

URBAN SOLUTIONS AND SUSTAINABILITY R&D CONGRESS 2023

BUILDING SUSTAINABLE, RESILIENT, AND LIVEABLE CITIES OF TOMORROW

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ANALYSING THE ENVIRONMENTAL IMPACT OF FOOD CONSUMPTION THROUGH LIFE CYCLE ASSESSMENT

Dr Yeo Zhiquan

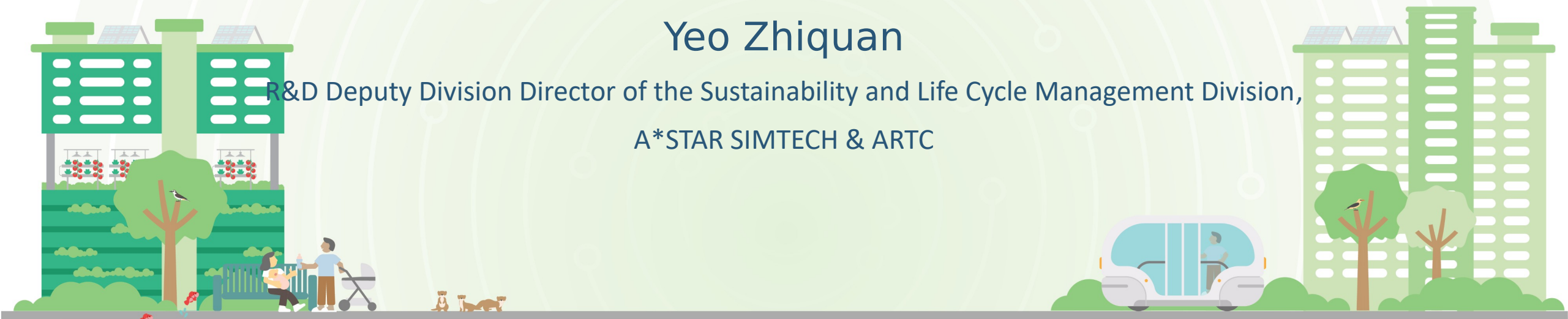
R&D Deputy Director
Sustainability and Life Cycle Management Division
Agency for Science, Technology and Research (A*STAR)



Analysing the Environmental Impact of Food Consumption through Life Cycle Assessment

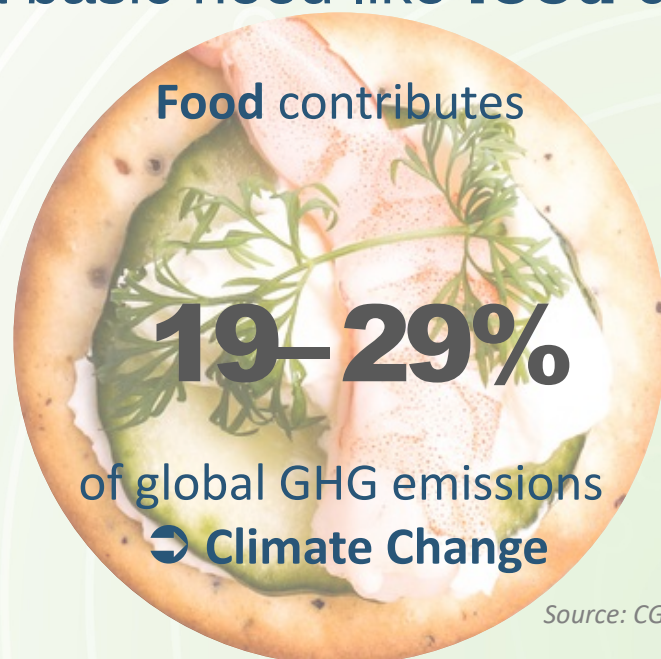
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R&D Deputy Division Director of the Sustainability and Life Cycle Management Division,
A*STAR SIMTECH & ARTC



Motivation of study

How does a basic need like **food** contribute to **climate change**?



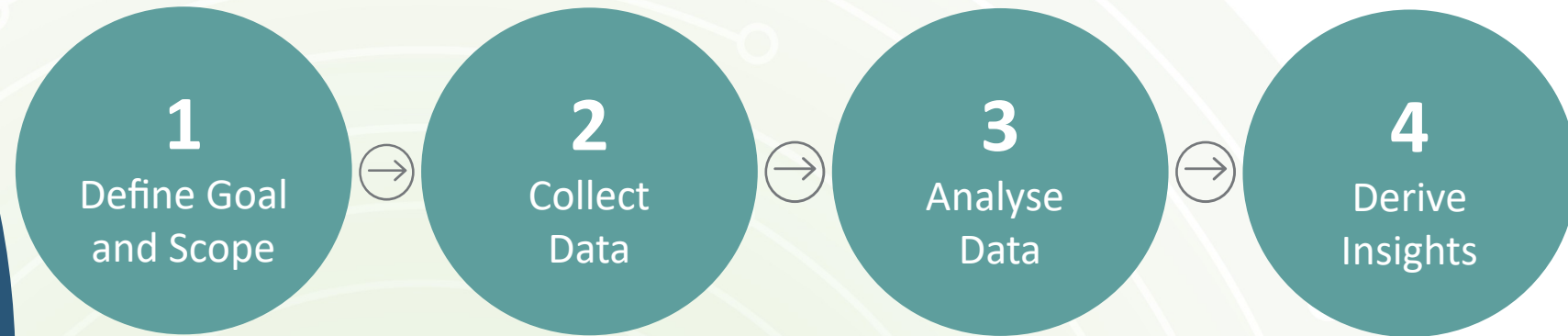
Source: CGIAR, 2019

How can the food **choices** we make **reduce environmental impact**?



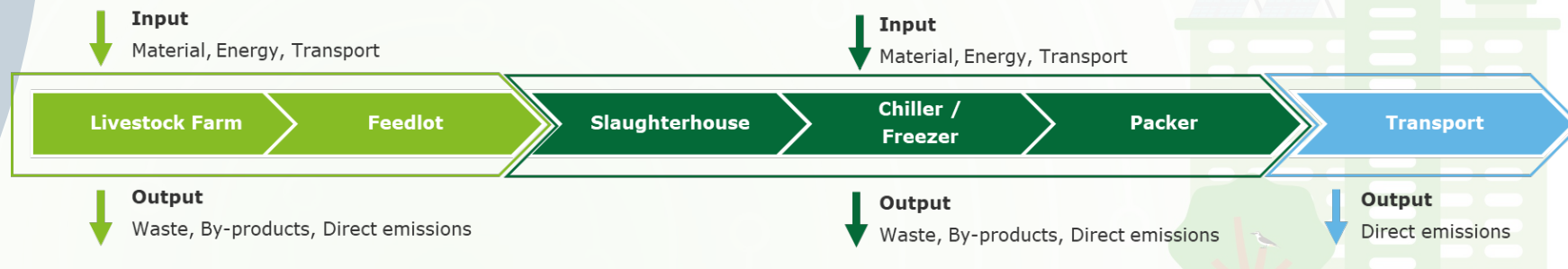
Objective

Quantify the environmental impact of key food items consumed in Singapore, using the Life Cycle Assessment (LCA) methodology.



Adapted from: ISO 14040/44

Example of fresh and frozen pork, mutton and beef

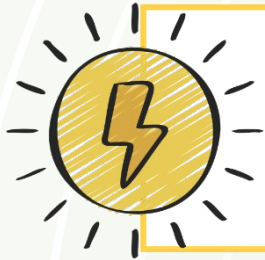


Environmental impact indicators considered



Greenhouse Gas (GHG) Emissions

- A measure of global warming and climate change associated with the production, processing and transportation of a food item.
- Measured in kg of carbon dioxide equivalent (kg CO₂-eq).



Energy Consumption

- Represents the net amount of energy consumed in the production, processing and transportation of a food item.
- Includes solar energy absorbed by crops for photosynthesis.
- Measured in kilowatt hour (kWh).



Water Consumption

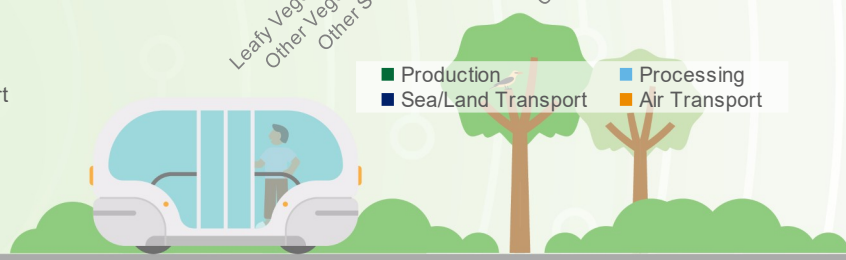
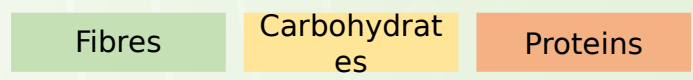
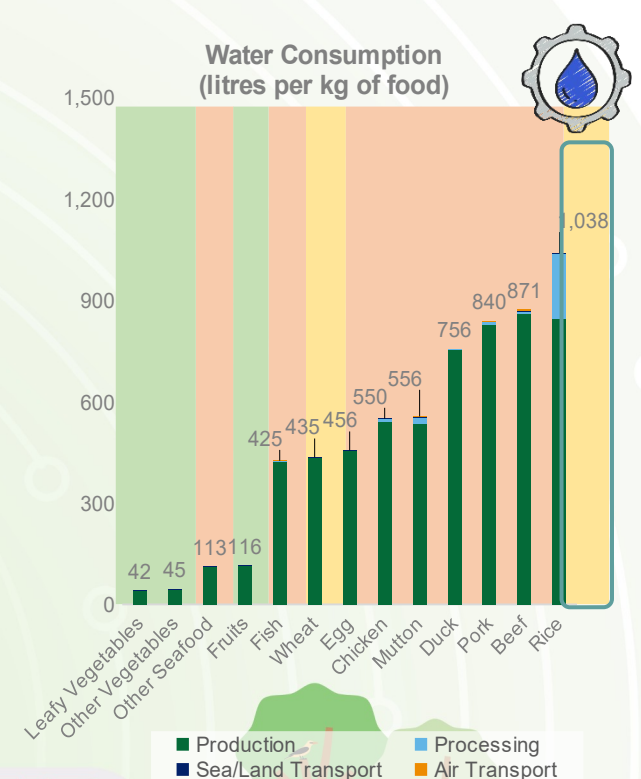
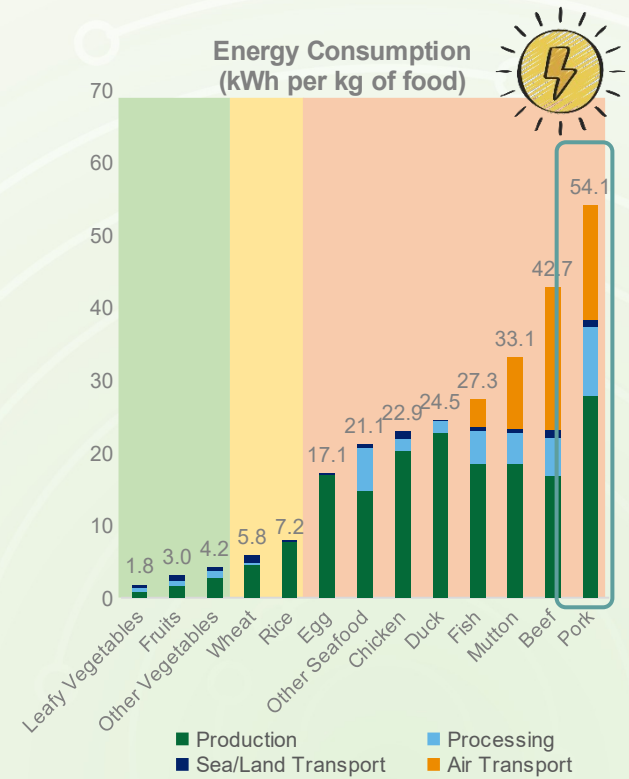
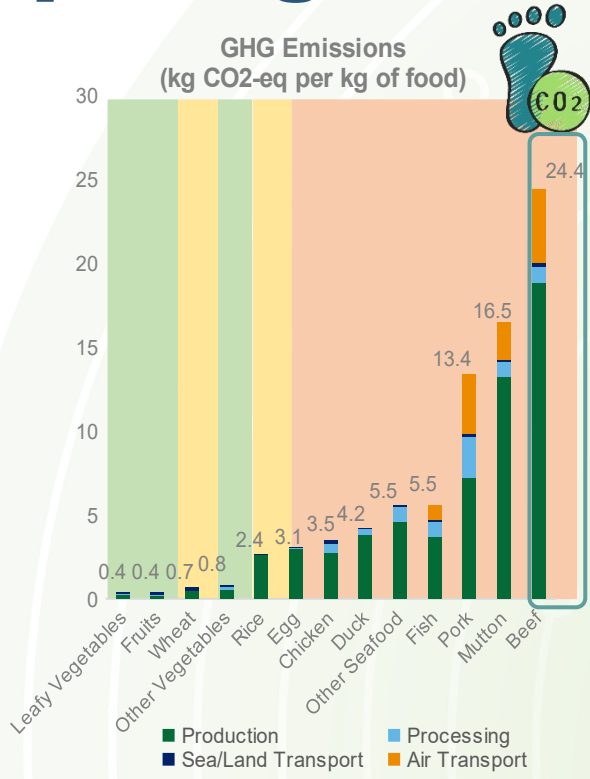
- Represents the net amount of water consumed in the production, processing and transportation of a food item.
- Excludes moisture in soil which is largely dependent on variable and location-specific precipitation and evaporation patterns.
- Measured in litres.

Beef emits the most GHG emissions...

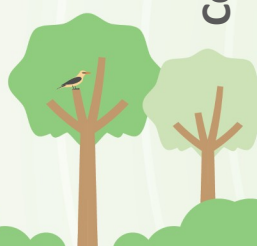
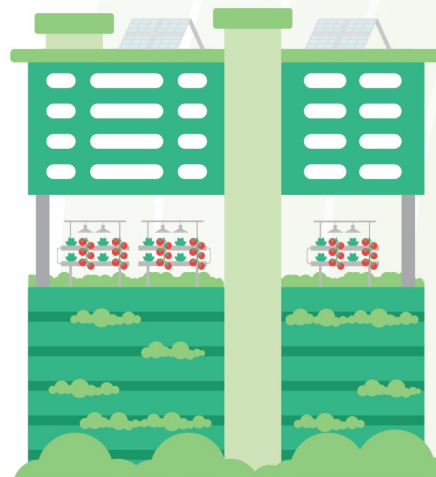
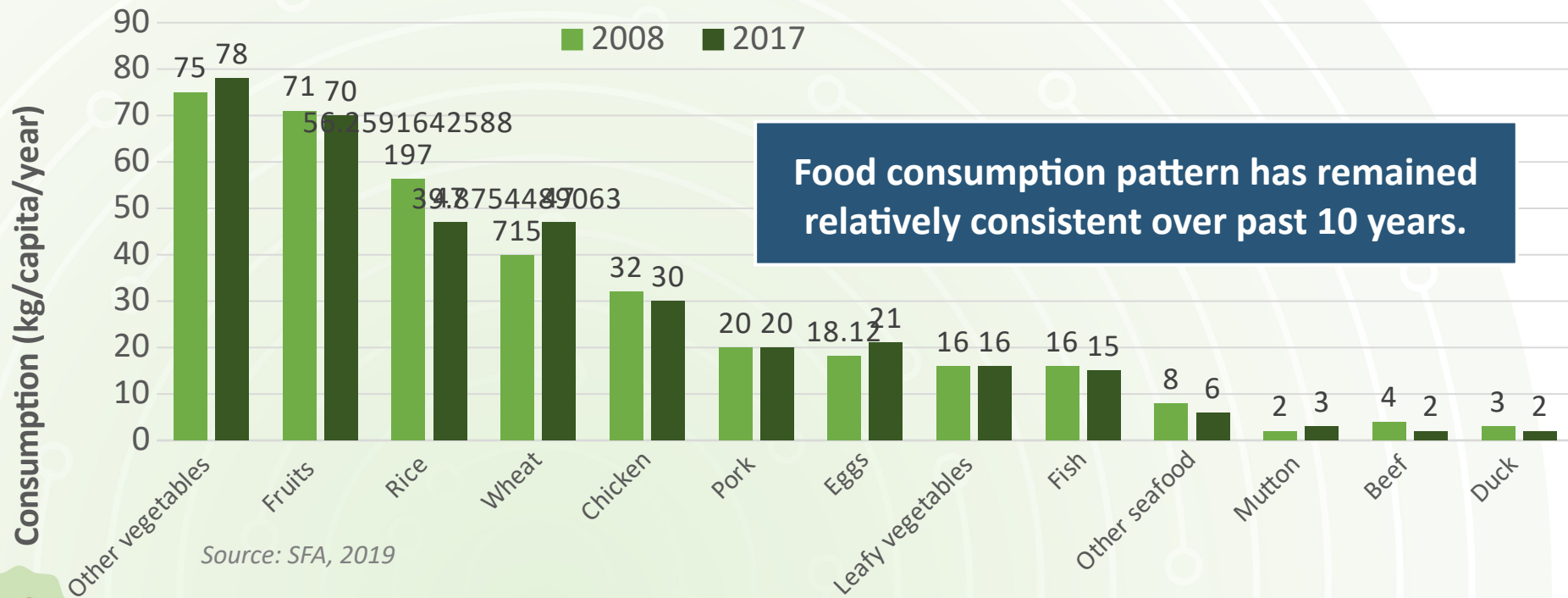
while **pork** and **rice** consume the most energy and water respectively.

per kg basis?

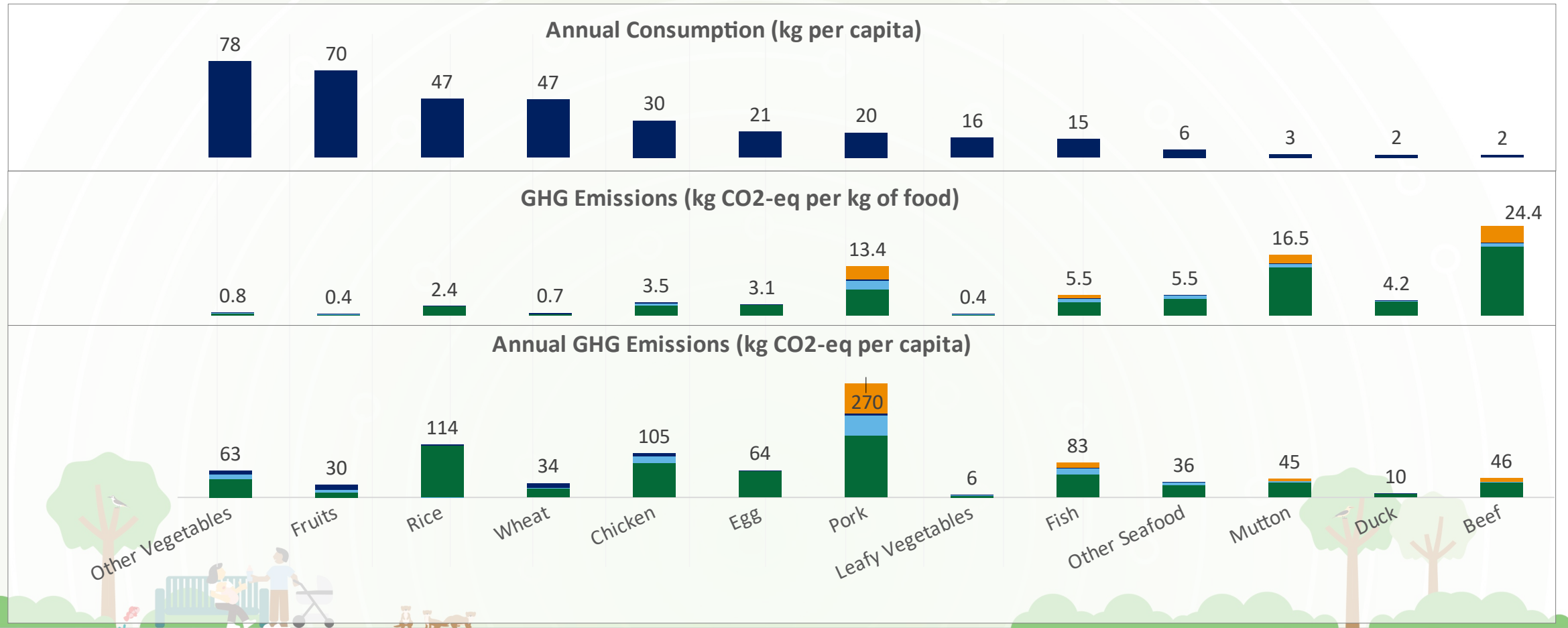
Impact of food on a



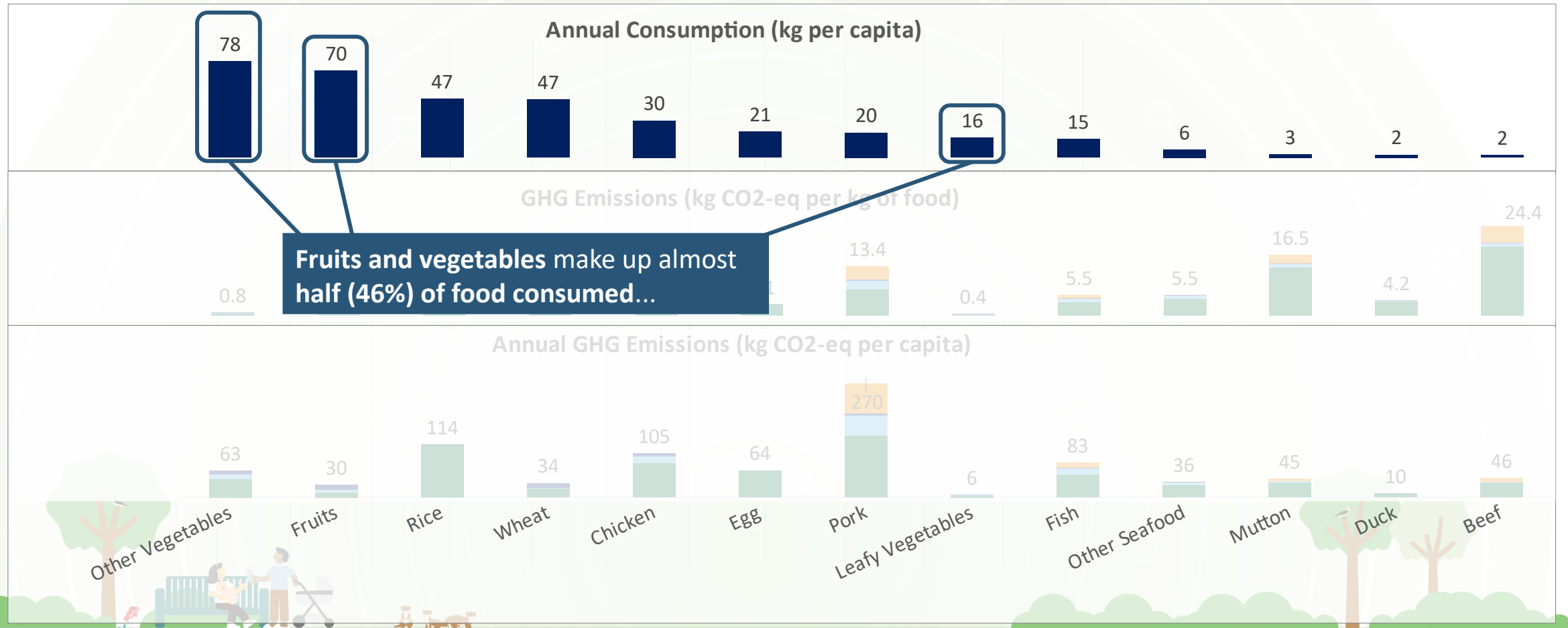
What is the food consumption pattern in Singapore?



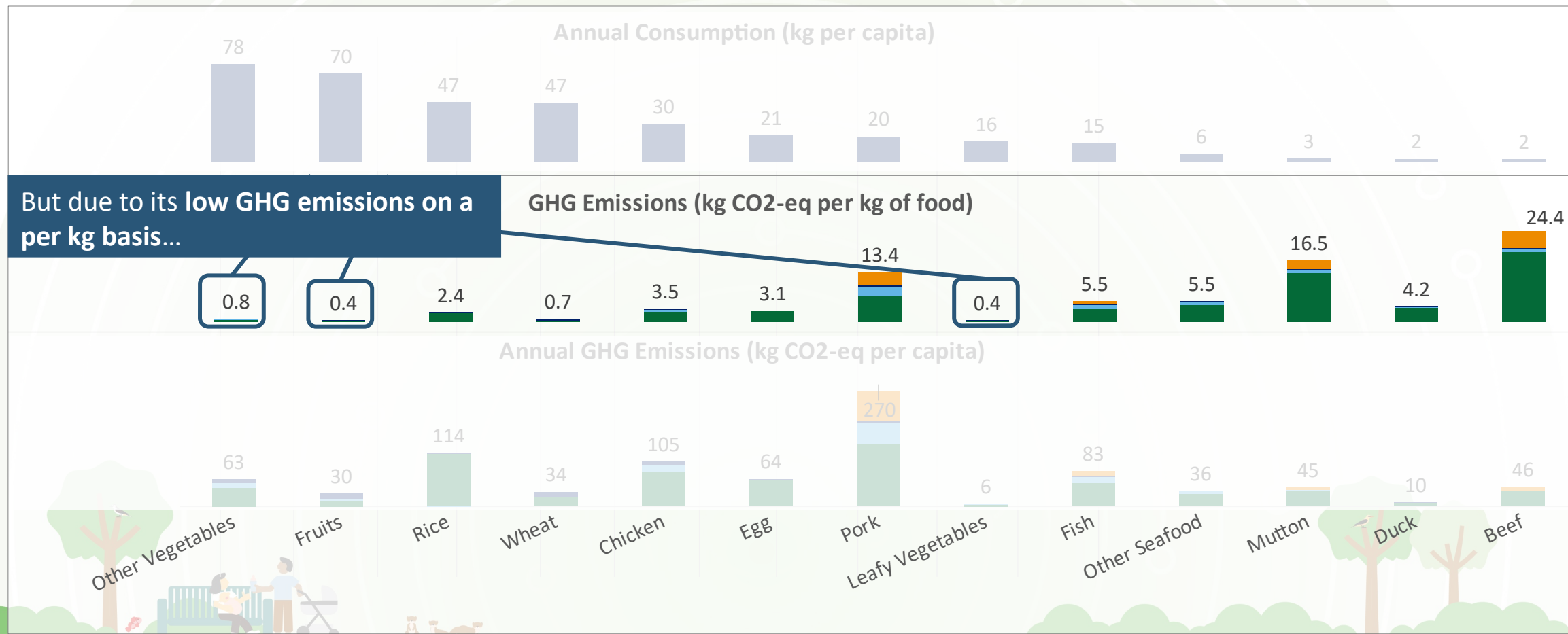
How does food consumption pattern affect environmental impact?



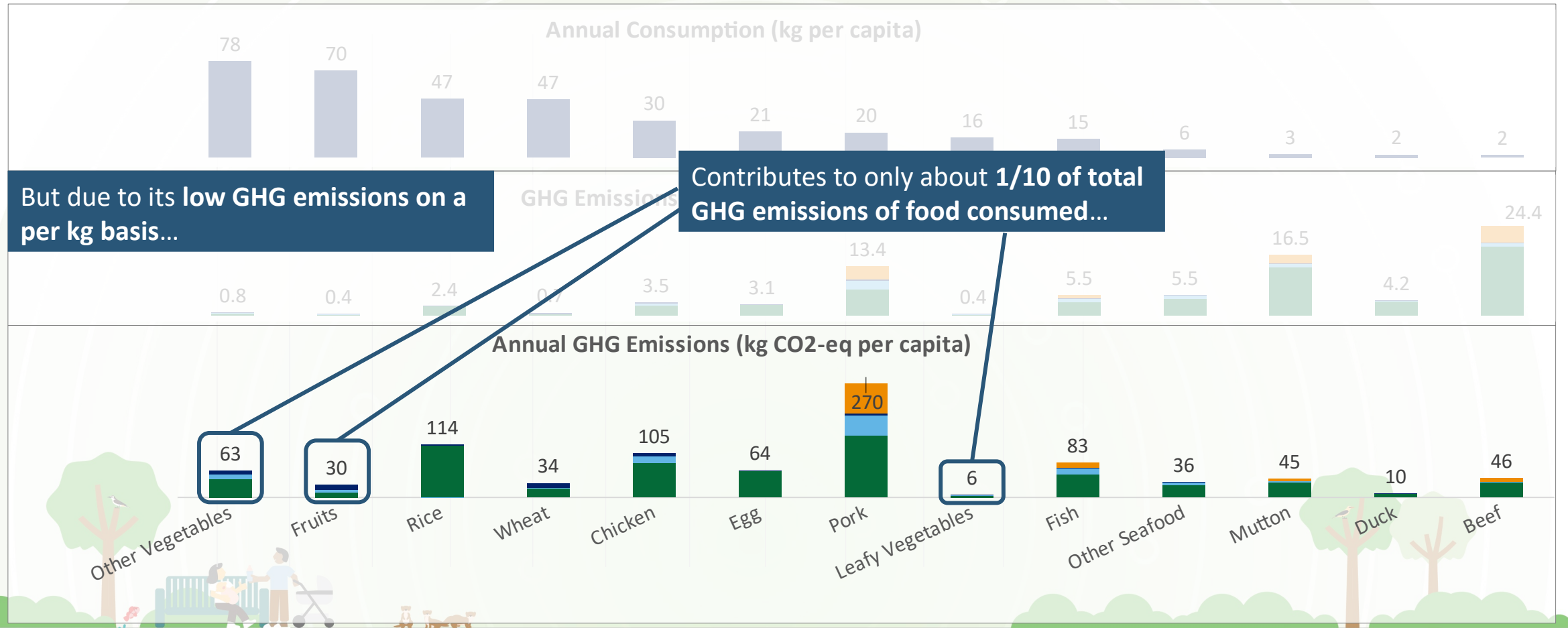
How does food consumption pattern affect environmental impact?



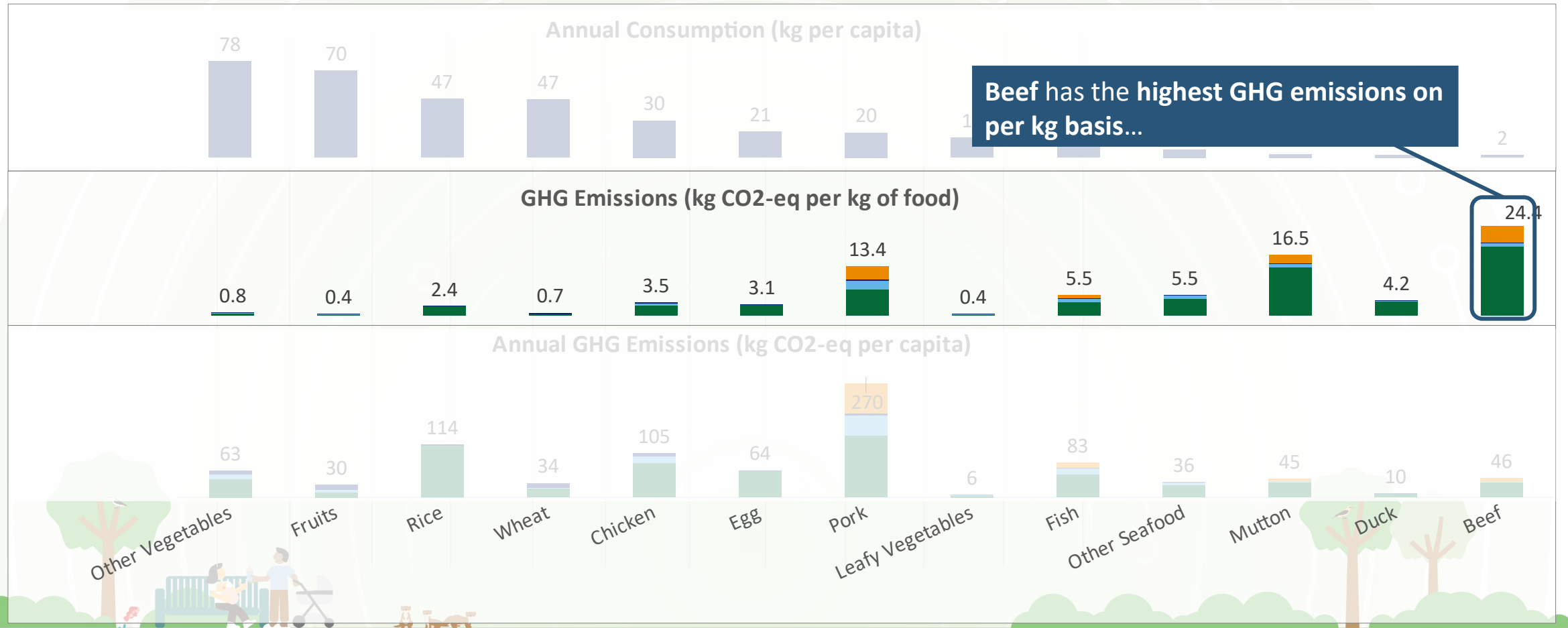
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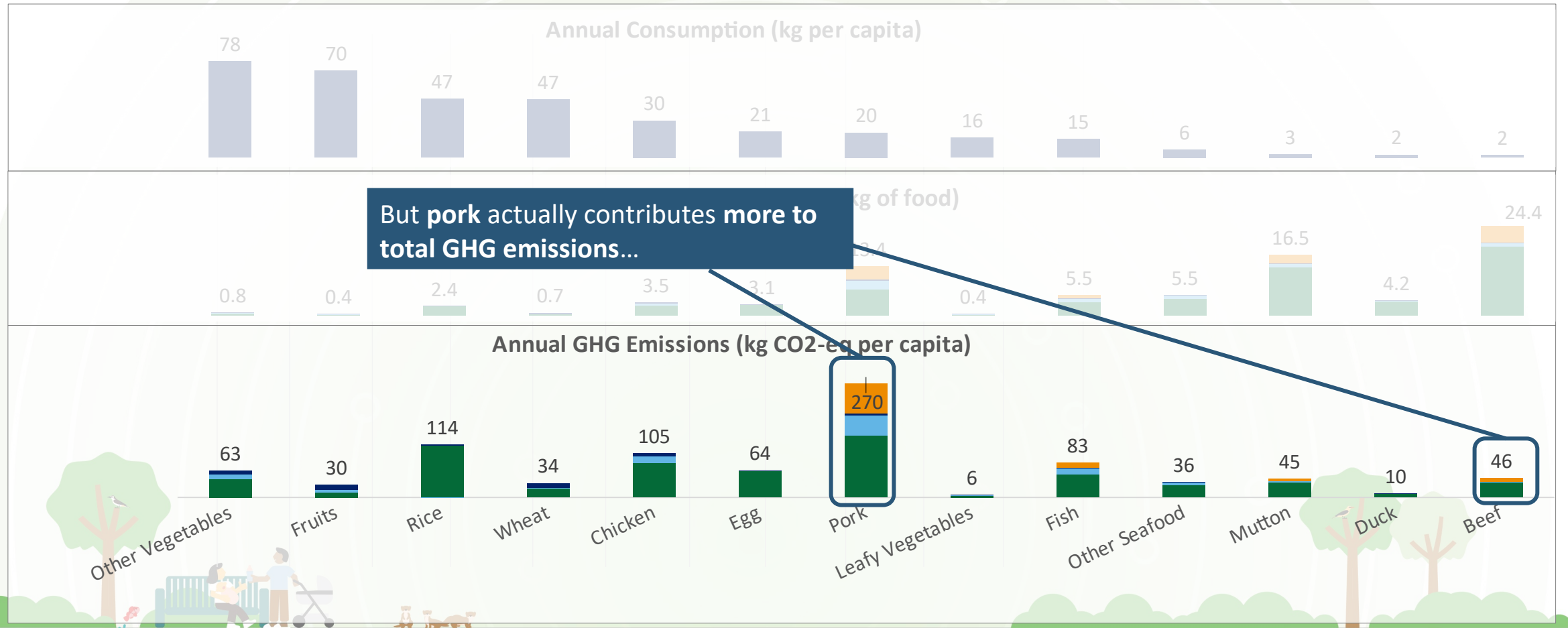
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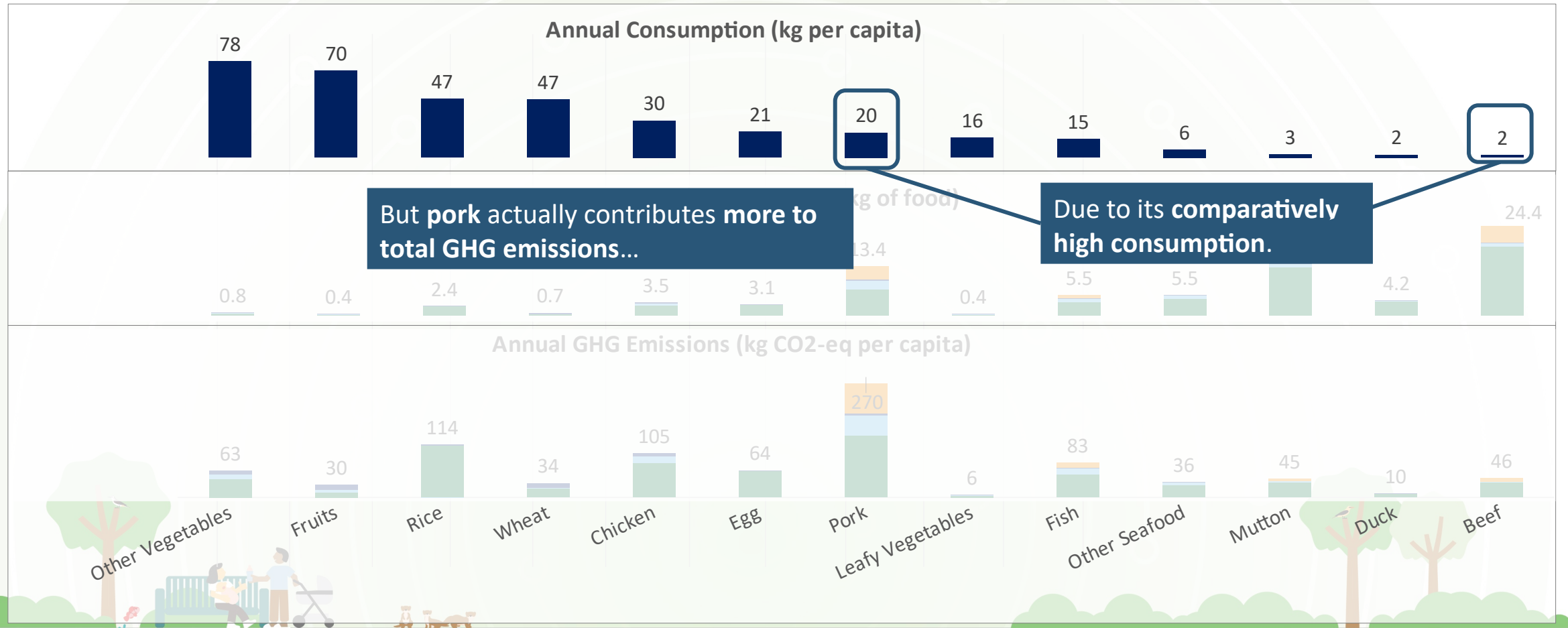
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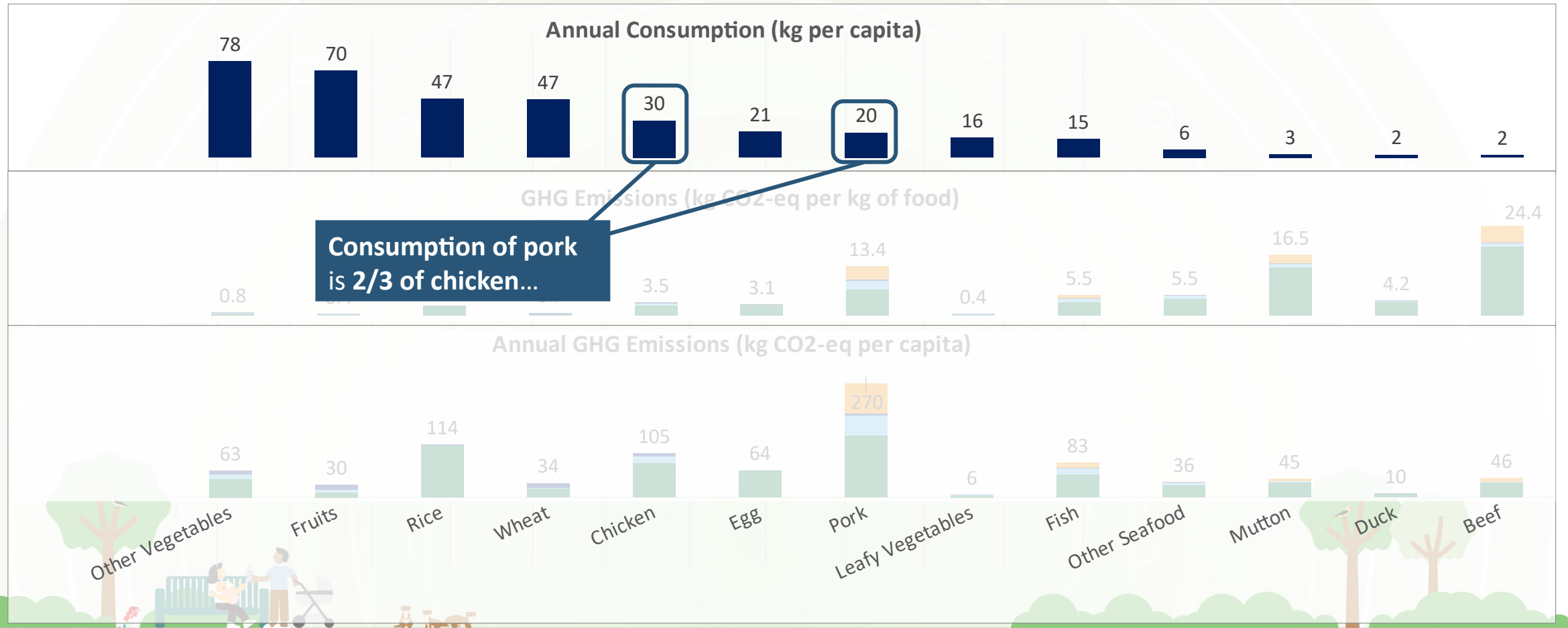
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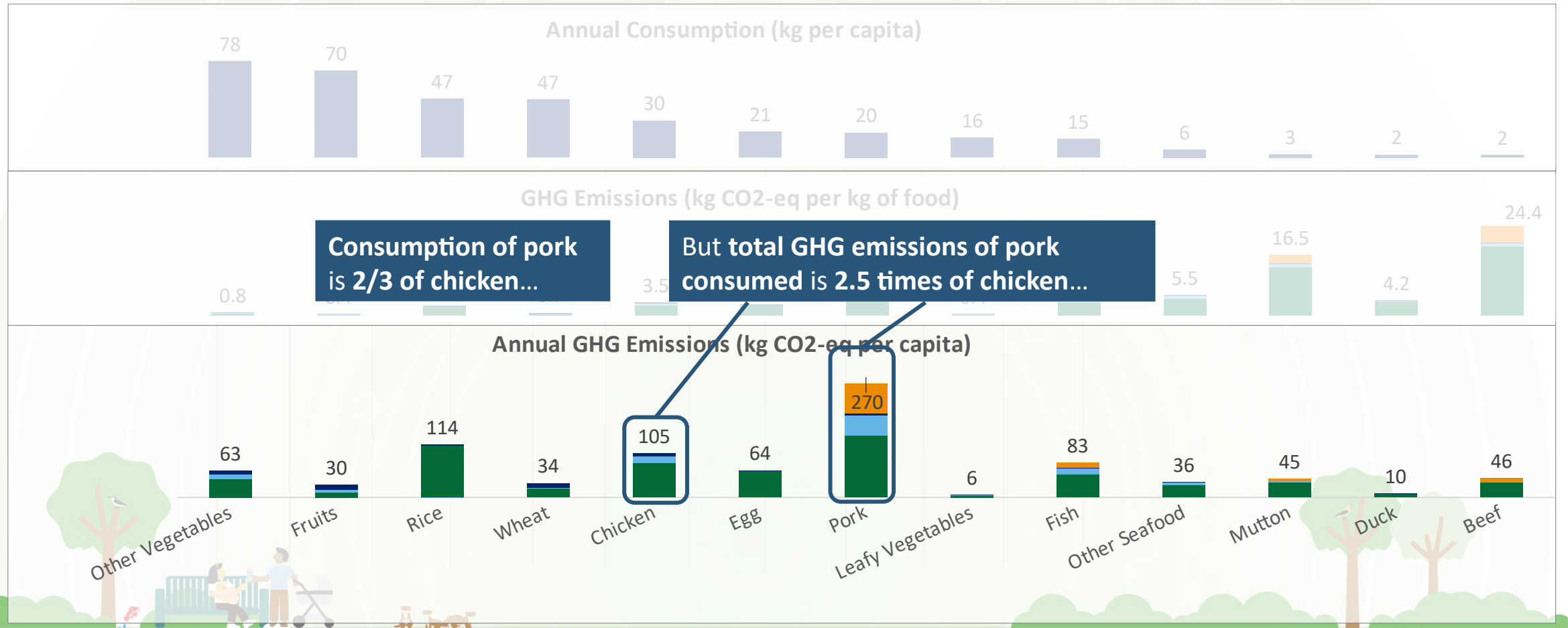
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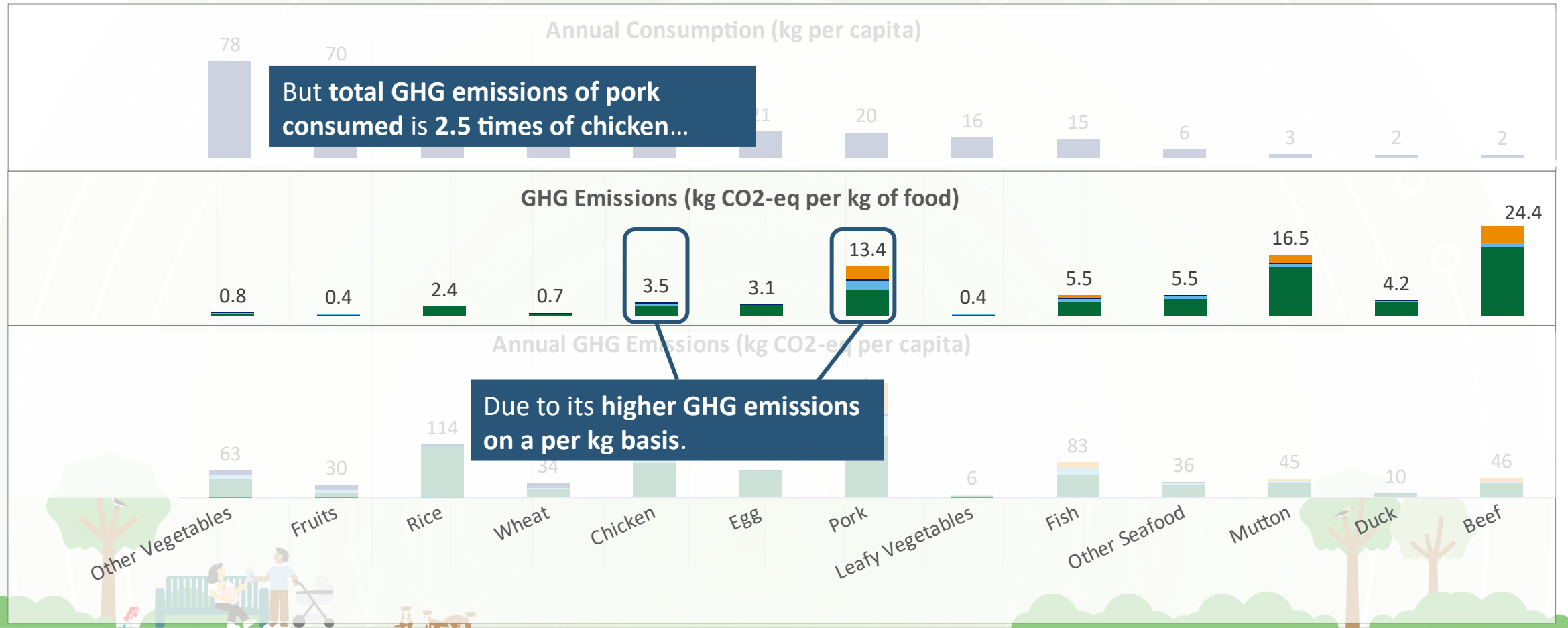
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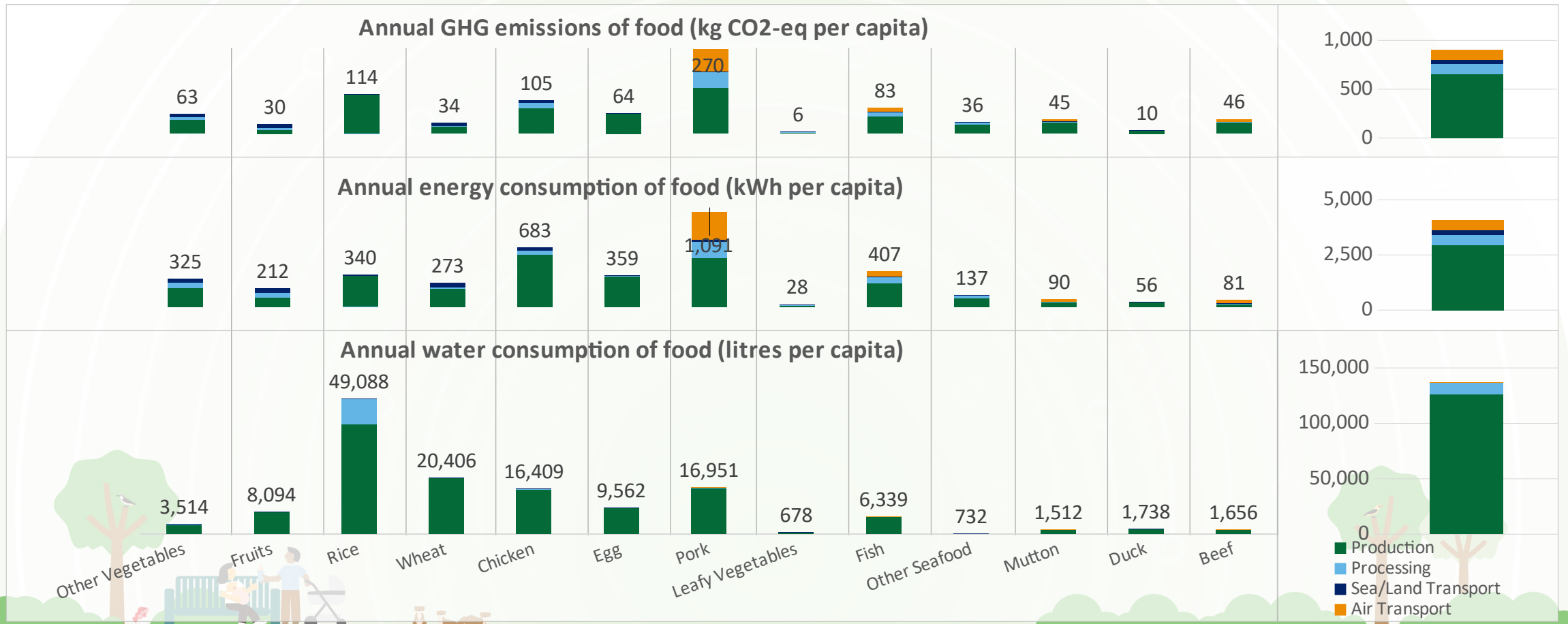
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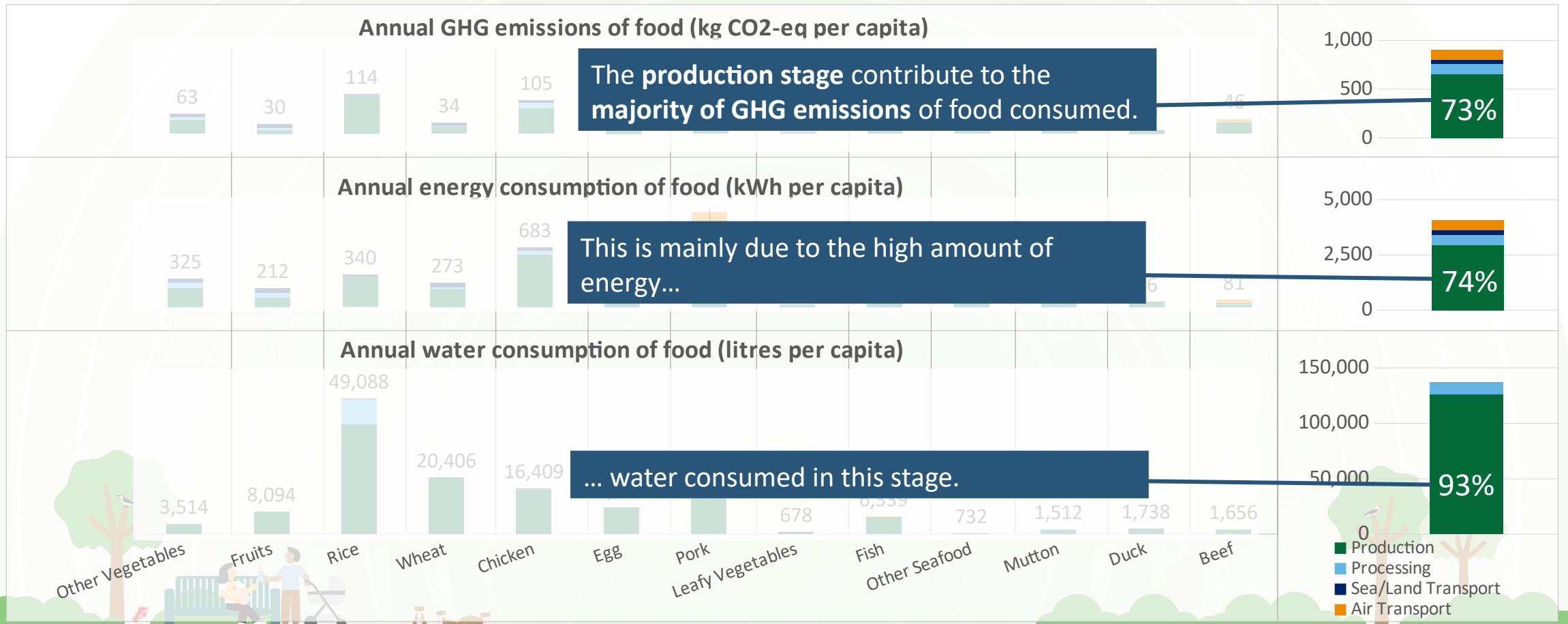
But total GHG emissions of pork consumed is 2.5 times of chicken...

Due to its higher GHG emissions on a per kg basis.

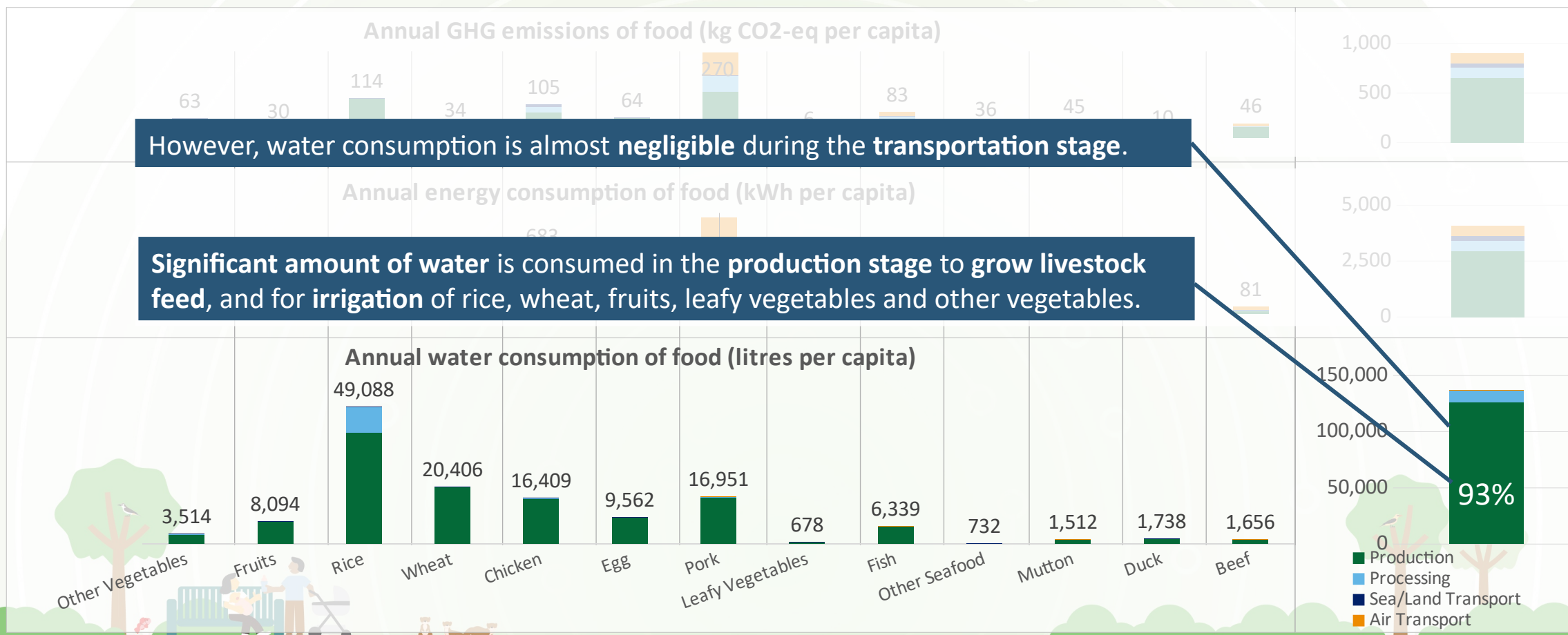
What factors contribute to the environmental impact of food?



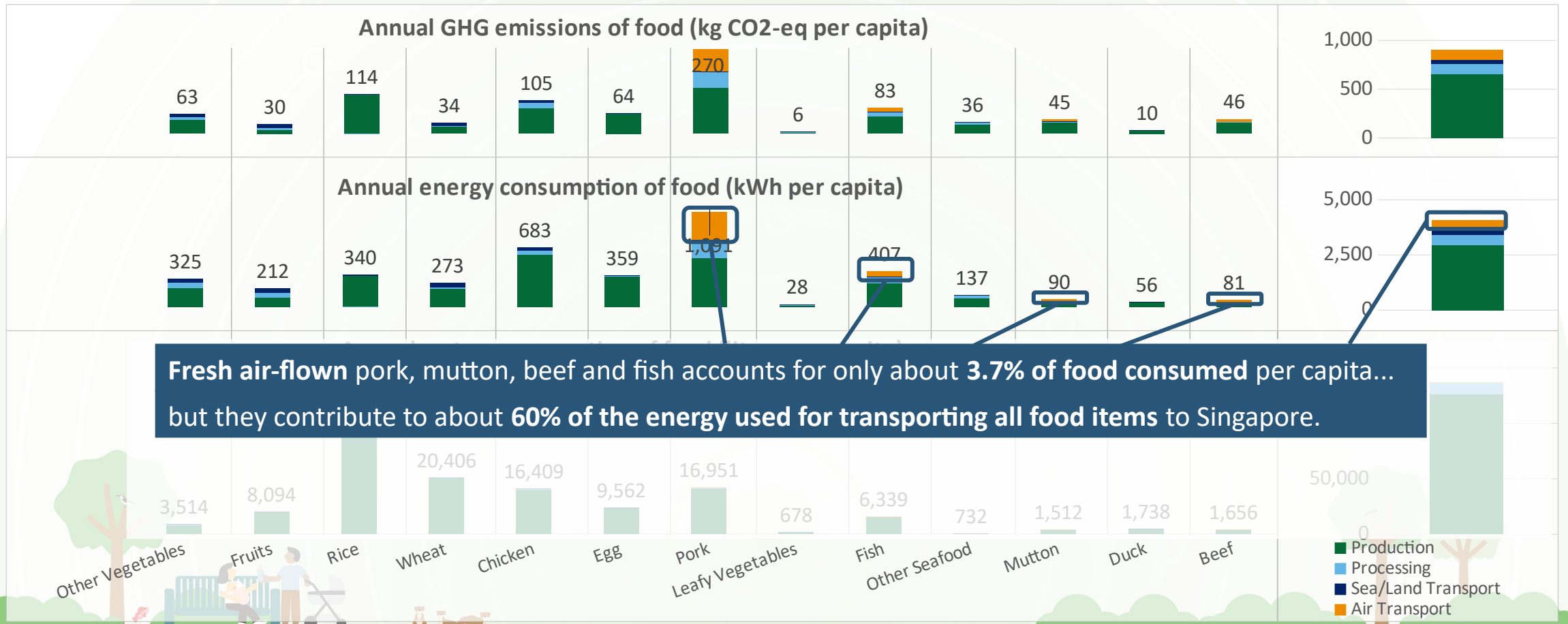
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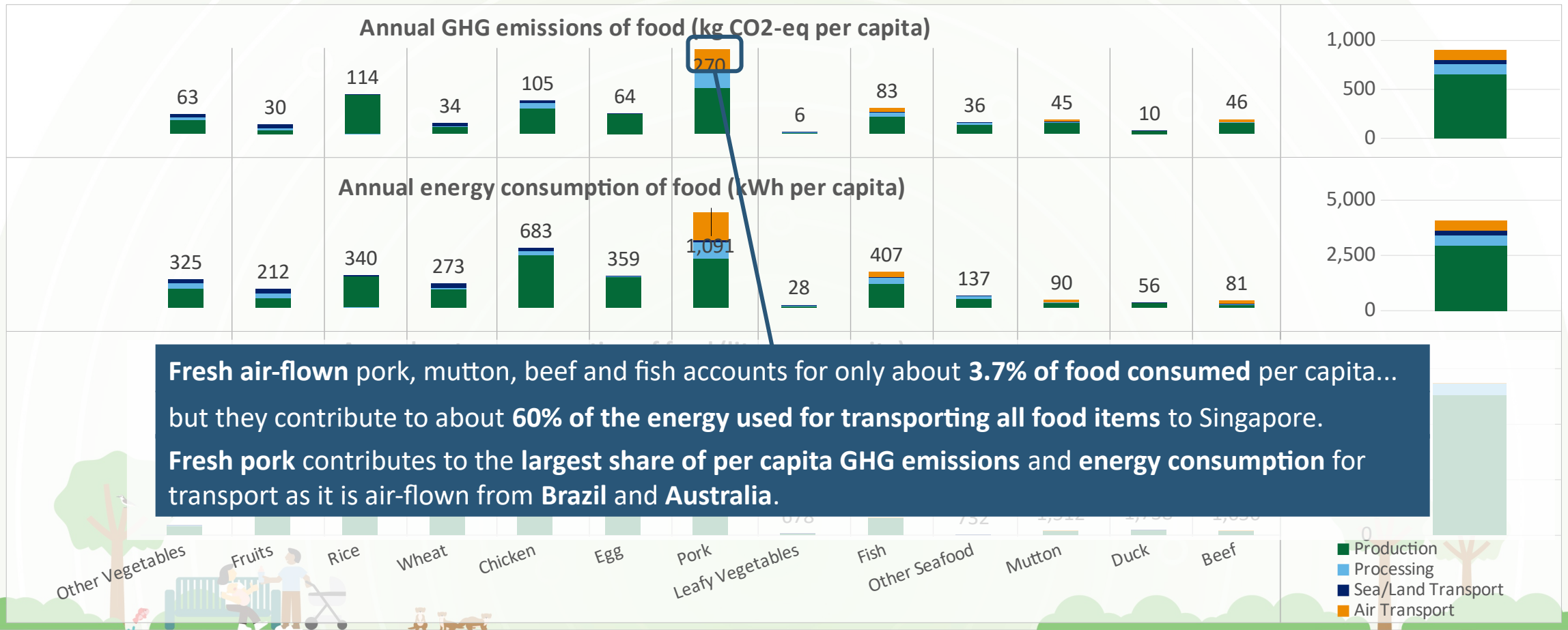
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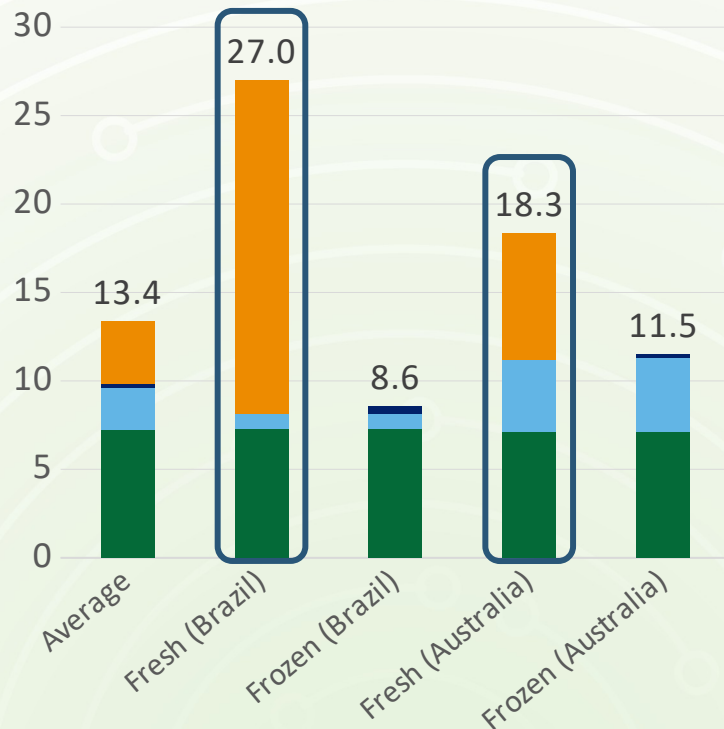


Quiz time

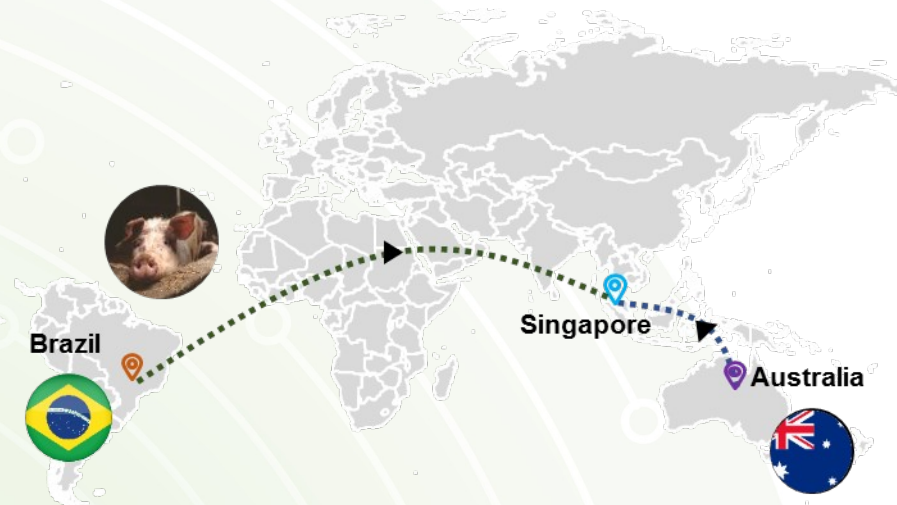
Which has higher environmental impact?

1. Fresh pork from Brazil
2. Fresh pork from Australia?

GHG emission (kg CO₂-eq) of pork



■ Production ■ Processing
■ Sea/Land Transport ■ Air Transport

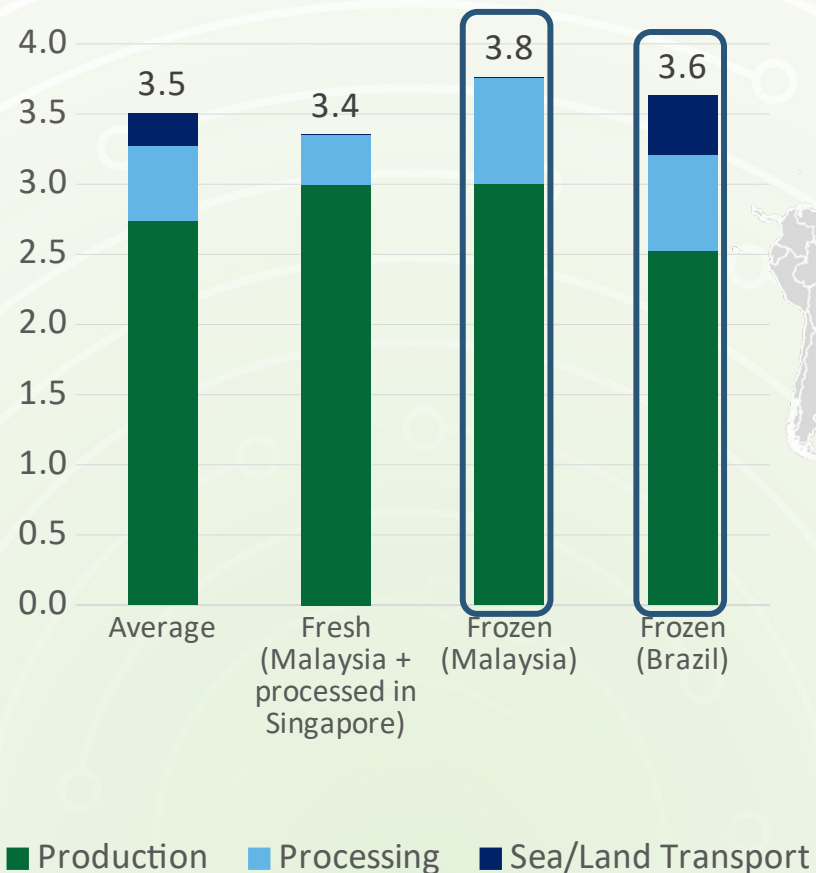


Quiz time

Which has higher environmental impact?

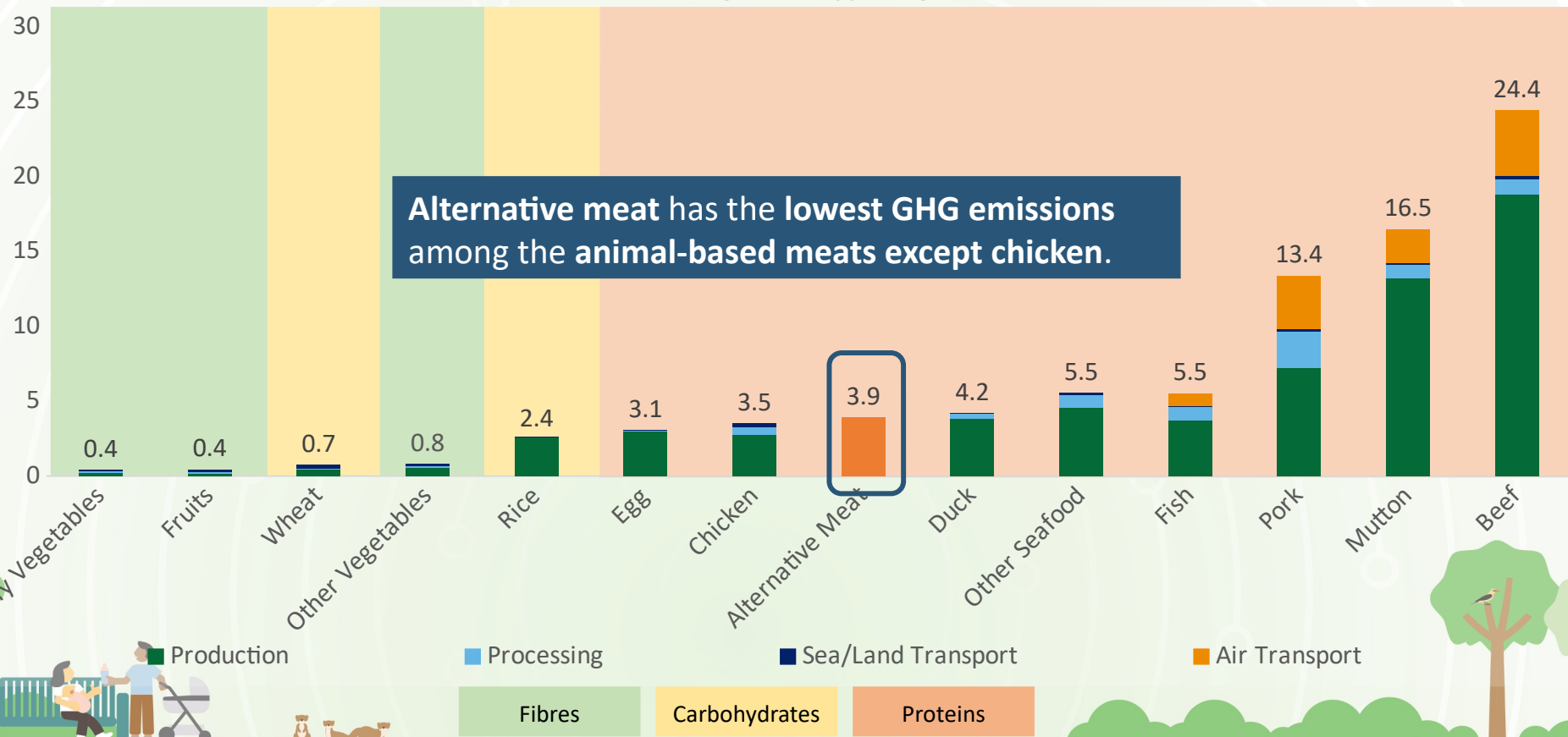
1. Frozen chicken from Brazil
2. Frozen chicken from Malaysia?

GHG emission (kg CO₂-eq) of chicken



How does the shift to alternative meat affect environmental impact?

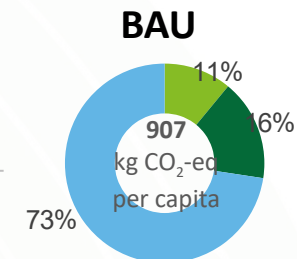
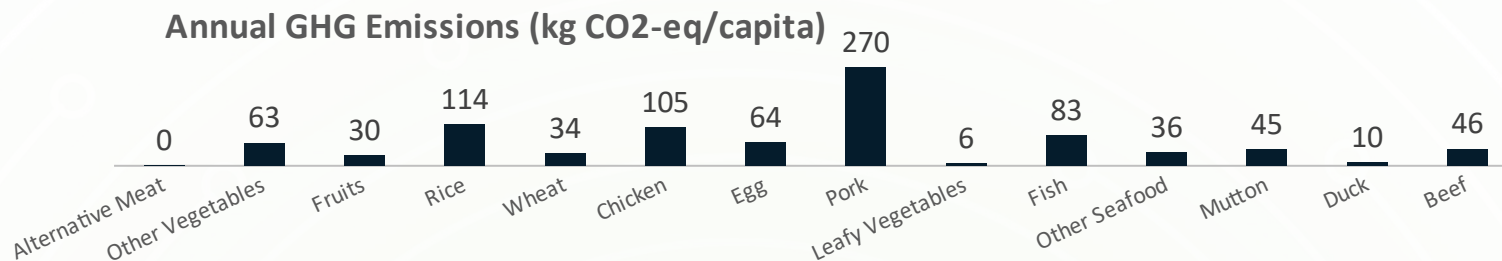
GHG Emissions (kg CO₂-eq per kg of food)



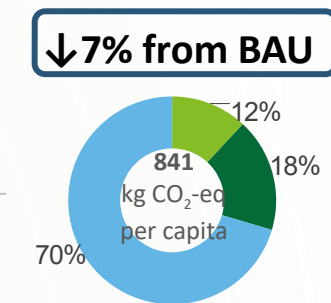
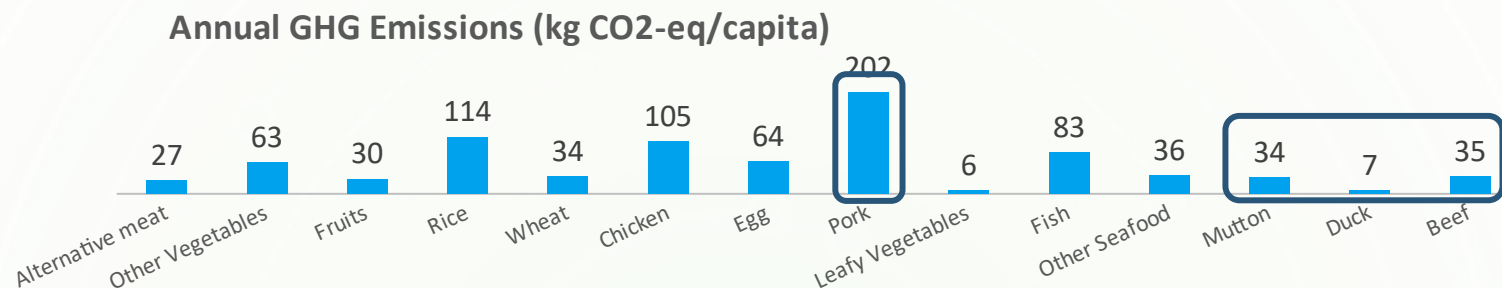
How does the shift to alternative meat affect environmental impact?

■ Fibres ■ Carbohydrates ■ Proteins

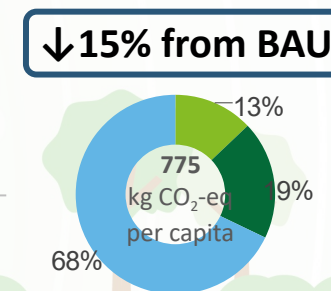
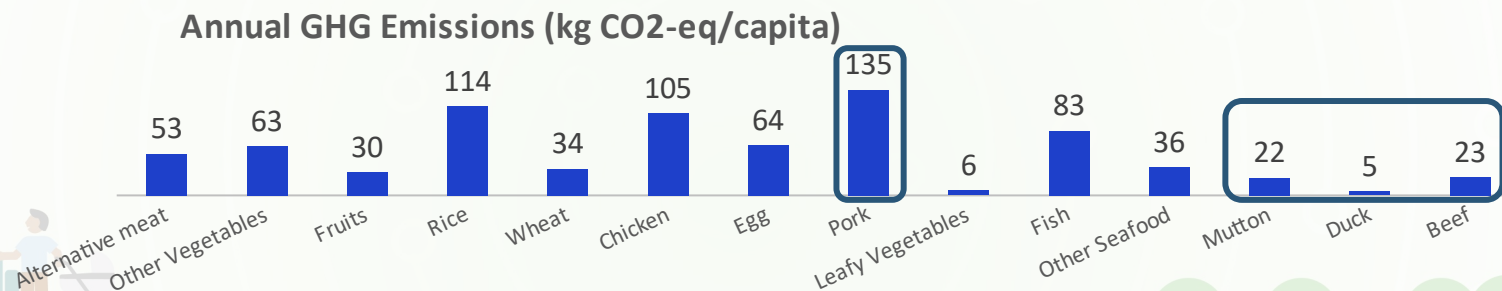
Business As Usual
 Diet consisting of 46% fibres, 26% carbohydrates, 28% animal-based



Scenario 1
 Replace 25% of red meats with alternative meats



Scenario 2
 Replace 50% of red meats with alternative meats



Conclusion

60% of energy used in transporting food items to Singapore is contributed by fresh air-flown meats and fish which only accounts for 3.7% of food consumed.

➔ *Sourcing fresh food from neighbouring countries or producing locally.*



Production stages contribute to majority (73%) of GHG emissions of food consumed in Singapore.

➔ *Sourcing food from countries with cleaner and renewable sources of electricity generation.*

Meats especially pork due to its relatively high consumption in Singapore and GHG emissions on a per kg basis contribute significantly to environmental impact.

➔ *Shifting to alternative meat or plant-based diet.*



Photo Credit: Impossible Foods



Thank You