Module 3: Life-Cycle Assessment, Packaging and Food Waste

Module Description

Module 3 focuses on how packaging should be evaluated not only as material waste, but as part of a wider food system that affects protection, shelf life, transport, safety, communication and loss reduction. Through Vietnamese cases, students learn to assess when packaging reduces environmental harm, when it creates unnecessary burdens, and how life-cycle thinking helps reveal trade-offs that are not obvious at first glance.

This module builds directly on Module 2's processing focus by shifting attention from production systems to the environmental consequences of packaging design, storage, logistics, recycling and food loss. By learning how to judge packaging through both life-cycle and waste-reduction lenses, students are better prepared to think critically about sustainable consumption and AI-supported diet planning in Module 4.

Learning Objectives

- Explain the basic logic of life-cycle assessment and why it matters for food packaging decisions.
- Differentiate between packaging that adds unnecessary waste and packaging that protects food, extends shelf life, or reduces loss.
- Identify packaging-related hotspots across production, transport, storage, retail, consumption, and end-of-life.
- Evaluate packaging systems in terms of protection, preservation, communication, recyclability, and likely food-waste consequences.
- Assess trade-offs between packaging reduction, food safety, product quality, shelf life, and recycling infrastructure.
- Design realistic improvements to food packaging systems in a Vietnamese context.

Module 3 Pre-class activities

Purpose: To prepare students to analyse food packaging systems in Vietnam through life-cycle thinking, food-waste prevention and circularity. The pre-class work is grounded in course models that treat packaging as a technical, communicative and regulatory system, and in research showing that packaging sometimes lowers overall environmental impact by reducing food waste, especially for perishable or high-impact foods.

Pre-class Activity 1: Choose one article or report from the list below and identify one key idea to help understand food packaging systems in Vietnam.

- Brennan, L., Lockrey, S., Ryder, M., Francis, C., Phan-Le, N. T., & Hill, A. (2021). *The role of packaging in fighting food waste: A systematised review of consumer perceptions of packaging. Journal of Cleaner Production, 281*, 125276. https://doi.org/10.1016/j.jclepro.2020.125276

- Hemachandra, S., Hadjikakou, M., & Pettigrew, S. (2024). *A scoping review of food packaging life cycle assessments that account for packaging-related food waste. The International Journal of Life Cycle Assessment, 29*, 1361–1378. https://doi.org/10.1007/s11367-024-02349-z
- United Nations Environment Programme. (2021). *Single-use supermarket food packaging and its alternatives: Recommendations from life cycle assessments.* https://www.lifecycleinitiative.org/wp-content/uploads/2023/03/UNEP-D010-Food-Packaging-Report.pdf
- Verghese, K., Lewis, H., Lockrey, S., & Williams, H. (2015). *Packaging's role in minimizing food loss and waste across the supply chain. Packaging Technology and Science.* https://www.worldpackaging.org/Uploads/SaveTheFood/Packagingroleminimisingwaste.pdf

Pre-class Activity 2: Short written response to a real-world case

Pick one of the following real-world cases:

Dragon fruit export packaging and post-harvest loss: Wageningen's Vietnam roadmap identifies major loss hotspots in the dragon fruit chain at farm level and at the exporter stage, including sorting, packaging, storage, and transport to the EU. It also recommends standardized farmer practices and stackable transport packaging to reduce pressure damage and loss. https://edepot.wur.nl/577022

Beverage cartons and circular packaging in Vietnam: Tetra Pak Vietnam and Dong Tien co-invested more than 3.5 million euros to upgrade recycling capacity for used beverage cartons, nearly doubling separation capacity to 17,000 tons per year and increasing the production of recycled pulp. This case is useful for thinking about packaging design, recovery infrastructure, and circular value creation. https://www.tetrapak.com/en-vn/insights/cases-articles/dong-tien-recycling-capacity

Low-value plastic packaging and EPR in Vietnam: WWF's policy brief on packaging EPR notes that high-value recyclable packaging is already separated to some extent, while low-value formats such as films, sachets, and composites are still mostly disposed of together with municipal waste. The report argues that a reliable EPR scheme is crucial for building large-scale collection, sorting, and recycling systems. https://wwfint.awsassets.panda.org/downloads/20210318_policy_brief_epr_vietnam_eng.pdf

Pick one of the questions below and write 200–250 words total and post to the online class discussion forum before the session.

- What insight does the reading give students about life-cycle assessment, packaging function or food-waste trade-offs?
- Does the case suggest that the best intervention is better packaging design, better logistics/storage, better recycling infrastructure or better policy?
- Which stakeholder group is most affected: producers, exporters, processors, retailers, consumers, recyclers or regulators?
- When might "less packaging" be the wrong answer?

Module 3 In-class activities

Packaging "Trade-off Audit" Workshop

Goal: Use pre-class work to evaluate packaging systems for sustainability, protection and waste reduction.

In groups, each student should share their answers. Identify overlaps. Teams select one packaging case to audit.

Audit questions:

- What is the package actually doing: protecting, preserving, communicating, portioning or enabling transport?
- What happens if the package is reduced, changed or removed?
- Does the main environmental burden come from the packaging itself, the food inside it or losses along the chain?
- How well does the current system fit Vietnam's storage, transport, retail and recycling conditions?

Output: Teams identify the top three trade-offs in the case and deliver a 2-minute presentation with justification.

Stakeholder Role-Play: "The Packaging Decision Meeting"

Goal: Explore competing priorities in packaging and waste decisions.

Scenario: A Vietnamese food company must redesign a package to improve sustainability, but the options create different risks around shelf life, transport, recyclability, cost and consumer acceptance.

Roles: packaging designer, food safety lead, exporter or retailer, sustainability manager, recycler, policymaker, consumer advocate.

Task: Each role argues for or against a proposed redesign using evidence about food protection, waste prevention, cost and end-of-life systems.

Debrief: Whose perspective dominated? Did the group focus too heavily on visible packaging waste and ignore food loss? Did recycling infrastructure matter more than material choice?

Microplastics Exposure Audit: "How Might This Package End Up in the Body?"

Goal: Examine how packaging decisions may influence human microplastics exposure, while distinguishing between strong evidence, weak evidence, and uncertainty.

Group task: Teams take one case from pre-class work and investigate it through an exposure lens rather than only a waste lens.

Teams identify:

- one packaging feature that could plausibly increase microplastic release or human exposure risk, such as abrasion, heat exposure, repeated handling, multilayer degradation or direct food contact under stressful conditions
- one point in the chain where exposure risk might increase most, such as filling, transport, storage, reheating, opening, or consumption
- one design or system change that could reduce likely exposure without compromising food safety, shelf life, or practicality
- teams must also decide what kind of evidence they are relying on: direct evidence, indirect inference or assumption. They should also explain where the science is still uncertain and avoid overstating the health claim

Output: A one-page Microplastics Exposure Audit in which teams present:

- the likely exposure pathway
- the strongest evidence supporting their concern
- the biggest uncertainty or limitation in the claim
- 1–2 recommendations for improving the packaging system

Post-class Reflection

Students respond to the prompt: “When does more packaging become more sustainable, and when does it become harder to justify?”

Students write one key insight and one lingering question for the next module.

This reflection helps students distinguish between visible waste and whole-system impact. It also prepares them for Module 4, where they will think about sustainability at the level of diets, choices, and AI-supported decision-making rather than at the level of a single package.