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ENVIRONMENTAL IMPACT OF FOOD IN SINGAPORE

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Prepared by

Deloitte.

A*STAR Singapore Institute of Manufacturing Technology

KEY TAKEAWAYS

Singapore imports over 90% of its food consumed locally.
As existing studies do not fully consider local consumption or import patterns in Singapore, it has been difficult to understand the environmental impact of food that the country consumes.

On average, meats, eggs and seafood have a disproportionate environmental impact as compared to fruits and vegetables, and grains.
Meats, eggs and seafood make up about a quarter of food consumed, but contribute to more than two-thirds of GHG emissions.

Consumption patterns affect Singapore-level environmental impact from food.
Pork accounts for the most GHG emissions (per annum per capita) even though GHG emissions from one kilogram of pork is half that of one kilogram of beef. This is because per capita consumption of pork is much greater than that of beef (6% vs 0.8%).

Production and processing contribute to the majority (over 80%) of GHG emissions of food consumed.
Hence, importing food (by sea) from countries that use more clean energy sources could potentially offset the GHG emissions from transportation.

Given Singapore's heavy reliance on imports, sourcing fresh or chilled food items from neighbouring countries or producing locally can lower GHG emissions from transportation.

Replacing **25%** of red meat consumed (pork, beef, mutton and duck) with plant-based meats could lower annual GHG emission per capita by **7%**.

Introduction

On 2 August 2019, Temasek organised a discussion by Dr Jonathan Low (Group Manager and Scientist at A*STAR SIMTech) on the environmental impact of key food items consumed in Singapore, as part of the Ecosperity Conversations series.

This discussion was based on a study conducted by Deloitte and A*STAR SIMTech that employed a Life Cycle Assessment (LCA) approach to assess and contextualise the environmental impact of key food items consumed in Singapore. Three main environmental impact indicators were considered – greenhouse gas (GHG) emissions, energy consumption and water consumption. The quantification of the three indicators can aid decision making by factoring in the GHG emissions and resources needed should Singapore choose to produce locally.

The food system contributes to 19–29% of global GHG emissions.[1] To understand the environmental impact of Singapore's food system, it is important to measure the GHG emissions of locally-produced and imported food and to track Singapore's climate change targets. Energy consumption reflects the amount and efficiency of energy resources. Similarly, water consumption measures the amount of water resources directly required to produce, process and transport food.

The session featured a discussion of the results of this study with various stakeholders from the public and private sectors. The discussion also explored potential pathways for policymakers businesses and individuals to reduce the environmental impact of food consumption in Singapore.

This summary report covers the key findings of the study and integrates key discussion points raised during the session.

[1] Vermeulen, S. J., Campbell, B. M., Ingram, J.S.I. (2012) Climate Change and Food Systems, Annual Review of Environment and Resources. 37, 195-222

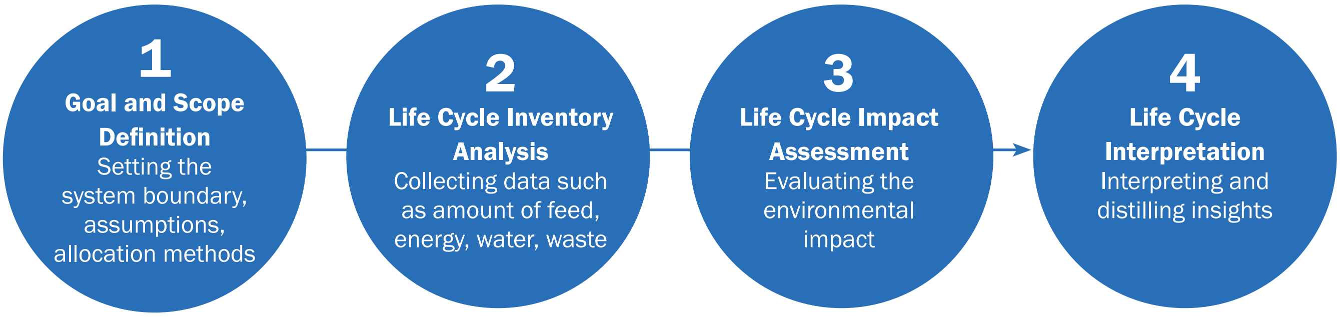
Study objective and approach

Many studies have been conducted to understand the environmental impact of the global food industry [2]. However, the majority of these studies are USA or Europe centric, and thus do not consider unique export-import country pairs for different regions. The main objective of this study was to quantify the environmental impact of key food items consumed in Singapore.

Methodology for Life Cycle Assessment

An LCA approach [3] based on ISO 14040 [4] and ISO 14044 [5] was used in this study, which is a technique to assess the environmental impact across the lifespan of a product in a systematic and holistic manner. The LCA is conducted in four phases – 1. Goal and scope definition, 2. Life Cycle inventory analysis, 3. Life Cycle impact assessment, and 4. Life Cycle interpretation (Exhibit 1).

Exhibit 1. The four main phases of the LCA approach used in this study.



Scope

The LCA was applied to analyse the environmental impact of 13 key food items consumed in Singapore by weight. These include 11 key food items tracked by the Singapore Food Agency (SFA), and two additional key food items of rice and wheat.[6] The 11 key food items tracked by SFA are fruits, leafy vegetables, other vegetables, chicken, pork, mutton, duck, beef, fish, other seafood and eggs.

System boundary

The system boundary for each food item was defined to include the production, processing and transportation stages. This study did not quantify the environmental impact of downstream activities within Singapore such as the retail distribution or consumption stages. Besides the direct environmental impact, the environmental impact embodied in all material and resource input, as well as waste, food loss, by-products and direct emissions output, were considered.

[2] 2016 Natural Resources Institute Finland (2016). [online] Available at: https://www.luke.fi/en/natural-resources/food-and-nutrition/effects-of-food-production-and-consumption-the-environment-and-climate/ [Accessed 21 Jun. 2019].
[3] Ecoinvent. Implementation of Life Cycle Impact Assessment Methods Data v2.2 (2010)
[4] ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework
[5] ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines
[6] Singapore Food Agency. (2019). Food Import & Export. [online] Available at: https://www.sfa.gov.sg/food-import-export [Accessed 14 Jun. 2019].

Three environmental impact indicators

Greenhouse gas (GHG) Emissions (kg CO_2-eq per kg of food)

GHG emissions or carbon footprint is an indicator used to measure the amount of GHG gases released into the atmosphere due to human activities. These gases cause the greenhouse effect that leads to global warming. The unit used for this indicator is in terms of carbon dioxide equivalent (CO_2-eq) and it is a measure of how much heat greenhouse gases trap in the atmosphere relative to carbon dioxide (CO_2). The GHG emissions considered in this study include CO_2, nitrous oxide (N_2O), and methane (CH_4).

In comparison to CO_2, an equivalent amount of N_2O and CH_4 have up to 265 times and 28 times the global warming potential.[7] CH_4 and N_2O emissions are converted and expressed as CO_2-eq. Within the food system, CO_2 is often the most ubiquitous GHG produced largely as a result of fossil fuel burning for transport, food production and processing machinery.

GHG emissions provide a measurable and comparable unit to express the total global warming impact. It is used in tracking Singapore's climate change targets and abatement goals.

Energy Consumption (kWh per kg of food)

The energy consumption indicator reflects the efficiency of using energy resources and provides comparability for the energy required for different food items should Singapore decide to produce or process any food items locally. It represents cumulative renewable and non-renewable energy use which includes energy from biomass, fossil, geothermal, nuclear, primary forest, water, wind and solar (e.g. photosynthesis and the use of photovoltaics to capture solar energy).

In food life cycles, energy consumption is a key environmental impact indicator because it is an essential resource needed to power the farms and logistics used throughout the supply chain – from production to transportation stage. It provides a good representation of energy needed in the production, processing and transportation of each food item in Singapore.

As Singapore moves towards strengthening the resilience in food supply by adopting technology to increase agriculture productivity, LCA can be used to track the potential changes in energy consumption.

Water Consumption (litres per kg of food)

The water consumption indicator used in the study specifically assesses the impact of water depletion, which can be used to assess the impact of water use when coupled with region-specific water scarcity index. It represents the total amount of water used within the system boundary. This includes water used in food production that is extracted from reservoirs, lakes, rivers and groundwater.

The LCA study computes water extracted for consumption across the life cycle of the food item based on the system boundary of production, processing and transportation. This quantification differs from the water footprint indicator, which quantifies the total volume of freshwater used from the environment. Water footprint includes soil moisture, water from water bodies, and water used to dilute/assimilate pollution. The water footprint indicator highlights water use from a global water cycle perspective.

Water consumption in this study does not include moisture in the soil, which contributes significantly to livestock farming (i.e. grazing pastures), and water used to dilute polluted water for safe discharge. This is because the two factors are not representative of how much water would be directly used if a food item was locally produced and processed in Singapore.

[7] Intergovernmental Panel on climate Change (2014). Climate Change 2014: Syntheses Report. Contribution of Working Groups I, II, III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. {online] Available at: https://ar5-syr.ipcc.ch/

Meats, eggs and seafood generally have higher GHG emissions, energy consumption and water consumption than fruits and vegetables, and grains

Exhibit 2 illustrates the environmental impact of the 13 key food items (per kg) consumed in Singapore. The 13 key food items are categorised into three groups:

1. Fruits and vegetables – fruits, leafy vegetables and other vegetables
2. Grains – wheat and rice
3. Meats, eggs and seafood – chicken, pork, mutton, duck, beef, fish, other seafood and eggs

Environmental impact trends were similar to that of other existing studies.[8,9,10] By category, fruits and vegetables, and grains were found to have lower GHG emissions than meats, eggs and seafood. Out of the meats, eggs and seafood considered, beef and mutton had the highest and second-highest GHG emissions per kg respectively. This is due to the direct emissions from enteric fermentation and manure management at the production stage.

Meats, eggs and seafood had the highest energy consumption among the three food categories, followed by grains, and fruits and vegetables. The energy consumption of pork stands out in comparison to other livestock like beef and mutton. This is because housing and manure management systems are required throughout the production of pork, as compared to the production of beef and mutton which are pasture grazed.

It is also interesting to note that during the processing stage of rice, energy consumption is offset (negative). This offset is due to by-products such as husk being used as source biomass for clean energy generation.[11]

Rice has the highest water consumption per kg due to flooding of the paddy fields during the production stage. These results may differ from common water footprint values where beef has the highest amount of water per kg (some studies have quoted this figure to be up to 15,400 litres/kg [13]).

This difference results from the use of water consumption, instead of water footprint, as the water-related environmental impact indicator in this study. The typical water footprint for livestock production would consist of 87% soil moisture, 6% water from water bodies (water consumption) and 7% water used for dilution of pollution.[14] Specific to the case of beef, a large percentage (93%) of water is taken up in the form of soil moisture to sustain large areas of farmland and pasture.

[8] Vermeulen, S. J., Campbell, B. M., Ingram, J.S.I. (2012) Climate Change and Food Systems, Annual Review of Environment and Resources. 37, 195-222.

[9] Poore, J., Nemecek. (2018) Reducing food's environmental impacts through producers and consumers, Science 360(6392), 987-992.

[10] Clune, S., Crossin, E., Verghese, (2017) Systematic review of greenhouse gas emissions for different fresh food categories. J. Clean. Prod. 140, 766–783.

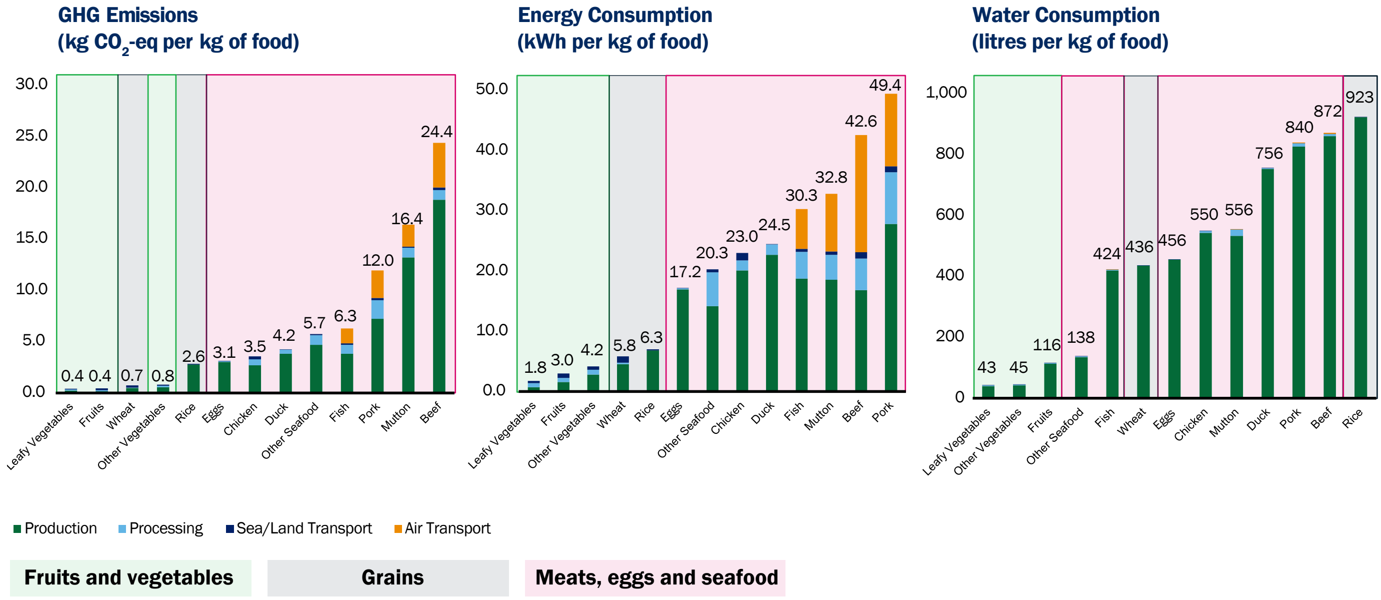
[11] Rice Knowledge Bank. Using rice husk for energy production. [online] Available at http://www.knowledgebank.irri.org/step-by-step-production/postharvest/rice-by-products/rice-husk/using-rice-husk-for-energy-production. (2019)

[12] Brouwer, C., Prins, K., & Heibloem, M. (1989). Irrigation water management: irrigation scheduling. Training manual, 4.

[13] The Water we Eat. [online] Accessed at: http://thewaterweeat.com/

[14] Mekonnen, M. M., & Hoekstra, A. Y. (2010). The green, blue and grey water footprint of farm animals and animal products (Vol. 1). Delft: UNESCO-IHE Institute for water Education.

Exhibit 2. GHG emissions, energy consumption and water consumption for one kg of each food item.

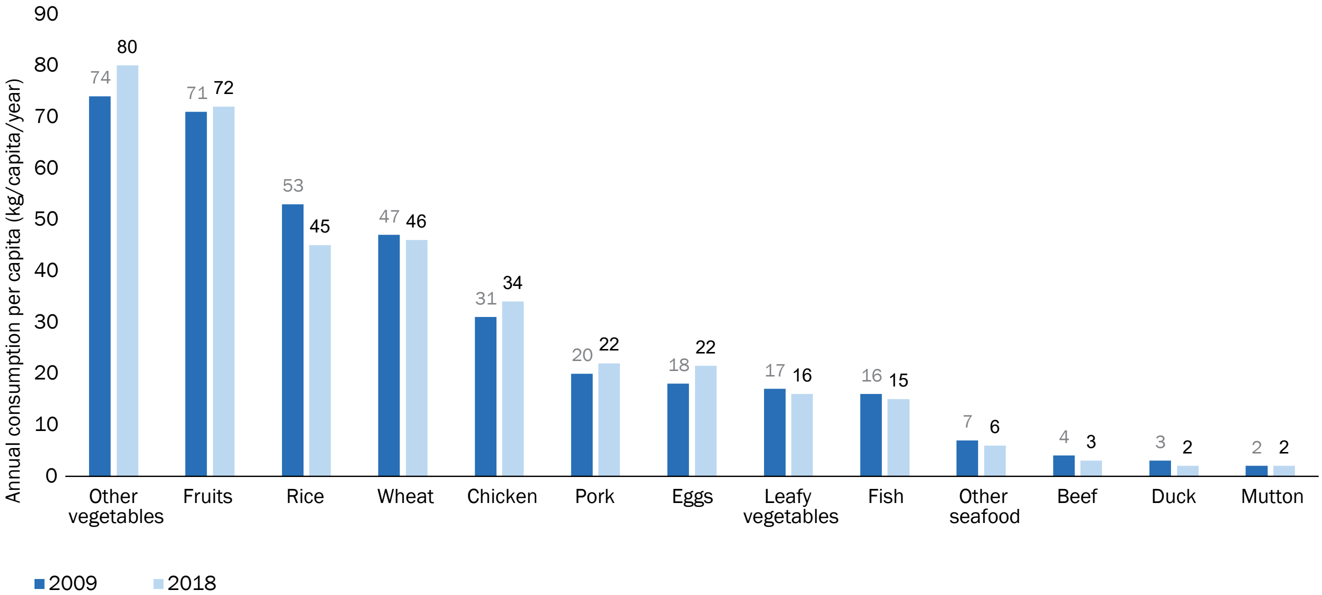


Consumption patterns of key food items in Singapore have remained consistent over the last decade

Understanding the environmental impact of food consumed in Singapore requires consideration of local food consumption patterns. The 13 key food items analysed in this study are the most consumed food items by weight in Singapore. They form a significant part of the diet of the average person residing in the country. Of these 13 food items, eggs, fish, leafy vegetables and bean sprouts (within "other vegetables" category) are both locally produced and imported, while the remaining food items are imported.

Local consumption pattern per capita in 2018 (Exhibit 3) has not changed significantly as compared to consumption trends 10 years ago.

Exhibit 3. Food consumption in Singapore (2009 and 2018).



Note: The values represented in Exhibit 3 are rounded to nearest whole number. For the purpose of calculation, exact numbers have been used in the report.

Consumption patterns affect the local environmental impact of food

Singapore imports more than 90% of the food consumed, with more than 75% sourced from the Asia Pacific region. In Singapore, 367 kg of food is consumed per person per annum, consisting of 46% fruits and vegetables. 25% grains and 29% meats, eggs and seafood (Part A of Exhibit 4). Annual food consumption in Singapore amounts to 954 kg CO_2-eq of GHG emissions per capita (equivalent to driving over 3,600 km on an average passenger car).

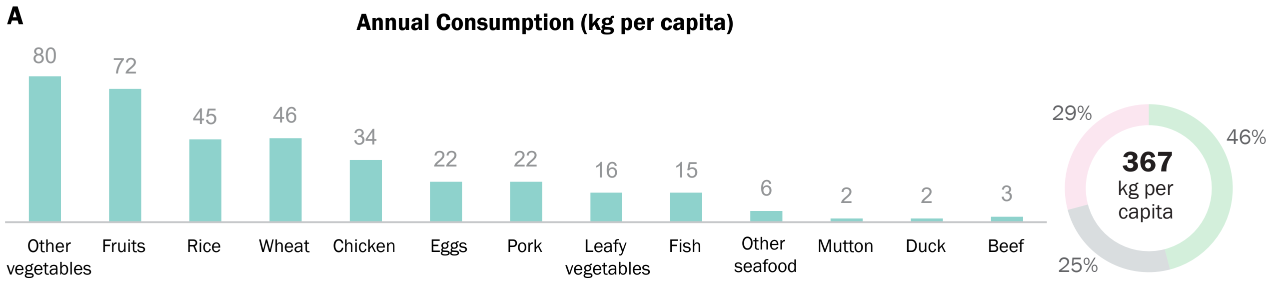
Despite accounting for less than a third of annual consumption, 'Meats, eggs and seafood' per capita by weight (Part A Exhibit 4) contributes to more than two-thirds of expenditure and GHG emissions. Fruits and vegetables account for about half of the total consumption in Singapore but contribute to less than a quarter of total expenditure and about one-tenth of total GHG emissions (Parts A, B and C of Exhibit 4).

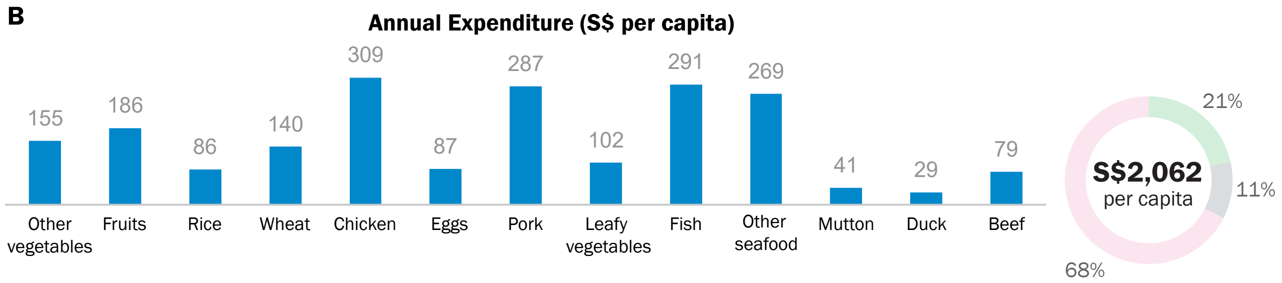
Grains account for about a quarter of the total consumption in Singapore but contribute to only about 11% of expenditure of all key food items due to their low retail cost (Parts A and B of Exhibit 4). Despite rice and wheat being consumed in similar amounts, GHG emissions per capita for rice is almost 3.5 times higher than wheat (Parts A and C of Exhibit 4).

This is due to the rice cultivation process. In flooded rice paddies, microbes break down decaying organic matter, releasing up to 12% of global CH_4 emissions and a significant amount of N_2O.

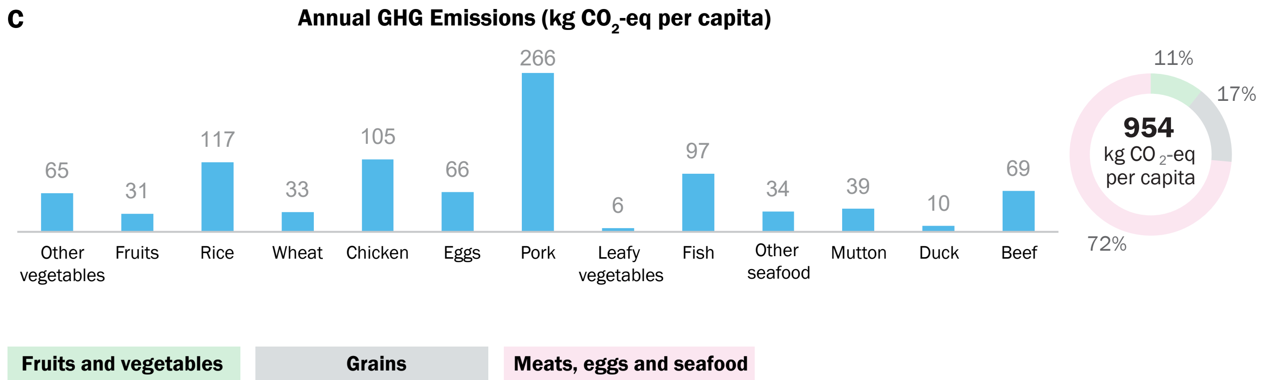
The subsequent sections in this report will feature detailed discussions on the main life cycle components that contribute significantly to GHG emissions, energy consumption and water consumption for the 13 key food items considered. The effect of consumption trends on these three environmental impacts will also be considered.

Exhibit 4. Consumption in kg per capita (A), expenditure in S$ per capita (B) and GHG emissions in kg CO_2-eq per capita (C) for 13 food items per annum in Singapore.





Consumers in Singapore spend most on fish and other seafood, contributing to approximately 27% of total food expenditure.



Annual GHG emissions of food consumed per capita

Part A of Exhibit 5 represents GHG emissions emitted when producing, processing and transporting per kg of each food item consumed in Singapore. To understand the GHG emissions of each food item consumed per capita (Part C of Exhibit 5), values in Part A of Exhibit 5 were multiplied with per kg consumption of each food item (Part B of Exhibit 5). Part C of Exhibit 5 then describes the contribution of each food type to an average person's food GHG emissions per annum.[15]

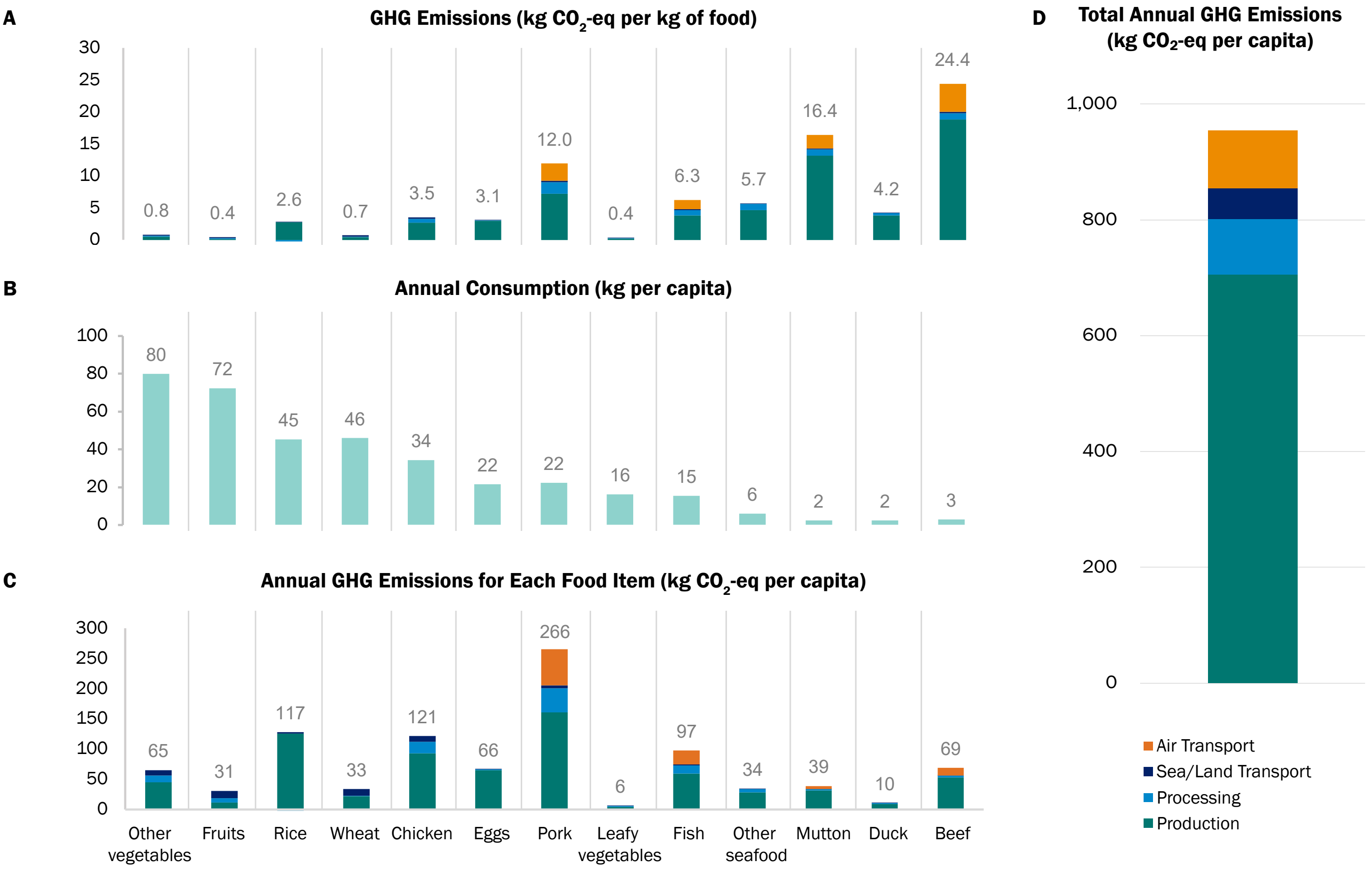
Although beef has the highest GHG emissions on a per kg basis, it only accounts for approximately 7% of total GHG emissions per capita per annum due to low consumption (0.8%). While pork has about half the GHG emissions on a per kg basis compared to beef, it is the highest GHG emissions contributor per capita per annum due to significantly higher consumption (6%) (Part C of Exhibit 5).

Despite relatively high annual consumption, fruits and vegetables contribute disproportionately less to GHG emissions. For example, other vegetables account for approximately 22% of the total consumption per capita but contribute only to 8% of total GHG emissions per capita.

As the majority of Singapore's food is imported, it is important to consider how much of the GHG emissions of food consumed yearly is attributable to transport. GHG emissions from air transport are about double the GHG emissions from land and sea transport despite the significantly lower imports by air (Part D of Exhibit 5).

[15] Department of Statistics Singapore (2019). [online] Available at: https://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data [Accessed 14 Jun. 2019].

Exhibit 5. GHG emissions for each kg of food consumed in Singapore and corresponding GHG emissions (A x B = C) per capita per annum for each food item. Values displayed in Part C take into account interim rounding-effect. Part D shows the aggregate total of GHG emissions for all 13 food items per kg per capita (summation of data in Part C of Exhibit 5).



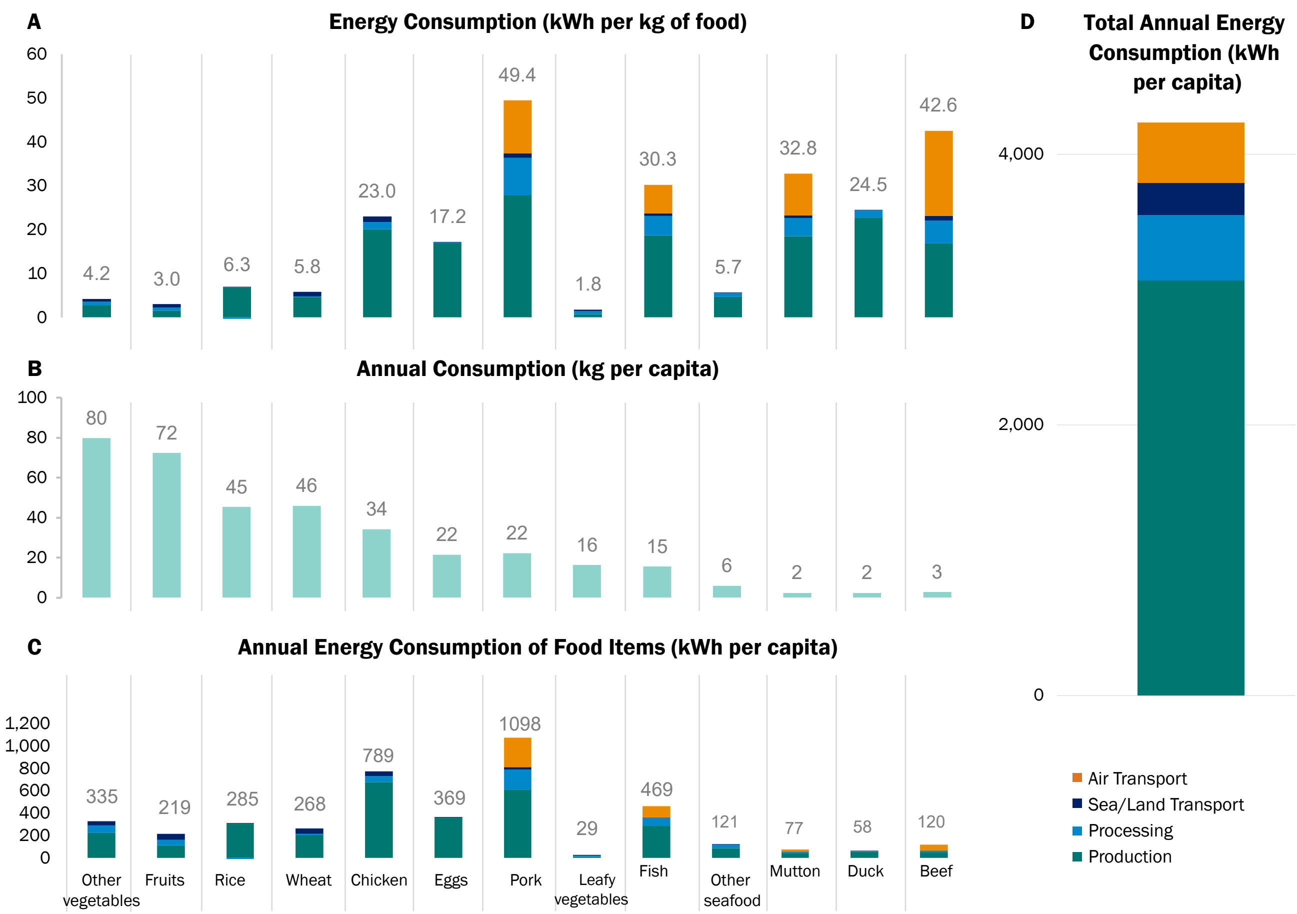
Annual energy consumption of food consumed per capita

Part A of Exhibit 6 represents energy consumption when producing, processing and transporting one kg of each food item. Part C of Exhibit 6 shows the energy consumption of each food type based on annual food consumption per capita. This has been obtained by layering the values in Part A of Exhibit 6 with per kg consumption of each food item (Part B of Exhibit 6).[16]

Although the food production stage takes up the bulk of energy consumed, transporting food by air takes up a disproportionately high portion of the energy consumed per capita (Part D of Exhibit 6). Although chilled air-flown pork, mutton, beef and fish account for less than 9% of the annual food consumed per capita, transporting them chilled to Singapore via air transport takes up about 10% of overall energy consumption for all food types. Air transport for these meats and fish also accounts for about 65% of the energy used for total transportation of food items to Singapore (including food that is transported by sea and/or land).

Cleaner electricity generation reduces GHG emissions, even if it consumes the same amount of energy during food production and processing. For example, 91% of mutton and 27% of beef imported are from fossil fuel-dependent Australia; this increases the proportion of GHG emitted versus energy consumed during the two stages. The reverse is true for imported chicken, of which 46% are from Brazil - a country drawing 75% of its electricity from hydropower.

Exhibit 6. Energy consumption for each kg of food consumed in Singapore and corresponding energy consumption (A x B = C) per capita per annum for each food item. Values displayed in Part C take into account interim rounding-effect. Part D shows the aggregate total of energy consumption for all 13 food items per kg per capita (summation of data in Part C of Exhibit 6).



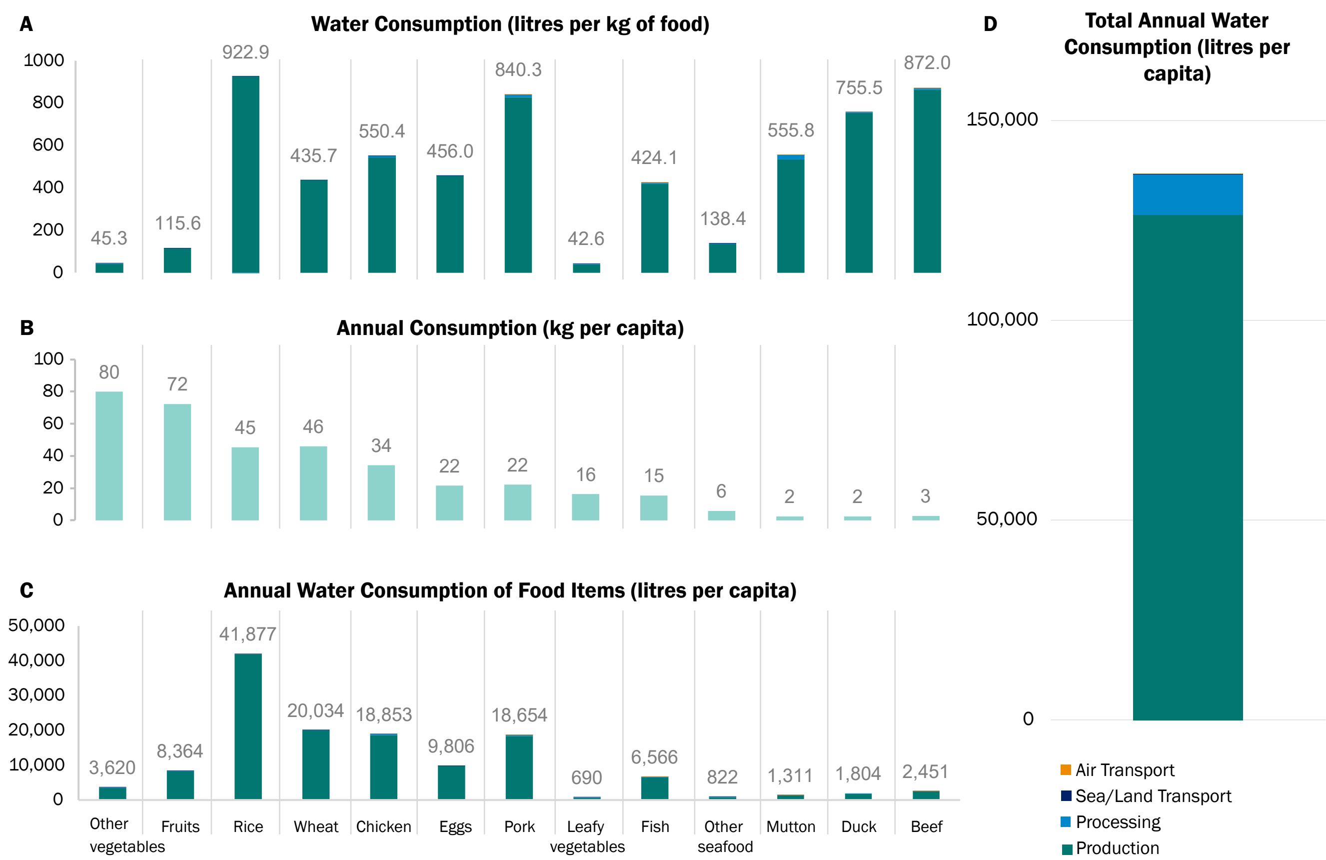
[16] Department of Statistics Singapore (2019). [online] Available at: https://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data [Accessed 14 Jun. 2019].

Annual water consumption of food consumed per capita

When considering the water consumption of food, feed production for meats, eggs and seafood, and direct irrigation for crops are the biggest direct contributors. It helps to consider how Singapore's water supply will be stressed if different food items are produced or processed locally.

Data shows the majority of water consumed comes from the production stage (92.5%) and this is attributed to the feed production for meats, eggs and seafood, and irrigation for rice, wheat, fruits, leafy vegetables and other vegetables. Water consumption (Part D of Exhibit 7) for processing and transportation is almost negligible.

Exhibit 7. Water consumption for each kg of food consumed and corresponding water consumption (A x B = C) per capita per annum for each food item. Part D shows the aggregate total of water consumption for all 13 food items per kg per capita (summation of data in Part C of Exhibit 7).



Pathways to reduce environmental impact

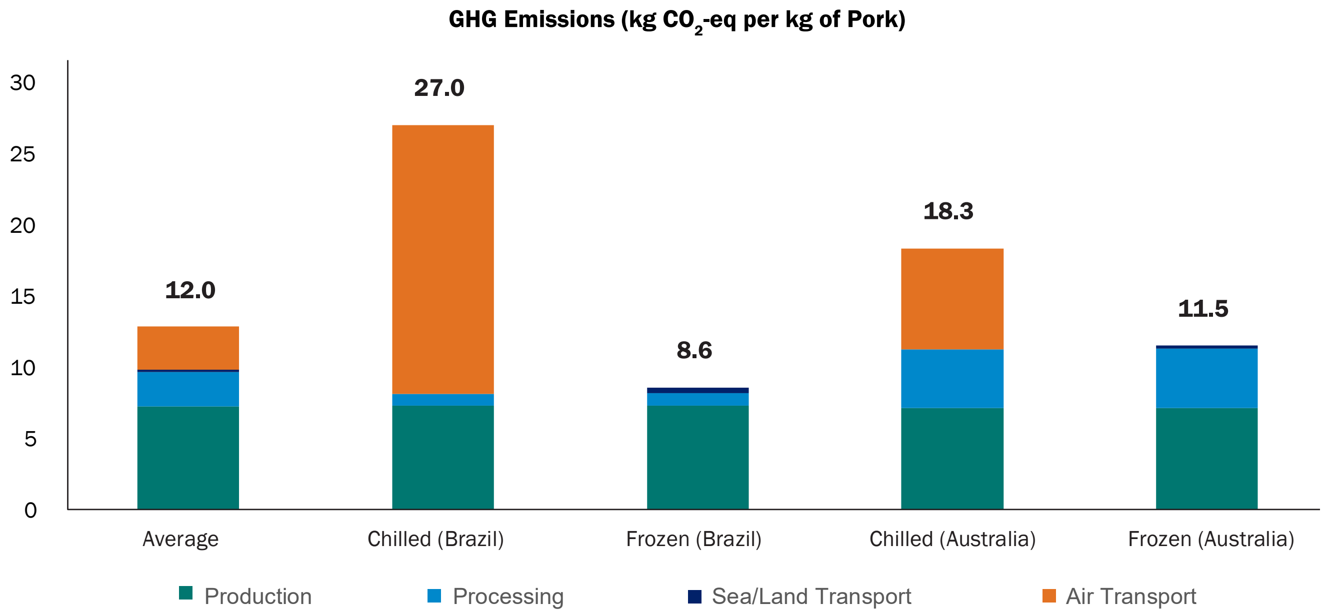
Sourcing chilled food items from neighbouring countries or producing locally

Transportation is responsible for roughly 16% of our global GHG emissions and consumes about 16% of energy demand.[17] 65% of the energy used in transporting all food items to Singapore is contributed by chilled air-flown pork, mutton, beef and fish, which only accounts for 9% of the food consumed.

Importing from countries that use cleaner modes of transport will reduce GHG emissions. Generally, chilled food from countries farther away is flown in to preserve the freshness of the food, while frozen food is shipped into the country via sea transport. Therefore, the import of chilled food items through air transport will significantly increase GHG emissions. The GHG emissions during the transportation stage for food imported from Brazil are about 45 times more when flying in the chilled meat than shipping it frozen through sea freight. A similar comparison can be seen for chilled and frozen pork from Australia (Exhibit 8).

Hence, sourcing chilled food items from neighbouring countries or producing locally can serve to meaningfully reduce the environmental footprint as this means avoiding the need to import food through air transport.

Exhibit 8. GHG emissions for each kg of pork during the production, processing and transportation stages.



Note: Fresh meat refers to animals that are produced overseas, and transported to Singapore for processing. Chilled meat refers to animals that are produced and processed overseas, and transported to Singapore in chilled form. Frozen meat refers to animals that are produced and processed overseas, and transported to Singapore in frozen form.

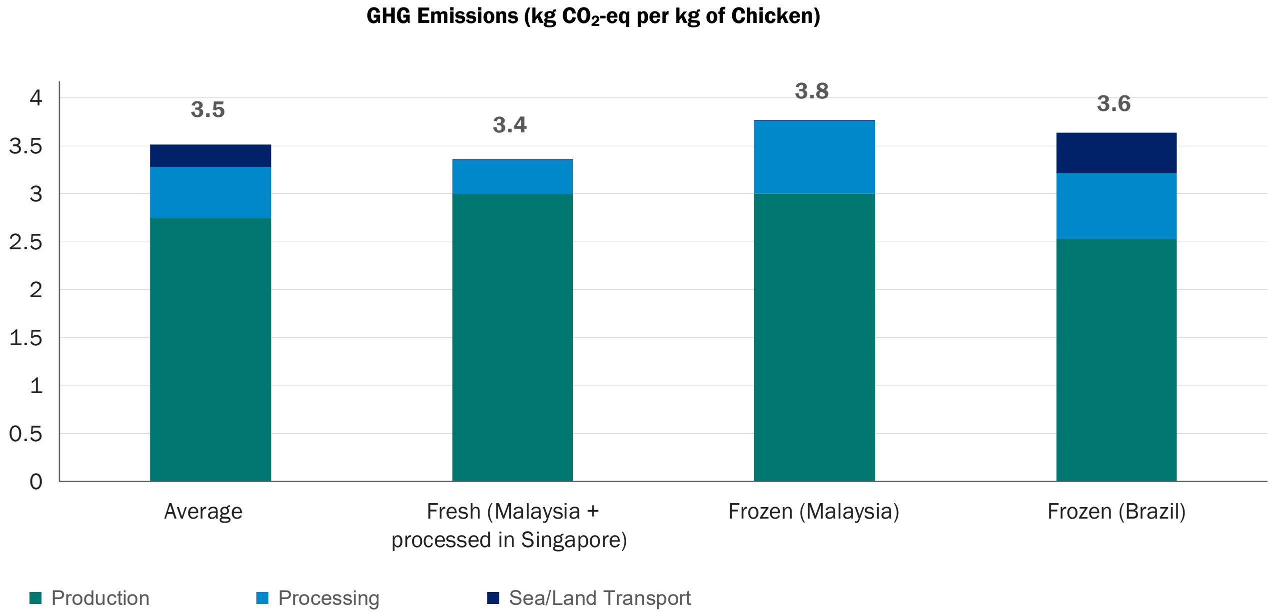
[17] World Energy Council, World Energy Resources 2016 (2016). Available at: https://www.worldenergy.org/wp-content/uploads/2016/10/World Energy-Resources-Full-report-2016.10.03.pdf [Accessed 14 Jun. 2019].

Cleaner energy sources

Approximately 25% of anthropogenic global GHG emissions come from the generation of electricity, which is the largest contributor amongst all economic activities.[18] Energy consumption during the food production and processing stages is the main contributor to GHG emissions from food.

Diverse technologies are available today to capitalise on cleaner energy sources. These energy sources vary across countries, with countries that use cleaner sources for their electrical grid contributing less to GHG emissions. For instance, 75% of Brazil's electrical grid is sourced from hydropower [19] while Malaysia's electricity comes from a mix of natural gas (37%), crude oil (30%) and coal (23%).[20]

Exhibit 9. GHG emissions for each kg of chicken during the production, processing and transportation stages.



Hence, GHG emissions from the production and processing stages for frozen chicken imported from Brazil is 15% lower than that from Malaysia. This leads to lower overall GHG emissions when importing from Brazil despite the increased distance for transportation. Therefore, sourcing food from countries with cleaner and renewable sources of electricity generation can meaningfully reduce environmental impact.

[18] Change, I. C. (2014). Mitigation of climate change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 1454.

[19] International Energy Agency (2019). [online] Available at: https://www.iea.org/countries/Brazil/ [Accessed 14 Jun. 2019].

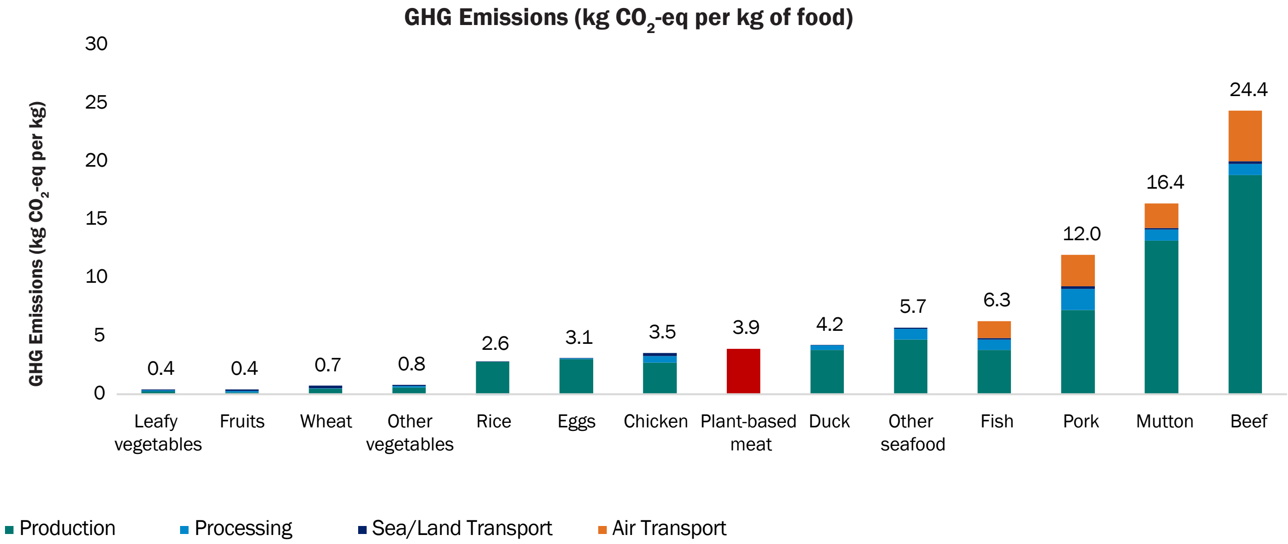
[20] Malaysia Energy Information Hub (2011). [online] Available at: https://meih.st.gov.my/statistics [Accessed 14 Jun. 2019].

Consider plant-based meats

Currently, 29% of the average diet of a Singapore consumer consists of meats, eggs and seafood.[21] Shifts in our diet to food products with lower GHG emissions is a possible pathway to reduce the environmental impact of our food consumption.

With the launch of plant-based meats in Singapore like Impossible Foods and Beyond Meat, there are emerging options for Singapore consumers to substitute their meat intake with such plant-based products. These meat alternatives are derived from plants (mostly soybean[22] and pea[23]) which provide the necessary protein intake in the diet. As shown in Exhibit 10, consuming less traditional meat and more of these plant-based meats could lead to a significant decrease in the GHG emissions of our food supply due to the lower environmental footprint of plant sources (taking into account the sea transportation to Singapore).

Exhibit 10. The environmental impact if consumers in Singapore shift to a plant-based meats diet.



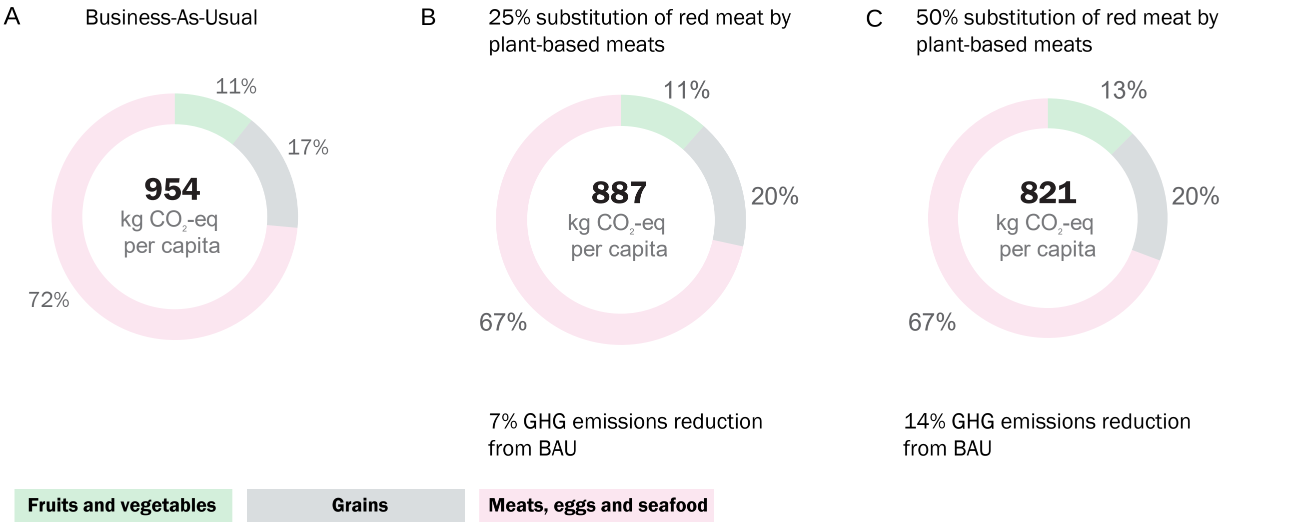
[21] Singapore Food Agency. (2019). Food Import & Export. [online] Available at: https://www.sfa.gov.sg/food-import-export [Accessed 14 Jun. 2019].

[22] Impossible Foods (2019). [online] Available at: https://impossiblefoods.com/ [Accessed 14 Jun. 2019].

[23] Beyond Meat - Available at: Heller, M. C., & Keoleiank, G. A. (2018). Beyond Meat's Beyond Burger Life Cycle Assessment: A Detailed Comparison between a Plantbased and an Animal-Based Protein Source. CSS18-10.

If Singapore consumers substitute 25% of their red meat consumption - namely beef, mutton, pork and duck - with plant-based meats, there will be a 7% reduction in GHG emissions as compared to the business-as-usual scenario. Correspondingly, a 50% substitution of red meat will result in a 14% reduction in GHG emissions (Exhibit 11).

Exhibit 11. Three different scenarios for GHG emissions: Part A represents business-as-usual, Part B represents 25% plant-based meats meats substitution, and Part C represents 50% plant-based meats substitution.



A dietary shift to plant-based meats could offer a significant reduction in the environmental impact of food. However, the plant-based meat industry is still nascent. Availability and adaptation of efficient technologies could help achieve economies of scale. This would make plant-based meats more accessible and affordable for consumers.

Increase consumer awareness

Shifting consumer preferences favourably towards a more sustainable diet plays an important role in reducing our environmental impact. Environment impact labeling might be an effective approach to empowering consumers with information to choose an environmentally friendly option. A study [25] conducted in Australia suggests that consumers underestimate the environmental impact associated with their food choices. Based on the study, consumers are likely to choose food items with lower environmental impact if food items are clearly labelled with information on their environmental impact.

Environmental impact labeling could even be combined with nutritional labeling, to signal to consumers that diets which are better for the planet are also better for health. However studies [26, 27] show attitudes towards nutritional labels differ significantly based on demographic factors such as ethnicity and age in Singapore. As such, labelling efforts should also be complemented by education and awareness of food labels.

[25] Camilleri A.R., Larrick R.P., Hossain S.,Patino-Echeverri D. (2018). Consumers underestimate the emissions associated with food but are aided by labels. Nature Climate Change.

[26] Vijaykumar S1, Lwin MO, Chao J, Au C. (2013). Determinants of food label use among supermarket shoppers: a Singaporean perspective. Journal of Nutrition Education and Behavior, Volume 45, Issue 3, 204 – 212.

[27] Mandle, J., Tugendhaft, A., Michalow, J., & Hofman, K. (2015). Nutrition labelling: a review of research on consumer and industry response in the global South. Global health action, 8, 25912. doi:10.3402/gha.v8.25912.

Conclusion

By studying the environmental impact of food in Singapore's context, we can better understand how our food consumption actually contributes to climate change, as well as how the food choices we make can help to reduce environmental impact.

At an individual level, consumers can make the choice to purchase food produced locally or regionally over food air-flown from countries far from Singapore. This is due to the significantly higher environmental impact of food items transported by air. A conscious shift in dietary preferences to reduce meat consumption and incorporate more vegetables or plant-based meat could also lead to significantly lesser GHG emissions, water consumption and energy consumption due to food consumed. This can be attributed to proportionately higher environmental impact of animal-based protein than plant-based food items.

Food manufacturers and retailers can drive the initiative to identify and develop food sourcing strategies by taking environmental factors into consideration. They can be supported by the policymakers and agencies to identify food sourcing countries with cleaner energy sources or sourcing locally-produced food items to reduce the environmental impact of the food in Singapore.

Policymakers can work closely with the industry and other stakeholders to uplift the technological capability of the local food and agri-tech industry. Public institutions and foundations can also create funding mechanisms to support the research organisations in driving cost-efficient and environmentally friendly food production.

Collaboration among different stakeholders accompanied by identification of priority investment areas is key to achieve a meaningful reduction of the environmental impact of food consumed in Singapore as well as meet the current national food strategy. It is important to ensure there is coordination to achieve synergy and accelerated progress towards a climate-resilient and future-ready food supply.