GLOBAL FOOD PRODUCTION HOTSPOT AND MITIGATION ANALYSIS

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Client: United Nations Food Programme
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GHG — Food production is attributed to 26% of total global greenhouse gas emissions

WATER USE — 70% of total global freshwater withdrawals are used for agriculture

LAND USE — 50% of habitable land is used for agriculture

EUTROFICATION — Agriculture causes 78% of total global ocean and freshwater eutrophication

ENVIRONMENTAL PROBLEM

Rapid global population growth and an increase in income per capita has necessitated an increase in food production to meet demand. Agricultural practices must adapt to an ever changing climate with less predictable yields while implementing sustainable practices to minimize emissions. There are many high-level global footprints and highly specific Life Cycle Assessments (LCA's) that are commissioned. However, mid-level contribution analyses on global food production that connect them are much rarer. Our contribution analyses on global food production includes the methodology of LCA to identify hotspots within food production processes with mitigation strategies.

OBJECTIVES

The primary goal is to aid the United Nations Environmental Food Programme (UNEP) in evaluating global food production. Sustainability Target 2.4 aims to enable increases in sustainable food production while protecting ecosystems and incorporating methods for climate resiliency by 2030. Data sources utilized are FAO Stat, Agri-footprint 6.3 and existing food LCA literature with the OpenLCA software. Project objectives:

- Rank top food items by combining global production values with environmental impact intensities from five impact categories: greenhouse gas (GHG), land use, water use, marine and freshwater eutrophication
- Conduct contribution analyses for the five impact categories for the top food items using Agri-footprint 6.3 data within OpenLCA software to identify hotspots within the food production system
- Research mitigation strategies through literature review of existing peer-reviewed LCA's and highlight recommendations

RESULTS

Top ranked food items with high global warming impact potential

Rank	Food Item	Total Annual Production 2022 (kg)	GHG Intensity (kg CO2e/kg)	Total Impact (kg CO2e)
1	Meat of cattle with the bone, fresh or chilled	6.93E+10	28.33	1.96E+12
2	Rice	7.76E+11	1.04	8.08E+11
3	Maize (corn)	1.16E+12	0.63	7.33E+11
4	Raw milk of cattle	7.53E+11	0.96	7.23E+11
5	Raw milk of buffalo	1.44E+11	3.75	5.38E+11
6	Meat of buffalo, fresh or chilled	6.90E+09	59.73	4.12E+11
7	Wheat	8.08E+11	0.51	4.12E+11
8	Oil palm fruit	4.25E+11	0.66	2.79E+11
9	Meat of sheep, fresh or chilled	1.03E+10	24.48	2.51E+11
10	Sugar cane	1.92E+12	0.12	2.29E+11
11	Meat of goat, fresh or chilled	6.37E+09	32.81	2.09E+11
12	Meat of pig with the bone, fresh or chilled	1.23E+11	1.67	2.05E+11
13	Soya beans	3.49E+11	0.58	2.02E+11
26	Hen eggs in shell, fresh	8.70E+10	0.57	4.96E+10

**Food items included as alternatives for comparison were hen eggs and sugar from beets

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FINDINGS

RICE

HOTSPOT:
*Fertilizer application &
flooded soil conditions during cultivation*

MITIGATION: *Alternate wetting & drying,
mid-season draining of fields;
partial or complete removal of rice straw*

MAIZE

HOTSPOT:
Fertilizer application & drying process

MITIGATION:
Intercropping & sweet maize production

MILK

HOTSPOT:
Dairy cow housing systems & feed crops

MITIGATION:
Manure management and regenerative agriculture

WHEAT

HOTSPOT:
*GHG emissions from wheat leaves &
diesel from farming equipment*

MITIGATION:
*Optimizing fertilizer &
alternative fuel for farm equipment*

OIL PALM FRUIT

HOTSPOT:
Land transformation & deforestation

MITIGATION:
*cultivation on low carbon grassland &
optimize fertilizer*

SUGAR CANE AND BEET

HOTSPOT:
Land transformation & deforestation

MITIGATION:
*Reduced human sugar consumption &
increased production of renewable bioethanol*

MEAT OF PIG

HOTSPOT:
GHG emissions from feed & manure

MITIGATION:
*Locally-sourced legume or insect-based feed
& manure management*

EGG

HOTSPOT:
*GHG & land transformation
from imported soy feed*

MITIGATION:
Locally-sourced legume or insect-based feed

SOYA BEANS

HOTSPOT:
*Land transformation, deforestation &
GHG emissions*

MITIGATION:
Intercropping, optimizing fertilizer and land use

IMPACT

This project demonstrates the benefits of life cycle thinking (LCT) and the application of LCA to understand emissions within the food production process. Industry stakeholders, policy makers and other stewards can use such results to enhance climate resiliency strategies and sustainability efforts in the context of agriculture and global food production. By bridging the data gap between global level LCAs focused on dietary shifts and LCAs of individual food items, a more complete discussion connecting their functionality to work in parallel was achieved. Our analysis identifies mitigation approaches that can be improved upon and highlights the importance of prioritizing lowering emissions from food production globally.