

Food wastage footprint

Impacts on natural resources

Presentation of the FAO FWF study

September 2013





Food wastage – Why is it an issue?



Each year, about $\frac{1}{3}$ of all food produced for human consumption in the world is lost or wasted

Food wastage represents a missed opportunity:

- ☐ To improve global food security : by 2050, food production will need to be 60 % higher than in 2005/2007;
- ☐ To mitigate environmental impacts generated by agriculture: food supply chains have important environmental externalities.

Food wastage – Why is it an issue?

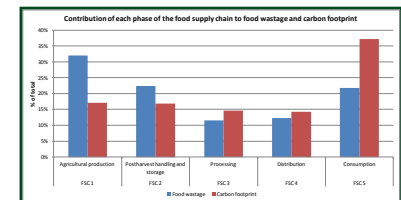
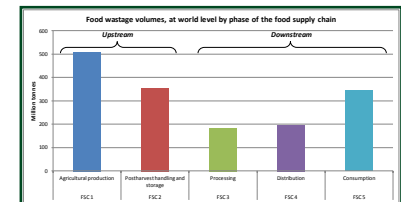
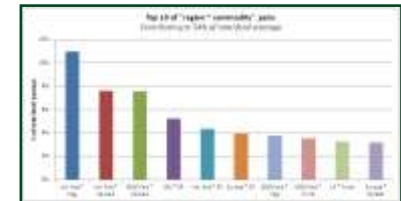


To date, no study has analyzed the environmental impacts of global food wastage

The Food Wastage Footprint (FWF) model was developed to answer 2 key questions:

- ❑ What is the magnitude of the impacts?
- ❑ Where do these impacts come from? (in terms of regions, commodities or phases the supply chain)

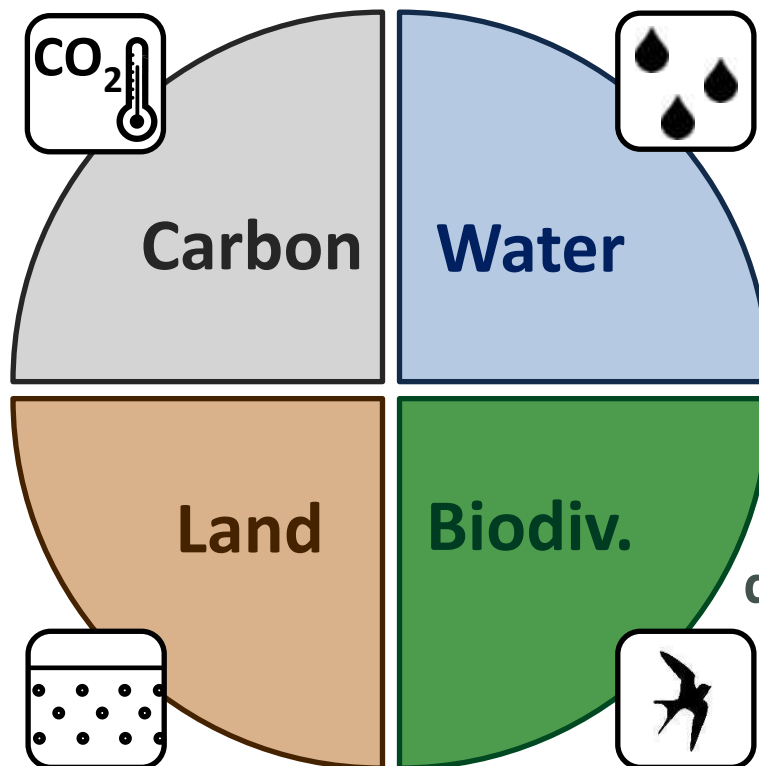
... in order to point towards action areas to reduce food wastage.





The environmental footprint of food wastage is assessed through 4 indicators

A quantitative assessment has been made for **carbon footprint**, **blue water footprint**, and **land occupation**.



For **biodiversity** a combined semi-quantitative/qualitative approach was used.

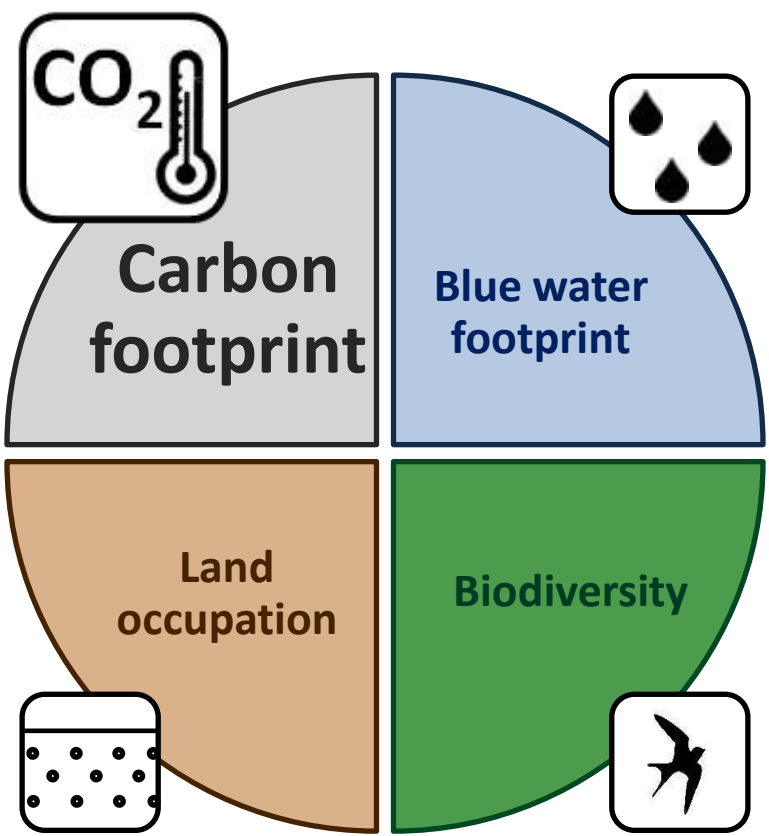


The environmental assessment is complemented by an **economic quantification**.

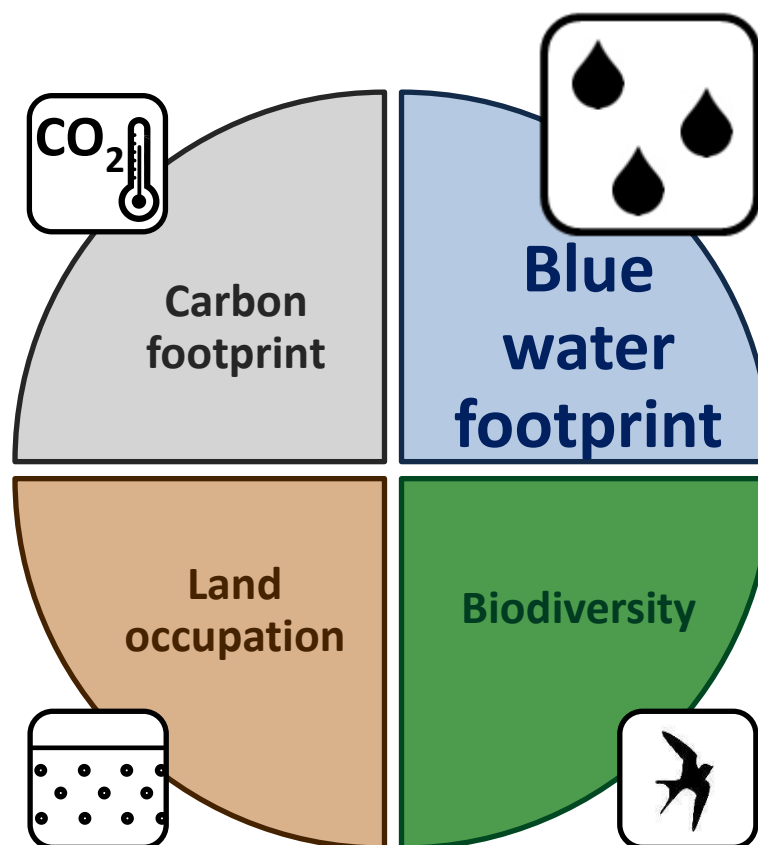


Indicators – Carbon footprint

Carbon footprint of food wastage: the total amount of **GHG** emitted throughout the life cycle of the product, expressed in **kg of CO₂ eq.**

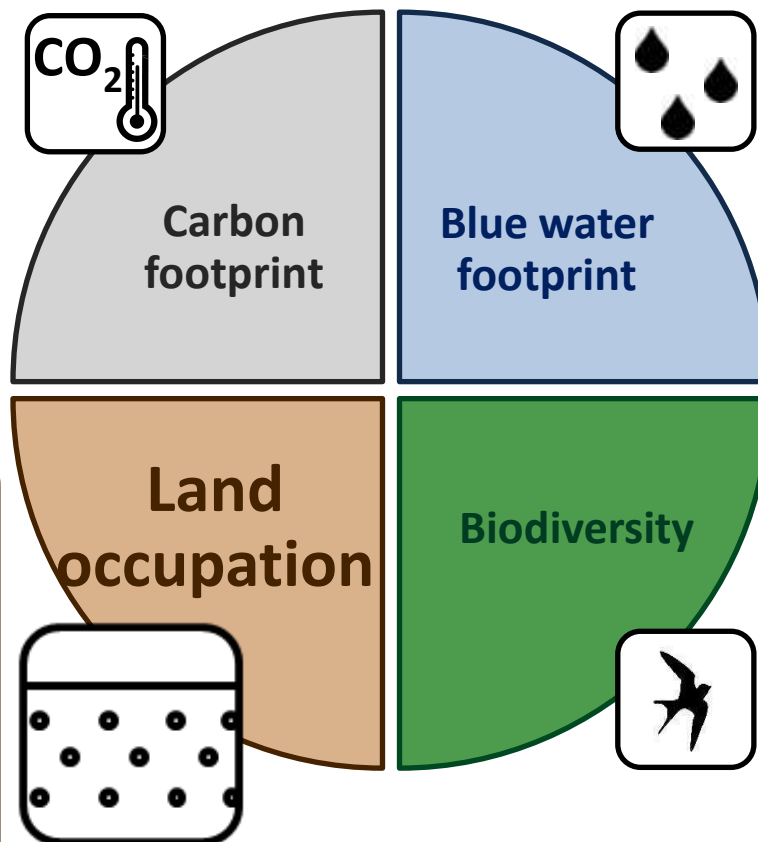


Indicators – Blue water footprint



Blue water footprint of food wastage: the total consumption of surface and groundwater resources to produce the product. It is expressed in m^3 .

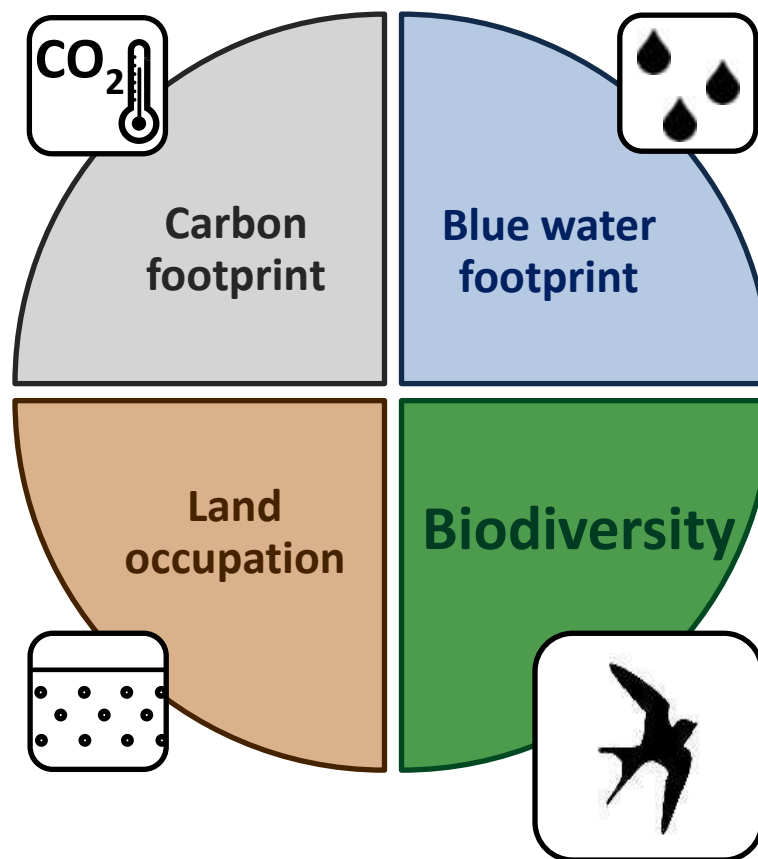
Indicators – Land occupation



Land occupation of food wastage:

“Physical” surfaces –
i.e . **areas of agricultural land**
necessary to produce
foodstuff (both arable
and non-arable land)
expressed in **hectares**.

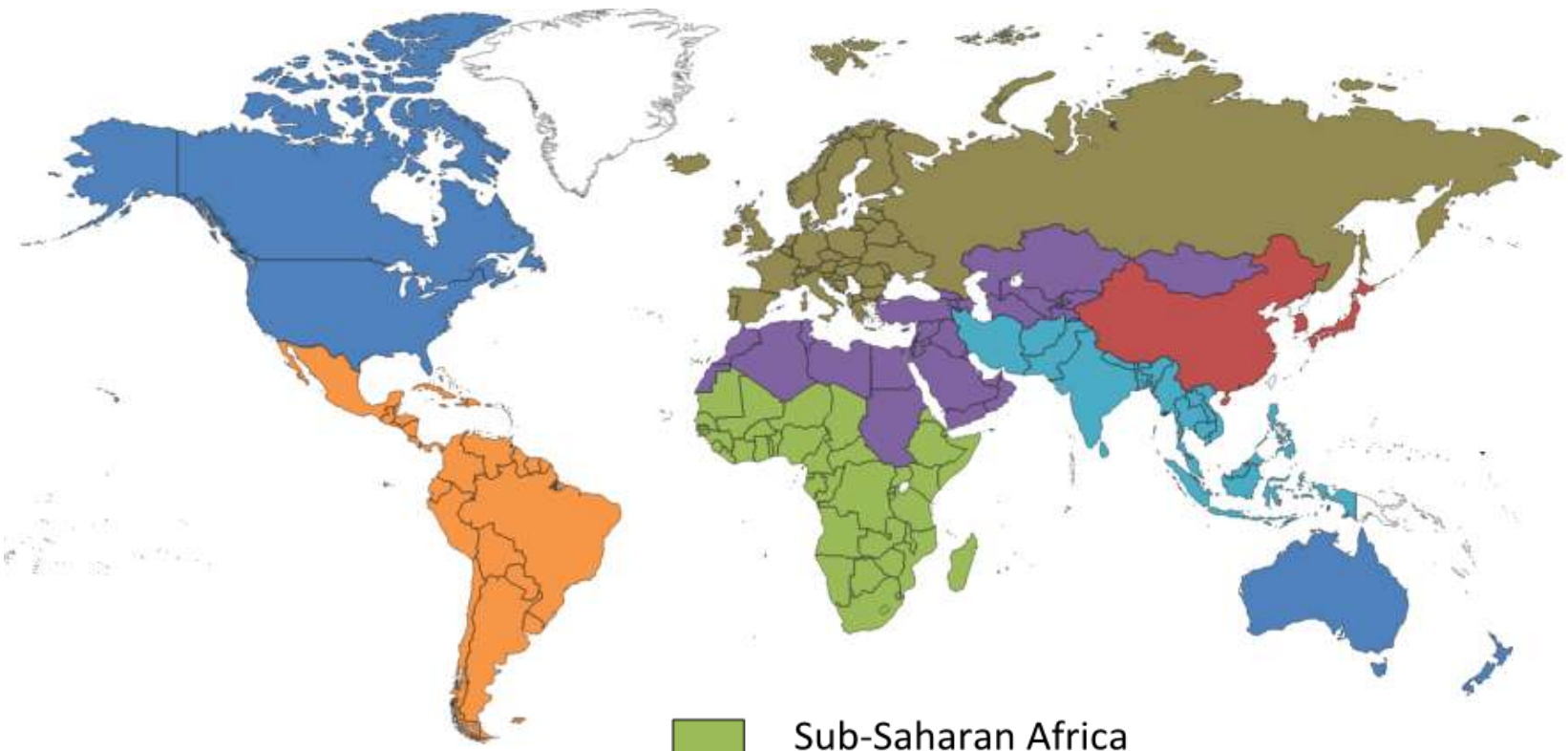
Indicators – Biodiversity



Diversity of life on Earth. **The impact of food on biodiversity** is assessed through deforestation due to agriculture, Red Listed species, Marine Trophic Index.



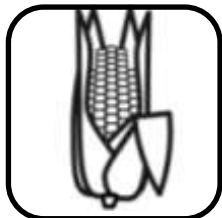
The scope is global in terms of world regions



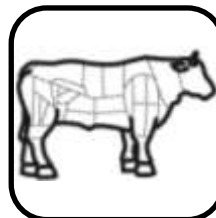
- Europe
- North America & Oceania
- Industrialized Asia
- Sub-Saharan Africa
- North Africa, Western Asia & Central Asia
- South and Southeast Asia
- Latin America



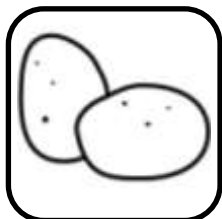
The scope is global in terms of agricultural commodities



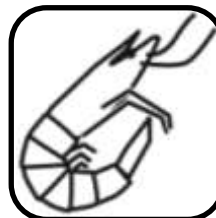
Cereals (excluding beer)



Meat



Starchy roots



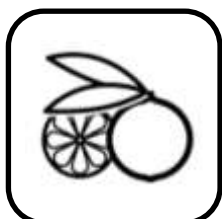
Fish & Seafood



Oilcrops & Pulses



Milk (excluding butter)
& Eggs



Fruits (excluding wine)

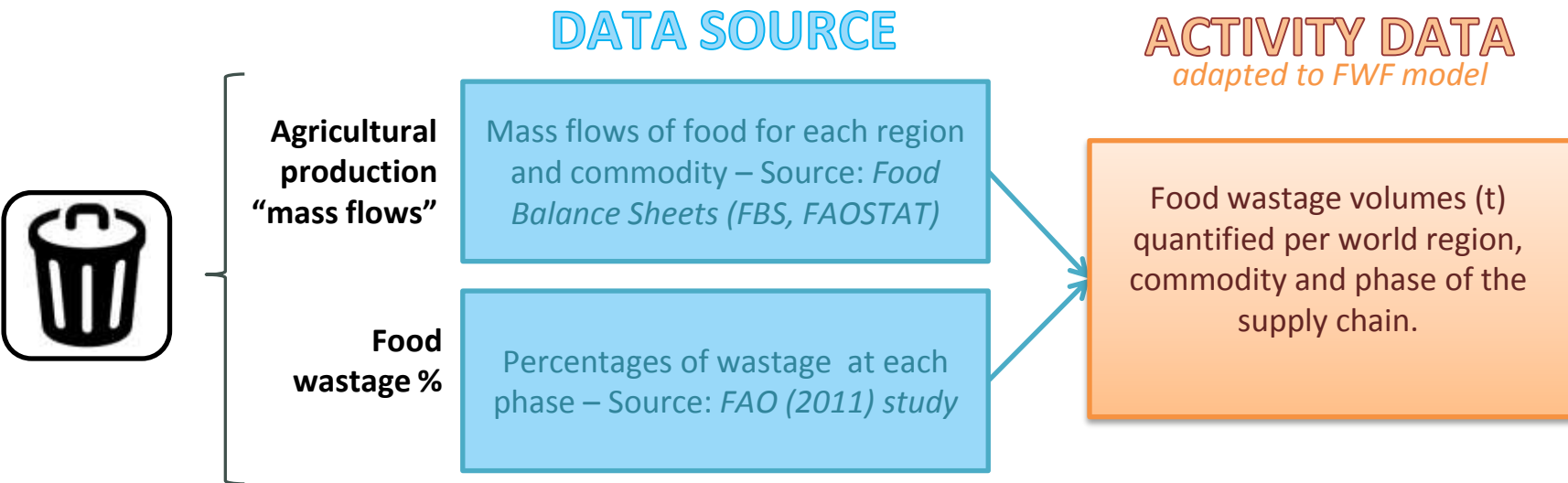


Vegetables

Data sources – Food wastage volumes



Food wastage quantities are obtained by combining data on food mass from FAO and wastage percentages from literature



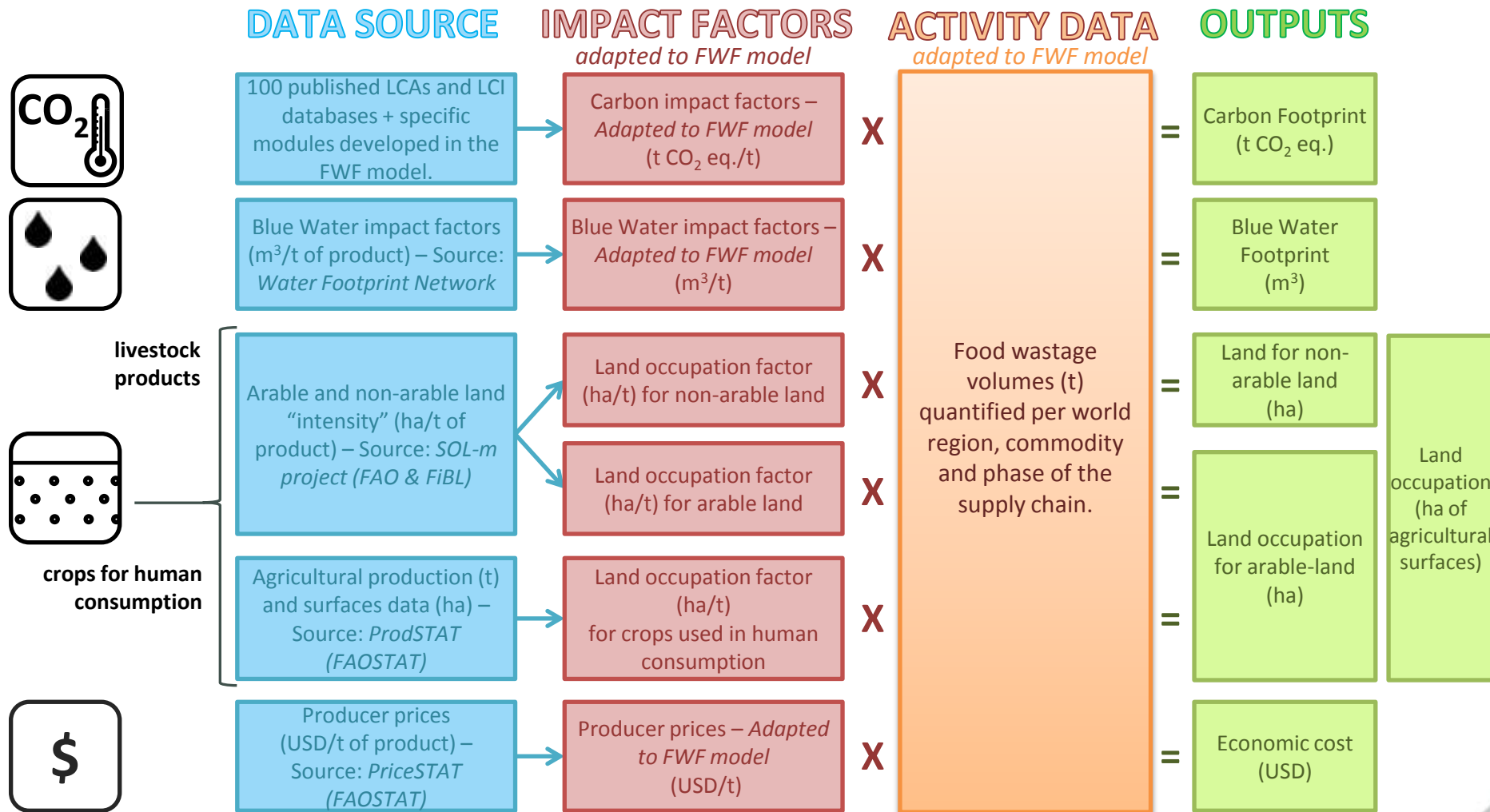
❑ The model has also calculated 2 types of food wastage volumes:

- Volumes for the edible and the non-edible parts of food;
- Food wastage for only the edible part of food.

Data sources – Quantitative assessment



The quantitative assessment is based on specific impact factors



Data sources – Biodiversity



Biodiversity is assessed through 3 indicators

DATA SOURCE

INDICATORS

OUTPUTS



Annual mean agricultural surface change rate from 1990 to 2010 (ha/yr) – Source: *ProdSTAT (FAOSTAT)*

Annual mean forest cover change rate from 1990 to 2010 (ha/yr) – Source: *FAOSTAT Forestry*

Percentage of species threatened by agriculture
Source: *Red List of threatened species IUCN*

Decline in abundance and diversity of fish. Source: *Marine Trophic Index*

Maximum potential extent of deforestation due to agriculture

Extent of Red Listed species of mammals, birds and amphibians threatened by agriculture

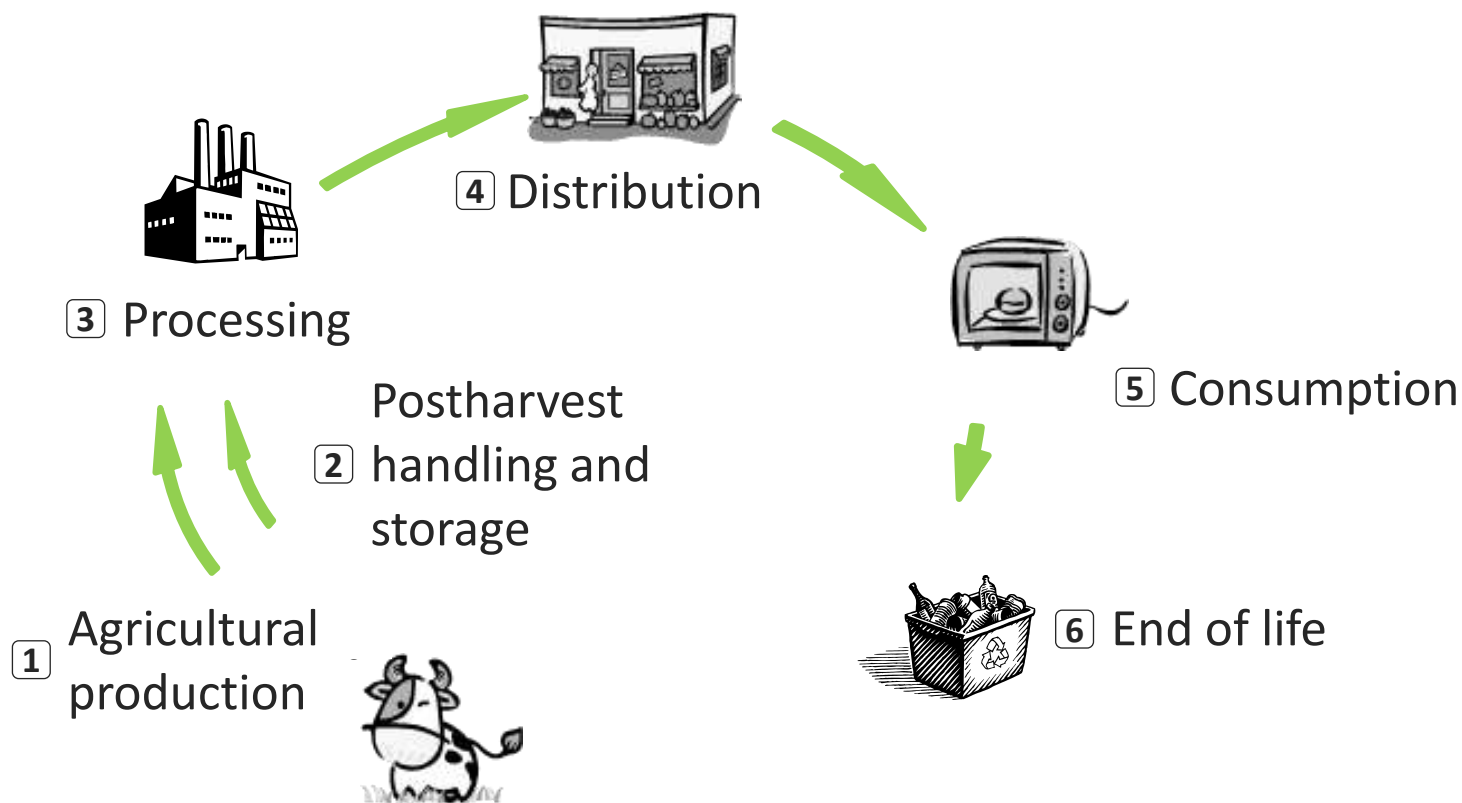
Average change in mean trophic level since 1950 in selected Large Marine Ecosystems

Analysis of indicators regarding biodiversity and wastage location

What is the environmental impact of food waste?



The later in the life cycle a product is wasted, the greater the impacts of its useless production and transformation



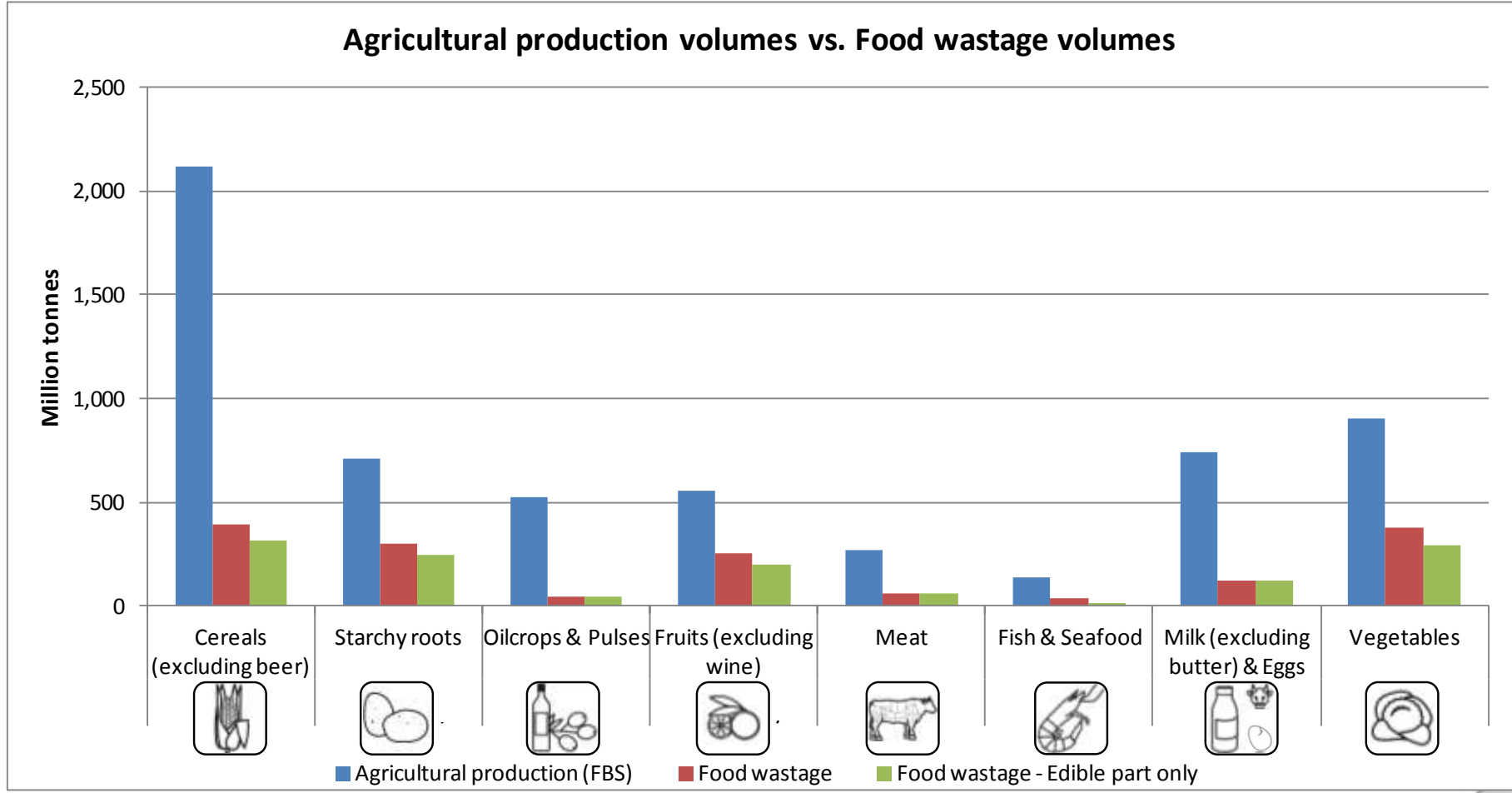
Sources of food wastage (stages 1 to 5) and sources of environmental impacts (stages 1 to 6) in the food life cycle.



The global volume of food wastage in 2007 is estimated at 1.6 Gt of “primary product equivalents”

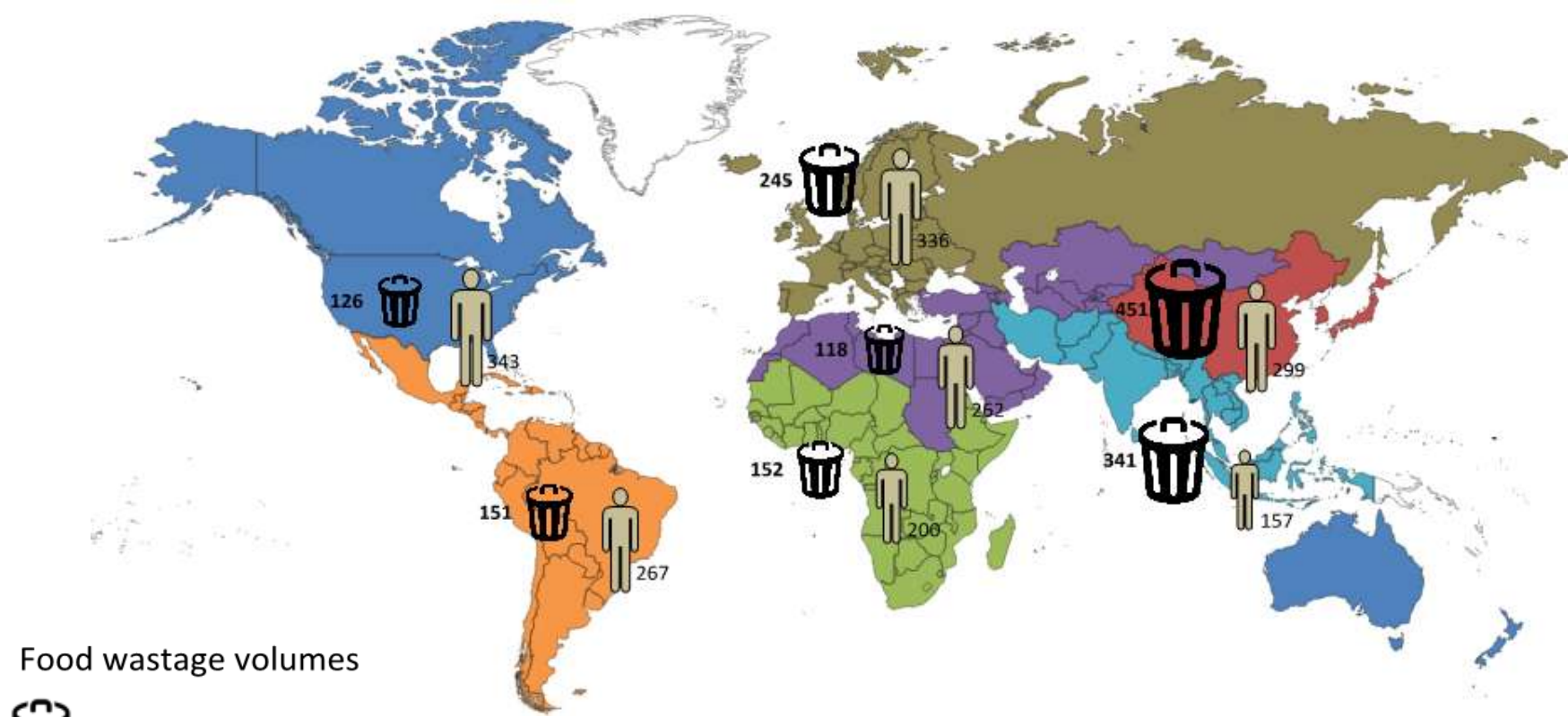


The food wastage for the edible part of food only is 1.3 Gt



The sum of the domestic agricultural production of all countries is about 6 Gtonnes. This value includes also agricultural production for other uses than food.

 Each world region has a specific profile in terms of food wastage (volumes, type of commodities)



Food wastage volumes

 Mtonnes

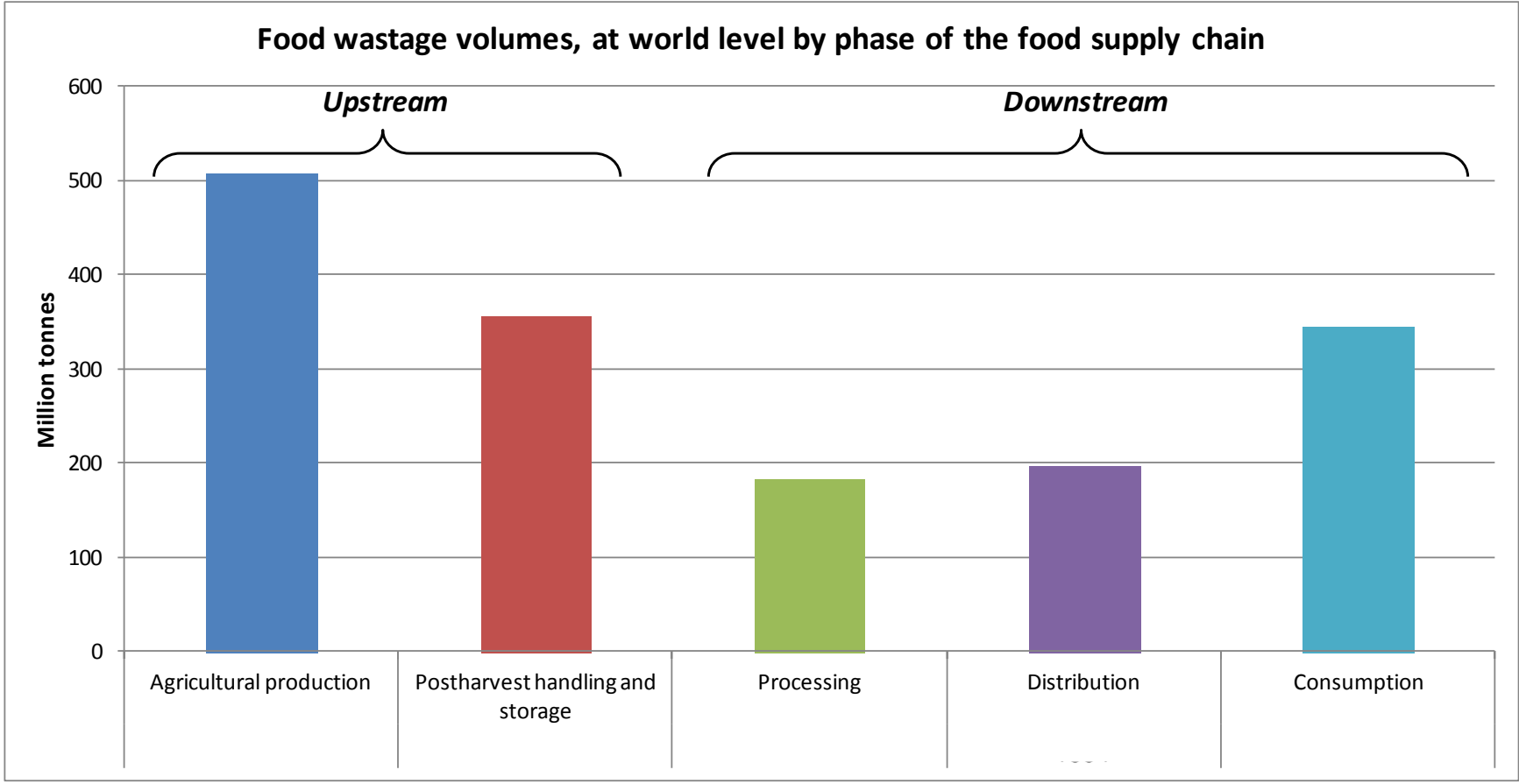
Food wastage per capita

 kg of food wastage per capita and per year

Volumes for the edible and the non-edible parts of food.



At global level, food wastage is balanced between the upstream (54%) and downstream (46%) of the supply chain

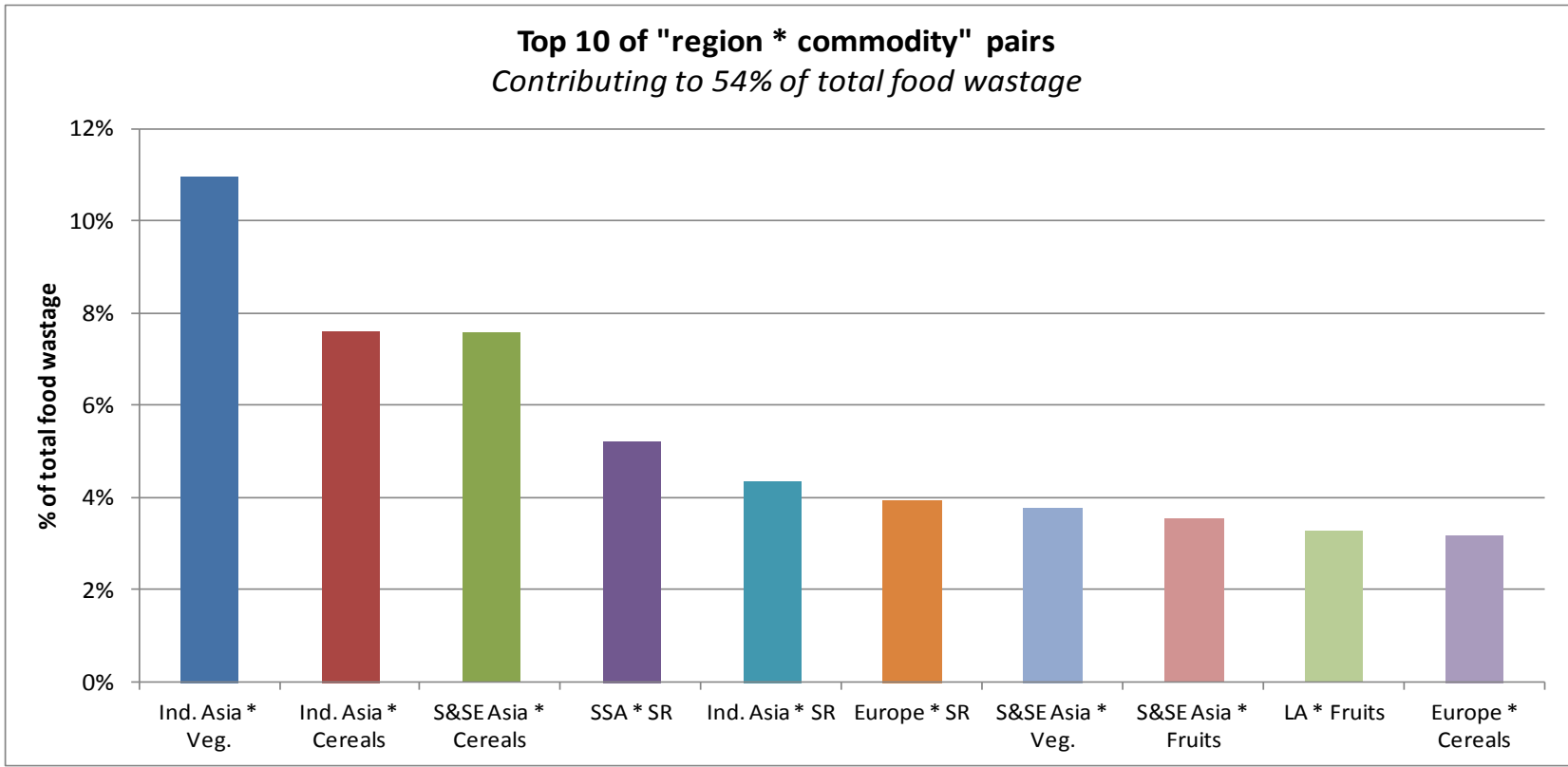




This is the Top 10 of “region * commodity” pairs for food waste



Asia appears 6 times in the top 10 and dominates it with vegetables and cereals

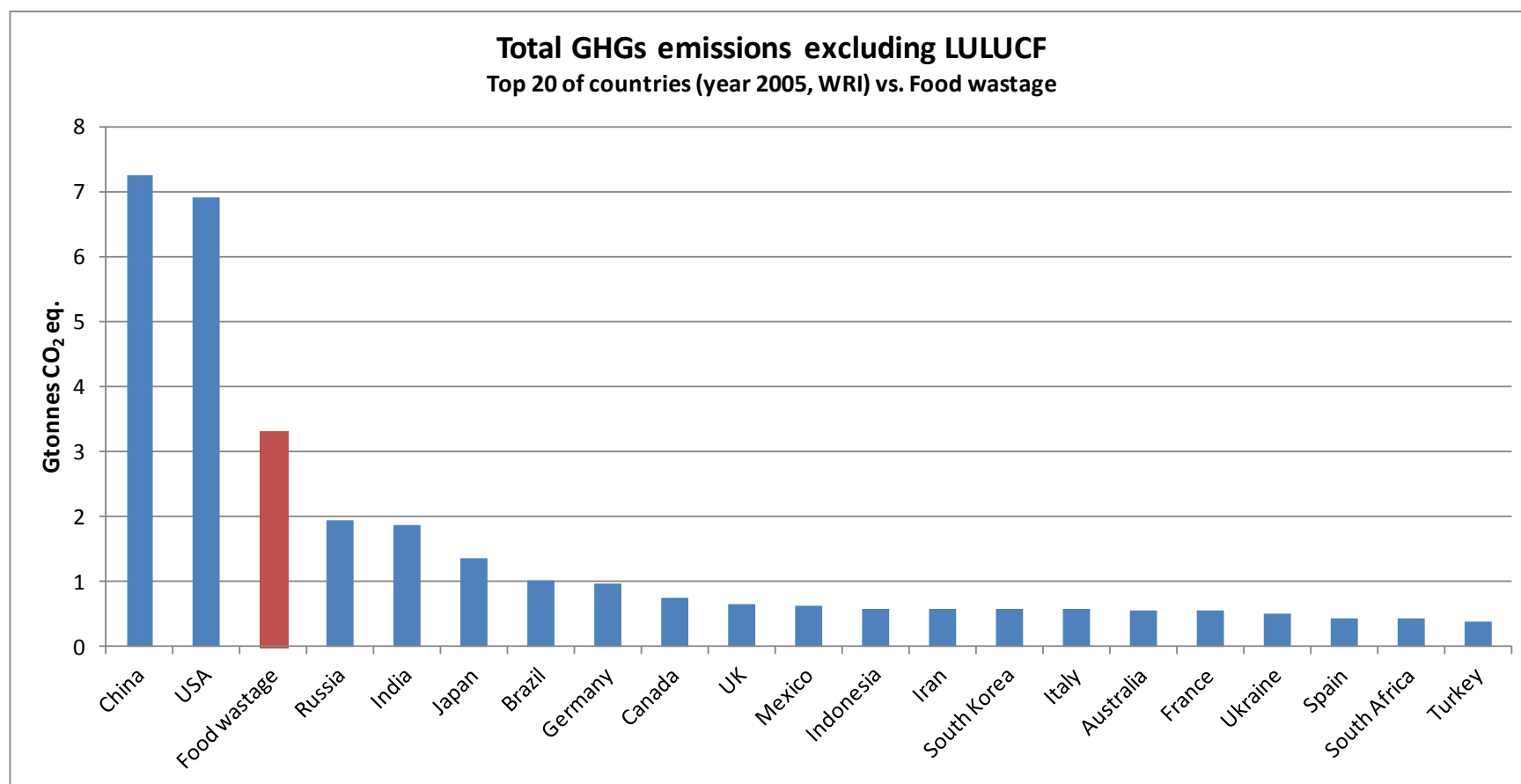




The carbon footprint of food wastage is estimated to 3.3 Gt CO₂ eq., equivalent to more than twice the total GHG emissions of USA road transportation in 2010



If food wastage was a country, it would rank as the 3rd top emitter

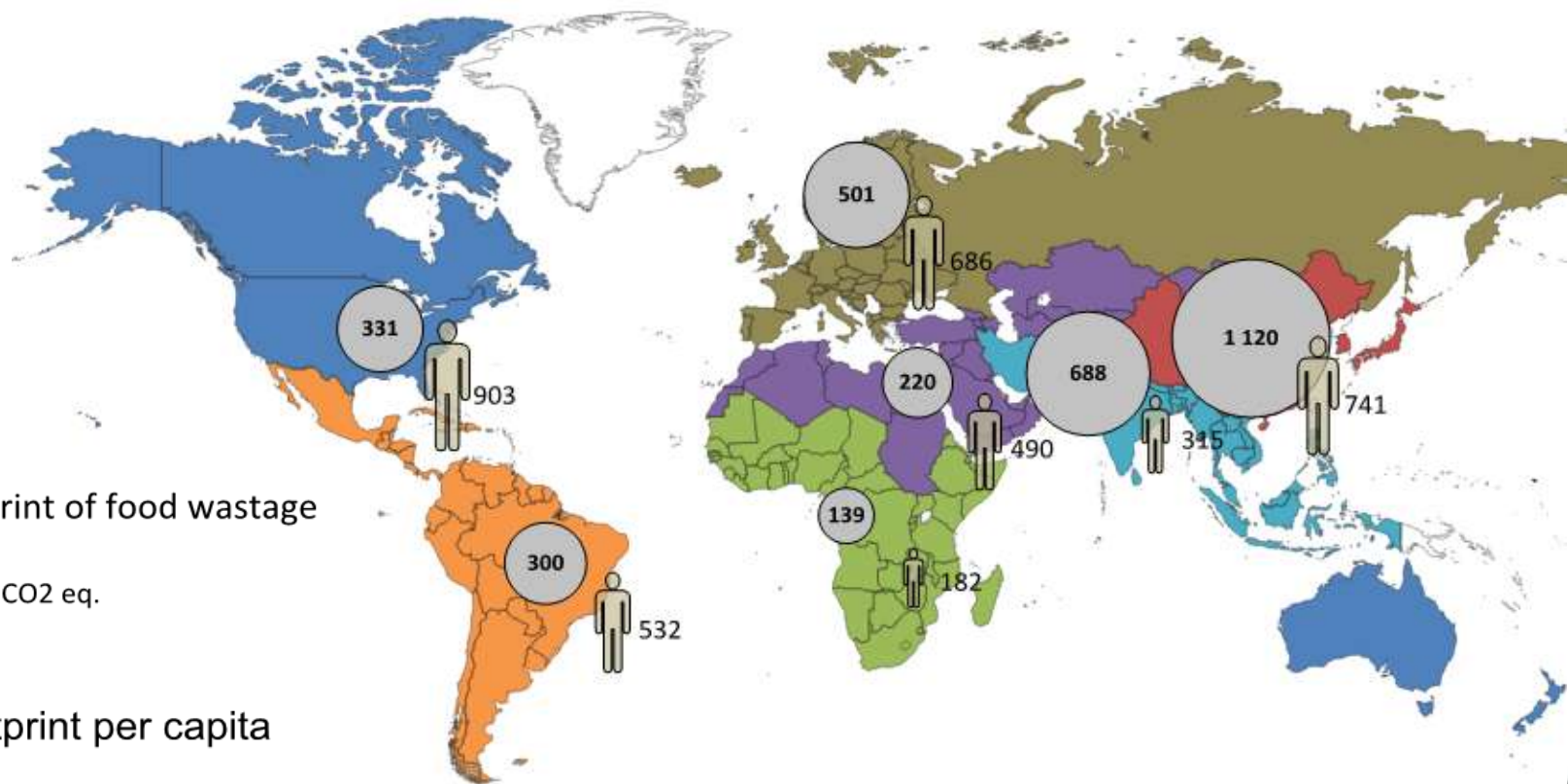




The major contributor to the carbon footprint is Asia, with 44% of the footprint in this continent due to cereals



The average carbon footprint of food wastage is about 500 kg CO₂ eq. per cap and per year, equivalent to 2,300 km in an average car



Carbon footprint of food wastage

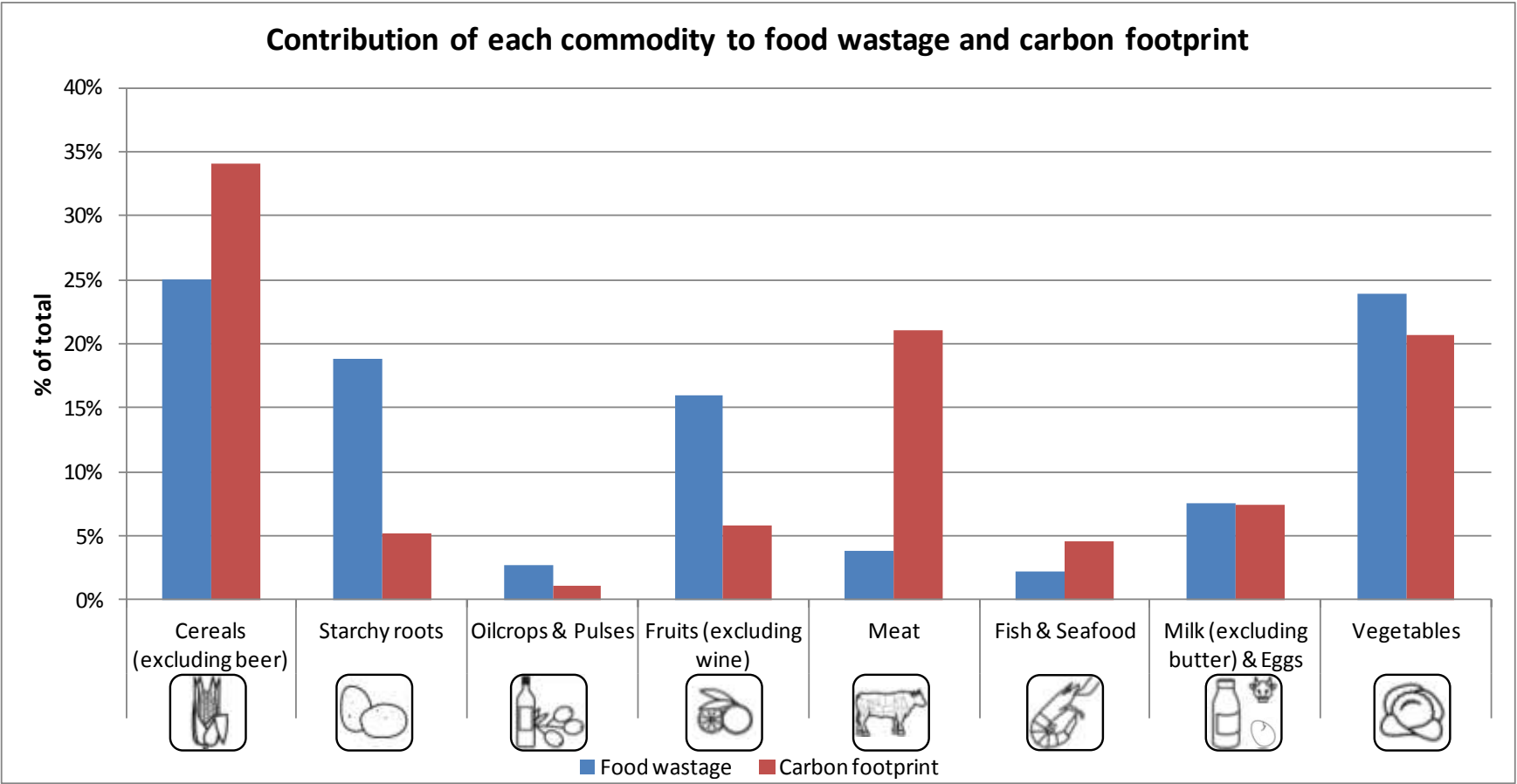
● Mtonnes CO₂ eq.

Carbon footprint per capita

👤 kg CO₂ eq. per cap. and per year

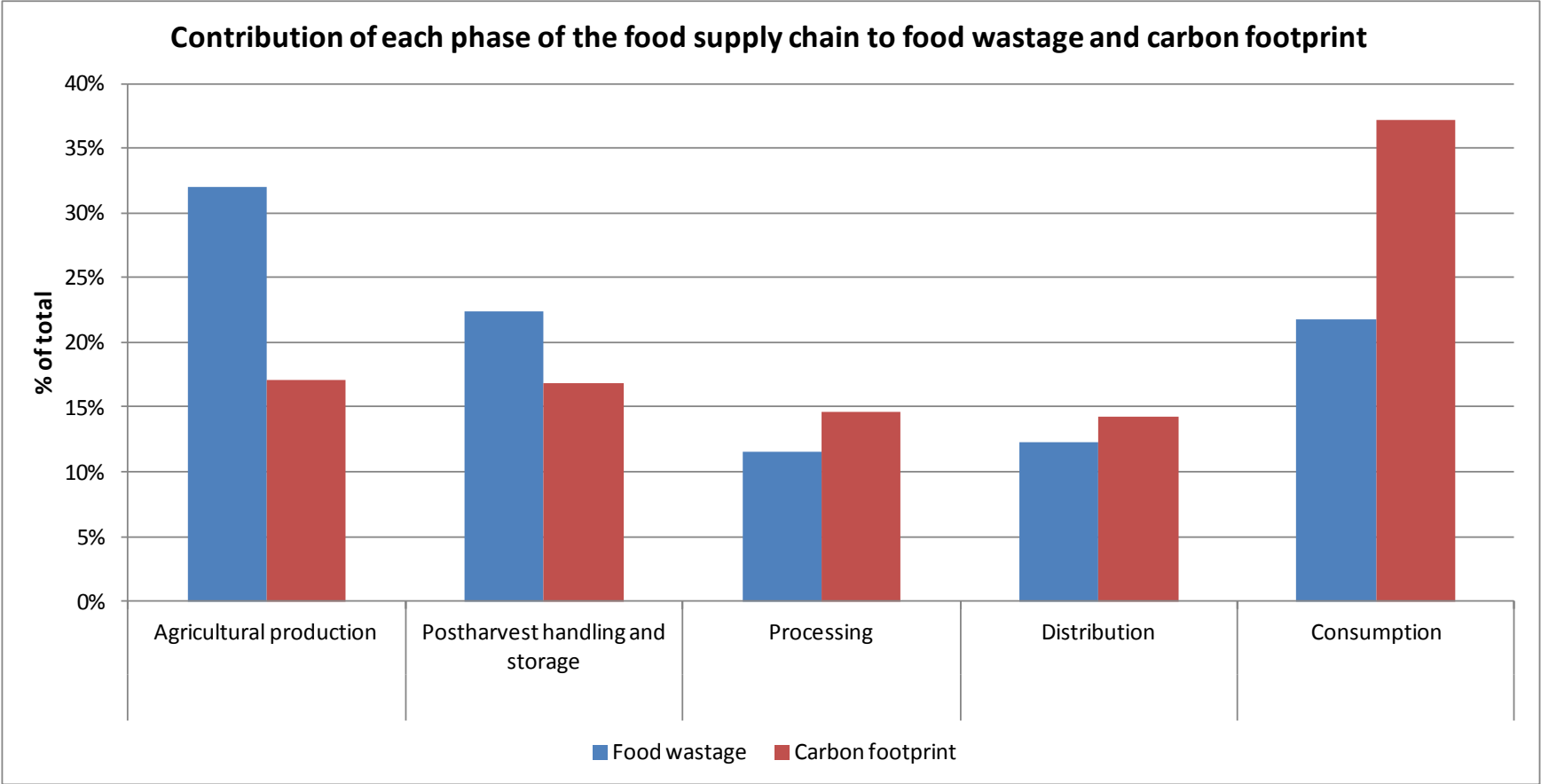


Animal products: 33 % of global carbon footprint, but only 15 % of food wastage volume



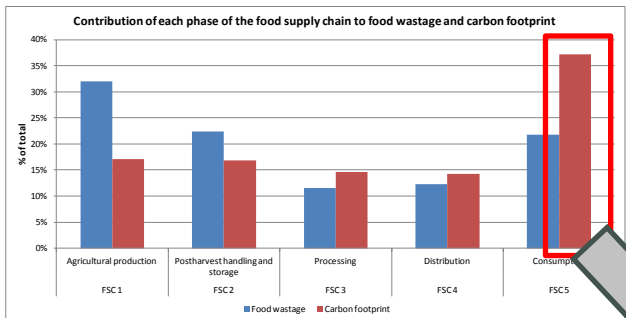


The highest carbon footprint occurs at the consumption phase because impacts of previous phases add up

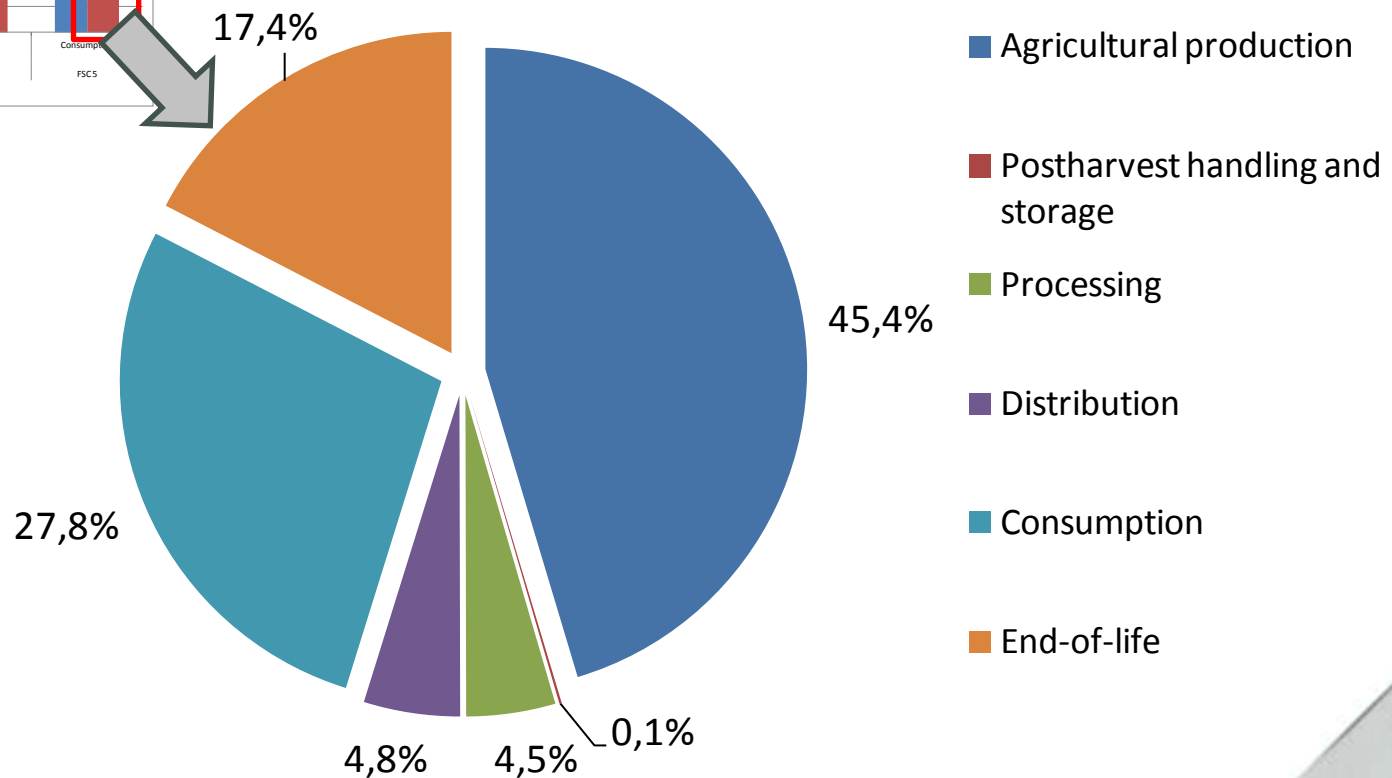




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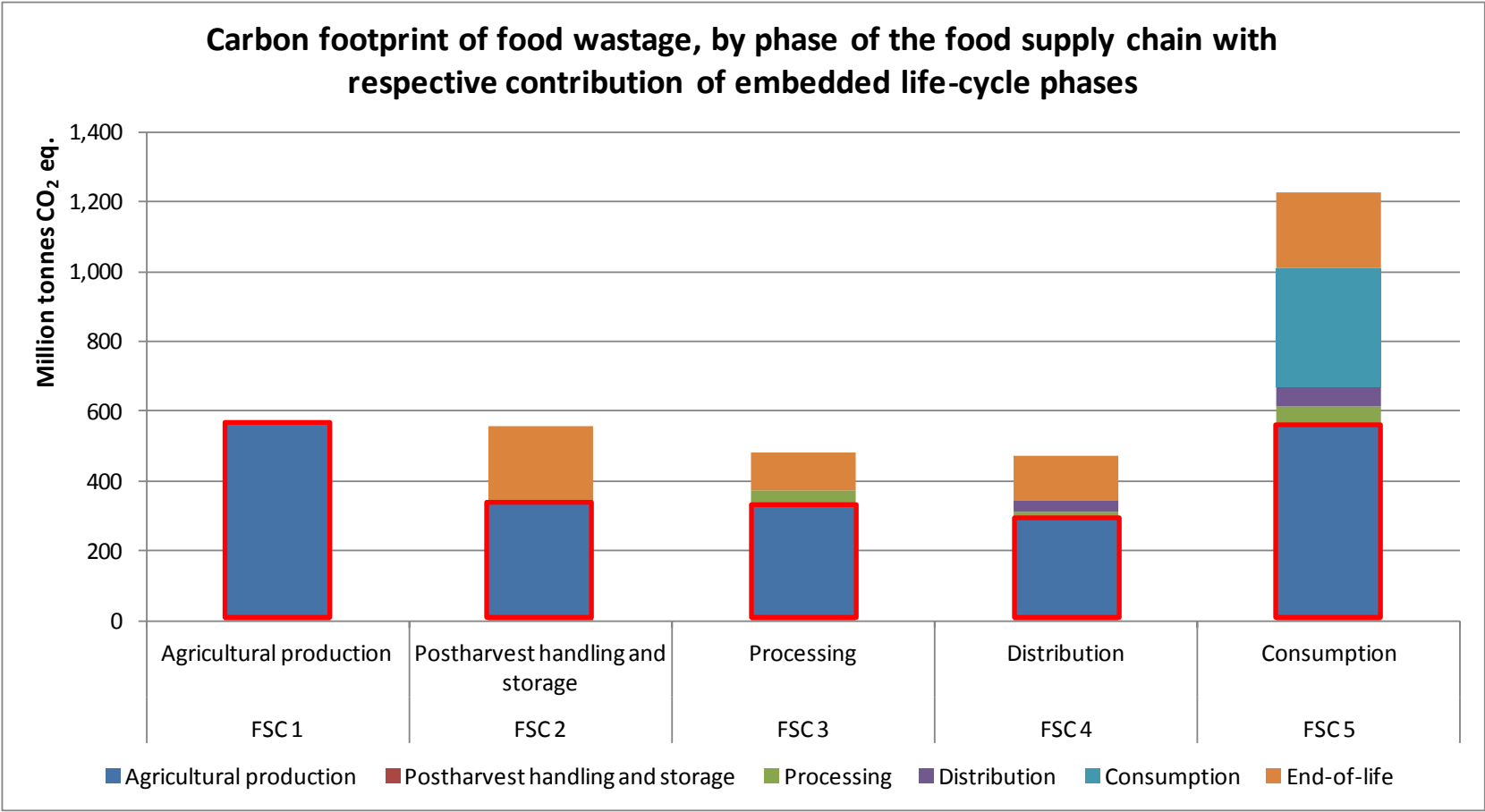


Carbon footprint at consumption phase with respective contribution of embedded life-cycle phases



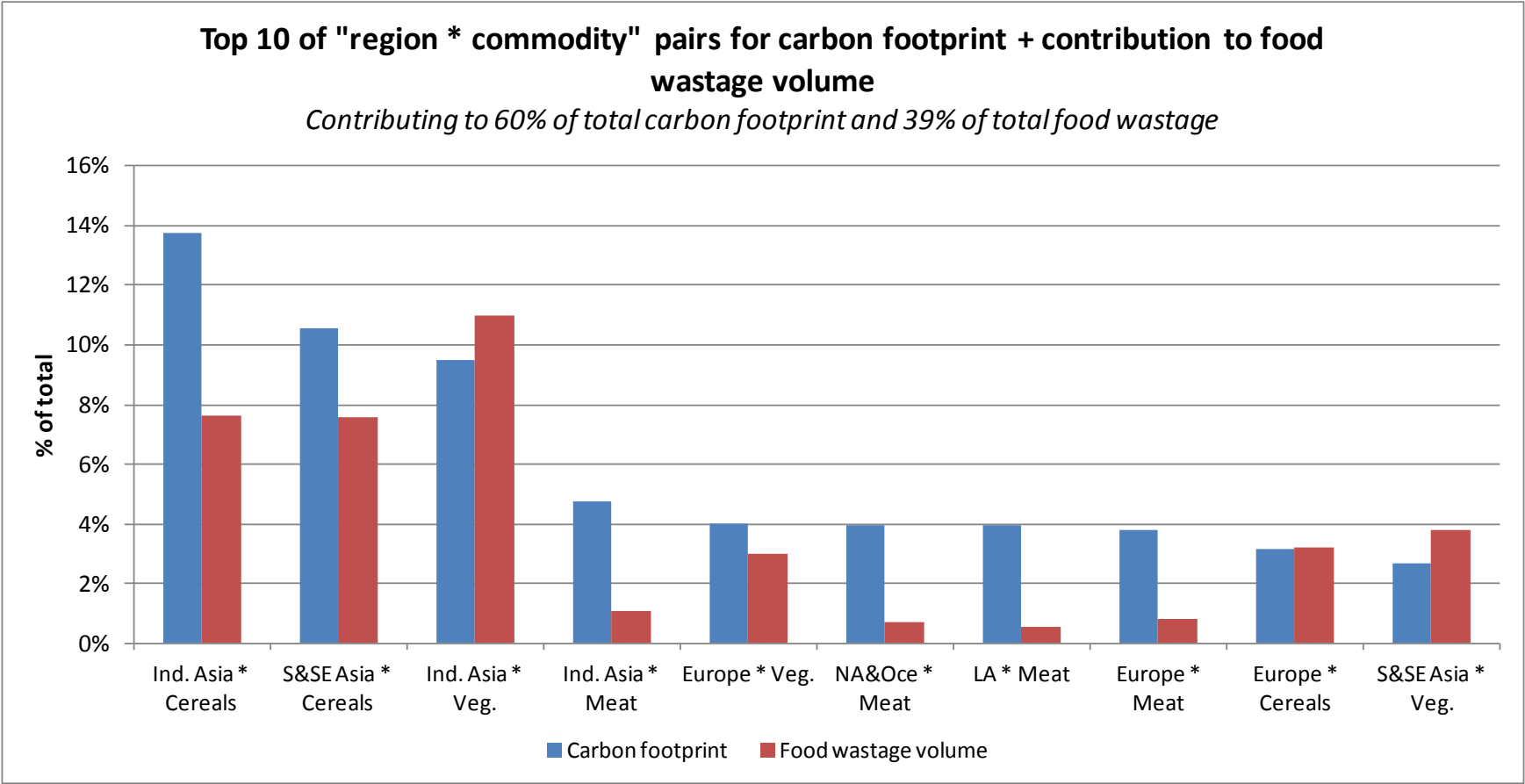


GHG emissions from the agricultural phase are always the major contributors to the carbon footprint of each FSC phase





Wastage of cereals in Asia is a hotspot because of high volumes and because the main wasted cereal is rice which is a CH₄-emitting crop



This figure indicates if the carbon footprints of the hotspots (region * commodity pairs) are driven by volumes or impact factors.



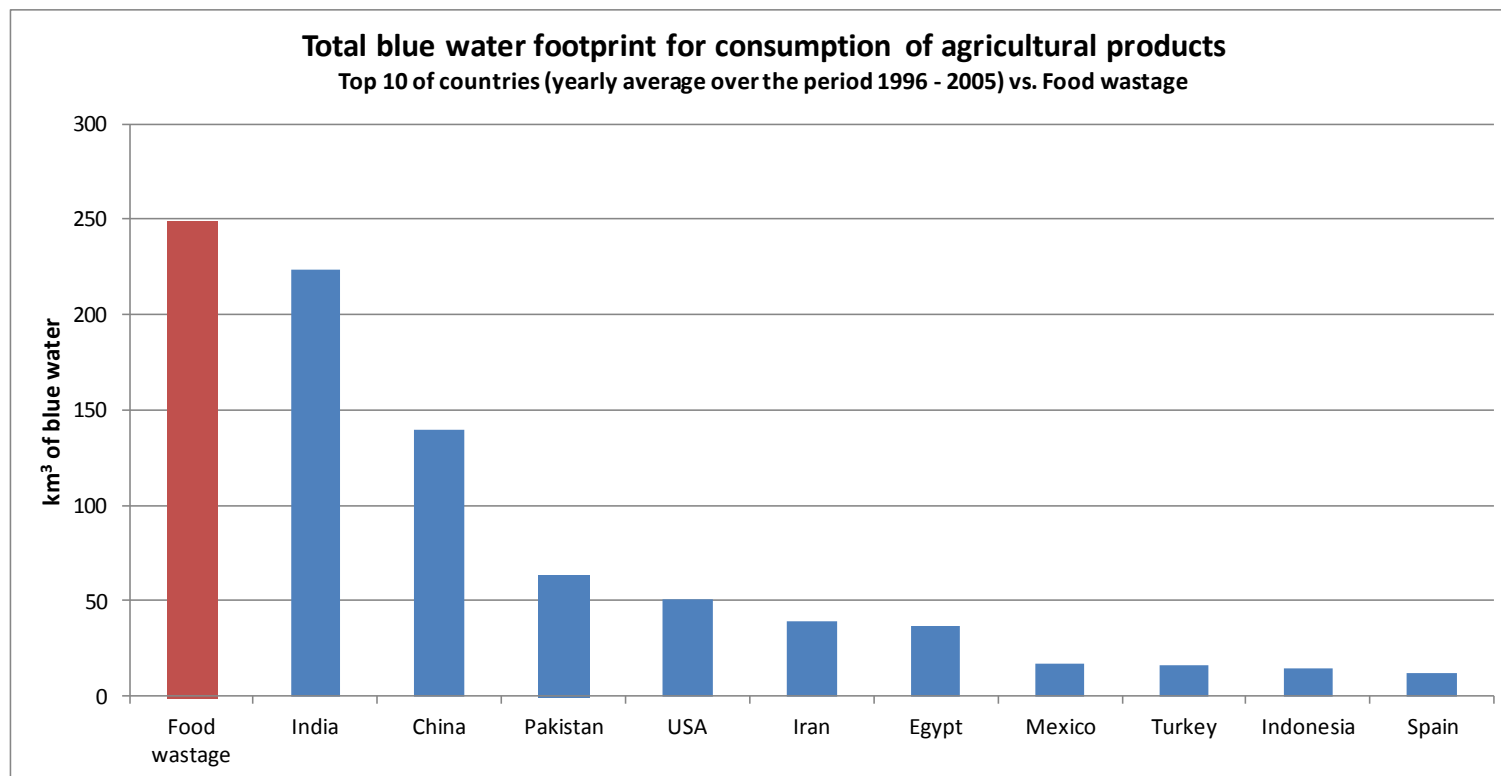
Blue water footprint



The blue water footprint of food wastage is about 250 km³, equivalent to 3 times the volume of lake Geneva



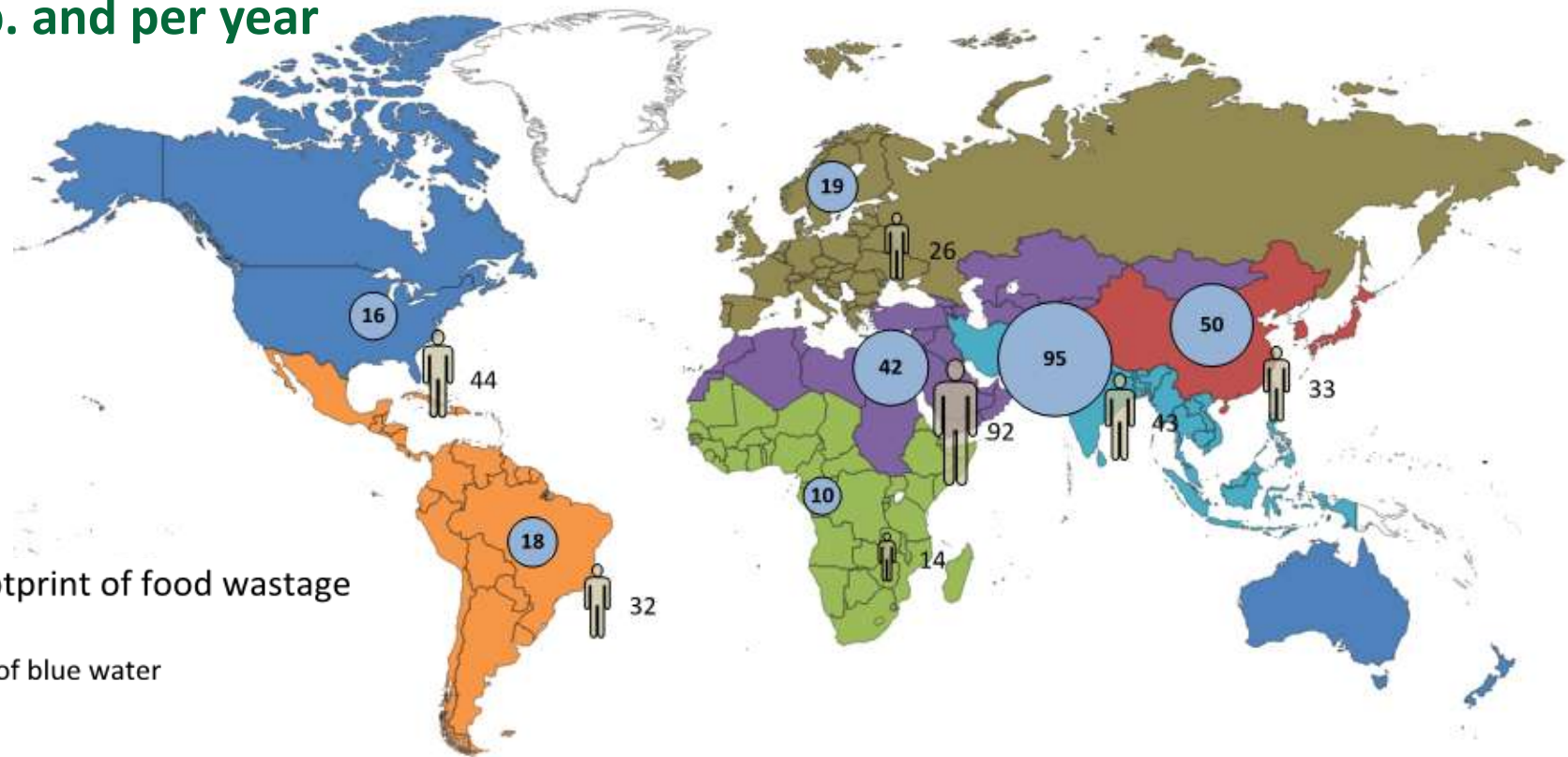
If food wastage was a country, it would rank 1st in the list of countries' water footprint for consumption of agricultural products





Blue water footprint

-  Major contributors are Asia and NA,WA&CA, with 60% of the footprint in this area due to cereals (mostly wheat and rice)
-  The average blue water footprint of food wastage is about 38,000 L per cap. and per year



Water footprint of food wastage

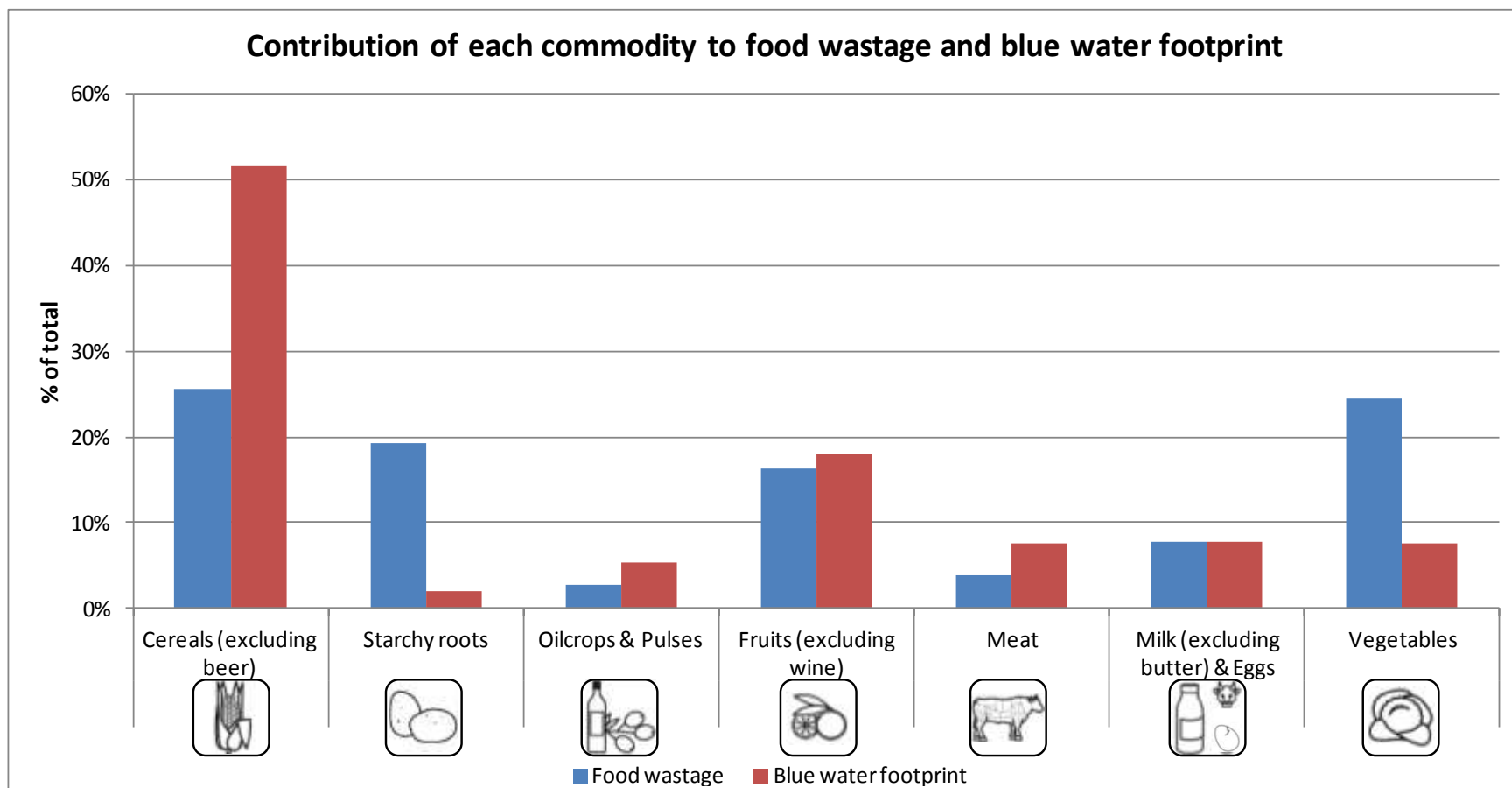
 km3 of blue water

Water footprint per capita

 Blue water m3 per cap. and per year



Cereals and fruits contribute to 52 % and 18% of total water footprint whereas their contributions to volumes are 26% and 16%

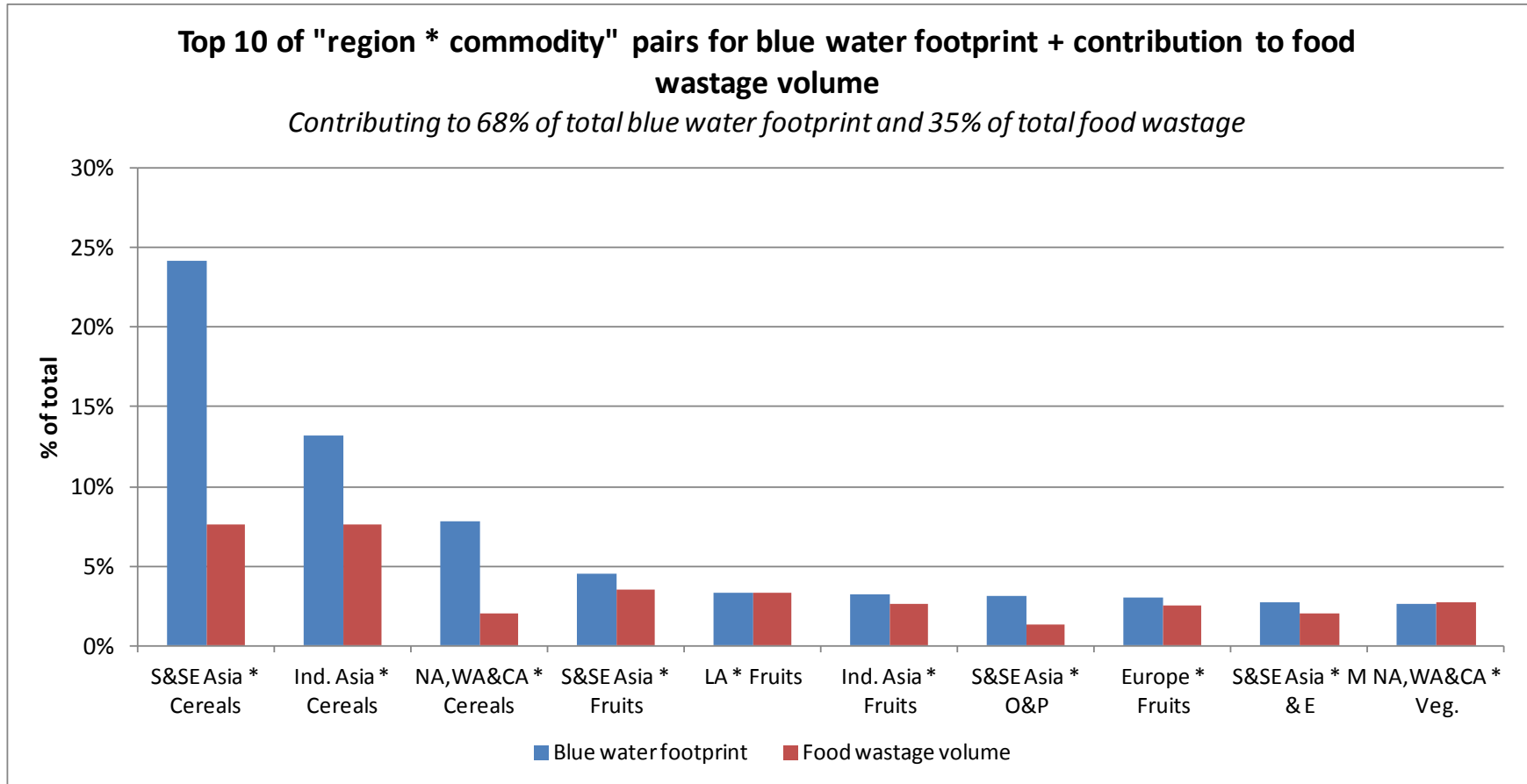




Blue water footprint



For cereals, the footprint is related to the water intensity of the commodity, whereas for fruits it is more related to the wastage volumes



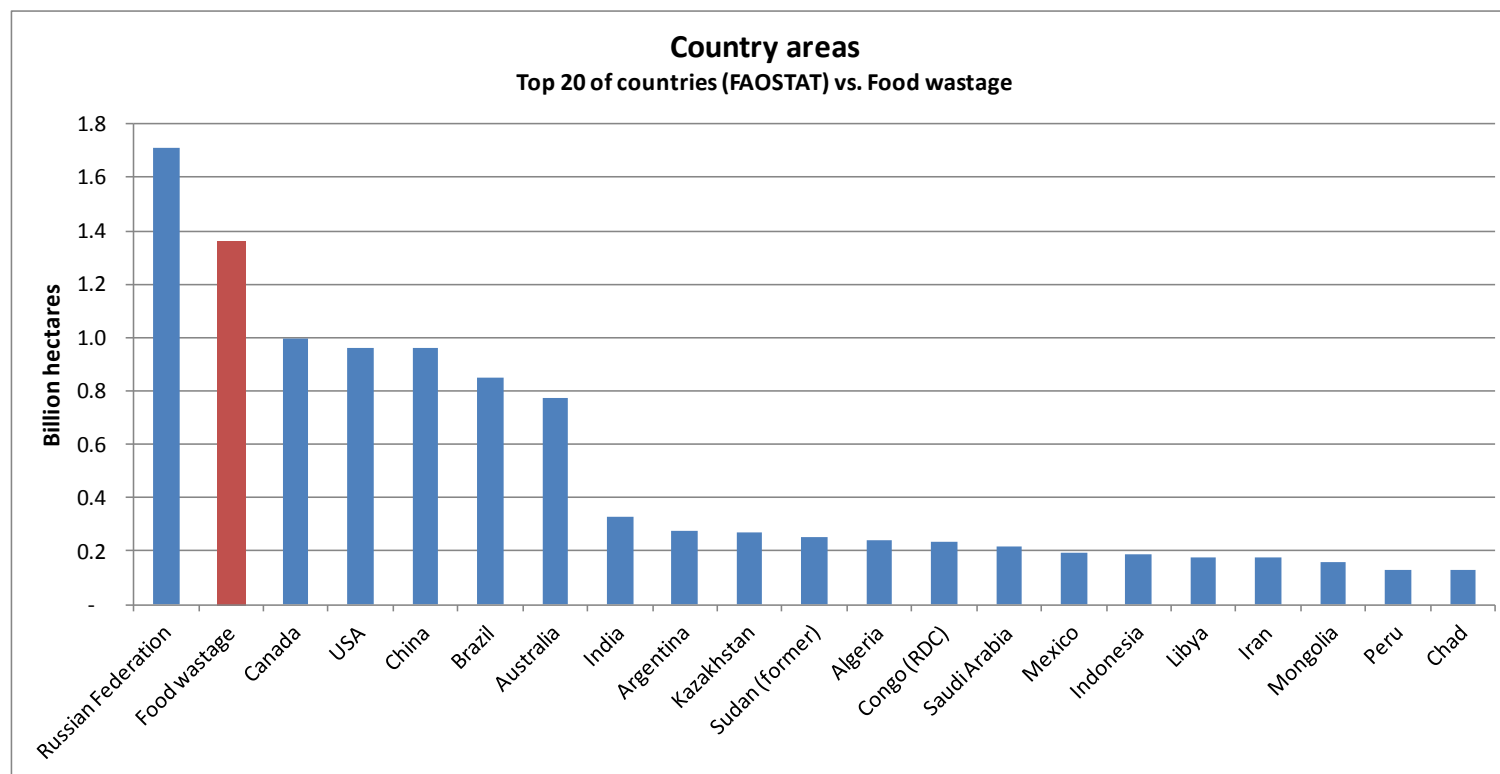
This figure indicates whether the water footprints of the hotspots (region * commodity) are driven by high volumes or high impact factors.



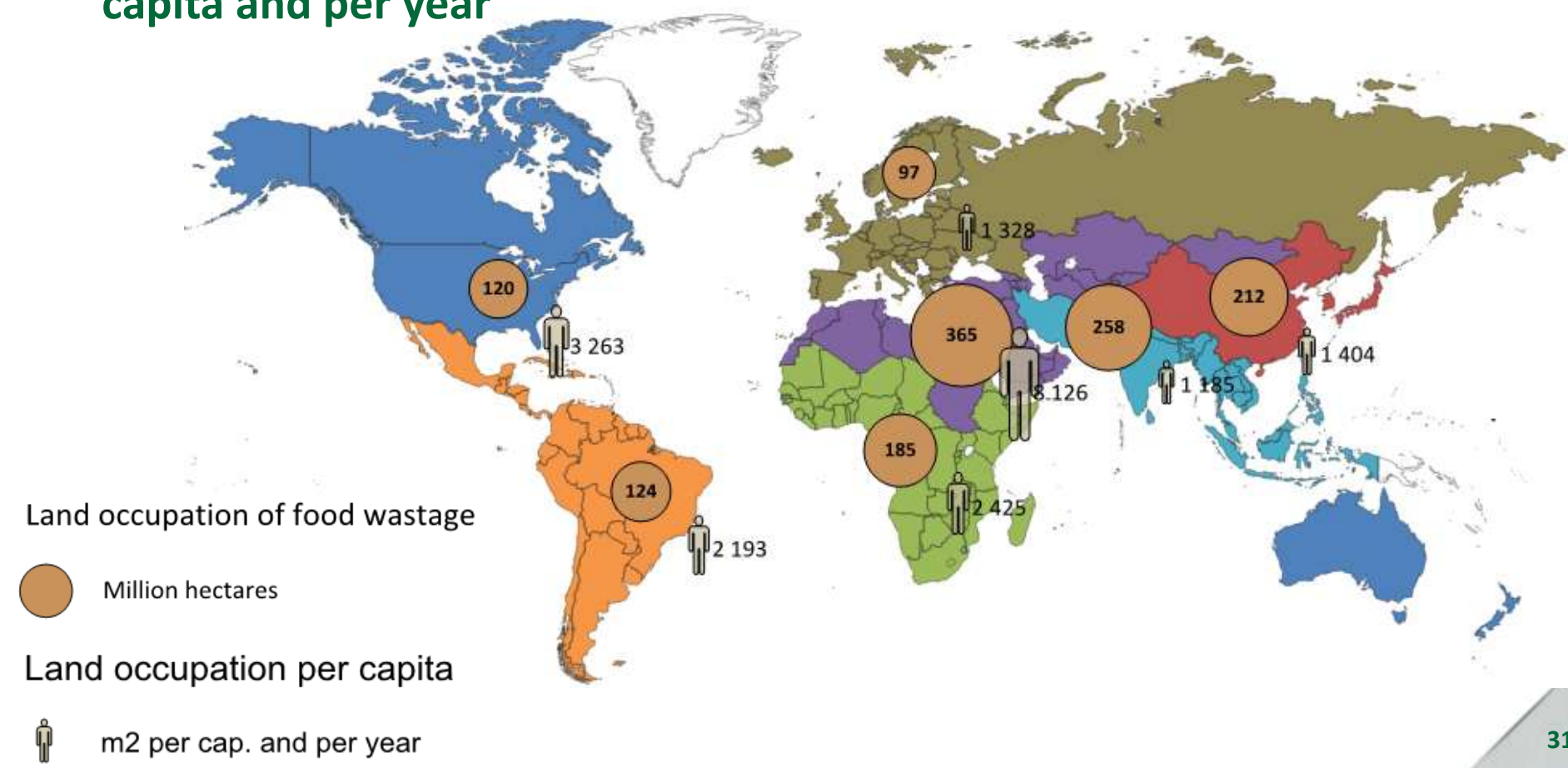
Food waste in 2007 occupied almost 1.4 billion hectares, equal to about 28% of the world's agricultural land area

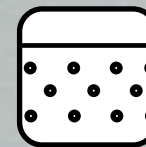


Surfaces occupied can be compared to the areas of the world's largest countries: food waste is 2nd behind the Russian Federation

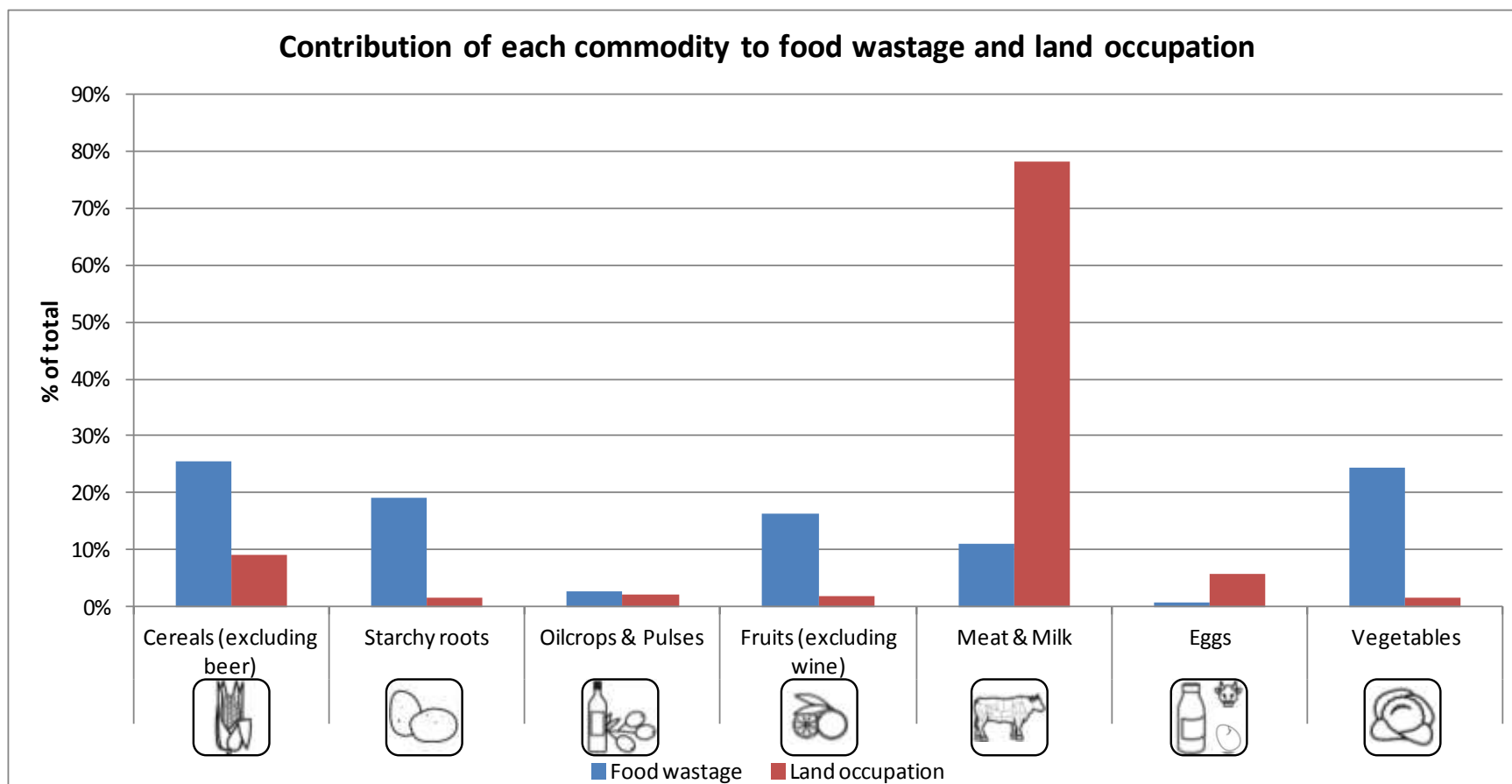


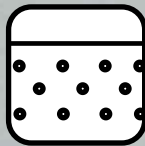
-  The major contributor is NA,WA&CA, with 85% of the land occupation in this region due to non-arable land for meat & milk
-  The average land occupation of food wastage is about 2,000 m² per capita and per year





The major contributors to land occupation of food waste are meat & milk, with 78% of the total surface, whereas their contribution to total food waste is 11%





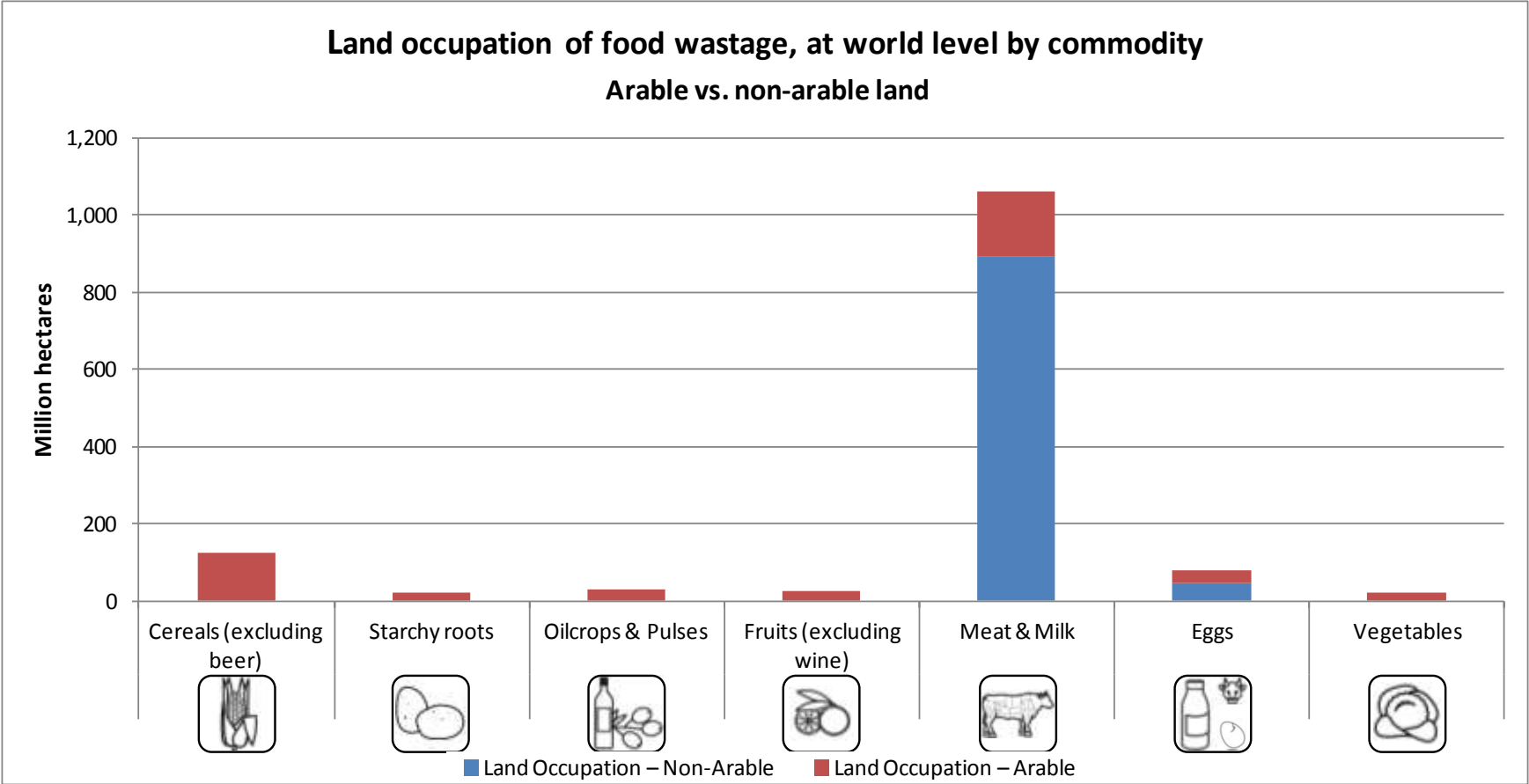
Land occupation



The majority of the surfaces occupied to produce lost/wasted meat & milk are non-arable land

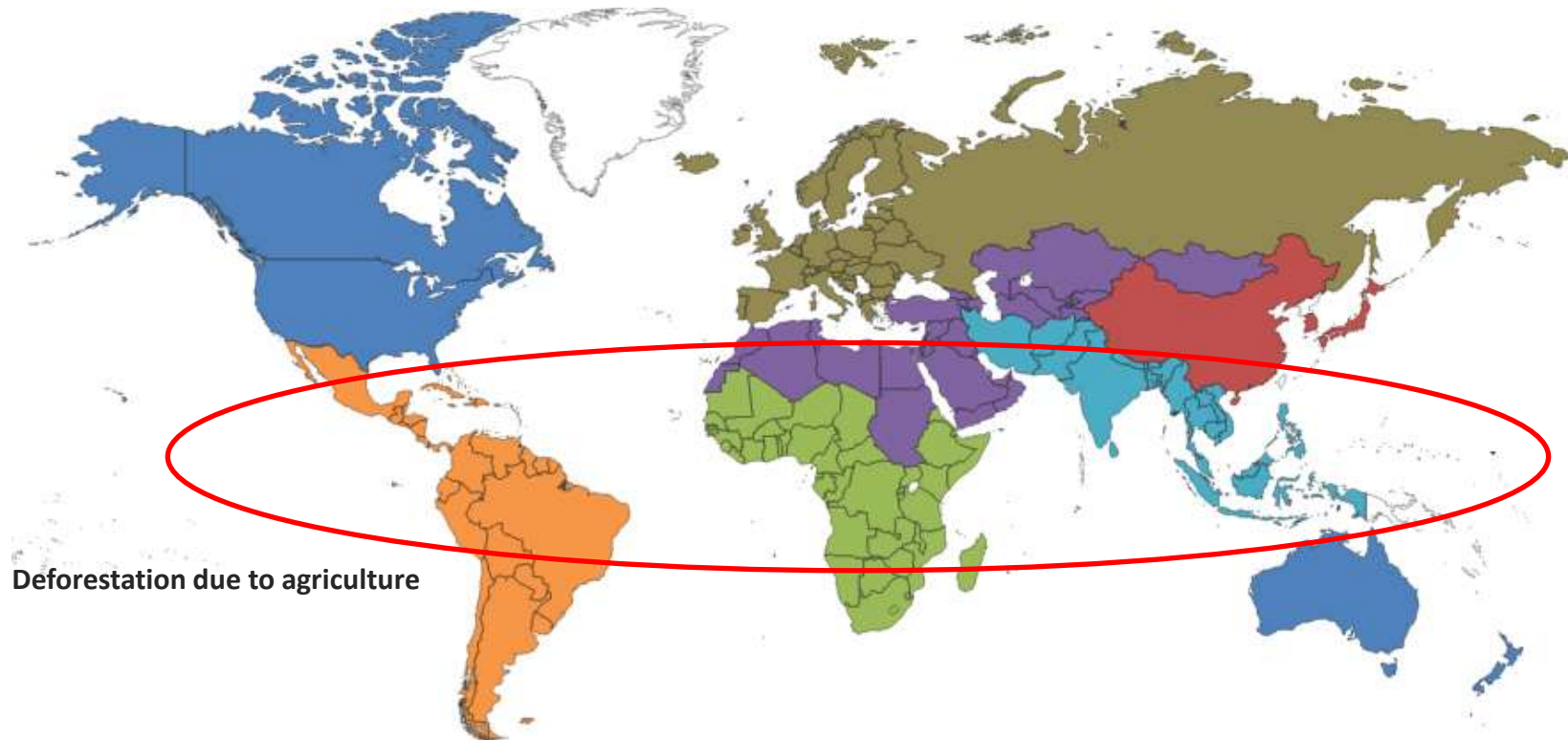


Meat & milk occupy 95% of the non-arable land





Deforestation due to agricultural expansion seems to occur today mainly in tropical and sub-tropical areas of the African continent, Western and South-Eastern Asia and South America

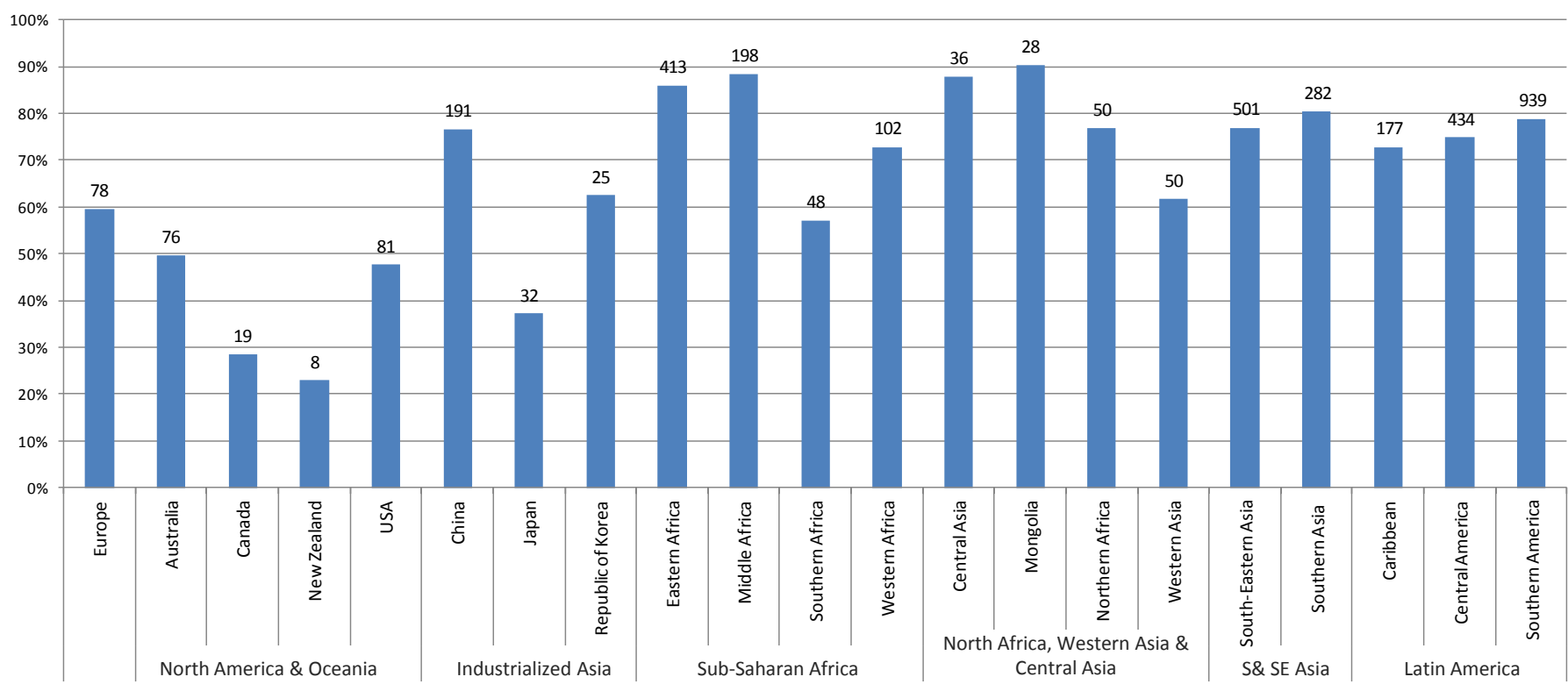


Deforestation due to agriculture



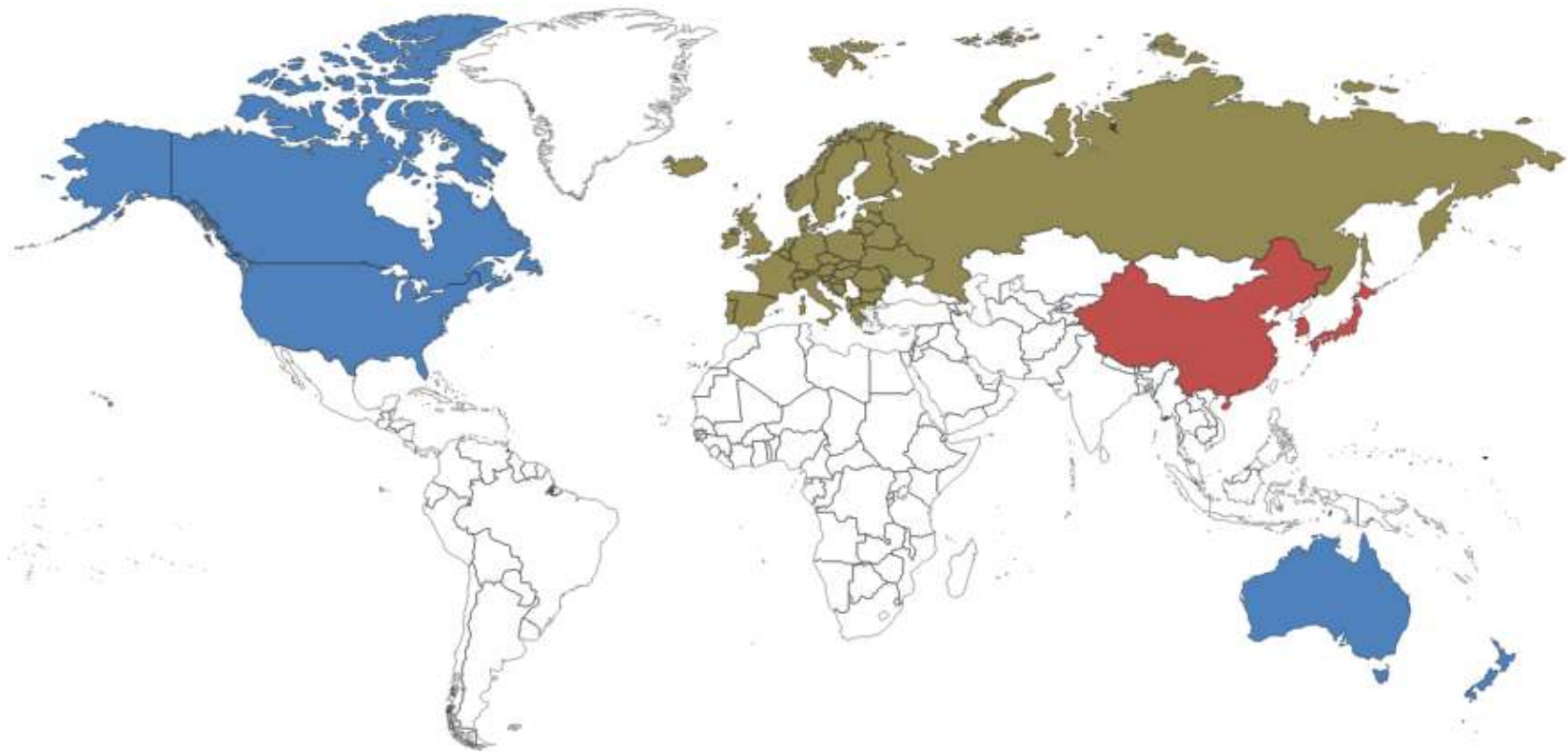
Overall 66% of Vulnerable/endangered/critically endangered species are threatened by agriculture

Percentage of red list species threatened by agriculture
(Mammals, Birds, Amphibians)





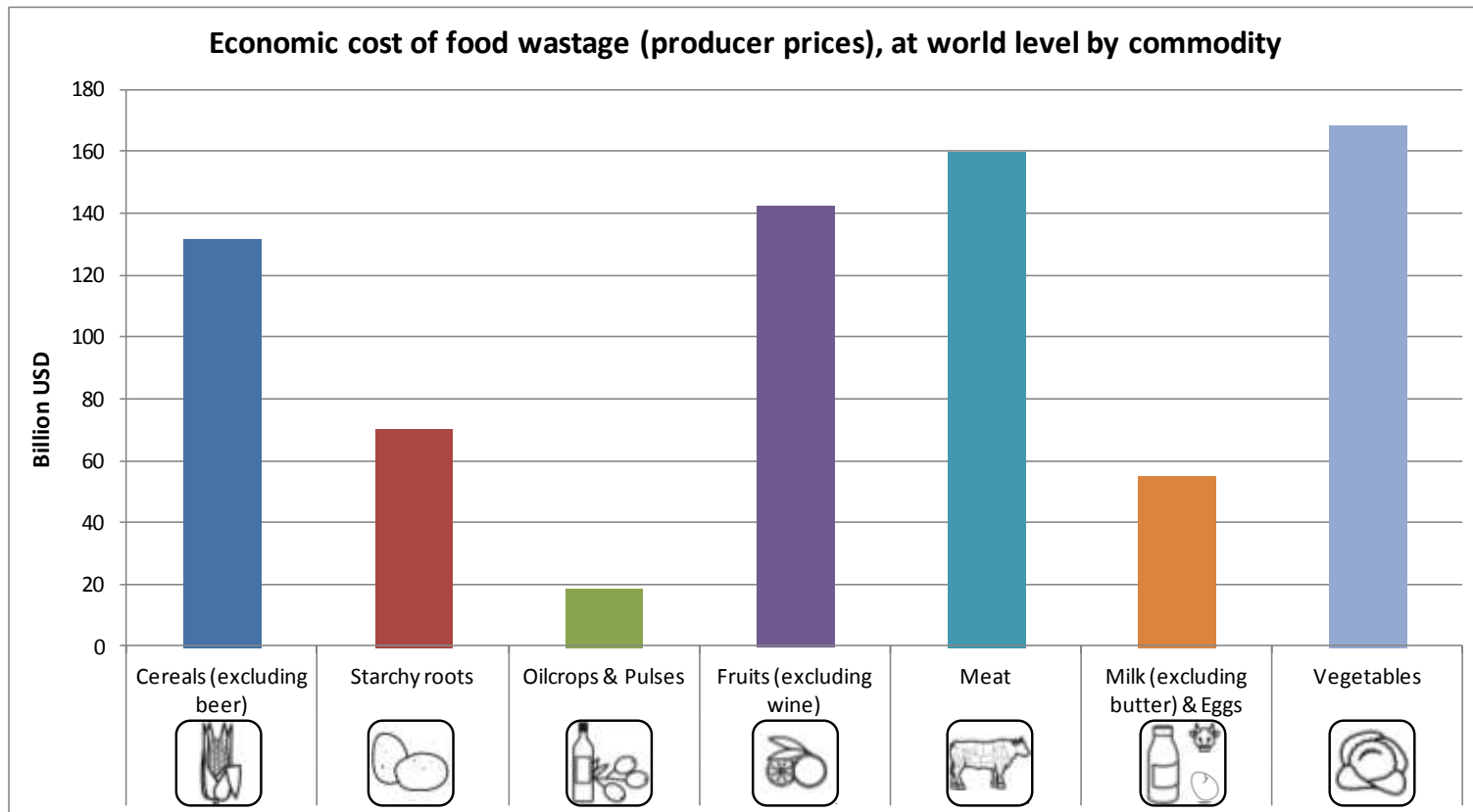
Fisheries have been declining or collapsing in most regions' seas since 1950 but this decline occurs at very different rates



Europe, NA&Oce, Ind. Asia have approximately $\frac{2}{3}$ of their seas showing declining trends in Marine Trophic Index since 1950.

 On a global scale, the cost (based on 2009 producer prices) of wastage is 750 billion USD

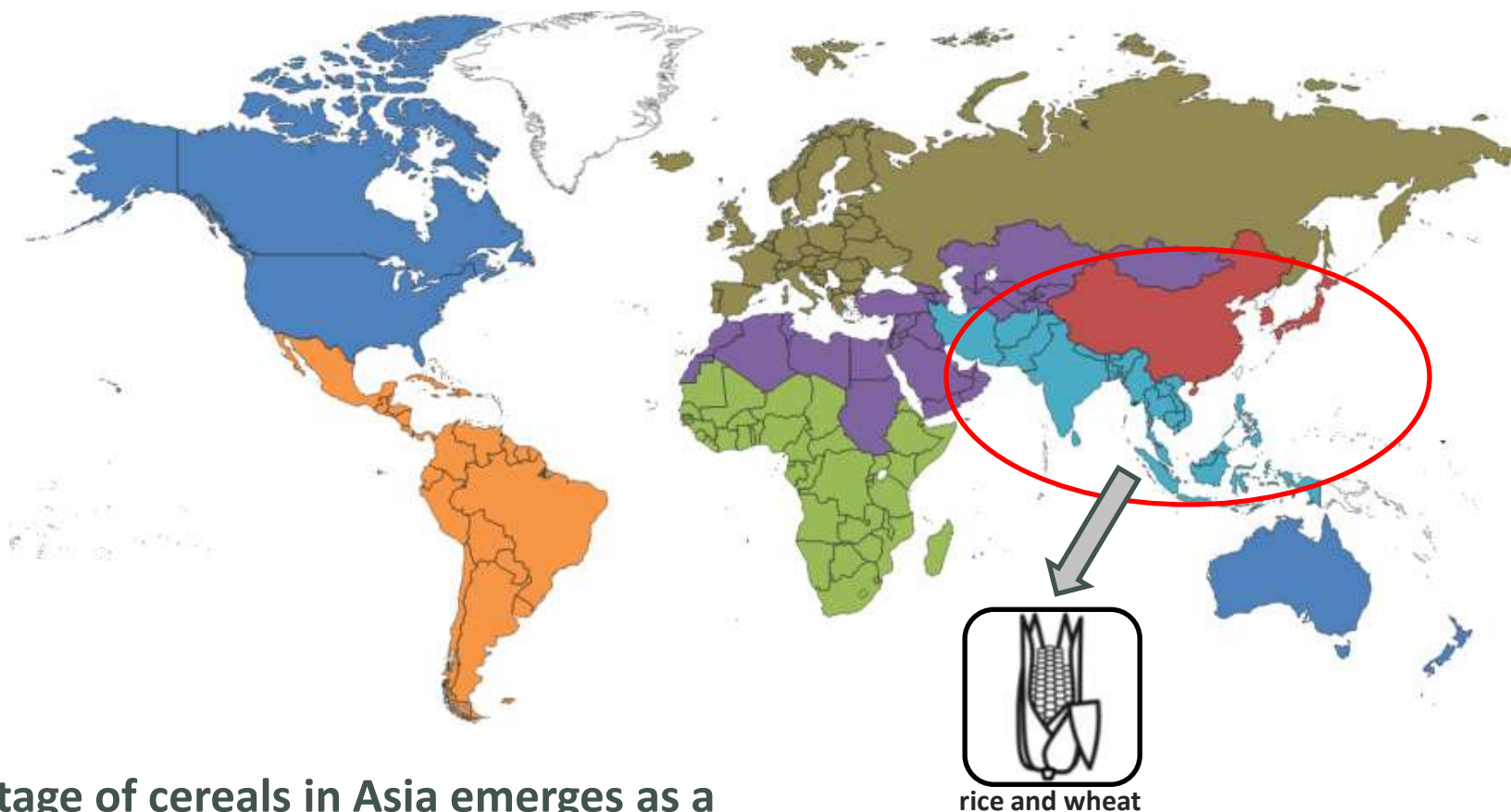
 The major contributors are vegetables, meat, fruits and cereals



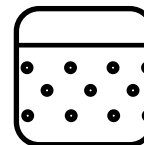
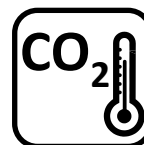
Cross analysis



The global analysis allow to identify a number of Region * Commodity hotspots

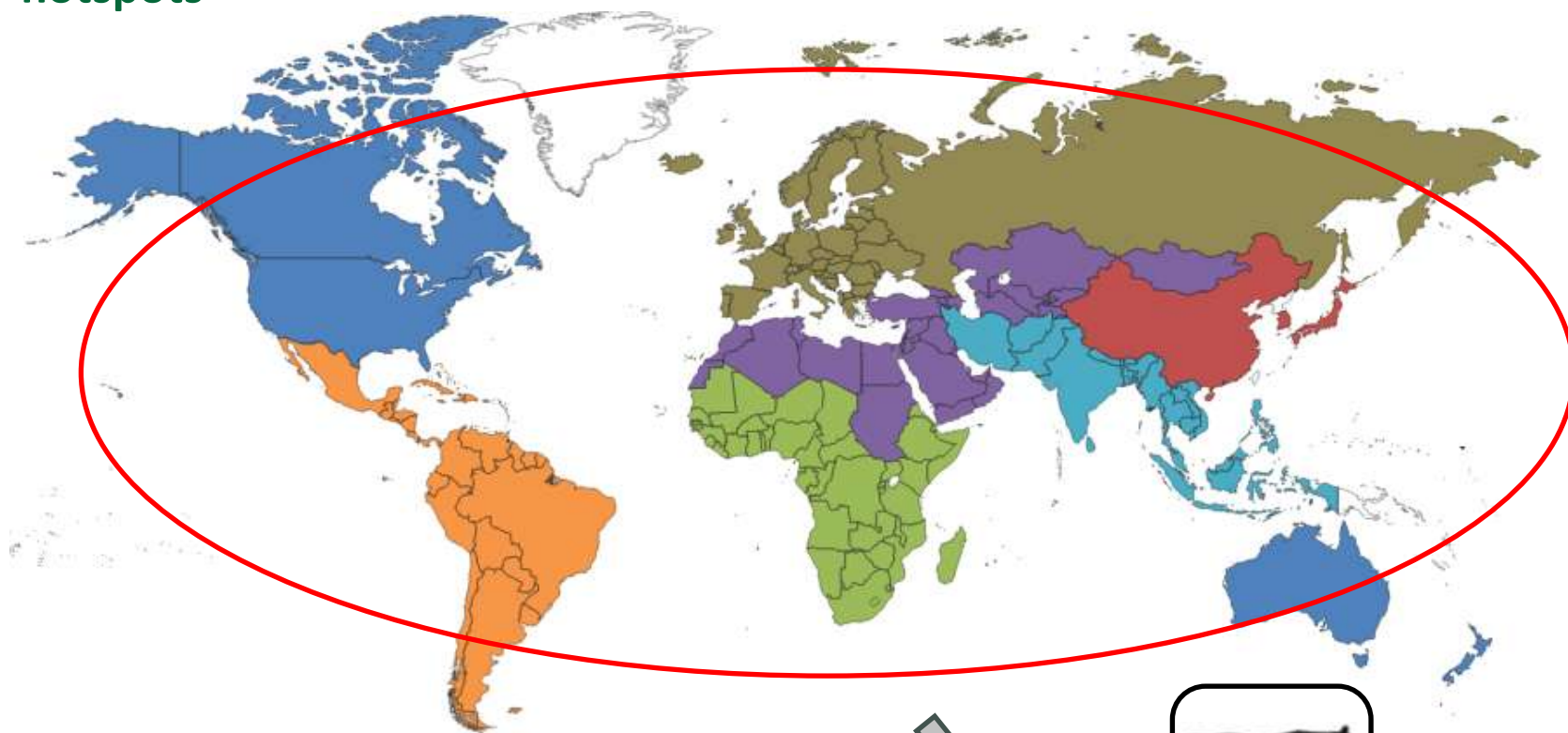


Wastage of cereals in Asia emerges as a significant hotspot, main contributing crops are rice and wheat.

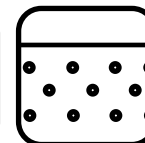
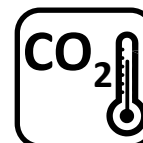
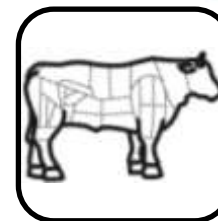




The global analysis allow to identify a number of Region * Commodity hotspots



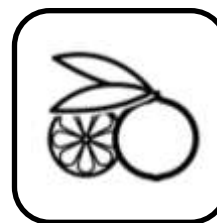
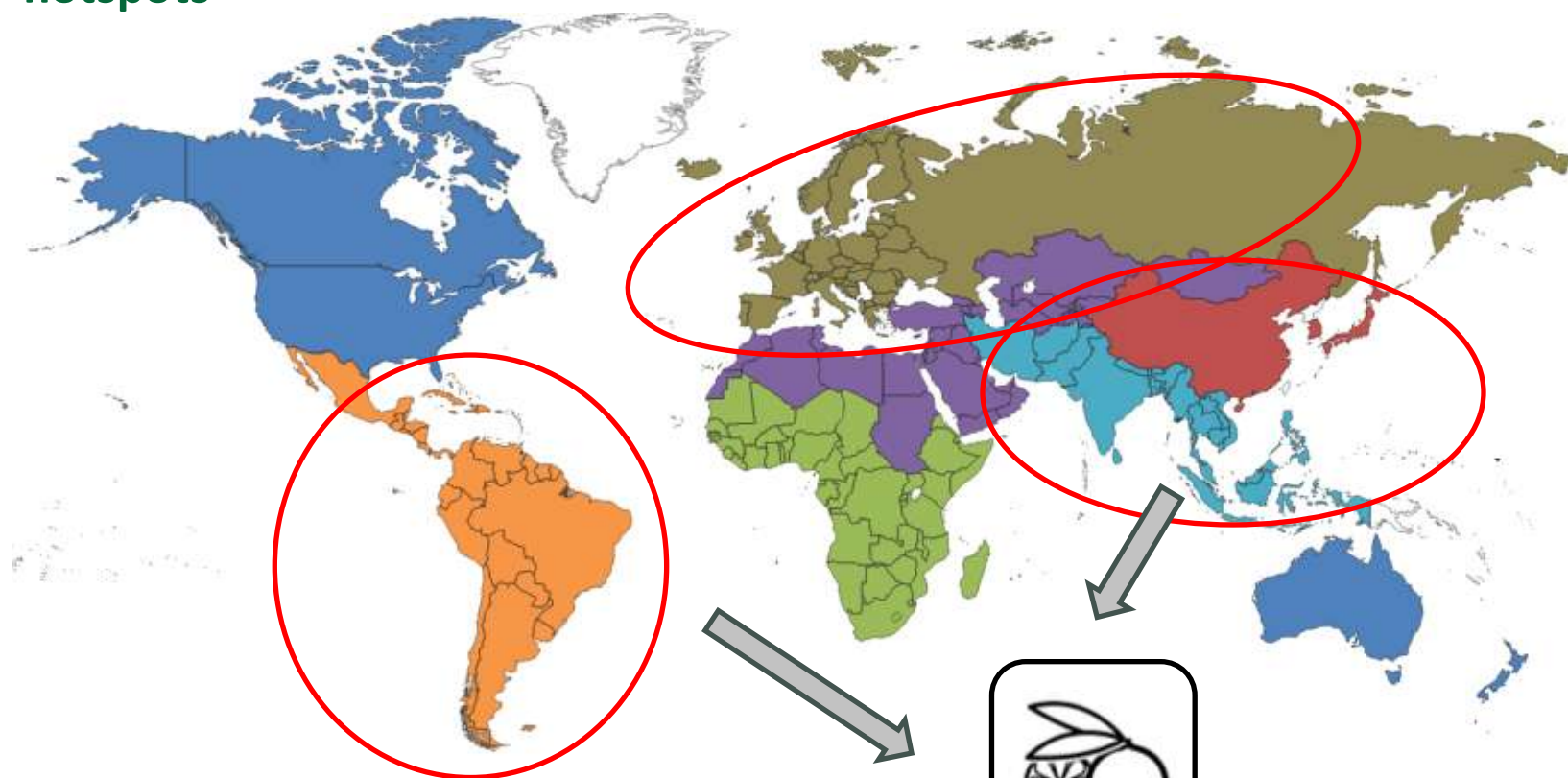
The high impacts of meat in terms of land occupation and carbon footprint make it a major hotspot, although wastage volumes are comparatively low.



Cross analysis



The global analysis allow to identify a number of Region * Commodity hotspots

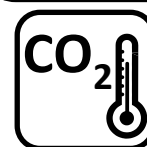


Fruit wastage emerges as a blue water hotspot in Asia, LA and Europe, linked more to food wastage volumes than to the water intensity.

Cross analysis



The global analysis allow to identify a number of Region * Commodity hotspots



The carbon footprint of vegetables singles them out as a hotspot in Ind. Asia, Europe, and S&SE Asia, mainly due to large wastage volumes.

- ❑ Food wastage ranks as the **3rd top emitter** after USA and China and occupies close to **30% of the world's agricultural land area**. Its annual blue water footprint is equivalent to **3 times the volume of lake Geneva**.
- ❑ With such figures, a reduction of food wastage at global, regional, and national scales would have a **substantial positive effect** on natural and societal resources.
- ❑ By **highlighting the magnitude** of the environmental footprint of food wastage, the results of this study – by regions, commodities or phases of the food supply chain – allow **prioritizing actions and defining opportunities** for various actors' contributions to resolving this global challenge.

Potential improvement areas



There are several potential improvement areas for future research

☐ Quantification of food wastage : Definition of food waste / Food wastage percentages

- Need for a harmonization, which would enable more comparability of national data and between studies quantifying food waste arisings.

☐ Quantification of environmental impacts

- In further research, priority should be given to the integration of land use change in the carbon footprint accounting.
- Certain aspects could not be taken into account (e.g. land occupation and water footprint relating to non-agricultural phases; water footprint and land occupation for fish & seafood).

☐ Analysis of the variability of the results

- Each input of the FWF model has an attached uncertainty. Integrating an uncertainty calculation module in the model would be a valuable option to support the analyses.

Potential improvement areas



There are several potential improvement areas for future research

☐ Water footprint and water scarcity



- Need to complement water footprint figures with aspects on water scarcity to see if some trends or similarities exist between the two indicators.
- Data available on the GAEZ v3.0 portal were adapted to the FWF model.

☐ Land occupation and land degradation



- Data provided in FAO LADA (2011) were adapted to the FWF model in order to complement land occupation figures with a view on land degradation aspects.
- This allowed getting a view on: The land degradation status/trend/class of the surfaces occupied to grow uneaten food.

☐ In both cases, it is “low resolution” analyses, and results* should be taken with caution. Further work is required.

*Results not presented here, available in the summary and technical reports of the FWF study.

FAO & IIASA, 2012. GAEZ v3.0 - Global Agro-ecological Zones. Available at: <http://www.gaez.iiasa.ac.at/>.

FAO LADA, 2011. Global Land Degradation Information System (GLADIS) version 1.0. An information database for land degradation assessment at global level

About this study

- The FWF is a project of the Natural Resources Management and Environment Department initiated in April 2012 and managed by Ms Nadia El-Hage Scialabba.
- Phase I of the project (impacts of food wastage on climate, water, land and biodiversity) has been commissioned to BIO Intelligence Service.
- Phase II of the FWF project addresses the accounting of environmental and social externalities of food wastage, including a comparison with food wastage reduction investment costs and footprint scenarios for 2050.
- This FWF project is undertaken with the generous financial support of Germany.

Contacts

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