Perspectives

Sustainability implications of rising global pork demand

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Implications

- Current projections point to rising global pork demand fueled by population and income growth mainly in the developing world.
- Global pork trade is driven by imbalance between national demand and supply and influenced by supply shocks and trade disruptions.
- Increasing pig production due to rising pork demand can intensify a host of environmental challenges such as increasing GHG emissions and land and water stresses.
- Balancing the need to meet rising pork demand and to ensure environmental sustainability requires a multipronged approach, encompassing technological development and adoption, resilient production systems, responsible consumption choices, well-functioning global markets, and stronger environmental regulations.

Key words: environmental sustainability, global pork demand, market projection, swine production

Introduction

Pork plays a very important role in the dietary choices of consumers in many parts of the world. As an important source of animal protein and other nutrients, demand for pork is projected to rise in the near future (OECD/FAO, 2022). Much of the projected increase is due to growing demand in Asia, and to a lesser extent in Latin America, fueled by growing income levels and population. Africa's pork demand is also projected to rise, although from a much lower base and mainly due to population growth. In the developed world, demand is expected to remain stable. Current projections also assume normalized demand and supply conditions after recent shocks from the African Swine Fever (ASF). While rising pork demand at the global scale provides the global swine sector with further growth opportunities, it will intensify important sustainability challenges in swine production. These challenges include on-farm greenhouse gas (GHG) emissions, indirect emissions related to feed production and associated land use and land use changes, and increased risk of pollutant release to soil, water, and air. In addition, supply shocks and disruptions to trade linkages can also threaten the smooth functioning of the global pork and feed markets. This paper summarizes current projections on future pork demand, characterizes factors affecting market stability, reviews the key environmental sustainability challenges, and offers perspectives on how to balance the challenges to simultaneously meet rising demand and enhance the swine sector's environmental sustainability.

Current Projections and Major Drivers of Rising Pork Demand

Several international/supranational organizations and national agencies regularly publish projections on international agricultural commodity markets (see summary provided in Bouyssou et al., 2021). Among them are the decadal projections released annually by the Organization of Economic Cooperation and Development (OECD) and the Food and Agriculture Organization of the UN (FAO). According to the latest OECD/FAO projection to the year 2031 (OECD/FAO, 2022), global pork demand is expected to rise from the average annual level of 110.5 million metric tons during the most recent triennial period (i.e., 2019–2021) to 128.9 million metric tons in 2031 (Figure 1a). The main growth engine of global pork demand is Asia, where total demand is projected to rise from 61.4 million metric tons to 76 million metric tons during the projection period. On a per capita basis, an average Asian consumer will increase pork consumption from 10.4 to 11.9 kg. Within Asia, China maintains its dominant position as the world's largest consumer, with total demand rebounding from the recent ASF-caused slump to 58.9 million metric tons. Continued income growth is expected to push China's annual per capita pork consumption to 31.2 kg, approaching the consumption level in the European Union (EU), the world's second largest pork market. Elsewhere in Asia, rising demand is also expected in growing economies such as Vietnam and the Philippines but not for high-income countries such as Japan and Korea. Latin America and Africa will increase their respective consumption

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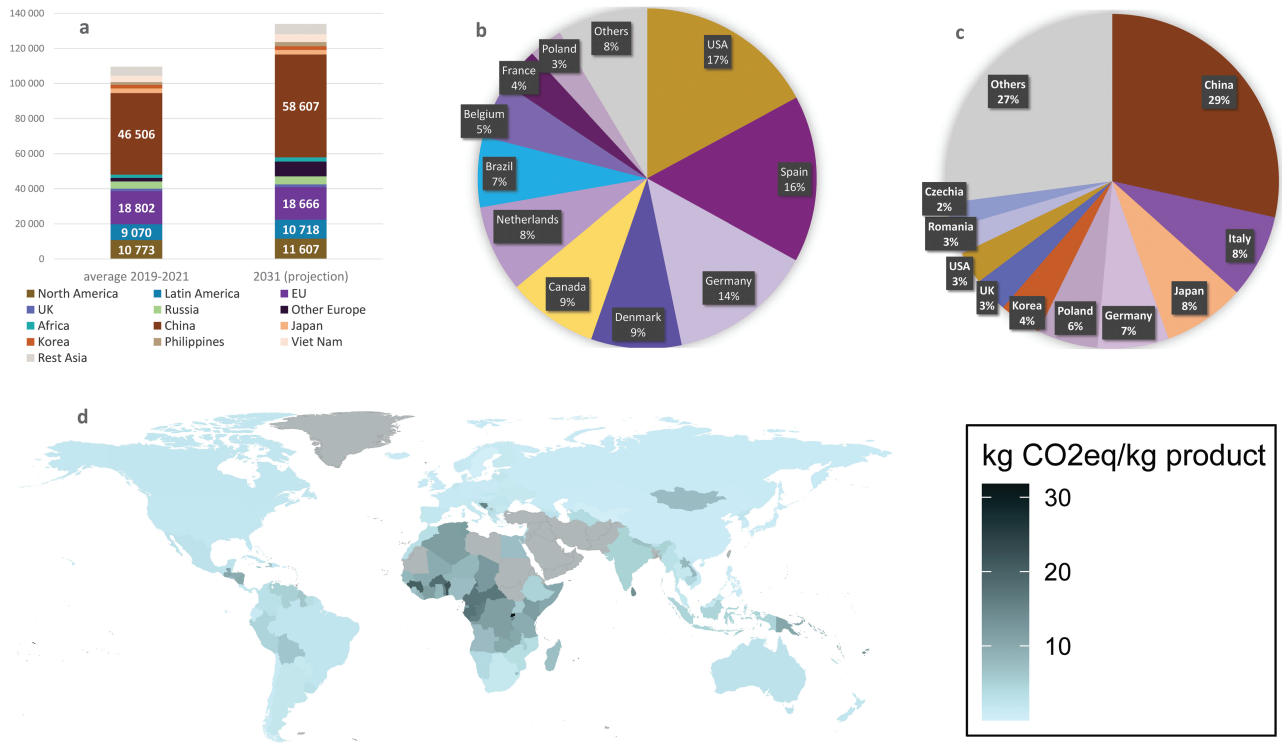

Figure 1. a: Current and projected pork production (unit: 1,000 metric tons, carcass weight equivalent. source: OECD/FAO (2022); b: Shares of global pork exports by top exporters, 2019–2021 (source: comtrade.un.org); c: Shares of global pork imports by top importers, 2019–2021 (source: comtrade.un.org). d: On-farm swine emission intensities by country (source: FAO).

levels, but due to different reasons: rising demand in Latin America is driven by higher per capita consumption while Africa's growing demand is due to expected population growth. In the developed world, total and per capita consumption levels will remain flat or show very modest increase, reflecting relatively inelastic pork demand relative to income changes when per capita consumption of all meats has already reached very high levels.

Supply Shocks, Trade Linkages, and the Feed-Pork Nexus on the Global Market

To meet expected rising global pork demand, one immediate concern for the global swine sector is to manage supply shocks such as the ASF outbreaks, which damaged production capacity in a number of key producing countries. For instance, ASF outbreaks in China that first emerged in August 2018 reduced the country's pig herd by 4.8% and sow herd by 8.3% already by December 2018 as compared to the previous year (official statistics as cited in Han et al. (2022)). Other studies, however, point to much higher reductions (e.g., You et al., 2021). The ASF outbreak led to significant economic losses for swine farmers, suppressed consumer demand, and drastically increased pork imports in China (Mason-D'Croz et al., 2020; You et al., 2021; Han et al., 2022). The ability for the global swine sector to meet the expected rising demand is contingent on successful efforts to recover from ASF outbreaks and to prevent similar adverse shocks in the future.

Global swine production and pork demand are not evenly distributed at country level, necessitating the need to balance demand and supply through trade linkages. As shown in Figure 1b, global pork exports are dominated by several large exporters in North America (USA and Canada), the EU (Spain, Germany, Demark, the Netherlands, etc.), and Brazil. The top 10 exporters contributed 91% of world total pork exports (by carcass weight equivalent) during 2019–2021. On the import side (Figure 1c), China has become the dominant importer, having imported 29% of world imports during 2019–2021, followed by Japan (8%) and Korea (4%). China's emergence as the leading importer can be partially explained by the significant supply shocks it suffered in recent years; more fundamentally, cost disadvantages in China's swine sector will likely imply continued imports, even after the country completes its full recovery from the ASF shocks (Han et al., 2022). Significant intra-EU trade is also observed, as Italy, Germany, Poland, Romania, and Czechia are all among the top 10 importers. Compared to the more concentrated global exporters, importing countries are more diverse, as the top 10 importers only have a combined share of 73%, indicating that more importing countries depend on the global markets. There are also strong bilateral dependencies among the importing and exporting countries. For instance, the world's main exporting countries (e.g., Spain, Germany, USA, and Canada) have all maintained significant exports to the Chinese market in recent years; however, bilateral trade frictions (with the USA and Canada) and export restrictions due to ASF outbreaks (in Germany) have led to

quite large shifts in market shares of leading exporters on the Chinese market. Against the backdrop of significant geopolitical tensions and weakened global trade institutions, trade frictions may continue to cause re-configurations of pork trade patterns, thereby demanding countries with surplus production to build more resilient trade relationships while being nimble in seeking out new export markets when trade frictions arise.

One of the underlying determinants of the current global pork trade pattern is the cost and availability of feed such as maize and soybean, a factor that is naturally advantageous to North and South America. Both the EU and especially China are major importers of animal feed. In the Chinese case, soybean imports have approached or even exceeded 100 million metric tons (about six times of its domestic production) in recent years. Given the current production efficiency and technology in China and its resource constraints, the absence of feed imports would threaten the country's 95% pork self-sufficiency goal and result in much larger pork imports, which in turn would translate into significant adjustment of swine production at the global level and likely change the world soybean trade patterns. Therefore, whether or not and to what extent China changes its self-sufficiency goals in pork and soybean will have major implications on the global markets (Yu and Cao, 2015).

Environmental Sustainability Implications of Rising Pork Demand

The animal food sector as a whole is responsible for 14.5% of the anthropogenic GHG emissions (Gerber et al., 2013). On-farm emission intensity of swine production is generally far less than for cattle but higher than for poultry, although significant differences exist across different production systems and countries (Figure 1d), according to the FAO's emission intensity dataset (https://www.fao.org/faostat/en/#data/EI). Adding indirect emissions from feed production and counting emissions related to land use changes would add significantly more GHG emissions to pork production, as shown in recent life-cycle assessments (see e.g., Poore and Nemecek, 2018; Crippa et al., 2021). According to the summary provided in Willet et al. (2019), on a per serving basis, pork emits less than 10% of the GHG emissions from a serving of beef or lamb but more than twice of the emissions from poultry. As such, advocates of mitigating climate change in the agricultural and livestock sector often encourage dietary shifts away from animal sourced food including pork, which would result in reduced swine production (see e.g., Willett et al., 2019; Costa et al., 2021; Clora et al., 2021). Within the meat sector, strong arguments have also been made to favor poultry over red meats, due to the former's relative lower emission intensity and lower capital and technological requirements.

In addition to GHG emissions, increasing swine production triggered by rising pork demand can also lead to other environmental stresses. As a whole, 37% of the ice-free global land surface is pastureland used for animal husbandry, while a significant part of cropland is devoted to crop production to feed livestock (IPCC, 2019). According to Willett et al. (2019), one serving of pork uses similar amount of cropland as lamb but demands about four times as much of cropland as one serving of rice or wheat. Similarly, a serving of pork on average consumes 3.8 cubic meters of water, exceeded only by the water use of rice, fruits, lamb and poultry. In total, livestock production accounts for 8% of human water use, a share that is likely to rise with global warming (Nardone et al., 2010). Other environmental concerns include air, soil, and water pollutions. These concerns have led to more stringent environmental regulations in a number of countries. For instance, during the period of January 2014 to May 2018, the Chinese government released a number of policy directives and guidelines and enacted two environmental protection laws to regulate livestock and poultry productions; however, ASF related damages to the country's swine sector have effectively forced the government to roll back some of these environmental regulations (Han et al., 2022).

Balancing Rising Demand and Environmental Sustainability

Global outlooks for the swine sector point to the dilemma between meeting the consumers' growing demands on the one hand, and being environmentally sustainable on the other hand. This dilemma calls for tools and measures that can help to balance these concerns, including both measures addressing demand and production. As already mentioned, encouragement of dietary solutions and behaviors (e.g., the EAT Lancet reference diet proposed by Willett et al. (2019)) that can reduce the demand growth for pork and other meat is one such demand-oriented measure. Authorities in several (mainly high-income) countries have adjusted their dietary recommendations in this direction (e.g., European Commission, 2022). Other demand-side measures include initiatives to reduce loss and waste of swine parts in the processing, trade and consumption stages, for example by technological improvements, product innovation, or development of more differentiated sales channels to increase the value-added from parts of the swine. Such measures may lead to higher efficiency, as production of fewer animals will be necessary to meet the increasing demand for pork. Karwowska et al. (2021) refer to estimates suggesting that some 23% of the EU meat sector production is wasted, such as losses occurring in the manufacturing and distribution stages, and these losses are likely to be even higher in some other parts of the world.

Within swine farms, a few measures can also be implemented or adopted more broadly. For on-farm emissions from swine production (mainly from manure), this may include requirements to housing conditions, manure technology and management. In order to ensure countries' motivation to adopt such requirements without facing the risk of losing market shares, internationally agreed standards for such requirements are important. As suggested by substantial international variations in swine mortality (Gaus and Haxsen, 2004), improved management of swine health and survival rates may also reduce the number of animals necessary to produce the demanded

amount of pork, and as such contribute to more sustainable production. For more indirect swine-related emissions (via feed production), an important element is feed conversion ratio. The feed conversion ratio varies considerably across countries (Gaus and Haxsen, 2004), but can be influenced via animal breeding, farmers' optimization of growing conditions, and especially via optimized feed sourcing, which for many countries is critically dependent on the access to relevant feed components through international trade.

Last but not the least, functioning global market is fundamental for achieving economic and resource efficiencies in swine and feed production and pork consumption at global level, as it allows countries with relative abundancy in resources and/or production efficiencies to increase production and export to countries with relative resource scarcity and/or inefficient production. This is especially the case if the true costs of economic factors and environmental externalities are adequately reflected in market prices. For this to happen, it is imperative that global markets continue to function with transparency and stability, and trading rules under the auspice of the World Trade Organization (WTO) are upheld. To the extent that national regulations on negative environmental externalities such as GHG emissions differ across countries, it is important that new national measures aiming at "leveling the playground" do not unnecessarily restrict trade.

Conclusions

Global demand for pork is projected to rise further in the coming decade, driven by expected income and population growth in diversified geographical locations across the globe. At the current technological level and with unchanged intensities of resource uses, rising global demand would imply increasing feed demand, land and water use, GHG emissions, and air, soil and water pollutions. While some of the sustainability outcomes will be global (e.g., GHG emissions), others can be country- and location-specific. We argue that functioning global markets for both pork and feed are important to generate economic gains to both net importing and net exporting countries. To allow swine production to be located in places with not only economic but also environmental and resource efficiencies, there is a need for harmonizing environmental regulations and elevating climate change mitigation ambitions from all countries. In addition, to adapt to likely changing regulatory conditions (e.g., agricultural carbon taxes have gathered tractions in policy discussions in a number of countries), concerted efforts from the global swine sector are needed to continuously innovate, to improve production efficiencies such as feed conversion ratio, and to reduce damaging environmental footprints. With heightened societal attentions to climate change, particularly in the western world, autonomous changes in consumer diet favoring food choices that are perceived to be environmentally friendly are currently emerging (Statista, 2018; Hielkema and Lund, 2021), requiring increasing awareness of such changes and concrete actions by the global swine sector.

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