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SSPICEIT!
Sustainability Skills Program for International Catering operators and Entrepreneurs through Integrated Training

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Città metropolitana di Roma Capitale · POUR LA SOLIDARITÉ European think & do tank · CIPFP CAMINO DE SANTIAGO ESCUELA DE HOSTELERÍA & TURISMO DE LA RIOJA · Escola Profissional AMAR TERRA VERDE · AKMI · WORK'S · iED · CAPITALE LAVORO

Submodule n°9: Life Cycle Assessment

THEMATIC AREA	**How to implement circular practices in one's business**
SUB AREA OF REFERENCE	*Sustainable food*
HOURS	4
LEARNING OBJECTIVES	
By learning this module, the student should be able to: **1. Identify and implement practices coherent with sustainable waste management.** **2. Adopt sustainable practices in one´s job.**	
LEARNING ACTIVITIES	
Theoretical	**Practical**
Exposure of the contents through resources like PowerPoint and apps created specifically for this course.	Exercises, discussions, and practice tasks for the students to measure the knowledge acquired during the module.

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CONTENT

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SUBMODULE 9: Life Cycle Assessment

1. Life cycle assessment (LCA)

LCA is like a secret recipe for understanding the whole story of our ingredients, from where they start to how they end up on our plates. Imagine LCA as the 'behind-the-scenes' tour of your favourite recipes. It helps us uncover how our ingredients are grown, harvested, transported, and even what happens to the leftovers. It is like a map that shows us the journey of our food, from farm to fork.

But why is this relevant in the culinary world? Well, as chefs and culinary experts, we have a special role in making choices about the ingredients we use and how we prepare them. By understanding the environmental impact of our culinary choices, we can create amazing dishes that not only taste great but also help protect our planet.

In today's culinary adventure, we will learn about the different ingredients, how they are sourced, and their impact on the environment. We will see how 'farm to table' is not just a catchphrase but a concept we can influence.

LCA is like a detective tool for the culinary world. It helps us look at food and ingredients from start to finish, just like the journey of a recipe. Here is what it involves:

- **The Beginning (Raw Materials):** It starts with where our ingredients come from. For example, where are the vegetables grown? How are the animals raised for meat? LCA looks at how these things impact the environment.

Figure 1: Image of jcomp from freepik.com

- **The Middle (Production and Cooking):** When we cook, we are in the middle of our food's journey. LCA helps us understand how cooking methods, like grilling, baking, or frying, can affect the environment.

Figure 2: Imagem from freepik.com

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- **The End (Waste and Disposal):** After a meal, there are leftovers and rubbish. LCA helps us see what happens to the food scraps and packaging. Can they be composted or recycled, or do they end up in a landfill?

Figure 3: Image from freepik.com

2. Challenges in the kitchen

Sometimes, it is not easy to make the most eco-friendly choices in the kitchen. We may need to balance taste, cost, and sustainability. LCA helps us find solutions.

Let us break down the four stages of Life Cycle Assessment (LCA) with practical examples:

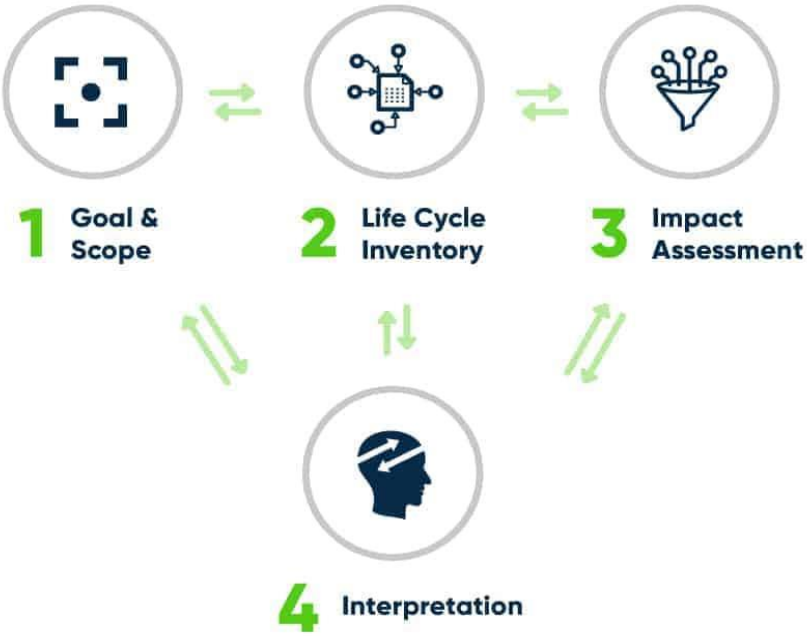

Figure 4: Image from ecochain.com

- **Goal and Scope Definition:** This is where we set our culinary detective mission. We decide what we want to investigate and why. For instance, we might want to know the environmental impact of our signature pasta dish. Our goal is to understand where we can make it more sustainable.

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- **Life Cycle Inventory (LCI):** In this stage, we gather all the clues or data we need. For our pasta dish, this means finding out where our ingredients come from. We would collect information on the pasta, the sauce, vegetables, and even the energy used to cook it. This helps us see the whole picture.

- **Life Cycle Impact Assessment (LCIA):** Now, it is time to put on our detective glasses. We take the data we have collected and analyse it. We want to know how our pasta dish affects the environment. Do any of our ingredients have a big carbon footprint? Are there water or energy issues we need to consider?

- **Interpretation:** This is where we become culinary eco-detectives. We look at the results from our analysis. For example, we might find that using locally grown vegetables reduces the carbon footprint of our pasta. We would then decide to source our veggies from local farms and encourage our customers to do the same.

3. Practical example

This practical example outlines the Life Cycle Assessment (LCA) for a signature dish, Grilled Salmon with Seasonal Vegetables. The assessment evaluates the environmental impact of sourcing, preparing, and serving the dish, identifying opportunities to reduce its carbon footprint, water usage, and waste.

1. Goal and Scope Definition:

Goal: To assess and minimize the environmental impact of preparing and serving one portion of Grilled Salmon with Seasonal Vegetables.

Functional Unit: 1 serving of the dish (200g salmon, 150g vegetables, 10g olive oil, spices).

System Boundaries: From sourcing raw ingredients to serving the dish. Exclusions include restaurant construction and kitchen equipment manufacturing.

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2. Life Cycle Inventory (LCI):

Ingredient Sourcing:

Ingredient	Origin	Transport Mode	Distance (km)	Farming Practice	Packaging
Salmon (200g)	Farmed in Norway	Refrigerated Truck	1,500	Aquaculture	Styrofoam Box
Zucchini (80g)	Local Farm (Portugal)	Small Truck	50	Organic	Cardboard Box
Carrots (70g)	Local Farm (Portugal)	Small Truck	50	Organic	Loose
Olive Oil (10g)	Spain	Large Truck	600	Conventional	Glass Bottle

Kitchen Utilities:

The dish requires utilities such as a gas stove for grilling and water for cleaning vegetables. Below is the utility usage per serving:

Utility	Activity	Usage per Serving	Energy Source
Stove (Gas)	Grilling salmon	8 minutes	Natural Gas (0.2 kg CO_2)
Water	Cleaning vegetables	2 litters	Tap Water

Waste Generated:

Waste includes organic vegetable peels, non-recyclable Styrofoam from salmon packaging, and recyclable cardboard from vegetables.

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3. Life Cycle Impact Assessment (LCIA)

The environmental impacts are calculated for the following categories:

Step 1: Carbon Footprint

The carbon footprint is calculated for ingredient transport, farming practices, and cooking.

- Salmon Transport: 1,500 km × 0.0017 kg CO_2/km = 2.55 kg CO_2
- Zucchini Transport: 50 km × 0.0017 kg CO_2/km = 0.085 kg CO_2
- Carrots Transport: 50 km × 0.0017 kg CO_2/km = 0.085 kg CO_2
- Olive Oil Transport: 600 km × 0.0017 kg CO_2/km = 1.02 kg CO_2
- Farmed Salmon: 4 kg CO_2/kg × 0.2 kg = 0.8 kg CO_2
- Organic Vegetables: 0.2 kg CO_2/kg × 0.15 kg = 0.03 kg CO_2
- Gas Stove Cooking: 0.2 kg CO_2 = 0.2 kg CO_2
- **Total Carbon Footprint: 4.77 kg CO_2 per serving**

Step 2: Water Footprint

Water usage includes farming and kitchen utilities:

- Salmon Farming: 10 liters/kg × 0.2 kg = 2 liters
- Vegetables Farming: 50 liters/kg × 0.15 kg = 7.5 liters
- Cleaning Vegetables: 2 liters
- **Total Water Use: 11.5 liters per serving**

Step 3: Waste Assessment

The waste generated is classified by type and disposal method:

Waste Type	Quantity per Serving	Disposal Method
Vegetable Peels	30g	Compost
Styrofoam (Salmon)	15g	Landfill
Cardboard (Vegetables)	5g	Recycling

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4. Interpretation and Recommendations

Key Findings:

- Hotspot: Salmon transportation contributes 53% of the total carbon footprint.
- Secondary Impact: High water usage in vegetable farming.

Recommendations:

- Replace salmon with a locally sourced fish (e.g., trout) to reduce transport emissions by 90%.
- Use energy-efficient appliances to reduce cooking-related emissions.
- Switch from Styrofoam to biodegradable packaging for salmon.
- Compost vegetable waste to avoid landfill impact.

5. Revised Carbon Footprint:

By implementing these changes, the estimated carbon footprint per serving is reduced to 2.3 kg CO_2, a 52% reduction.

4. Why LCA matters.

Ingredient Sourcing: Let us say you are considering two different suppliers for your signature tomato sauce. Supplier A provides tomatoes grown locally using sustainable farming practices, while Supplier B's tomatoes are imported from another country.

LCA can help you assess the environmental impact of each option. You find out that Supplier A's tomatoes have a lower carbon footprint because they require less energy for transportation and use fewer chemicals in their farming process. This means you are making more eco-friendly choices for your sauce.

Waste Reduction: You are also focused on reducing food waste. LCA helps you analyse your food preparation and serving processes. You discover that by adjusting portion sizes and using creative recipes for leftover ingredients, you can significantly cut down on food waste.

Menu Development: LCA guides your menu development. You realize that certain dishes have a smaller environmental footprint. For example, plant-based dishes tend to be more sustainable than those centred around animal products. This knowledge influences your menu choices and encourages you to feature more plant-based options.

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Customer Awareness: As you share your commitment to sustainability with your customers, they appreciate your efforts. They are not just dining at a restaurant; they are supporting a mission to reduce the environmental impact of their meals. This builds customer loyalty and helps attract environmentally conscious diners.

Economic Benefits: LCA is not just about being eco-friendly; it can also be economically beneficial. By sourcing locally, reducing waste, and choosing more sustainable ingredients, you can lower operational costs and increase profitability. Plus, as sustainability becomes a selling point, you gain a competitive edge in the restaurant industry.

5. Challenges and limitations for LCA

Challenges:

1. **Data Availability:** Gathering accurate and comprehensive data for all stages of a product's life cycle can be challenging. Some data might be proprietary, incomplete, or unavailable. This can affect the accuracy of the assessment.

Figure 5: Designed by rawpixel.com / Freepik

2. **System Boundaries:** Deciding what to include within the system boundaries of an LCA can be complex. It is not always clear what stages should be considered, especially when dealing with complex products or systems.

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Figure 6: Image from freepik.com

3. **Interconnected Processes:** Products and processes are often interconnected. For example, changes made to reduce one environmental impact may increase another. Balancing these trade-offs can be difficult.

Figure 7: Image from freepik.com

4. **Complexity:** LCA models can become overly complex, especially for multifaceted products. Managing and interpreting this complexity can be a challenge.

Figure 8: Image from freepik.com

5. **Lack of Standardization:** There are various methods and software tools for conducting LCA, but there is not always a consistent standard. This can make it challenging to compare assessments conducted using different methods.

Figure 9: Designed by vectorjuice / Freepik

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Limitations:

1. **Simplifications:** LCA involves simplifications to make the process manageable. For example, it may assume linear processes, constant product compositions, and fixed lifetime of products, which can lead to some inaccuracies.

Figure 10: Designed by stories / Freepik

2. **Subjectivity:** Setting the goals and scope of an LCA involves subjective decisions. What environmental impact categories to consider, what time frames to use, and how to weigh different impacts are subjective choices that can influence results.

Figure 11: Image from freepik.com

3. **Temporal Aspects:** LCA typically considers environmental impacts at a single point in time. It may not capture how impacts change over time or the cumulative effects of a product over its life.

Figure 12: Image from freepik.com

4. **Local Variability:** Environmental impacts can vary significantly based on the location and local conditions. LCA might not capture these variations accurately.

Figure 13: Image from freepik.com

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5. **Limited Future Predictions:** LCA is retrospective, looking at past or current data. It cannot predict future technological advancements or changes in consumer behaviour that may affect the environmental impact.

Figure 14: Designed by vectorjuice / Freepik

6. **Single-Issue Focus:** LCA often focuses on specific environmental impacts like greenhouse gas emissions or energy use. This may overlook social or economic considerations.

Figure 15: Image from freepik.com

Our dishes not only delight the palate but also leave an imprint on the planet. As we conclude our exploration of Life Cycle Assessment (LCA), we have gained a new lens through which to view our culinary creations.

LCA is the compass that guides us on a journey from the source of our ingredients to their final resting place. It illuminates the environmental footprints of our choices and provides insights into how we can become culinary eco-champions. Through LCA, we have discovered that our culinary decisions matter, not only in taste but in sustainability.

By choosing locally sourced, seasonal, and eco-friendly ingredients, we reduce our carbon footprint and nourish our planet. We have recognized that minimizing food waste and embracing plant-based options can transform our menus into champions of sustainability.

But we must also acknowledge the challenges and complexities of LCA. It is a tool that relies on data, and in a world of interconnected systems and subjective choices, not all answers are straightforward.

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As culinary professionals, students, and enthusiasts, we now hold the power to make a difference with every dish we create. We can choose to be mindful of the environment, to be conscious of the impact of our culinary decisions. LCA has shown us that each plate is an opportunity to make the world a greener, more sustainable place.

Exercise: Conducting an LCA of a specific ingredient	
Pre-requisites	Knowledge of Life Cycle Assessment (LCA), its phases, and the environmental impacts of food production.
Time	1,5 hours
Tools	PC or smartphone, internet connection, notebooks, calculators, and research tools.
Objectives	1. To engage students in applying the LCA process to analyse the environmental impact of a specific ingredient. 2. To develop critical thinking and problem-solving skills by identifying and addressing sustainability challenges associated with food production.

Instructions

1. Understand the Problem

Begin by selecting a single ingredient used in your dishes. This could be an imported item (e.g., avocado, coffee beans) or a locally sourced ingredient (e.g., potatoes, olive oil). Make sure the ingredient has specific sustainability challenges (e.g., long transport distances, high water use in cultivation, or excessive packaging).

2. Empathize

Put yourselves in the role of different stakeholders (e.g., farmers, suppliers, chefs, and consumers).

- What are the key needs and concerns related to this ingredient?
- For example, a chef may prioritize quality and availability, while a consumer might value eco-friendly sourcing and minimal waste.
- Think about environmental concerns like carbon emissions, deforestation, or water use associated with this ingredient.

3. Define the Problem

Identify specific sustainability challenges associated with the ingredient's life cycle.

- Example questions:
    - Where is this ingredient sourced from?

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- What is the environmental impact of its farming or production process (e.g., pesticide use, irrigation)?
- How is it transported and stored?
- Does its packaging contribute to environmental waste?

Document the most critical issues to be addressed in your analysis.

4. Ideate

Brainstorm ideas for improving the ingredient's environmental impact at each stage of its life cycle.

- Example improvements:
  - Sourcing the ingredient locally to reduce transport emissions.
  - Switching to suppliers who use organic farming methods.
  - Encouraging reusable or biodegradable packaging.

5. Prototype

Develop a visual representation of your findings and solutions.

- Create a simple diagram or flowchart showing the current life cycle of the ingredient and the proposed improvements.
- Indicate the stages where your solutions can make the greatest impact.

6. Test and Gather Feedback

Present your findings and ideas to the class or group.

- Highlight the specific sustainability issues and how your proposed changes address them.
- Gather feedback from peers on the feasibility and effectiveness of your ideas.

7. Refine and Iterate

Based on the feedback, adjust your proposed solutions.

- Ensure that your recommendations are practical and align with consumer needs.
- Document any trade-offs or limitations (e.g., higher costs for sustainable farming methods).

8. Final Presentation

Deliver a final presentation to the class or instructor. Include:

- A summary of the ingredient's life cycle and its sustainability challenges.
- Proposed solutions and their expected impact.
- A clear diagram of the ingredient's improved life cycle.

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Deliverables:

A written or visual summary of the LCA for the selected ingredient, highlighting key findings and sustainability recommendations.

Appendix

1. Glossary of Key Terms

This glossary provides definitions for key terms used throughout the learning material. It serves as a handy reference for students to better understand the terminology related to sustainable food practices, energy efficiency, local food systems, and more.

Sustainable Agriculture: A method of farming that focuses on environmental stewardship, economic profitability, and social responsibility. It aims to minimize the negative impact of agriculture on the environment while ensuring the long-term viability of farming.

Energy Efficiency: The practice of using less energy to perform a specific task or achieve a particular outcome, often by using energy-efficient appliances, techniques, or practices.

Carbon Footprint: The total amount of greenhouse gases, primarily carbon dioxide (CO2), produced directly or indirectly by an individual, organization, event, or product throughout its lifecycle. It is often measured in units of carbon dioxide equivalent (CO2e).

Local Food: Food that is grown, produced, or sourced within a specific geographical region, typically with an emphasis on supporting local farmers and reducing food miles (the distance food travels from farm to plate).

Circular Economy: An economic system that aims to minimize waste and make the most of resources by designing products and materials for durability, reuse, remanufacturing, and recycling.

Food Waste: The edible food that is discarded at various stages of the food supply chain, from production and processing to distribution and consumption.

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Composting: The natural process of breaking down organic matter, such as food scraps and yard waste, into nutrient-rich soil conditioner known as compost, which can be used to enrich soil for gardening and farming.

Sustainable Farming Practices: Methods of farming that prioritize environmental conservation and long-term ecological balance. Examples include crop rotation, cover cropping, and reduced pesticide use.

Renewable Energy: Energy derived from sources that are naturally replenished, such as sunlight, wind, and hydropower, and do not deplete finite resources like fossil fuels.

Food Security: The condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Monoculture: The practice of cultivating a single crop species over a large area of land, often with the aim of maximizing production but at the risk of depleting soil and increasing vulnerability to pests and diseases.

Sustainable Kitchen Appliances: Energy-efficient and eco-friendly kitchen appliances designed to reduce energy consumption, water use, and environmental impact.

Regenerative Agriculture: A type of farming that aims to improve soil health, sequester carbon, and enhance biodiversity through practices like minimal soil disturbance, cover cropping, and rotational grazing.

Food Miles: The distance food travels from the place of production to the consumer's plate. Reducing food miles is a key aspect of promoting local and sustainable food systems.

Circular Food System: An approach to food production, distribution, and consumption that minimizes waste, optimizes resource use, and emphasizes the importance of recycling and reusing food and food-related materials.

Food Resilience: The capacity of a food system to withstand and recover from shocks and stresses, such as climate change, economic fluctuations, and supply chain disruptions.

Sustainable Packaging: Packaging materials and designs that minimize environmental impact, reduce waste, and promote recyclability or compostability.

Fair Trade: A trading system that ensures fair wages and working conditions for producers in developing countries, often involving agricultural products like coffee and chocolate.

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Biodiversity: The variety and variability of life on Earth, including the different species of plants, animals, and microorganisms, their genes, and the ecosystems they form.

Organic Farming: A farming method that avoids the use of synthetic pesticides, herbicides, and genetically modified organisms (GMOs) and emphasizes soil health, biodiversity, and sustainable practices.

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2. Bibliography

Content:

ENERGY STAR - Energy-Efficient Appliances: https://www.energystar.gov/products/appliances

Food and Agriculture Organization of the United Nations (FAO) - Energy-Smart Food for People and Climate: http://www.fao.org/energy-smart-food/

Sustainable Agriculture Research & Education (SARE) - Energy Efficiency on the Farm and in the Home: https://www.sare.org/resources/energy-efficiency-on-the-farm-and-in-the-home/

International Energy Agency (IEA) - Energy Efficiency Indicators: https://www.iea.org/topics/energy-efficiency/energy-efficiency-indicators

European Commission - Environment: https://commission.europa.eu/about-european-commission/departments-and-executive-agencies/environment_en

European Environment Agency (EEA): https://www.eea.europa.eu/en

Food and Agriculture Organization of the United Nations (FAO): https://www.fao.org/home/en

European Food Safety Authority (EFSA): https://www.efsa.europa.eu/en

European Environment Information and Observation Network (Eionet): https://www.eionet.europa.eu/

European Sustainable Development Network (ESDN): https://www.esdn.eu/

Sustainable Europe Research Institute (SERI): https://www.seri.at/

United States Environmental Protection Agency (EPA) - Energy Efficiency: https://www.epa.gov/energy/energy-efficiency

U.S. Department of Energy - Energy-Saving Tips for the Kitchen: https://www.energy.gov/energysaver/save-electricity-and-fuel/appliances-and-electronics/energy-saving-tips-kitchen

Local Harvest**:** https://www.localharvest.org/newsletter/

LCA Learning: https://www.lifecycleinitiative.org/

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3. Further readings

- ***Pollan, M. (2011). The omnivore's dilemma. Bloomsbury Publishing PLC.***- Explores the modern food industry and the impact of our food choices.
- ***Participant Media & River Road Entertainment present; a film by Robert Kenner; producers, Robert Kenner, Elise Pearlstein; writers, Robert Kenner, Elise Pearlstein, Kim Roberts; directed by Robert Kenner. (2009). Food, Inc. [Los Angeles, CA]: Magnolia Home Entertainment.*** - A visual exploration of the food production industry and its environmental and social consequences.
- ***Pollan, M. (2009). In defence of food. Penguin.*** - Offers practical advice on making healthier and more sustainable food choices.
- ***Dan Barber (2016). The Third Plate: Field Notes on the Future of Food. Paperback. Penguin Press.*** Chef Dan Barber explores the evolution of American food from the 'first plate,' or industrially produced, meat-heavy dishes, to the 'second plate' of grass-fed meat and organic greens and says that both of these approaches are ultimately neither sustainable nor healthy.

Websites:

- The Sustainable Food Trust: Offers articles, reports, and resources on sustainable food systems.
- Energy Star: Provides information on energy-efficient appliances and practices.
- Local Harvest: Connects consumers with local farmers and food producers.

Organizations:

- Slow Food: Advocates for sustainable and local food traditions.
- The Ellen MacArthur Foundation: Promotes the circular economy and its applications in various industries, including food.
- Food Tank: A think tank focused on sustainable agriculture and food systems.

Videos:

- TED Talks on Food: Features a collection of TED Talks on various food-related topics, including sustainability.
- Food, Inc. (Documentary): A powerful documentary that explores the modern food industry and its impact.
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4. Acknowledgment

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Thank you for your support and contributions.

Sincerely,

Rodolfo Meléndrez Rodriguez

Chef / Cooking Techniques Course Coordinator

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