of chicken feed produced in the UK (Defra 2018b), this means that chicken feed in the UK may be using up to 1,248,800 tonnes of soy annually. We have not yet found data on how much of this the chicken industry has been able to replace with alternative sources of protein. To put these figures at the consumer level, a study in the Netherlands found that for every kilogram of pig meat, 263g of soy was used, and for every kilogram of chicken meat, 575 grams of soya (Hoste and Bolhuis 2010).

Country of origin for UK soybean and soy oilcake imports

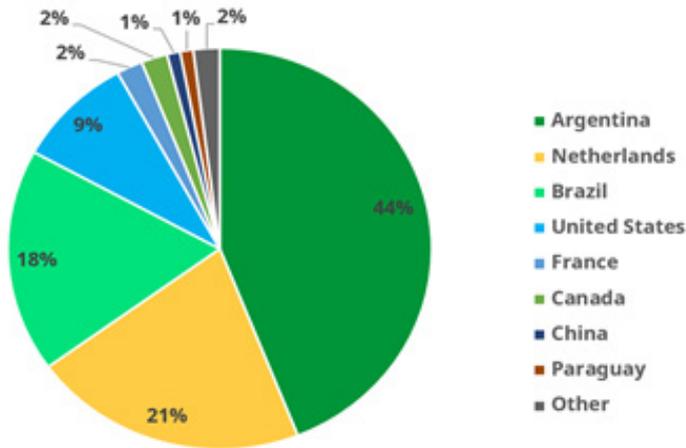


Table derived by Feedback from UK Customs data (HMRC 2018)

Note: Many of the imports from the Netherlands and France are likely to have originally come from South America.

Soy in UK pig feed:

The NPA highlight that “over the past ten years the pig industry has halved its inclusion of soya in pig diets, by substituting with rapeseed meal, peas, beans and distillers’ waste as sources of crude protein” (National Pig Association 2013). While this is important progress, overall soy imports into the UK continue to rise. Given the environmental impact of soy, further reductions in pig and poultry farming, and elsewhere, are paramount.

UK imports (offset against exports) of soy beans, and oilcake/other solid residues from soybean oil from EU and non-EU countries between 1996-2017

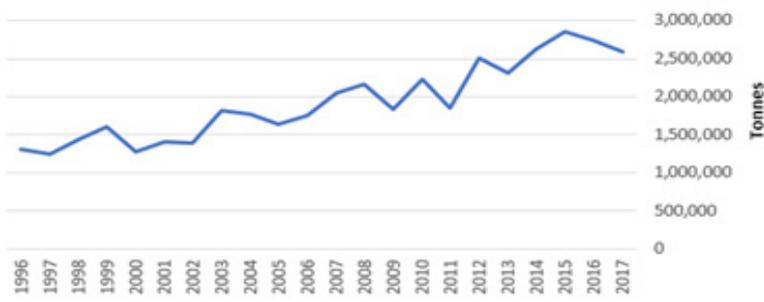


Table derived by Feedback from UK Customs data (HMRC 2018)

8. SMALL-SCALE AGRO-ECOLOGICAL FARMING

There are 30,000 premises with pigs in the UK, including those with pet pigs, but 92% of pork production comes from about 1600 farms (AHDB Pork 2018). It is therefore important to consider smallholder pig farming due to their number and also small agroecological farms, which are an indispensable piece of the puzzle when designing a sustainable food system that can feed the growing global population (Altieri 2009; Pretty et al. 2006).

Farm scale and disease:

Highly concentrated large numbers of animals found in large-scale intensive farming are more susceptible to infection and increase the risk of emergence of more virulent disease strains (Garner, Hess, and Yang 2006; Mennerat et al. 2010; Jones et al. 2013). In contrast to high-density pig production, village pig production may result in virus fitness loss and manifest as lower virulence viruses (Drew 2011). On other hand, researchers have pointed to the role of cash-strapped small-scale pig farmers in the spread of African Swine Fever in countries such as Mozambique, Nigeria and Russia as they practice emergency sales of their animals as soon as they suspect disease (Costard et al. 2015).



Rare breeds, emerging disease and food security:

Drew, a viral pig disease specialist of the UK Animal and Plant Health Agency has noted that the high density and almost clonal nature of pig genetics can provide a 'monoculture' environment detrimental of natural resistance to pathogens and which may lead to explosive outbreaks of novel disease (Drew, 2011). There are also growing concerns about the erosion of genetic resources in livestock (Ajmone-Marsan 2010), because animal genetic diversity is critical for food security and rural development. Through the maintenance of rare breeds, smallholders play a crucial role in protecting the UK's food security (RBST 2018), as this maintains genetic diversity and allows farmers to select stock or develop new breeds in response to changing conditions, including climate change and new or resurgent disease threats (Hoffmann 2010). Furthermore, rare-breed smallholders also make important contributions to the rural economy, education, and British heritage (RBST 2018).

Legally defining the smallholder:

A legal precedent for defining the low-risk smallholder in the UK and the EU exists in the (Food Standards Agency 2018) Feed Law Practice Guidance (p.10) on the scope of EC Regulation 183/2005 (on feed business registration). The guidance states that the following activities are currently outside the scope of EC Regulation 183/2005 and do therefore not require registration as a feed business operator:

- Keeping / feeding of food-producing animals kept for:
- private domestic consumption
- the direct supply by the producer of small quantities of primary products to
 - the final consumer
 - local retail establishments directly supplying to the final consumer

In the US, a family farm can directly supplement the diet of its pigs with its own kitchen scraps, including those that contain unprocessed meat, without first undergoing the SHPA boiling procedure (US Department of Agriculture 2009; Leib et al. 2016). However, given the risk context in the UK and Europe – such as the presence of African Swine Fever in Eastern Europe - we believe that it will not be possible to have such an exemption in the UK or EU even though currently the law is routinely broken. For instance, a survey of 313 smallholder farms in the UK found that 24% of smallholders fed uncooked household food waste to their pigs (Gillespie, Grove-White, and Williams 2015).

Because of both the important role of smallholders and the fact that uncooked household food waste continues to be fed to pigs at the smallholder level, Feedback is planning further research to develop sound recommendations that support smallholders. Risk management at the smallholder level will need to be proportionate to the scale of risk. For example, in their discussion on farm scale, disease epidemics and antibiotic resistance, (Gilchrist et al. 2007) consider “a definable, small farm size with minimal numbers of animals” less risky in terms of disease prevention (p.315). At the same time, we will need to bear in mind the proximity of farms of different sizes in the UK and the potential airborne spread of Foot and Mouth Disease.

9. POTENTIAL FOR FEEDING MORE UNUSED FOOD TO PIGS IN UK

Surplus food and agricultural by-products already used in livestock feed: 662,000 tonnes of unused food are currently sent from the UK retail and manufacturing sectors to animal feed as a whole (WRAP 2016, 11). Agricultural by-products, such as rape meal, wheat middlings, spent brewers’ grains and molasses are important ingredients of pig feed. As these ingredients are well accepted in the industry, this report does not discuss them further.

Unused surplus from primary production: WRAP estimate that 2.5 million tonnes of food is wasted in the UK at primary production level (Quinn 2017a). From Feedback’s experience with farmers through its Gleaning Network, and through its 2018 report Farmers Talk Food Waste (Bowman 2018), we know that many vegetable farms already sell some of their surplus stock to livestock feed, although the price they receive for this is generally minimal. However, there is considerable potential for the expansion for this, if it could be made more cost effective for farmers than ploughing their excess food back into the field.

Volumes of unused food currently leaving the food supply chain: Every year in the UK hospitality and food service sector, approximately 920,000 tonnes of food is wasted, equivalent to one in six of the 8 billion meals served each year (WRAP et al. 2013). Catering food waste, and meat and fish food waste occurring at manufacturing and retail level, add up to a total of 1,461,200 tonnes of food which would be liberated to feed to pigs and chickens. In addition to this, if we use Defra’s rough estimate that 75% of non-meat food wastes are mixed and therefore could not be fed to pigs under current law because of risks of cross contamination with meat (Defra 2013), then a further 75% of the remaining 1,358,000 tonnes wasted at manufacturing and retail level could be used as feed – equal to roughly 1,018,500 tonnes.

This leads to a combined total of 2.5 million tonnes – 20% of the UK’s total estimated food waste - if we include provisional estimates for farm level food waste. Further work is needed to prevent such waste in the first place and redistribute unavoidable surplus to humans, but any unavoidable surplus from these 2.5 million tonnes would be additional to a current total of 662,000 tonnes of food currently sent from the retail and manufacturing sectors to animal feed (WRAP 2016). In contrast, under current legislation WRAP estimate that the maximum optimal additional food waste that could be sent from retail and manufacturing to animal feed would be an additional 143,000 tonnes – only 1% of the UK’s total estimated food waste.



World War II poster. Credit: Imperial War Museum

A full breakdown of the types of food waste is available in the Annex which can be downloaded from: <http://feedbackglobal.org/wp/wp-content/uploads/2018/07/Annex-Pig-Idea-Policy-report.pdf>

Household food waste: An estimated 7.3 million tonnes of food are wasted at consumer level annually in the UK (WRAP 2017). We have excluded consumer food waste from these calculations given the additional challenges of keeping household surplus fresh and free from contaminants.

Authorised use of poultry processed animal protein (PAP) in pig feed and vice versa: The European Commission is reviewing legislation to allow the feeding of processed animal protein (PAP) derived from non-ruminants to non-ruminants of a different species – including using poultry PAP in pig feed and vice versa. In 2014, the British Poultry Council came out in favour of this measure, as long as rigorous processes can be put in place to avoid same-species or ruminant material finding its way into feeds (Searby 2014). While increasing the use of offal and overlooked cuts of meat in direct human consumption should be a priority, using any left-over animal proteins safely in feed for omnivorous livestock makes perfect sense, and would be an important step forward.

10. THE ENVIRONMENTAL CASE

10.1 The environmental problems related to conventional feed

Land: Globally, livestock production already occupies approximately 75% of agricultural land (Foley et al. 2011). In 2010, the British livestock industry required an area the size of Yorkshire to produce the soy used in feed (WWF 2017). Approximately 85% of the UK's total land footprint is associated with meat and dairy production but provides only 48% of the UK's total protein and 32% of its total calories (de Ruiter et al. 2017). 70% of UK land is used for farming, a high proportion compared to similar countries (Kleanthous 2009).

Greenhouse gas emissions: The meat industry is responsible for 14.5% of global emissions directly (Gerber and FAO 2013, 14). A BPEX commissioned study concluded that “feed contributes 78% of the total carbon footprint of pork production” and concludes that “using feed as efficiently as possible” should be the biggest priority for reducing the environmental impact of British pork production (Fry and Kingston 2009, 1–2). Agriculture is responsible for about 7% of UK greenhouse gas emissions, with the livestock industry contributing the majority of this at 5% of total emissions (AHDB 2013).

Deforestation: The UK imported 2,847,180 tonnes (imports minus exports) of soy bean and oilcake of which as much as three quarters came from Brazil and Argentina (HMRC 2018), contributing pressures on deforestation in those countries. Between 2005 and 2016, at least 1.1 million hectares of native vegetation in the Amazon and Cerrado biomes were directly cleared for soy (TRASE 2018). Argentina contains the highly biodiverse Gran Chaco region and has lost 22 percent of its forests between 1990 and 2015, primarily for soybean farming and cattle ranching. Conversion of the Chaco forest and grasslands to croplands and pasture is estimated to have released 3,024 million metric tons of carbon dioxide between 1985 and 2015 (Mighty Earth et al. 2018).

Efforts to tackle deforestation like the Brazilian Soy Moratorium and “Cerrado Manifesto”



focus on Brazil, and provide perverse incentives for feed companies to shift deforestation to Argentina and Paraguay (Mighty Earth et al. 2018). Even so, in May 2018, five traders and multiple soy farmers were fined a total of US \$29 million by the Brazilian government for soybean cultivation and purchasing that is connected to illegal deforestation (Byrne 2018). Two of the five companies fined – Cargill and Bunge - are among the top five soy exporters from Brazil, and some of the few companies that have adopted zero deforestation commitments. The fine demonstrates the vulnerability of the companies' systems for monitoring and tracking their supplies and the fact that they cannot guarantee that their sources are deforestation free (Vasconcelos and Burley 2018). The Trase tool shows the continued risk faced by soy traders regarding supply chain deforestation risk (TRASE 2018).

Because of the ban on feeding meat to omnivorous livestock in 2001, an animal feed protein deficit equivalent to 2.9 million tonnes of soymeal resulted in an increase of EU soya imports of 3 million tonnes between 2001 and 2003 (Steinfeld et al. 2006).

10.2 The environmental impact of food waste:

For the environmental impact of food waste

Carbon Emissions: The Food and Agriculture Organisation estimates that global food waste accounts for 8% of total anthropogenic GHG emissions, nearly as much as global road transport emissions (FAO 2013a). A recent study 'Drawdown' concluded that global reduction of food waste was the third most important action that could be taken to reduce global emissions, ahead of tackling deforestation and solar energy (Project Drawdown 2017).

Land and Soil: The production of food that is wasted uses up "1.4 billion hectares of land – 28 per cent of the world's agricultural area" (FAO 2013b). This is equivalent to the land area of China and India combined. Europe's wasted meat and milk is estimated to account for 5.1% of arable land used to grow food that is never eaten globally (FAO 2013b).

Water: The water that is currently used to grow food that is wasted would be enough for the household water needs of 9 billion people, the number expected on the planet by 2050 (Stuart 2009).

Food prices: McKinsey Global Institute estimate that the alleviation on land, water, fossil fuels and other resources created by resource efficiency, including food waste reduction, would lead to lower and less volatile food prices (Dobbs et al. 2011).

10.3 Potential environmental benefits of feeding surplus food to omnivores:

The UN estimates that enough grain could be freed to feed an extra three billion people if all livestock globally was fed with surplus and by-products (UNEP 2009). If the law was changed, the potential reduction of land used for growing feed crops would be over 20% of total land used for EU Pork. However, optimising the use of currently permissible surplus food, would only result in a land use reduction of 1.2%. (zu Ermgassen et al. 2016). Feeding meat-containing surplus food to pigs also could "reduce demand for up to 268,000 hectares of soybean production, which could mitigate ca. 2.6 % of the forecast expansion of soybean, reducing pressure on high-biodiversity tropical biomes accordingly (zu Ermgassen et al. 2016).



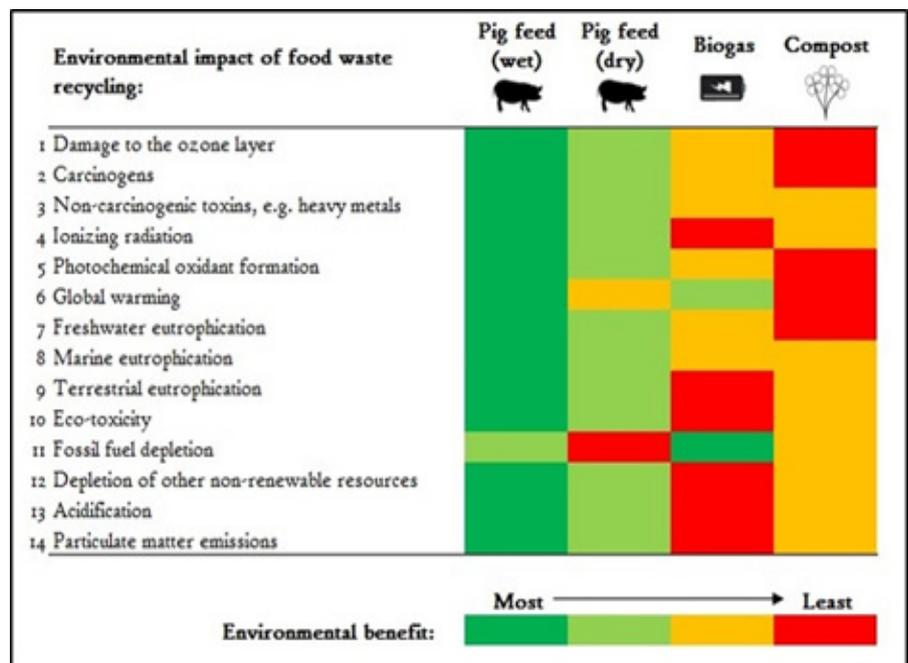
Carbon emissions: Even replacing small percentages of compound feed mix with currently permissible treated surplus food, such as pumpkins, mushrooms and yoghurt, could lead to significant carbon savings. For example, switching 10% of total broiler chicken feed to the food waste mix developed by the NOSHAN project could lead to a total avoidance of 6.2 million tons of CO₂ emissions to the atmosphere each year (Gillman 2018). A similar adoption of treated surplus food as part of livestock feed globally could lead to a “reduction of natural land transformation by 30% and agricultural land occupation by 12%, which would protect carbon sinks and prevent greenhouse gas emissions from the additional intensive agriculture.” (Gillman 2018).

UK climate change and food waste reduction commitments: Reducing the environmental impact of the UK livestock industry and food waste can make a major contribution to the UK meeting its emissions targets under the Climate Change Act (UK Government 2008). According to WRAP, a 30% reduction of food waste by 2025 would not be achievable under current legal conditions (WRAP and Parry 2014), meaning the UK would not be on track to meet Sustainable Development Goal 12.3 to halve food waste by 2030. Legislation regulating the safe feeding of heat-treated meat-containing surplus food to pigs could contribute to the introduction of statutory targets to halve food waste from farm to fork by 2030 against 2015 baselines, in line with SDG 12.3.

COMPARING FEED TO ANAEROBIC DIGESTION

Using surplus food as animal feed scores better on 12 out of 14 environmental (e.g. eutrophication and eco-toxicity) and health (e.g. carcinogens) indicators compared to anaerobic digestion or composting (Salemdeeb et al. 2017) (see table below). The calculations in the study were based on the current UK energy mix for the energy needed to render the surplus food safe. If renewable energy was used, feed could potentially beat biogas and compost on all indicators.

The UK can still meet its renewable energy targets despite diversion of food waste from AD to livestock feed, through investment in wind, solar and other renewables, and sending unavoidable food wastes not suitable for livestock feed to AD.



10.4 Why feeding surplus food to pigs is environmentally preferable to other alternatives to soy:

Some of the biggest feed manufacturers have set finding alternatives to soy as a top priority -for instance, ABN is looking at alternatives such as peas, rapeseed and insect meal (Randall 2014). There is no doubt that we need a range of solutions to make the food system sustainable, but it is important to bear in mind the limitations of some of the alternatives:

Rapeseed: Rapeseed oil has seen a startling rise in production in the UK in the past decade, mainly driven by its use in biofuel, but also as an alternative cooking oil. Yet biodiesel made from rapeseed emits roughly 20 percent more CO₂ than diesel or petrol (Oxfam International et al. 2016), whilst simultaneously encroaching on land which was previously used to grow food or graze livestock, putting upwards pressure on food prices. Rapeseed is also significantly less land efficient than palm oil (May-Tobin et al. 2012) – meaning that it raises pressures on global agricultural land use, and therefore indirectly contributes to deforestation. Finally, rapeseed feeds have been found to be less digestible than soy feeds (Gonzalez-Vega and Stein 2012), making it a less efficient feed.

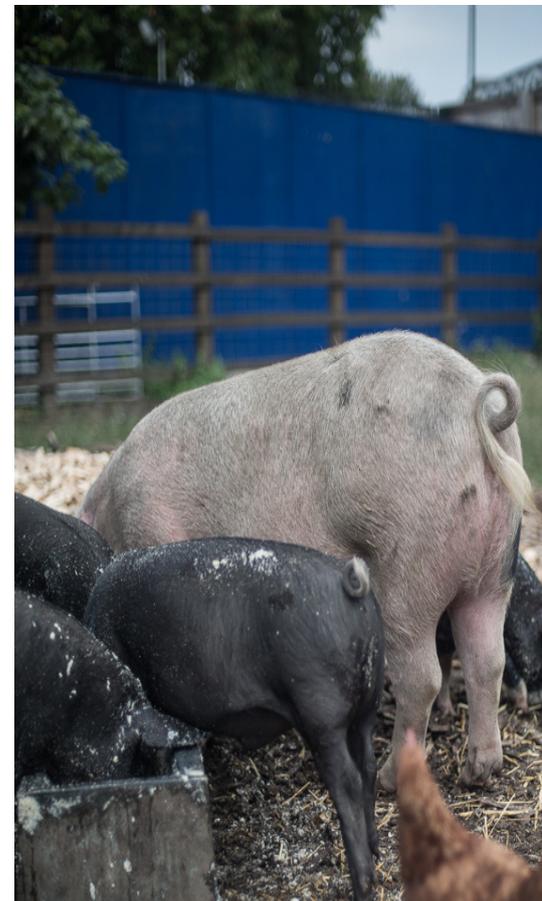
Insects: Insects may be part of the solution, but they are currently only allowed to eat what farmed fish – and soon other omnivorous non-ruminants - are allowed to eat directly: vegetable food surplus, fish that is a different species and non-ruminant processed animal protein (insect amendment to the 999/2001 reg on TSE) (EU 2017). Thus, while insects may contribute to reducing the protein deficit, they would not at this stage help to prevent more surplus leaving the food chain. Moreover, according to a key Life Cycle Assessment (LCA) (van Zanten et al. 2015), using larvae meal as animal feed results in “decreased land use” but “increased global warming potential and energy use”, mostly because of the additional energy needed for growing and processing the larvae.

Another LCA of insects showed that a higher insect yield was achieved via the use of feed with good nutritional quality (e.g. rye meal, soybean meal), but then the final product was associated with high environmental impacts. On the other hand, low quality feeds for the insects, based on manure (currently illegal to feed manure to insects in the EU), had low efficiency for insect yields as it caused an increase in the use of resources at the insect growing stage, which overcame the benefits from manure utilization (Smetana et al. 2016). An EFSA scientific opinion also noted that viruses that affect humans and farm animals can survive in insects, and thus feeds for insects containing meat would need to be heat-treated to make them safe, in the same way as normal animal feed (EFSA Scientific Committee 2015).

11. POTENTIAL ETHICAL BENEFITS FOR BRITISH PIG FARMING

The high potential cost savings of switching to feeds with a high surplus food component would liberate money for farmers to invest in improvements to environmental and ethical standards without having to increase prices, and thus remain competitive. For instance:

Resisting the rise of factory farming and supporting SMEs: There has been an increasing tendency in the UK pig industry towards concentration of higher numbers of animals. Compassion in World Farming (CIWF 2018) found that approximately 70% of UK farm animals are now kept in factory farms. A Joint Scientific Opinion by the European Medicines Agency



and the European Food Safety Authority highlights that “The stress associated with intensive, indoor, large scale production may lead to an increased risk of livestock contracting disease” (CIWF 2017). Factors associated with factory farming such as high stocking density, a barren environment, and absence of bedding and straw for rooting are animal welfare risks associated with tail biting (European Food Safety Authority (EFSA) 2007). The National Pig Association (2018) notes that in contrast to other major pig producing countries such as the US, the Netherlands and Denmark, “40% of the UK sow herd is housed permanently outdoors. Of the indoor sows, 90% are housed on straw and of the finishing pigs, 66% are on straw. The vast majority of pig production businesses would fall under the SME (less than 250 employees) category and most are still family owned”. UK minimum welfare standards are higher than those in many other EU countries, but some UK farms have been found to be breaking welfare regulations by keeping pigs on bare concrete slats with no bedding, and routinely cutting off piglets’ tails to prevent biting (Farms not Factories 2018).



High pig feed costs play a part in driving animal cruelty, over-use of antibiotics and air and water pollution in factory farming. Cheaper feed could help farms invest in higher welfare. And feeding pigs safe, nutritious, and varied food leftovers rather than just dried pellets made from soy and cereal, helps boost their welfare and reduce stress. It is perfectly safe for pigs to eat meat and even small scraps of pork, as long as it is treated properly. Feeding pigs on heat-treated food waste is a win-win for animal welfare, pig farmers and the environment



Tracy Worcester, Farms not Factories

Increased animal welfare: Reducing feed costs may support farmers wishing to invest in animal welfare. In addition, feeding surplus food to pigs may improve animal welfare directly. Deficiencies of essential amino acids may exacerbate tail biting in fattening pigs and deprivation of feeding behaviour, even when nutritional needs are met, may contribute to tail biting in pigs (Manteca et al. 2008, 230). While tail biting is triggered by a large number of variables, in certain situations it may be possible to contribute to a reduction in tail biting by replacing conventional feed with heat-treated leftovers that contain meat, allowing pigs to return to the type of diet they have evolved to eat as omnivores. Adding a diversity of surplus-food-based feeds, so long as these give optimal nutrition balanced out over time may maintain homeostasis and reduce levels of stress (Manteca et al. 2008). Feeds made from surplus food could provide the additional food types required for a high welfare score in the foraging category for welfare outcome assessments in UK pig-farm assurance schemes (Mullan et al. 2011).

Reduction in antibiotics use: By 2050, drug-resistant infections are expected to cause 10 million deaths annually – becoming a bigger killer than cancer is today (Review on Anti-Microbial Resistance 2014). Reducing feed cost pressures may support farmers wishing to invest in reducing the levels of anti-biotics required on UK pig farms such as alternatives like probiotics. Moreover, “fermented liquid feed may strengthen the role of the stomach as the first line of defence against possible pathogenic infections by lowering the pH in the gastrointestinal tract thereby helping to exclude enteropathogens” (Missotten et al. 2015). And fermented liquid feed can reduce coliform levels in the lower gut (Brooks, Beal, and Niven 2001) as well as preventing the proliferation of other pathogens such as Salmonella (Missotten et al. 2015).

Reducing meat consumption overall: While it may be good to make environmentally friendly options for meat more affordable and increase demand for such meat over conventional meat, Feedback would like to insist on the importance for a reduction of overall meat consumption. If every country in the world were to adopt the UK’s 2011 average diet and meat consumption, 95% of global habitable land area would be needed for agriculture – up from 50% of land currently used (Ritchie and Roser 2017). Both a drastic reduction in food and agricultural waste, and a radical change in dietary patterns are fundamental ingredients of a sustainable global food system. Cutting food and agricultural waste by half could reduce the area of global cropland by around 14% and GHG emissions by 22-28% compared to a scenario achieving optimal yields through sustainable intensification alone. Adding healthy diets - with a significant reduction in energy-rich foods such as sugars and saturated fats, including livestock products - to a scenario of reduced waste and optimal yields, would lead

12. INDUSTRY AND PUBLIC OPINION

to a further reduction in the area necessary for cropping by an estimated 5%, pasture by 25% and the total GHG emissions by 45% (Bajželj et al. 2014).

Farming Industry Opinion: Zu Ermgassen et al (2018) “found strong support (>75%) for the relegalisation of swill among both pig farmers and other stakeholders”, based on a survey of 82 pig farmers and 81 other agricultural stakeholders at a UK agricultural trade fair. Of the farmers surveyed, 60 have large farms with more than 1,000 animals, making up approximately 4% of the 1,410 large pig farms in the UK. The biggest concerns of those who were supportive of relegalisation were farm financial performance and efficiency, benefit to the environment and reduction of trade-deficits. The biggest industry concerns by those who were less supportive were about disease control and consumer acceptance of swill-fed pork, which suggests that if these barriers can be overcome, an even broader range of industry would be supportive.

Public Opinion: In Japan, a survey of consumers found that those most knowledgeable about the pig industry showed the strongest approval of recycling surplus food as feed (Sasaki et al. 2011) indicating that education may help improve public acceptance. Another consumer study found that “the willingness to pay for the pork produced with feed from food residuals was approximately an additional 19.3 yen / 100g-pork in comparison with to ordinary Japanese pork” and that the willingness to pay for reduced GHG emission pork was an additional 0.4 yen / g-CO₂. The study concluded that labels with information on resource recycling and CO₂ reduction encourage consumers to purchase the pork produced with feed from food residuals (Kurishima et al. 2011). The Pig Idea has already been very successful with the public, but together with REFRESH, Feedback are conducting further research into British and Spanish consumer views of pork fed on surplus food, which will be published in 2019.

Catering Industry Opinion: Leading celebrity chefs support Feedback’s Pig Idea campaign, including Thomasina Miers and Hugh Fearnley-Whittingstall, with significant potential for supporting consumer and industry acceptance of feeding heat-treated surplus food to pigs and chickens.



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In the five years since Feedback first launched its Pig Idea campaign, food waste has risen even further up the list of priorities for restaurants and the wider foodservice sector, with thousands of operators separating their waste and taking giant steps to reduce it in the first place. Armed with the latest scientific evidence and surveys, Feedback makes a very compelling case for at the very least a review of the current legislation which prohibits catering waste being fed to pigs. The economic, ethical and environmental case is strong and the Sustainable Restaurant Association believes that with clear communication and the suggested safety measures in place, chefs and diners would give this their wholehearted support as it is good for pigs, good for farmers and good for the planet

”

Andrew Stephen, Chief Executive of the Sustainable Restaurant Association.

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Feedback enables the regeneration of nature by reducing the demands placed on it by the food system. To do this, we challenge power, catalyse action and empower people to achieve positive change.

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