



Module 1 – Foundations of Sustainable Agri-Food Systems & Circular Economy

Hands-On Activity A: Global Food Systems Mapping: Planetary boundaries & SDG

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Data Collection & Reflection Worksheet for Module 1 HOA A

Student Name(s): _____ Class/Period: _____

Date: _____

Group Members: _____

Part A – Choose Your Food & Focus Category

1. Our chosen food:

Example: hamburger, tomato, rice, pasta, orange juice, salad, sushi, grilled cheese, lentil soup

2. Food-system categories (circle or highlight all that appear in your food's journey):

- Inputs
- Production
- Processing & Distribution
- Consumption
- Waste & End-of-Life
- Influencers

3. Our *focus category* for deep analysis (choose ONE):

- Inputs Production Processing & Distribution Consumption Waste

(If needed, note any key influencers that strongly affect your food: policy, labor, environment, economics.)



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Part B – Components in Your Food’s Journey (Check All That Apply)

Check the components that are part of YOUR chosen food’s journey. Add notes if needed.

Category	Components (Check all that apply to your chosen food)
Inputs	<input type="checkbox"/> Seeds / seedlings / animal genetics <input type="checkbox"/> Water for irrigation or processing <input type="checkbox"/> Soil or hydroponic media <input type="checkbox"/> Fertilizers or soil amendments <input type="checkbox"/> Pesticides / crop protection inputs <input type="checkbox"/> Livestock feed <input type="checkbox"/> Energy or fuel <input type="checkbox"/> Machinery, tools, equipment
Production	<input type="checkbox"/> Farms (crop production) <input type="checkbox"/> Ranches & livestock operations <input type="checkbox"/> Greenhouses or vertical farms <input type="checkbox"/> Aquaculture or fisheries <input type="checkbox"/> Community gardens
Processing & Distribution	<input type="checkbox"/> Food manufacturing or processing plants <input type="checkbox"/> Slaughterhouse / butcher (if applicable) <input type="checkbox"/> Packaging operations <input type="checkbox"/> Transportation (trucks, ships, trains) <input type="checkbox"/> Warehousing / cold storage <input type="checkbox"/> Wholesalers or distributors <input type="checkbox"/> Retail: grocery stores, markets, cafeterias
Consumption	<input type="checkbox"/> Households / home kitchens <input type="checkbox"/> Restaurants / cafes / school cafeterias <input type="checkbox"/> Institutional kitchens (hospitals, universities) <input type="checkbox"/> Food preparation, cooking, serving, purchasing
Waste & End-of-Life	<input type="checkbox"/> Unused food (spoiled or expired) <input type="checkbox"/> Food scraps from prep or leftovers <input type="checkbox"/> Packaging waste (plastic, cardboard) <input type="checkbox"/> Agricultural byproducts <input type="checkbox"/> Composting or recycling programs <input type="checkbox"/> Landfills / waste hauling services
Influencers (Cross-cutting)	<input type="checkbox"/> Human labor at every stage <input type="checkbox"/> Policies & regulations <input type="checkbox"/> Economic systems (prices, wages, markets) <input type="checkbox"/> Environmental conditions (climate,

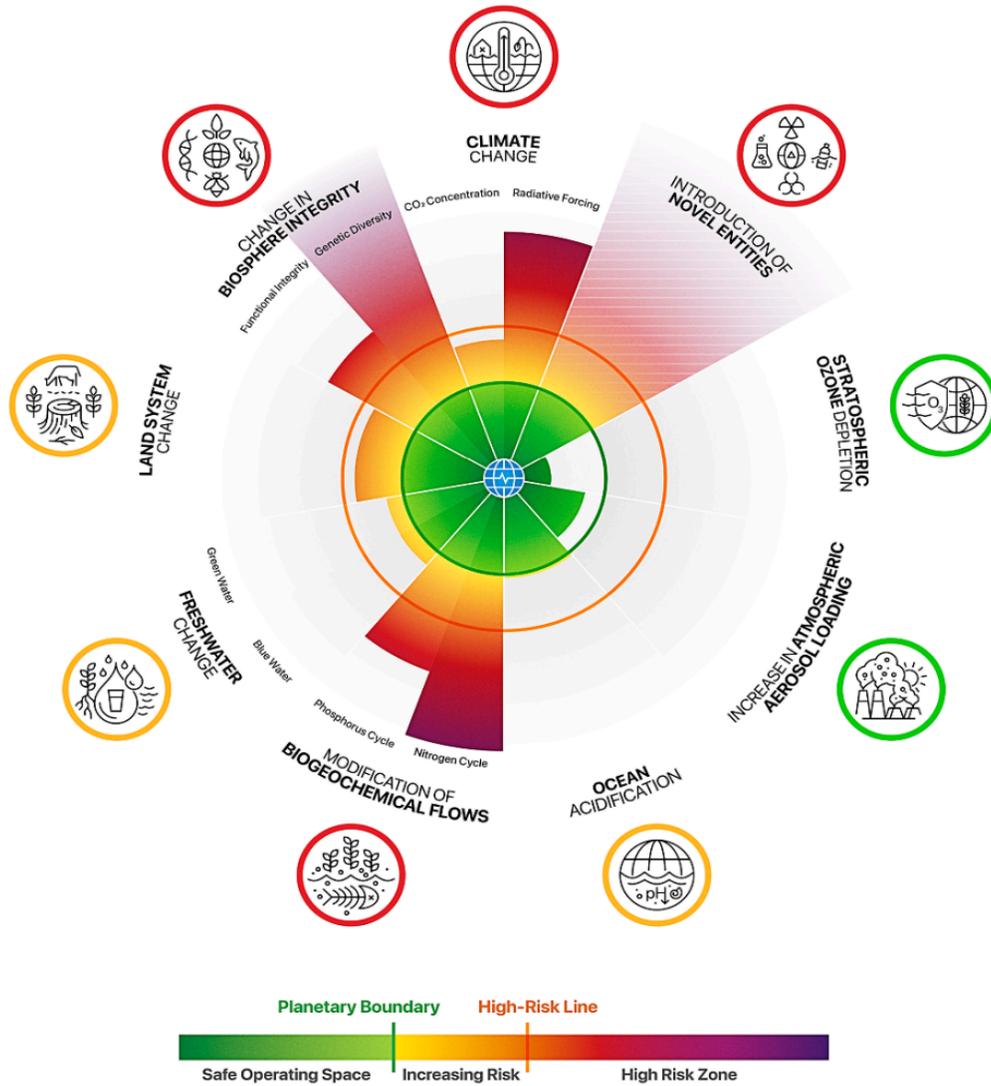


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	water availability) <input type="checkbox"/> Social & cultural factors (traditions, demand, food access)
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Part C – Planetary Boundaries for Our Focus Category



1. Nine Planetary Boundaries (PBs)

(Start with the ones you think are **most affected** by your food’s system.)

- Climate Change ★
- Biosphere Integrity / Biodiversity Loss ★



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- Land-System Change ★
- Biogeochemical Flows (Nitrogen & Phosphorus) ★
- Freshwater Use ★
- Ocean Acidification
- Atmospheric Aerosol Loading
- Stratospheric Ozone Depletion
- Novel Entities (plastics, chemicals, pesticides, microplastics)

2. Planetary Boundaries connections for our *focus category* (Inputs, Production, etc.):

Fill in at least **3–5 strong connections**. See example below

Planetary Boundary	Component in our food's system	How is it affected? (short explanation)

Example:

Planetary Boundary	Component in our food's system	How is it affected? (short explanation)



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Climate Change	Cattle production	Cows release methane (CH ₄), a powerful greenhouse gas; fertilizers also emit nitrous oxide (N ₂ O).
Land-System Change	Grazing land + feed crop fields	Forests/grasslands are cleared to grow feed or create pasture for cattle.
Biogeochemical Flows (N & P)	Fertilizer on corn/soy feed crops	Excess fertilizer runs off into waterways, causing nutrient pollution and dead zones.
Freshwater Use	Irrigation for cattle feed crops	Water-intensive crops (like corn/alfalfa) require large amounts of freshwater.
Biosphere Integrity (Biodiversity Loss)	Conversion of natural habitats	Habitat loss from grazing + monoculture feed crops reduces plant and animal diversity.

Part D – SDG Connections

1. SDGs that connect strongly to our food + focus category (check all that apply):

- SDG 2 – Zero Hunger
- SDG 6 – Clean Water and Sanitation
- SDG 7 – Affordable & Clean Energy
- SDG 8 – Decent Work & Economic Growth
- SDG 12 – Responsible Consumption & Production
- SDG 13 – Climate Action
- SDG 14 – Life Below Water
- SDG 15 – Life on Land
- Other: _____



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SUSTAINABLE DEVELOPMENT GOALS



2. SDG details. See example below.

SDG # & Name	Where it appears in our food's system (component/category)	Positive contribution or negative pressure? Explain.

Example:



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SDG	Where	Positive or Negative? Why?
SDG 13 (Climate Action)	Production	Negative—cattle produce methane + fertilizer emissions.
SDG 15 (Life on Land)	Production	Negative—grazing/feeding uses a lot of land and reduces habitats.
SDG 12 (Responsible Consumption & Production)	Cafeteria waste	Could be positive if we reduce waste, but negative if large portions are thrown away.

Part E – Connections, Feedback Loops & Leverage Point

1. Important cause-and-effect links on our map

List 3–4 **key arrows** you drew on your system map poster. See example below. Ask yourself: “What chain reactions might this change cause?”, “Is this a balancing or reinforcing feedback loop?”, “Could your waste become someone else’s input?”.

Arrow / Relationship	Type (cause-effect, feedback loop, etc.)	What it shows
	<input type="checkbox"/> cause-effect <input type="checkbox"/> feedback loop	
	<input type="checkbox"/> cause-effect <input type="checkbox"/> feedback loop	



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	<input type="checkbox"/> cause-effect <input type="checkbox"/> feedback loop	
	<input type="checkbox"/> cause-effect <input type="checkbox"/> feedback loop	

Example:

Arrow / Relationship	Type (cause-effect, feedback loop)	What it shows
Fertilizer use → Nitrogen runoff	<input checked="" type="checkbox"/> cause-effect	More fertilizer for cattle feed crops leads to nutrient pollution in rivers and lakes.
More grazing land → Less forest cover	<input checked="" type="checkbox"/> cause-effect	Expanding cattle grazing areas results in deforestation and habitat loss.
Increased beef demand → More cattle production → More methane → More climate change	<input checked="" type="checkbox"/> feedback loop	A reinforcing loop: rising demand increases emissions, which worsen climate impacts that threaten agriculture.
Water scarcity → Lower feed crop yields → More land needed for production	<input checked="" type="checkbox"/> feedback loop	A climate–water–food loop: drought reduces yields, pushing producers to expand land use.

9. Our main *feedback loop* (if you made one):

Loop name/description:

Example for Burger: “Beef Demand → Production → Emissions → Climate Stress → More Production Pressure” (Reinforcing Loop)



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What happens as it cycles?

Example for Burger: More hamburger demand → more cattle → more methane → more climate change → harder growing conditions → more pressure to produce cattle → even more emissions.

10. Our *leverage point* (place where a small change could have a big impact):

Leverage point we chose:

Example for Burger: Reduce food waste from uneaten hamburger portions in school cafeterias.

What change could be made there?

Example for Burger: Introduce a “flex-size” serving system where students choose the burger size that matches their appetite (full, half, or mini), and pair it with a share table for uneaten items.

What big impacts might that change have (on PBs, SDGs, or people)?



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Example for Burger: By throwing away fewer burger portions, we waste fewer resources. This means less methane from rotting food, less land needed to grow feed, less irrigation water used, and fewer fertilizers entering rivers. It also helps the school save money and supports goals like SDG 12 (using resources responsibly) and SDG 13 (reducing climate impacts).

Part F – Individual Reflection (for Turn-In)

Each student should answer these **in their own words** on this sheet (or attached paper).

1. **Which Planetary Boundary was most affected by your food's system, and why?**



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Example for Burger: Climate Change was the most affected PB because producing beef for hamburgers releases large amounts of methane and other greenhouse gases.

2. Which SDG is most relevant to your group's map, and what part of the system connects to it?

Example for Burger: SDG 13 (Climate Action) is most relevant because beef production releases high methane and fertilizer-related emissions, which we showed in our Production category.

3. What surprised you most when mapping your food's components, impacts, or feedback loops?

Example for Burger: I was surprised by how many steps happen before the burger even gets to school—especially the amount of land and water used to grow cattle feed. I didn't realize hamburgers had so many climate-related feedback loops.

4. Identify one leverage point where redesigning or improving the system could create meaningful sustainability benefits. Explain your idea.

Example for Burger: A big leverage point is letting students choose smaller burger portions. This reduces food waste and helps cut emissions, land use, and water use, supporting SDG 12 and SDG 13. A small change in serving size can make a big difference.



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5. **Imagine this food system 20 years from now. What would it look like if we made your change? How might it affect you or your community?**

Example for Burger: If we reduce oversized burger portions in schools and let students choose smaller sizes, in 20 years there would be much less wasted food. That means fewer greenhouse gas emissions from landfills (less methane), lower demand for beef (so less deforestation and water use), and schools could save money. In my community, this could also mean healthier meals, less pressure on local farms and water supplies, and more awareness among students about making responsible food choices. It's a small change, but over time it could shift the whole system to be more sustainable.

Skills You'll Use

- **Systems Thinking:** seeing how one food connects to land, water, climate, and people.
- **Data Organization:** turning sticky notes into categories, tables, and a visual map.
- **Evidence-Based Reasoning:** linking components to Planetary Boundaries and SDGs.
- **Collaboration & Communication:** building a shared poster and explaining it to others.