ASIA-EUROPE ENVIRONMENT FORUM

BACKGROUND PAPER

DECARBONISATION OF FOOD SYSTEMS IN ASIA AND EUROPE

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SMEs GOING CIRCULAR

Decarbonisation of Food Supply Systems

ENVforum Annual Conference 2022

1. INTRODUCTION: AGRI-FOOD DECARBONISATION: A GLOBAL OUTLOOK

Introduction

The Conference of Parties (COP) 26 meeting of the United Nations Convention on Climate Change (UNFCCC) held in Glasgow, the United Kingdom, in November 2021 put the urgency of a low-emission food system firmly back at the top of the global agenda. Therefore, this year's Asia-Europe Environment Forum aims to spark an exchange of ideas and solutions focusing on the decarbonisation of the agri-food system, which will be crucial to achieving net-zero goals among Asia-Europe Meeting (ASEM) partners and limiting the planet's warming to 1.5 degrees. The future of the agri-food business is circular, and small and medium-sized enterprises (SMEs) have a pivotal role in this impending systemic transformation.

Agri-food systems encompass the production and storage, post-harvest handling, transportation, processing, distribution, marketing, consumption and disposal of food.[1] The system encompasses crops, livestock, forestry, aquaculture, and fisheries subsectors.[2]

According to the Intergovernmental Panel on Climate Change (IPCC), the global agri-food system is responsible for up to 19Gt CO2-equivalent (CO2e) per year, some 37 per cent of overall anthropogenic emissions. These emissions[3] are generated throughout the life cycle of food. Most of these emissions (71 per cent) occur on-farm,[4] pointing to low-carbon agricultural practices as essential to reducing climate impacts. About 35 per cent of global agri-food emissions occur in Asia, while 9 per cent originate in Europe.[5]

Due to its large population and land area, climate-induced changes in crop yields in Asia will affect the most people. In Europe, fields further south are expected to become increasingly dry, affecting production and food prices. Changes in invasive pest species will affect both regions, with areas of both decreasing or increasing abundance and a turnover of different crop pests. Therefore, agri-food is not just a key driver but will be adversely affected by climate change.

Against this backdrop, there is a need to develop and implement new agri-tech and food-tech solutions, together with shifting diets for lower climate impact.

SMEs have an important role to play. Due to their essential role in contributing to local 'communities' livelihood and food self-sufficiency and their interest in including more environmentally sustainable agricultural practices, agri-food SMEs can lead the decarbonisation of the sector while adapting to the changing needs of food production and consumption. This report will begin by identifying key sources of emissions from the agri-food sector in ASEM. From there, it will explore the significant role SMEs play in reducing these emissions.

The Agri-Food System in Europe[6]

With over 38 per cent of its land farmed,[7] the agri-food system has shaped and continues to shape landscapes and lifestyles in the European Union (EU). In the EU-28, agri-food employs about 30 million people (including 22 million in the agricultural sector), generating about 3.5 per cent of the ' 'region's gross domestic product (GDP).[8] Europe is one of the world's leading exporters of food and the third-largest importer after the United States and China.

Europe's agri-food production is dominated by livestock products (including dairy). However, grains, vegetables, wine, fruits, and sugar are major products. Livestock production is higher in Western Europe (10.4 million

1 Food and Agriculture Organization of the United Nations, The State of Food and Agriculture 2021: Making Agrifood Systems More Resilient to Shocks and Stresses (Rome: FAO, 2021), ISBN 978-92-5-134329-6, S2CID 244548456, https://doi:10.4060/cb4476en.

2 Clayton Campanhola and Shivaji Pandey (eds), "Chapter 33 - Agrifood Systems," in Sustainable Food and Agriculture (Rome: Academic Press, 2019): 305-330, ISBN 9780128121344, https://doi.org/10.1016/B978-0-12-812134-4.00033-9.

3 C. Mbow et al., Food Security in Climate Change and Land: an IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems (Geneva: IPCC, 2019).

4 M. Crippa et al., "Food systems are responsible for a third of global anthropogenic GHG emissions," Nat Food 2 (2021): 198–209, https://doi.org/10.1038/s43016-021-00225-9.

5 "Emissions shares," FAOStat, last modified 2022, https://www.fao.org/faostat/en/#data/EM.

6 For the purposes of the background paper, "Europe" refers to the European partners of the ASEM process. In this regard, "Europe" and the "European Union (EU)" are used interchangeably.

7 Eurostat, Agriculture, forestry and fishery statistics, 2020 edition (Luxembourg: Eurostat Statistical Books, December 2020), https://ec.europa.eu/eurostat/documents/3217494/12069644/KS-FK-20-001-EN-N.pdf/a7439b01-671b-80ce-85e4-4d803c44340a?t=1608139005821.

8 European Environment Agency, Climate change adaptation in the agriculture sector in Europe, (Luxembourg: European Environment Agency, 2019), EEA Report No 04/2019 https://www.eea.europa.eu/publications/cc-adaptation-agriculture.

tonnes of protein produced) compared to Eastern Europe (2.7 million tonnes) and cattle milk and pork dominate.[9] Significant exports include grains (wheat and barley), dairy products, poultry, pork, fruit, vegetables, olive oil, and wine. Over two-thirds of agri-food production in Europe occurs in just seven countries, making the agri-food system in the region highly sensitive to yield changes.

While food production has been generally increasing in Europe, the number of farms is decreasing and there is a consistent shift from small and local farms towards bigger, and often corporate-owned, farms,[10] with very large farms (over 100 ha) responsible for over half of the agricultural area in the EU-28.[11] This trend is linked with the growth of monocultures which tend to generate high environmental impacts through the use of high volumes of pesticides, fertilisers and antibiotics.

Yet, despite the increase in intensive agriculture and larger farms, small farms still represent 69 per cent of the farms in the EU.[12] As agriculture intensification is one of the main causes of biodiversity loss and ecosystem degradation, small farms which employ less intensive land use are playing a crucial role in maintaining biodiversity and a range of essential ecosystem services, including regulation of soil and water quality. About 9 per cent of agricultural land in the EU is part of Natura 2000 protected areas, and over 8 per cent is considered organic farming.[13]

In terms of emerging technologies and practices, precision agriculture and regenerative agriculture show the highest potential for transforming agri-food systems in Europe. Precision agriculture can increase agricultural outputs and reduce the carbon footprint of food production by using digital technologies to tailor resource use and practices to specific contexts and variables. Initial implementations of precision agriculture in Europe have mostly focused on vegetable and dairy farming. A broader adoption of precision agriculture is under development through specific investment and policy strategies.[14]

Regenerative agriculture is a set of practices that increase biodiversity, enrich soils, improve watersheds, and enhance ecosystem services.[15] In Europe, regenerative agricultural practices are showing high potential for mitigating climate change and other negative environmental impacts of agri-food. For this reason, an increasing number of dedicated supporting actions are being and will be implemented at the European and national levels.

On the consumption side, the food consumed by European citizens each year requires a total land area for the production of about 185 million hectares, of which around 20 per cent is located outside Europe.[16] Animal-based food products account for 72 per cent of this land use.[17] The high production and consumption of animal products in Europe's agri-food system reflect the global increase in meat consumption and require high volumes of animal feed imports from outside the region.

"Over two-thirds of agri-food production in Europe occurs in just seven countries, making the agri-food system in the region highly sensitive to yield changes."

9 "Results," Food and Agriculture Organization of the United Nations: Global Livestock Environmental Assessment Model (GLEAM), last modified 2022, https://www.fao.org/gleam/results/en/.

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11 "Farms and farmland in the European Union – statistics," Eurostat, last modified November 2018, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics.

12 N. Guiomaret al., "Typology and distribution of small farms in Europe: Towards a better picture," Land Use Policy 75 (2018): 784-798, https://doi.org/10.1016/j.landusepol.2018.04.012.

13 European Commission, Farming for Natura 2000, (Luxembourg: European Commission, 2018), doi:10.2779/85823.

14 Remco Schrijver et al., Precision agriculture and the future of farming in Europe: Scientific Foresight Study (Brussels: STOA, European Parliament, December 2016), IP/G/STOA/FWC/2013-1/Lot 7/SC5, https://www.europarl.europa.eu/RegData/etudes/STUD/2016/581892/EPRS_STU(2016)581892_EN.pdf.

15 "What is Regenerative Agriculture?" EIT Food, last modified 2022, https://www.eitfood.eu/projects/regenag-revolution/what-is-regenerative-agriculture.

16 Jabier Ruiz Mirazo, Europe eats the world, (Brussels: World Wide Fund for Nature, May 2022), https://www.wwf.eu/what_we_do/agri_food/?6642391/Europe-eats-the-world.

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The Agri-Food System in Asia[18]

Small farms and businesses dominate the agri-food system in Asia. The vast bulk of the food is grown on family-owned farms.[19] However, across the value chain, small businesses play the roles of traders, market stallholders, trucking companies and lenders.

Asia stands out globally due to the high number of people living in rural areas; some 2.2 billion of the 4.5 billion people in the region rely on agriculture for their livelihood.[20] Agriculture plays a much larger role in the economy of Asia than in Europe, delivering nearly 10 per cent of the region's GDP.[21]

While much of the intensification and monocropping we have seen in Europe has also played out in Asia, consolidation has been much slower. Asian farms have origins in a long history of isolated subsistence systems where food was largely grown and consumed within a village. Today, typical farms are still less than 1ha in size. For example, the average size of a smallholder farm in Bangladesh is 0.24ha and in Vietnam 0.32ha.[22] Small farm sizes and other challenges limit productivity, which is very low by global (and European) standards. An estimated four of five people living below the poverty line live in rural areas.[23]

Rice is the dominant crop. 90 per cent of the world's production and consumption of rice occurs in Asia,[24] grown on some 140 million hectares of land.[25] Other significant crops by area planted are wheat, maize and soybeans.[26]

Two important trends are changing the nature of Asian agriculture, and both have implications for how we decarbonise. The first is at the consumption end of the agri-food system, the second on the supply side:

- The first is rapidly growing food consumption, particularly meat. As the Asian economy has grown rapidly over the last 30 years, wealthier consumers eat less rice and more meat. Food and feed crop demand in Asia are expected to nearly double in the next 50 years.[27]

- The second major trend is the mass migration of people (and therefore labour) out of rural Asia and into cities. Although agriculture remains a major employer in many of the developing countries in Asia, its overall contribution in the economy has declined. Higher-paying jobs in manufacturing and services in urban areas have attracted workers, causing a steady decline in the share of the rural population of developing Asia from 80 per cent in 1970 to 52 per cent in 2020.[28] As the outmigration of male workers continues, the sector is increasingly reliant on women and elderly workers to provide farm labour.[29]

Labour-saving agricultural machinery is filling the gap left by e the rural population's shrinking, ageing, and feminising labour base.[30] Of particular importance has been the expansion of tractors for the labour-intensive tasks of tilling, harvesting and weeding.

"The vast bulk of the food is grown on family-owned farms."

18 For the purposes of the background paper, "Asia" refers to the Asian partners of the ASEM process.

19 For a number of farms see Lowder et al. "Supplementary Data. Table 1: Number of agricultural holdings, by country, most recent census," The Number, Size, and Distribution of Farms. Smallholder Farms, and Family Worldwide (United Nations, 2016).

20 Asian Development Bank, Building Climate Resilience in the Agriculture Sector of Asia and the Pacific (Manila: ADB, December 2009), https://www.adb.org/publications/building-climate-resilience-agriculture-sector-asia-and-pacific.

21 Food and Agricultuee Organization of the United Nations, FAO Regional Conference for Asia and the Pacific, (Fiji: FAO, April 2018), https://www.fao.org/3/mw252en/mw252en.pdf.

22 George Rapsomanikis, The economic lives of smallholder farmers: An analysis based on household data from nine countries (Rome: FAO, 2015), https://www.fao.org/3/i5251e/i5251e.pdf.

23 Asian Development Bank, Asian Development Outlook 2021 Update: Theme Chapter: Transforming Agriculture in Asia (Manila: ADB, 2021), https://www.adb.org/sites/default/files/publication/726556/ado2021-update-theme-chapter.pdf.

24 Shika Jha et al., ADB Economics Working Paper Series: Regional Trade Opportunities in Agriculture (Manila, ADB, February 2010), https://www.adb.org/sites/default/files/publication/28262/economics-wp191.pdf.

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28 United Nations Department of Economic and Social Affairs, World Urbanization Prospects 2018 highlights (New York: United Nations, 2019), https://population.un.org/wup/publications/Files/WUP2018-Highlights.pdf.

29 SOFA Team and Cheryl Doss, The Role of Women in Agriculture, (Rome: FAO, 2011), https://www.fao.org/3/am307e/am307e00.pdf.

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Table 1: Agri-food SMEs in Asia and Europe – a comparison

WHAT IS COMMON?	WHAT IS DIFFERENT?
→ Climate-induced changes in food production and prices.	→ Agri-food production in Europe is dominated by livestock products, while agri-food production in Asia is dominated by rice.
→ The long-term trend toward intensive, monoculture cropping.	→ In Asia, the agri-food sector contributes a larger share of GDP.
→ SMEs in rural areas are struggling from lack of digitalisation and difficult access to the markets, a gap that can be fulfilled by service and innovator SMEs with high potential for reducing carbon emissions.	→ Small farms characterise the agri-food sector in Asia, while in Europe, farms are typically much larger.
	→ Asia has a population 3.5 times that of Europe

Recent Global Shocks

The scale of agri-food and its high dependence on fossil fuels makes the system vulnerable to global and regional economic performance and changes in energy supply.

In 2021, the recovery in food demand from the recession caused by COVID-19 saw a surge in food prices, raising concerns for a global food crisis. The situation was exacerbated (in part) by trade restrictions and more importantly by rises in fertiliser prices and international freight costs.

In 2022, trade bans and the closure of trade routes, as well as the disruption of the Ukrainian agricultural economy, are generating a scarcity of crucial food commodities in both Europe and Asia.

In February 2022, the FAO food price index reached a record high. Between 2020 and 2021, the cost of importing food has risen by 22 per cent in Asia and 12 per cent in Europe.[31] Due to the sharp increase in fertiliser prices, farmers in South Asia are expected to face challenges in securing their fertiliser supplies as early as October 2022.[32]

In a recent report on the impacts of the war in Ukraine, the UN Global Crisis Response Group analysis estimated that about 40 per cent of countries in Eastern Europe, East Asia, and the Pacific would be severely exposed to the impacts of rising food prices. In South Asia, the percentage is much higher, with 67 per cent of countries severely exposed. In these countries, rising food prices will particularly affect lower-income groups, which allocate over 50 per cent of their expenditure to food.

In ASEM, the war in Ukraine and global environmental and societal changes are shifting agri-food companies towards solutions less dependent on fossil fuels and productions that do not rely on imported feed.[33] Due to their tendency to focus on local supply chains, agri-food SMEs will become increasingly important for food sovereignty, employment, and economic output.

2. THE ROLE OF AGRI-FOOD SMEs

Traditional SMEs

Agricultural processors, retailers and traders offer contracts to farmers with advanced pricing, technical assistance, and market access, which benefit both farmers and traders.[34] On the supply side, they ensure farms have access to inputs such as fertiliser, crop protection products and labour. On the consumption side, wet markets, trucking companies and retailers provide access to markets for the farms' produce. The remote location of both farms and so many rural consumers result in a huge number of small and dispersed transactions across the system, giving smaller companies the edge in providing these services.

Particularly in Asia, finance is a critical service along the agri-food value chain. Small lenders provide over $50

31 "Food Price Index hit record high in February, UN agency reports," UN News, last modified 4 March 2022, https://news.un.org/en/story/2022/03/1113332.

32 Food and Agriculture Organization of the United Nations, The importance of Ukraine and the Russian Federation for global agricultural markets and the risks associated with the war in Ukraine, (Rome: 10 June 2022), https://www.fao.org/documents/card/en/c/cb9013en/.

33 "Global food crisis: Europe must choose between retreat and responsibility," Fondation Robert Schuman, last modified 4 April 2022, https://www.robert-schuman.eu/en/european-issues/0627-global-food-crisis-europe-must-choose-between-retreat-and-responsibility.

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billion[35] in finance, including crop cycle finance to farmers to cover the cost of inputs until they receive payment at the end of the season. Small traders also finance crops from the farm gate to markets. In finance, SMEs again have had a strong advantage over larger lenders (such as banks) who view farmers as unattractive clients due to high transaction costs and the reality that farms and other small businesses often lack documentation and sufficient collateral.[36]

Service and Innovator SMEs

In considering the role of SMEs in decarbonisation, we can start with traditional SMEs such as crop traders, wet market stall holders, truck drivers and fertiliser salespeople. These small companies comprise the bulk of the SME actors in Asia and Europe. However, two small categories of SMEs are emerging, which could have a more significant role in decarbonisation in ASEM. The first we will call farm service SMEs and the second innovator SMEs.

Service and Innovator SMEs in Asia

In Asia, as discussed in the background, farmers are faced with an exodus of labour to cities. We also highlighted the role of technologies such as mechanisation, irrigation and digital tools. To fill this labour gap and deliver technologies, a cadre of farm service companies is emerging to provide efficient delivery of crop management services. One example is tractor hire companies that drive tractors between farmers at the start of the season to deliver tilling services. Another is drone operators delivering spray services to multiple farmers each day. In both cases, the use of equipment is cutting labour costs by order of magnitude.

The second type of SME is the innovator SME, an emerging group of technology firms developing and promoting innovations such as robots, biotech crops, precision irrigation, digital finance and online marketplaces. These companies are typically funded by venture capitalist (VC) companies and universities to undertake research and development. They face significant risk in bringing a range of innovations to the sector.

Service and Innovator SMEs in Europe

In Europe, the increasing globalisation of food markets, while presenting potential benefits, has generated further barriers to SMEs in rural areas. Similar to what is observed in Asia, these SMEs face challenges such as long distances to major markets, fewer transport connections, poor digital connectivity and fewer training opportunities. In light of that, there is a need to strengthen and diversify local agri-food systems and short supply chains in Europe's agri-food sector.

The low rate of digitalisation in Europe's agri-food SMEs is also hampering the implementation of innovative production methods such as precision farming and other technologies that could reduce the negative impacts of the unstable demand for labour that characterises agricultural production in Europe. At the same time, available technologies are enabling new agri-food businesses increasingly started by young people.

From a broader perspective, the role of young people as agents of change in agri-food is expected to increase, also due to an increase in environmentally conscious consumption among the youth, with the emergence of new youth movements within the food, climate and health space. In fact, according to EIT Food, between 2021 and 2022, food sustainability has become more important for two-thirds (64 per cent) of 18–24-year-olds in Europe.[37]

All of this calls for institutions and businesses to adapt their value creation models and products to the food needs of the new generations. An interesting trend in this vein is the rapid development of the European market for alternative proteins, which is also seeing meat companies investing in alternative meat and seafood options.

"From a broader perspective, the role of young people as agents of change in agri-food is expected to increase."

35 Matt Shakhovskoy et al., Pathways to Prosperity: Rural and Agricultural Finance: State of the Sector Report (ISF Advisors, November 2019), https://isfadvisors.org/wp-content/uploads/2019/11/2019_RAF-State-of-the-Sector-10.pdf.

36 Dieter Fischer et al., Working with Smallholders: A Handbook for Firms Building Sustainable Supply Chains (Washington DC: IFC, July 2013), https://www.ifc.org/wps/wcm/connect/647f85fc-6ad7-4315-aad8-4967075a304b/Handbook+-+Working+with+Smallholders.pdf?MOD=AJPERES&CVID=ka-TX8j.

37 "Top 5 European food trends in 2022," EIT Food, last modified 28 January 2022, https://www.eitfood.eu/blog/top-5-european-food-trends-in-2022?_ga=2.95279068.191629376.1655998196-194634910.1655470441#3_-the-european-alternative-proteins-market-will-see-further-growth-in-2022-including-more-meaty-alternatives.

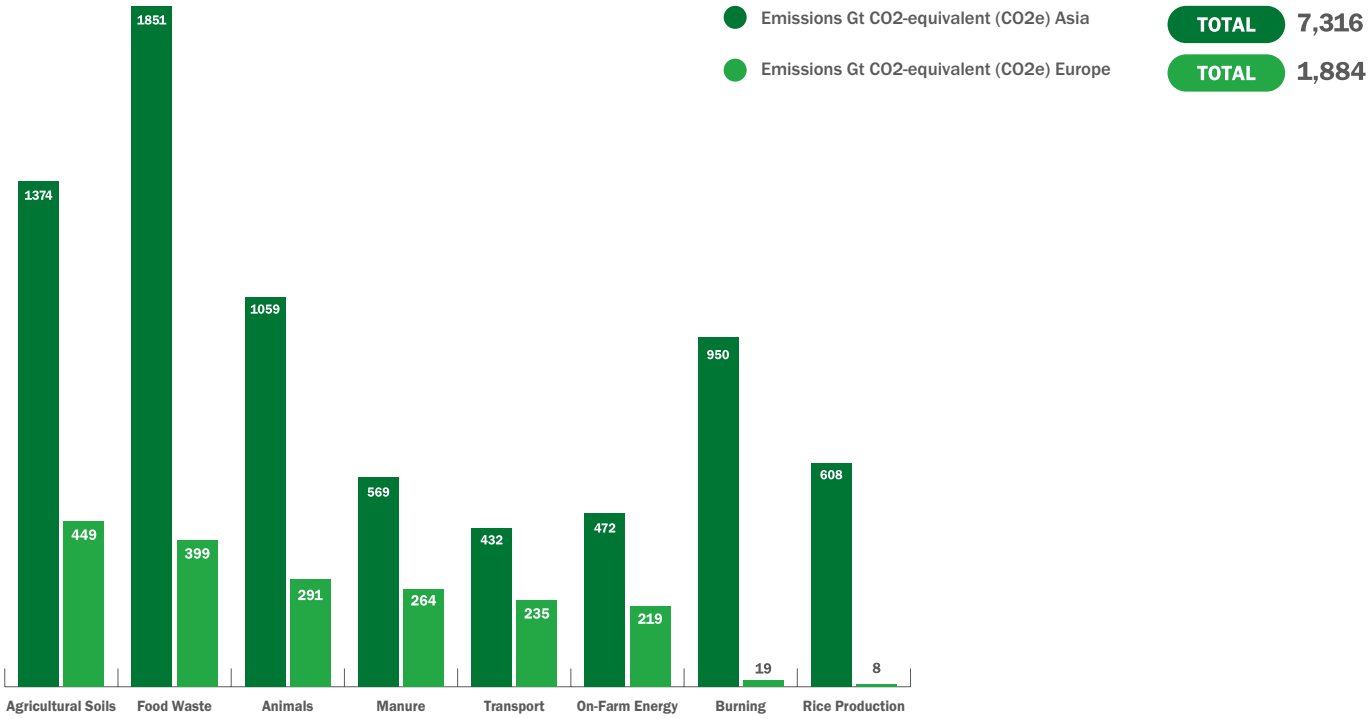
3. MITIGATING AGRI-FOOD EMISSIONS

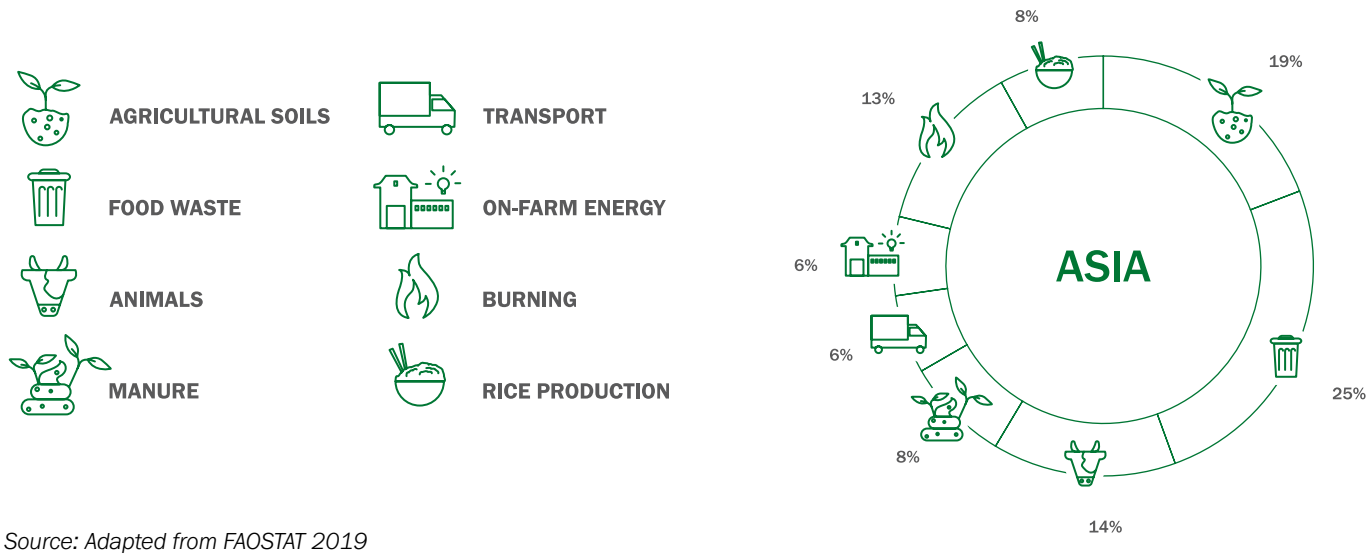
Emissions

The agri-food system in ASEM has a significant potential to reduce emissions, and even sequester emissions from other sectors. Any exploration of this opportunity to decarbonise must begin with mapping current emissions.

Emissions in ASEM stem from several sources. Leading causes are food waste, agricultural soils, livestock, manure burning of agricultural residues and savannahs for land clearing and rice cultivation.[38] For some of us, this list requires us to consider a significant shift in how we normally think about decarbonisation, which has conventionally focused on reducing fossil fuel usage.[39] Furthermore, these emissions are not static. As food production grows to feed a larger, wealthier population, these emissions will grow, particularly as a result of any increase in demand for meat.

Table 2: Agri-food related emissions in Asia and Europe





Source: Adapted from FAOSTAT 2019

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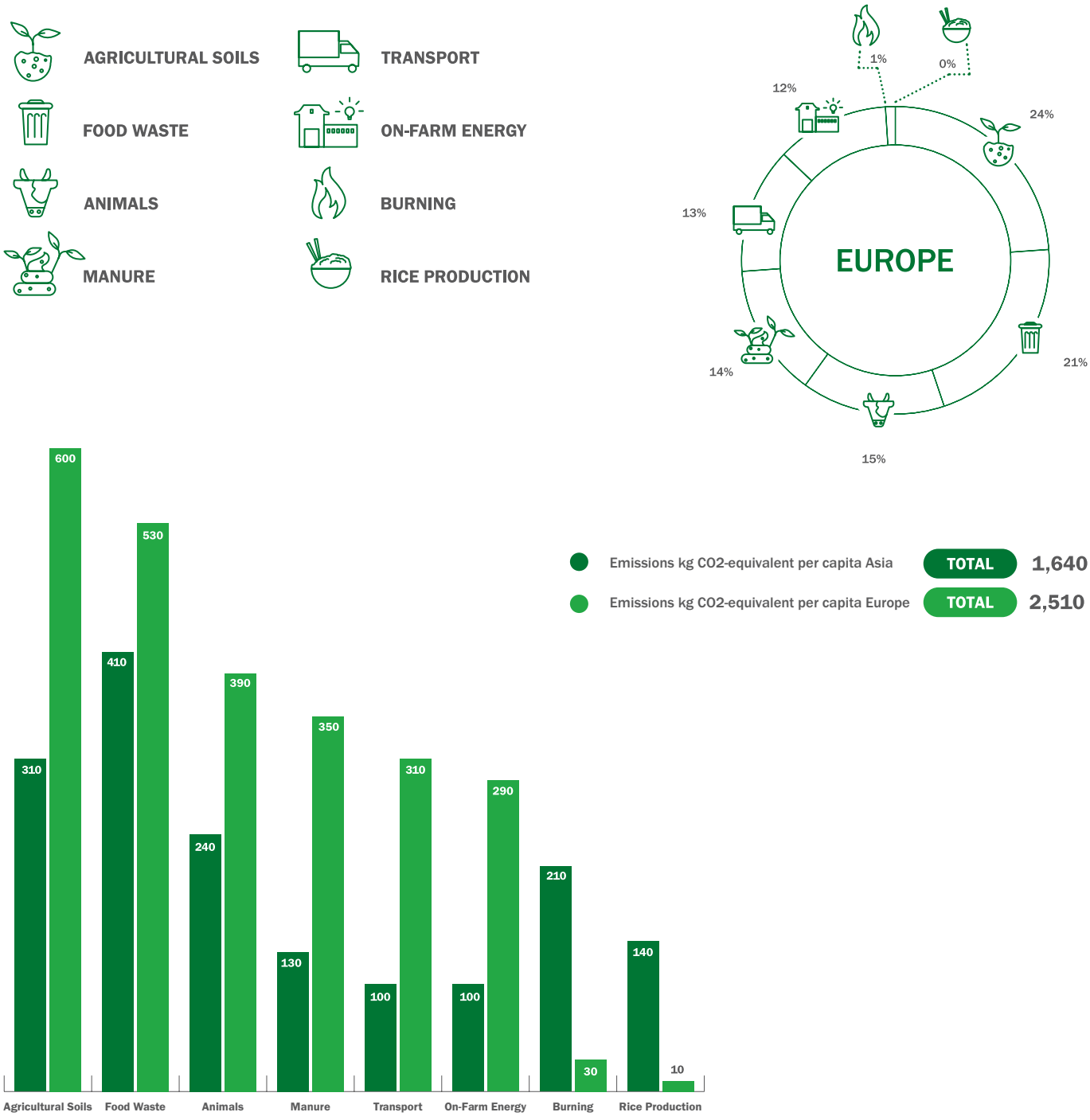
39 Only 5% of emissions need to be addressed via fuel switch for more carbon-efficient transport means. For more information see World Economic Forum, Net-Zero Challenge: The Supply Chain Opportunity: Insight Report January 2021 (WEF, January 2021), https://www3.weforum.org/docs/WEF_Net_Zero_Challenge_The_Supply_Chain_Opportunity_2021.pdf.

Table 2: Agri-food related emissions in Asia and Europe



Source: Adapted from FAOSTAT 2019

Agricultural Soils emit nitrous oxide naturally through the processes of nitrification and denitrification.[40] However, these emissions are driven upward when farmers use nitrogen fertiliser, apply livestock manure and retain crop residues. Conventional cultivation practices with exhaustive tillage and removal of crop residues by burning or for other uses have resulted in nutrient and carbon losses.[41]

In Europe, emissions from soils are approximately 600kg per person, and in Asia 310kg. The higher rate in Europe stems from most land-based farming emissions derived from the production of top feed-producing crops including maize, wheat, and soybeans, fueled a large part by higher meat consumption in the region.

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41 Mangi L. Jat, "Carbon sequestration potential, challenges, and strategies towards climate action in smallholder agricultural systems of South Asia," Crop and Environment 1, Issue 1 (March 2022): 86-101, https://www.sciencedirect.com/science/article/pii/S2773126X22000053.

Food Waste releases emissions when it is incinerated, composted or utilised as an input to biogas production. In most countries, however, the majority of solid food waste ends up in landfills and open dumps where the anaerobic decomposition of organic material releases methane gas.[42] In both regions, emissions from food waste are approximately 500kg per person.

Animals such as pigs, poultry, and cattle, also emit methane, a by-product of digesting feed.[43] Increasing disposable incomes are projected to drive strong annual growth of meat consumption in Asia. Production of beef (the most emission-intensive meat) is projected to grow in Vietnam and Indonesia by 24 per cent and 34 per cent, respectively, between 2015 and 2025.[44]

Emissions in Europe from food waste are 400kg per person, in Asia 240kg, again stemming from higher meat consumption.[45]

Manure emissions occur during the handling, storage, and treatment of manure. CH4 is produced from the anaerobic breakdown of manure, whereas N20 results from handling the manure aerobically and then anaerobically. Emissions from manure accounts for 350kg per person in Europe, and 130kg in Asia, also related to higher meat consumption in Europe.

Burning agricultural residues such as rice straw and savannahs for land clearing generates carbon dioxide emissions. Burning accounts for 210kg per person in Asia but is negligible in Europe.

Rice Production systems that employ extended periods of flooding emit methane through the anaerobic decomposition of organic matter[46] and account for 25-33 per cent of Southeast Asia's methane emissions.[47] Rice production produces 140kg per person in Asia, but is negligible in Europe.

Decarbonisation Strategies

The global mitigation potential in the agriculture sector is high—estimated at between 5.5 and 6.0 gigatons (Gt) of carbon dioxide equivalent per year by 2030 — with a potential for Asia to contribute up to 50 per cent of theoretical reductions and Europe about 25 per cent.[48]

There are four strategies that can play an important role in decarbonisation in ASEM. While not an exhaustive list, they are selected for their impact and economic viability.

Reducing Food Waste

The causes of food waste vary across ASEM. Post-consumer losses are considerable in Europe and the developed countries of Asia, representing 47 per cent of all food wastage globally.[49] In developing countries, most losses occur before food reaches the retailer.

The solutions are therefore different. Post-consumer losses are best addressed by changing consumer behaviour. On the other hand, food losses in developing Asia are better addressed through improved roads, logistics, trading, storage, and food handling.

Reducing Animal Protein Consumption

Both regions are responsible for significant and rising emissions from the production and consumption of animal-based foods. Transitioning to plant-based food and low-carbon protein alternatives to meat will bring about major emission reductions, followed by improving efficiency in food production and reducing food loss along the value chain.

Reducing per capita meat consumption in favour of plant-based food and low-carbon protein alternatives to meat accounts for about 70 per cent of total emission reduction potential considering the entire life-cycle of food in Europe.[50]

42 Kevin Karl and Franceso N. Tubiello, Methods for Estimating Greenhouse Gas Emissions from Food Systems: Part II: Waste Disposal (Rome, FAO, 2021), https://www.fao.org/3/cb7028en/cb7028en.pdf.

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44 "Economic growth in Asia to fuel meat consumption." Meat & Livestock Australia, last modified 30 July 2020, https://www.mla.com.au/prices-markets/market-news/2020/consumption-growth-in-asia-to-fuel-meat-consumption/.

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46 A Mosier et al., "Closing the global N20 budget: Nitrous oxide emissions through the agricultural nitrogen cycle," Nutrient Cycling in Agroecosystems 52, 2-3 (1998): 225-248.

47 Dina Umali-Deininger, "Greening the rice we eat." World Bank Blog, last modified 15 March 2022, https://blogs.worldbank.org/eastasiapacific/greening-rice-we-eat.

48 P. Smith et al., "Greenhouse gas mitigation in agriculture," Philosophical Transactions of the Royal Society (B) Biological Sciences 363, 1492 (2007): 789–813.

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50 Akenji L. 1.5-Degree Lifestyles: Towards A Fair Consumption Space for All (Berlin:Hot or Cool Institute, 2021).

Capturing More Carbon in Soils

Both regions also have significant opportunities to sequester carbon in soils and to reduce soil emissions. Globally, soils hold 2.3 times more carbon than atmospheric CO2 and 3.5 times more than terrestrial plants.[51] A range of circular and regenerative agriculture practices capture more carbon in the soil. For example, no-till agriculture or adding biochar to soils. Alternatively, strategies that slow the amount of stored carbon released into the atmosphere through burning, tillage, and soil erosion also sequester carbon. Soil carbon sequestration is estimated to account for 89 per cent of the technical mitigation potential in agriculture. This strategy is included here because of its significant potential to not only capture carbon but to create high yields and new income streams for farmers.

Empowering farmers to use fertilisers more efficiently drives down costs and reduces emissions from soils. Strategies include the use of organic fertilisers and better targeting traditional fertilisers to the specific needs of the soil, so nutrients are not wasted.

Better Management of Rice

Emissions from rice production can be reduced by improving water management in high-emitting, irrigated rice systems through mid-season drainage or alternate wetting and drying methods.[52] New rice varieties and practices that allow dry seed rather than flooded rice are critical.

"Both regions also have significant opportunities to sequester carbon in soils and to reduce soil emissions. Globally, soils hold 2.3 times more carbon than atmospheric CO2 and 3.5 times more than terrestrial plants."

Table 3: Agri-food carbon emissions in Asia and Europe - a comparison

WHAT IS COMMON?	WHAT IS DIFFERENT?
→ Agri-food contributes to a significant share of carbon emissions.	→ Asia has twice the potential for mitigating emissions from agri-food.
→ Consumer decisions around waste and animal proteins are critical to emission reductions.	→ Emissions from transport and on-farm energy use are higher in Europe.
	→ Emissions from rice production and residue burning are higher in Asia.

4. AGRI-FOOD SMEs: THEIR ROLE IN DECARBONISATION

It is helpful to return to our framework of traditional SMEs, service SMEs and innovator SMEs. Most traditional SMEs including farms, are themselves marginal businesses with little to gain from the required practice changes and, in any case, little control. They are generally reactive rather than opportunistic. For example, a retailer might choose to stock a soil test kit that reduces fertiliser waste, but they are unlikely to be the reason such kits become commonplace.

Instead, it is the innovator SMEs and the service SMEs that stand to both benefit from and even drive decarbonisation.

The role of the innovator SME is initially the most important. There are hundreds, if not thousands of technologies that will enable these changes in practice. Laser graders for rice flatten the land, reducing methane emissions, seed drills reduce the need to disturb soils, while stubble shredders allow crop residue to be recycled into soils rather than burnt. On the consumption side, meat and dairy alternatives have an important role.

51 R. Lal, "Soil carbon sequestration impacts on global climate change and food security," Science 304, (2004): 1623–1627.

52 "What is flooded rice?" AgLEDx, last modified 2022, https://agledx.ccafs.cgiar.org/emissions-led-options/production-systems/flooded-rice/.

Innovator SMEs have a critical role here, designing and commercialising appropriate and accessible smallholder technologies. In Asia, over the last fifty years, we have seen countless solutions repackaged by innovator SMEs for the Asian smallholder sector, including solar rice mills, two-wheel tractors, and treadle pumps. In Europe, precision and regenerative agriculture are becoming a solution and are increasingly adopted at small and large scales. These practices make use of nature-based solutions as well as innovations in technologies of satellite monitoring and connected agro-analytics.

In the case of on-farm technologies, the next step that brings innovation to the farm is the service SME. As we saw in the background, farmers in ASEM operate in a highly labour-constrained setting. Service SMEs are the most promising means of filling this gap. The growth of the itinerant tractor service in Asia for ploughing is perhaps the best example. One SME in a village can plough dozens of farms with a tractor in less than a tenth of the time the farmer takes to do this by hand. The same is true of motorised sprayings, laser graders and rice harvesters.

The service SME has a number of advantages in bringing mitigation practices to farmers. Take, for example, soil testing, laser grading and seed drilling. These technologies require a modest capital investment best delivered on not one but dozens or even hundreds of farms. The pathway to adoption by a service provider is straighter and smoother than an individual farm adapting in isolation.

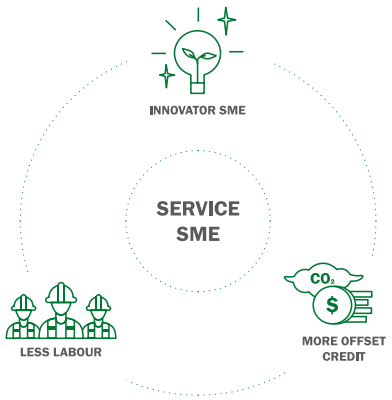
In Europe, service SMEs can play a crucial role in implementing product-as-a-service business models in line with the Circular Economy Action Plan.[53]

5. AGRI-FOOD SMEs IN ASEM: INNOVATION AND COLLABORATION

Future trends and leveraging innovation and collaboration to decarbonise the sector

Service SMEs sit at the center of three virtuous trends in ASEM, which will position them as central to decarbonisation: Innovation (led by innovator SMEs), reducing labour availability and more carbon offset credits.

Figure 1: Agri-food Service SMEs



In conclusion, the SME is a vital agent in collaboration toward decarbonisation. There is a new generation of passionate, values-driven, innovative entrepreneurs in the ascendency, many of them women and youth.[54] In the first instance, decarbonisation is the business of innovator SMEs to build technologies that are fit-for-purpose, low cost and reliable. But, we also need service SMEs that can finance these tools and enable these innovations to be delivered to dozens or even hundreds of labour-constrained farms.

Empowering innovator and service SMEs is at the heart of decarbonising agriculture, particularly on-farm. Fortunately, significant resources are available to meet this challenge. The carbon offset market is growing rapidly. The Institute of International Finance (IIF) estimates that demand for carbon credits could increase by a factor of 15 by 2030 and by a factor of up to 100 by 2050. Over $50 billion per annum will likely be available each year by 2030.

The service SMEs that deliver mitigation practices on farms are an ideal conduit for these funds. This is particularly true in Asia where costs are lower, and emissions are higher (than in Europe) resulting in a lower cost per tonne of emission reduction.

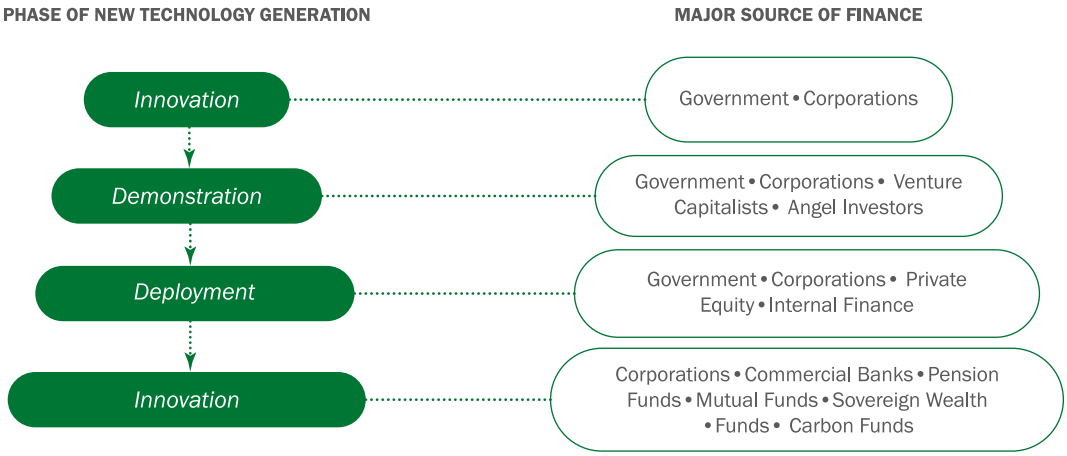
What remains to be done in order for innovator and service SMEs to step up to this challenge? Perhaps the most important missing piece in both Asia and Europe is financing. The availability of offset credits is only one side of the equation; up-front financing remains vital. While the availability of offsets is growing, access to finance is a major

53 European Commission, A New Circular Economy Action Plan: For a cleaner and more competitive Europe, (Brussels, European Commission, 11 March 2020), https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en.

54 Wasafiri, A Small Business Agenda, (UN, July 2021), https://www.un.org/sites/un2.un.org/files/2021/07/unfss-small_business_agenda.pdf.

barrier for climate entrepreneurs, particularly in developing economies.[55] The UNFCCC has developed a compelling framework that demonstrates the role of various sources of SME financing during the development and scaling up of climate solutions:

Figure 2: Financing for new agri-food technology generation



Source: Adapted from UNFCCC. (2018). Climate Technology Incubators and Accelerators.

6. CONCLUSION

A seismic shift is needed in ASEM's agri-food system to limit climate change. The millions of SMEs in the system are important agents of this change. Particularly in their capacity for innovation and the provision of farm services.

First, we need innovator SMEs to take the risk of building new technologies, and in the face of a warming planet, we need them to act quickly. However, getting these technologies on farms is not just about farmers changing practices. Service SMEs will be vital in taking many of these tools to farms, particularly in Asia, where farmers often lack access to financing to adopt these new tools. In Europe, service SMEs can significantly contribute to a more circular economy and enable a transition towards diets with a lower impact on the climate and biodiversity.

Governments, donors, non-government organisations (NGOs) and farmer groups need to acknowledge the important role of innovation and service climate-focused SMEs and then move to ensure they have the financing they need to grow.

"We need innovator SMEs to take the risk of building new technologies, and in the face of a warming planet, we need them to act quickly."

55 Christina Oraftik et al., Climate entrepreneurship in Developing Economies: Supporting Entrepreneurs Tackling Climate Change, (The Lemelson Foundation, March 2021), https://www.andeglobal.org/?action=tracking&file=2021/03/Climate-Entrepreneurship-in-Developing-Economies.pdf.

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