

Created by:

DeArcie Abraham

Founder & Owner, Bio-Waste Technologies LLC

Environmental Specialist | Compost Operations Manager | Anaerobic Digestion Operator

Confederated Tribes of the Umatilla Indian Reservation (CTUIR)

BOKASHI: FERMENTING FOOD WASTE INTO A VALUABLE SOIL RESOURCE

Key Facts

- Bokashi is a food waste fermentation process that converts organic materials into a nutrient-rich soil amendment.
- Unlike traditional composting, bokashi uses beneficial microorganisms to ferment organic matter in an oxygen-limited environment.
- The process preserves nutrients, organic carbon, and energy that would otherwise be lost through decomposition.
- Bokashi helps divert food waste from landfills and supports regenerative soil management practices.

How Bokashi Works

- Place food waste into an airtight container.
- Sprinkle bokashi bran containing beneficial microorganisms over each layer.
- Compress materials to remove excess air.
- Seal the container and allow fermentation for several weeks.
- Mix the fermented material directly into soil where natural soil organisms complete the breakdown process.

Materials Accepted in Bokashi Systems

Bokashi can process many materials that are often excluded from traditional composting:

- Fruits and vegetables
- Bread and grains
- Coffee grounds and tea leaves
- Cooked foods

- Meat and fish
- Dairy products
- Fats and oils
- Citrus peels
- Eggshells
- Food leftovers

Do Not Add:

- Materials covered in black mold
- Materials covered in green mold
- Severely rotten or putrefied food waste

Benefits of Bokashi

- Conserves valuable nutrients for soil health
- Retains more carbon than traditional composting
- Produces smells of vinegar, very little odor when properly managed
- Reduces greenhouse gas emissions associated with landfills
- Accepts a wider variety of food waste streams
- Requires minimal space and can be used indoors
- Supports soil microbial activity and earthworm populations
- Helps build healthy soil structure and fertility

Bokashi Tea

During fermentation, liquid runoffs known as **bokashi tea** may be produced.

- Contains nutrients, proteins, and organic compounds
- Can be diluted and applied to soil
- Supports beneficial soil microorganisms
- Returns nutrients to the soil ecosystem
- NPK varies depending on recipe

Environmental Benefits

- Reduces food waste entering landfills
- Minimizes carbon losses during waste processing
- Supports carbon sequestration in soils
- Improves nutrient cycling

- Enhances soil biodiversity
- Contributes to regenerative agriculture and sustainable food systems

Common Uses

- Home food waste recycling
- Community composting programs
- School and educational gardens
- Farm nutrient management
- Regenerative agriculture projects
- Food waste diversion initiatives
- Soil restoration and land regeneration efforts

Why Bokashi Matters

- Keeps valuable nutrients in local food systems
- Reduces dependence on landfills
- Creates healthier soils for growing food
- Supports sustainable agriculture practices
- Helps communities move toward a circular economy where food waste becomes a resource rather than a disposal problem

References

Wikipedia Contributors. *Bokashi (Horticulture)*. Wikipedia, The Free Encyclopedia. Available at: [https://en.wikipedia.org/wiki/Bokashi_\(horticulture\)](https://en.wikipedia.org/wiki/Bokashi_(horticulture))

Wikipedia Contributors. *Food Waste*. Wikipedia, The Free Encyclopedia. Available at: https://en.wikipedia.org/wiki/Food_waste

Wikipedia Contributors. *Soil Food Web*. Wikipedia, The Free Encyclopedia. Available at: https://en.wikipedia.org/wiki/Soil_food_web

Wikipedia Contributors. *Organic Matter*. Wikipedia, The Free Encyclopedia. Available at: https://en.wikipedia.org/wiki/Organic_matter

Wikipedia Contributors. *Fermentation*. Wikipedia, The Free Encyclopedia. Available at: <https://en.wikipedia.org/wiki/Fermentation>

Soil Health Benefits of Compost

Introduction

Soil is far more than a medium for growing plants. Healthy soil is a living ecosystem that supports plants, animals, microorganisms, water cycles, nutrient cycling, and human communities. The United States Department of Agriculture (USDA) Natural Resources Conservation Service defines soil health as the continued capacity of soil to function as a living ecosystem that sustains plants, animals, and humans. Soil health is determined by the interaction of physical, chemical, and biological properties working together to support productive and resilient ecosystems.

Modern agricultural practices, urban development, erosion, overgrazing, compaction, and loss of organic matter have degraded soils worldwide. The United States Environmental Protection Agency (EPA) reports that approximately one-third of the world's soils are moderately to highly degraded. Declining soil health contributes to reduced crop productivity, increased fertilizer dependency, poor water quality, erosion, flooding, and decreased resilience to drought. Compost is widely recognized as one of the most effective tools available for restoring and maintaining healthy soils. Produced through the controlled decomposition of organic materials, compost returns carbon, nutrients, and beneficial microorganisms to the soil. Scientific research consistently demonstrates that compost improves soil physical structure, nutrient availability, microbial diversity, water retention, erosion resistance, and climate resilience.

Soil Organic Matter: The Foundation of Soil Health

Organic matter is often considered the engine that drives soil health. Soil organic matter consists of decomposed plant residues, microbial biomass, humus, and other carbon-containing compounds. It influences nearly every aspect of soil function.

Compost serves as a direct source of soil organic matter. Regular compost applications replenish carbon lost through cultivation, erosion, and natural decomposition. EPA research has documented soil organic carbon increases of up to 200 percent following compost application under certain conditions.

Increased soil organic matter provides numerous benefits:

- Improves nutrient retention
- Increases water-holding capacity
- Enhances soil aggregation
- Supports microbial populations
- Improves root growth
- Reduces compaction
- Promotes carbon sequestration
- Increases long-term soil fertility

As soil organic matter increases, soils become more productive, biologically active, and resilient to environmental stress.

Physical Benefits of Compost

Soil Structure and Aggregation

Healthy soils contain stable aggregates, which are clusters of sand, silt, clay, organic matter, fungal hyphae, and microbial byproducts bound together into larger particles.

Compost promotes aggregate formation by supplying organic matter and supporting microorganisms that produce natural binding agents. Stable aggregates improve soil structure by creating pore spaces that allow air, water, and roots to move freely throughout the soil profile.

Benefits of improved aggregation include:

- Increased aeration
- Better root penetration
- Reduced crusting
- Improved seed emergence
- Enhanced microbial habitat
- Reduced erosion
- Greater resistance to compaction

Stable soil aggregates are one of the primary indicators of healthy soil systems.

Reduction of Soil Compaction

Compacted soils restrict root growth, reduce water infiltration, limit oxygen availability, and decrease biological activity.

EPA studies have documented reductions in soil density and compaction of up to 35 percent following compost application. Organic matter reduces bulk density while increasing pore space, allowing roots and soil organisms to move more freely through the soil.

Reduced compaction results in:

- Stronger root systems
- Improved nutrient uptake
- Increased biological activity
- Enhanced water infiltration
- Improved crop productivity

Water Infiltration and Water-Holding Capacity

Water is one of the most limiting factors in agricultural production. Compost improves both water infiltration and water retention.

Research summarized by the EPA found:

- Water infiltration increases up to 183 percent.
- Water-holding capacity increases between 35 and 57 percent.

Organic matter functions like a sponge, absorbing water during rainfall and gradually releasing it during dry periods. This characteristic makes compost particularly valuable in drought-prone regions.

Improved water management results in:

- Reduced irrigation needs
- Increased drought tolerance

- Reduced runoff
- Improved groundwater recharge
- Enhanced crop survival during dry conditions
- Reduced flooding during heavy rainfall events

Chemical Benefits of Compost

Nutrient Supply

Compost contains a broad spectrum of essential plant nutrients including:

Macronutrients:

- Nitrogen (N)
- Phosphorus (P)
- Potassium (K)

Secondary Nutrients:

- Calcium
- Magnesium
- Sulfur

Micronutrients:

- Iron
- Zinc
- Copper
- Manganese
- Boron
- Molybdenum

Unlike synthetic fertilizers, compost releases nutrients slowly through biological activity. This slow-release mechanism provides long-term fertility while reducing nutrient losses.

Improved Nutrient Retention

Healthy soils must not only contain nutrients but also retain them.

Compost increases soil cation exchange capacity (CEC), which measures a soil's ability to hold positively charged nutrients such as potassium, calcium, magnesium, and ammonium.

Higher CEC improves:

- Nutrient storage
- Nutrient availability
- Fertilizer efficiency
- Crop nutrient uptake
- Reduced nutrient leaching

As a result, nutrients remain available to plants for longer periods rather than being lost to runoff or groundwater contamination.

Soil pH Buffering

Many soils experience pH imbalances that limit nutrient availability and biological activity.

Compost acts as a natural buffer by helping maintain soil pH near neutral levels. Stable pH conditions improve nutrient availability and create favorable conditions for beneficial microorganisms.

Benefits include:

- Reduced soil acidity
- Improved nutrient uptake
- Enhanced microbial activity
- Reduced need for lime applications
- Improved crop performance

Biological Benefits of Compost

Compost as a Living Amendment

Soil is home to billions of organisms that drive essential ecosystem functions.

These organisms include:

- Bacteria
- Fungi
- Protozoa
- Nematodes
- Arthropods
- Earthworms
- Actinomycetes

Compost introduces beneficial organisms while providing food sources that stimulate native microbial populations.

Research reviewed by the EPA has documented up to twofold increases in microbial activity following compost applications.

Nutrient Cycling

Soil microorganisms convert organic nutrients into plant-available forms.

Microbial activity supports:

- Nitrogen mineralization
- Phosphorus release
- Carbon cycling
- Organic matter decomposition
- Root nutrient uptake

Without microbial activity, most nutrients would remain unavailable to plants.

Disease Suppression

One of the most valuable biological functions of compost is natural disease suppression.

Beneficial microorganisms compete with plant pathogens for nutrients, habitat, and resources.

Research conducted by USDA Agricultural Research Service has shown compost can significantly reduce populations of soilborne pathogens such as *Fusarium* species.

Disease suppression occurs through:

- Competition
- Predation
- Antibiotic production
- Enhanced plant immunity
- Improved microbial diversity

This can reduce dependence on chemical pesticides while promoting healthier plant growth.

Earthworms and Soil Fauna

Compost supports earthworms and other beneficial soil organisms.

Earthworms provide numerous services:

- Improved aeration
- Increased infiltration
- Enhanced aggregation
- Organic matter incorporation
- Nutrient cycling

Their castings are rich in plant nutrients and beneficial microorganisms that further improve soil fertility.

Compost and Climate Resilience

Climate change is increasing the frequency of droughts, floods, wildfires, and extreme weather events.

Healthy soils are one of the most effective defenses against climate-related stress.

Compost contributes to resilience by:

- Increasing water storage
- Reducing erosion
- Supporting vegetation establishment
- Improving drought resistance
- Reducing flood impacts
- Enhancing ecosystem recovery after disturbance

EPA research found compost-amended systems significantly improve the ability of soils to absorb and retain water, reducing damage associated with both drought and heavy rainfall.

Carbon Sequestration

Compost also contributes to climate mitigation.

When compost is applied to soil:

- Carbon is stored in stable organic matter.
- Soil organic carbon increases.
- Atmospheric carbon dioxide is removed from circulation.
- Dependence on synthetic fertilizers decreases.
- Landfill methane emissions are reduced through composting organic wastes.

These benefits make composting and compost application important tools for climate-smart agriculture and environmental stewardship.

Compost in Ecosystem Restoration

Compost is widely used in restoration projects because of its ability to rapidly improve degraded soils.

Applications include:

- Mine reclamation
- Wetland restoration
- Rangeland restoration
- Forest rehabilitation
- Roadside stabilization
- Construction site remediation
- Wildfire recovery

Compost improves vegetation establishment by supplying nutrients, improving moisture retention, supporting microbial communities, and reducing erosion.

Research demonstrates that compost applications can reduce soil erosion by up to 97 percent under certain conditions while improving vegetation success rates.

Conclusion

The benefits of compost extend far beyond waste diversion and nutrient recycling. Compost functions as a comprehensive soil-building tool that enhances the physical, chemical, and biological properties of soil. By increasing organic matter, improving water retention, supporting beneficial microorganisms, reducing compaction, suppressing diseases, and promoting carbon sequestration, compost creates healthier and more resilient soil ecosystems.

Whether produced through hot composting, cold composting, vermicomposting, bokashi fermentation, or anaerobic digestion followed by stabilization, compost remains one of the most effective and sustainable amendments available for improving soil health. The continued use of compost in agriculture, landscaping, ecosystem restoration, and community composting programs supports long-term environmental stewardship, food security, water conservation, and climate resilience.

References

U.S. Environmental Protection Agency. Benefits of Using Compost.

<https://www.epa.gov/sustainable-management-food/benefits-using-compost>

U.S. Environmental Protection Agency. Environmental Value of Applying Compost: Improving Soil Health for Stormwater Management, Contaminated Site Remediation, Ecosystem Restoration, Landscaping and Agriculture (2025). <https://www.epa.gov/land-research/environmental-value-applying-compost>

U.S. Environmental Protection Agency. Composting. <https://www.epa.gov/sustainable-management-food/composting>

USDA Agricultural Research Service. The Microbiology of Composts.

<https://www.ars.usda.gov/research/publications/publication/?seqNo115=162222>

USDA Agricultural Research Service. Compost Effects on Soil Microbiomes and Pathogen Suppression. <https://www.ars.usda.gov/research/publications/publication/?seqNo115=407992>

USDA Climate Hubs. Ecological Benefits of Compost for Rangeland Plant and Soil Health. <https://www.climatehubs.usda.gov/content/ecological-benefits-compost-rangeland-plant-and-soil-health>

ATTRA Sustainable Agriculture Program. Compost Tipsheet. National Center for Appropriate Technology.

EPA. Organic Materials Management Strategies. EPA530-R-98-007.

COMPOSTING GUIDE

Turning Organic Waste into Healthy Soil

Created by: DeArcie Abraham

Bio-Waste Technologies LLC

WHAT IS COMPOSTING?

Composting is the natural breakdown of organic materials such as food scraps, yard waste, crop residues, and manure by microorganisms and decomposing organisms into a rich, dark material called compost. Compost improves soil structure, increases soil organic matter, enhances water-holding capacity, supports beneficial soil biology, and reduces waste sent to landfills (U.S. Environmental Protection Agency [EPA], 2025; U.S. Composting Council [USCC], 2025). Composting allows organic waste to be transformed into a valuable soil amendment while reducing the environmental impacts associated with landfill disposal. When organic materials are buried in landfills, they decompose under low-oxygen conditions and produce methane, a greenhouse gas significantly more potent than carbon dioxide over a 100-year period (EPA, 2025).

Benefits of composting include:

- Reducing landfill waste and methane emissions.
- Producing nutrient-rich soil amendments.
- Improving soil structure and water retention.
- Supporting climate resilience and soil health.
- Returning nutrients to the soil through natural nutrient cycling.
- Conserving resources and reducing disposal costs.
- Supporting sustainable agriculture and landscaping practices.
- Recognized by the EPA as a preferred waste reduction strategy within the Food Recovery Hierarchy (EPA, 2025).

BENEFITS OF COMPOSTING

Compost improves soil health by increasing organic matter content and supporting beneficial microorganisms. Healthy soils provide improved nutrient availability, greater water infiltration, increased drought resistance, and improved plant productivity (USDA Natural Resources Conservation Service [NRCS], 2025).

Benefits include:

- Increased soil organic matter.
- Improved soil aggregation and structure.
- Greater moisture retention.
- Reduced soil erosion.
- Reduced reliance on synthetic fertilizers.

- Enhanced microbial activity.
- Improved crop productivity and plant health.
- Long-term carbon sequestration in soils.

Compost can absorb and retain significant amounts of water, helping landscapes remain productive during periods of drought and reducing irrigation demands (NRCS, 2025).

MATERIALS THAT CAN BE COMPOSTED

Successful composting depends on balancing nitrogen-rich materials (“greens”) with carbon-rich materials (“browns”).

Greens (Nitrogen-Rich Materials)

- ✓ Fruit scraps
- ✓ Vegetable scraps
- ✓ Coffee grounds
- ✓ Tea bags without staples
- ✓ Fresh grass clippings
- ✓ Green plant materials
- ✓ Herbivore manure (horse, cow, sheep, goat, rabbit)

Browns (Carbon-Rich Materials)

- ✓ Dry leaves
- ✓ Straw
- ✓ Hay
- ✓ Shredded cardboard
- ✓ Shredded non-glossy paper
- ✓ Wood chips
- ✓ Untreated sawdust
- ✓ Small twigs and branches

Maintaining an appropriate balance between greens and browns helps support microbial activity and efficient decomposition.

MATERIALS THAT SHOULD NOT BE COMPOSTED

Certain materials can create odors, attract pests, contaminate compost, or introduce pathogens.

- ✗ Meat
- ✗ Fish
- ✗ Dairy products
- ✗ Grease, oils, and fats
- ✗ Pet waste from cats and dogs

- ✗ Diseased plant materials
- ✗ Pesticide-treated materials
- ✗ Plastic products
- ✗ Glass
- ✗ Metals
- ✗ Pressure-treated wood

Avoiding these materials helps maintain compost quality and reduces potential health risks.

HOW COMPOSTING WORKS

Destruction

Organic materials are physically broken into smaller particles through natural weathering, insects, microorganisms, and handling activities such as chopping and turning.

Decomposition

Microorganisms including bacteria, fungi, protozoa, and actinomycetes consume organic matter and convert it into simpler compounds including carbon dioxide, water, and humus.

Nutrient Cycling

As decomposition progresses, nutrients are released and stabilized within humus. This finished compost becomes a valuable nutrient source that supports plant growth and completes the natural nutrient cycle.

The decomposition process is driven by four primary factors:

- Carbon
- Nitrogen
- Oxygen
- Moisture

When these components are properly balanced, decomposition proceeds efficiently.

HOW TO START A COMPOST PILE

1. Select a shaded, well-drained location.
2. Create a 6–12 inch layer of brown materials.
3. Add a thinner layer of green materials.
4. Continue alternating layers.
5. Moisten materials until they feel like a wrung-out sponge.
6. Monitor moisture regularly.
7. Turn the pile every one to two weeks.
8. Cover exposed food scraps with brown materials.

A minimum pile size of approximately 3 feet by 3 feet by 3 feet helps retain sufficient heat for active composting (EPA, 2025).

COMPOST RECIPE GUIDELINES

Recommended carbon-to-nitrogen ratio:

- 25–30 parts carbon to 1 part nitrogen.

General mixing recommendation:

- 2 parts browns to 1 part greens.

Additional recommendations:

- Chop materials into smaller pieces.
- Maintain adequate moisture.
- Provide sufficient oxygen through turning.
- Monitor temperature during active composting.

COMPOSTING KEY FACTS

- Ideal carbon-to-nitrogen ratio: 25–30:1.
- Minimum pile size: 3 ft × 3 ft × 3 ft.
- Ideal temperature range: 110°F–160°F.
- Temperatures above 140°F help destroy many weed seeds and pathogens.
- Approximately five turns during six weeks support effective hot composting.
- Active composting generally takes four to twelve months.
- Static composting may take six months to two years.
- Applying 2–5 inches of compost annually can improve soil quality and plant performance (USCC, 2025).

HOT COMPOSTING

Hot composting is the fastest composting method and requires active management.

How to Manage Hot Composting

- Build a pile at least 3 ft × 3 ft × 3 ft.
- Maintain a carbon-to-nitrogen ratio near 25–30:1.
- Keep materials moist.
- Monitor temperatures regularly.
- Turn the pile to provide oxygen.
- Maintain temperatures between 110°F and 160°F.

Hot Composting Do's

- ✓ Turn regularly.
- ✓ Monitor moisture.
- ✓ Maintain proper carbon-to-nitrogen balance.
- ✓ Cover food scraps with browns.
- ✓ Maintain proper pile size.

Hot Composting Don'ts

- ✗ Allow the pile to dry completely.
- ✗ Add excessive amounts of one material.
- ✗ Add plastic, glass, or metal.
- ✗ Allow anaerobic conditions to develop.
- ✗ Add cat or dog waste.

Typical completion time is approximately two to three months.

COLD COMPOSTING

Cold composting is a low-maintenance method that relies on natural decomposition over time.

How to Manage Cold Composting

- Add materials as they become available.
- Layer greens and browns when possible.
- Maintain moderate moisture.
- Turn occasionally or not at all.
- Allow microorganisms and weather conditions to drive decomposition.

Cold Composting Do's

- ✓ Continue adding plant materials.
- ✓ Maintain moderate moisture.
- ✓ Allow sufficient time for decomposition.
- ✓ Use compost once it becomes dark and crumbly.

Cold Composting Don'ts

- ✗ Expect rapid results.
- ✗ Allow piles to become waterlogged.
- ✗ Add plastics, metals, or glass.
- ✗ Add large amounts of meat or dairy.

Typical completion time is six to twelve months.

WORM COMPOSTING (VERMICOMPOSTING)

Vermicomposting uses specialized composting worms to convert food scraps into nutrient-rich worm castings.

How to Manage Worm Composting

- Use a ventilated worm bin.
- Maintain moist bedding.
- Place the bin in a shaded area.
- Feed small amounts regularly.

- Bury food scraps beneath bedding.
- Harvest castings periodically.

Recommended Bedding Materials

- ✓ Shredded newspaper
- ✓ Shredded cardboard
- ✓ Coconut coir
- ✓ Dry leaves
- ✓ Small amounts of finished compost

Foods Worms Prefer

- ✓ Fruit scraps
- ✓ Vegetable scraps
- ✓ Coffee grounds
- ✓ Tea bags without staples
- ✓ Crushed eggshells

Worm Composting Do's

- ✓ Maintain adequate moisture.
- ✓ Provide airflow.
- ✓ Chop food scraps into smaller pieces.
- ✓ Harvest castings regularly.
- ✓ Protect worms from extreme temperatures.

Worm Composting Don'ts

- ✗ Add meat.
- ✗ Add dairy.
- ✗ Add oils or grease.
- ✗ Add pet waste.
- ✗ Overfeed.
- ✗ Allow bedding to dry out.

Healthy Worm Bin Indicators

- Earthy smell.
- Active worms.
- Moist bedding.
- Food scraps gradually disappear.
- Dark, crumbly castings develop.

Problem Indicators

- Strong odors.
- Standing water.

- Fruit fly infestations.
- Mold buildup.
- Worms attempting to escape.

Typical completion time is two to four months.

FOOD SCRAP COMPOSTING METHODS

Food scraps are valuable nitrogen-rich compost ingredients.

Benefits:

- Easily available.
- High nutrient value.
- Improve compost quality.
- Reduce landfill disposal.

Recommendations:

- Fruit and vegetable scraps are ideal.
- Add extra browns if odors develop.
- Cover food scraps immediately.

Avoid adding:

- Meat.
- Dairy.
- Fatty foods.

SOIL INCORPORATION

Food scraps may be buried directly into soil where decomposition occurs naturally.

Guidelines:

- Bury materials beneath at least eight inches of soil.
- Allow one month to one year for decomposition.
- Works especially well around trees and shrubs.

CURBSIDE COMPOSTING

Many communities offer curbside collection programs for food scraps and yard debris.

Benefits include:

- Accommodates larger volumes of organic materials.
- Commercial facilities achieve higher temperatures.
- Diverts waste from landfills.
- Supports regional compost production.

COMMERCIAL COMPOSTING

Commercial composting facilities process large quantities of organic materials using specialized equipment.

Characteristics include:

- Windrow composting systems.
- Aerated static piles.
- Specialized equipment.
- Large-scale operations.
- Higher operating temperatures.
- Oregon DEQ permitting and regulation.

Finished compost is commonly used in:

- Agriculture.
- Landscaping.
- Erosion control.
- Soil restoration projects.

BIOPLASTICS AND COMPOSTING

Bioplastics may create contamination problems in both recycling and composting systems.

Concerns include:

- Often indistinguishable from conventional plastics.
- Can contaminate recycling streams.
- Many fail to decompose in home compost systems.
- Some commercial composters refuse compostable packaging.

Proper disposal guidance should always be verified with local compost facilities.

REDUCING ORGANIC WASTE

The most effective approach to managing organic waste is reducing waste generation before composting.

Primary strategies include:

- Prevent waste generation.
- Compost unavoidable organic materials.

This approach aligns with EPA Food Recovery Hierarchy recommendations (EPA, 2025).

FOOD WASTE PREVENTION

Food waste contributes significantly to greenhouse gas emissions and resource loss.

When food is wasted, so are the resources used to:

- Produce it.
- Process it.

- Transport it.
- Store it.
- Prepare it.
- Dispose of it.

The USDA estimates that 30–40% of the U.S. food supply is wasted annually, and approximately 31% of food purchased by consumers is discarded (USDA, 2025).

This represents approximately:

- 133 billion pounds of food.
- \$161 billion in economic losses annually.

ECONOMIC COST OF FOOD WASTE

A household consisting of two adults and two children may lose approximately \$1,500 annually due to wasted food (EPA, 2025).

Reducing food waste can:

- Save money.
- Increase food availability.
- Reduce disposal costs.
- Support environmental sustainability.

ENVIRONMENTAL COST OF FOOD WASTE

According to EPA estimates:

- Every 1,000 tons of food waste landfilled produces approximately 34 metric tons of methane.
- Food loss and waste embody approximately 170 million metric tons of carbon dioxide equivalent emissions.
 - 40% of all food is sent to the landfill
- This is comparable to emissions from approximately 42 coal-fired power plants (EPA, 2025).

Nearly half of all food waste occurs during the consumer stage.

Commonly wasted foods include:

- Fruits.
- Vegetables.
- Dairy products.
- Eggs.

FOOD SECURITY AND HUNGER

Feeding America estimates that approximately 44 million Americans experience food insecurity annually (Feeding America, 2025).

Research indicates that food currently wasted in the United States contains enough calories to feed more than 150 million people annually (ReFED, 2025).

Reducing food waste can help improve food security while reducing environmental impacts.

GRASSCYCLING

Grasscycling is the practice of leaving grass clippings on lawns after mowing.

Benefits include:

- Returning nutrients to the soil.
- Reducing fertilizer requirements.
- Reducing disposal needs.
- Conserving organic matter.

Grass clippings are among the largest components of residential landscape waste.

MULCHING

Mulch helps suppress weeds, conserve moisture, reduce erosion, and moderate soil temperatures.

Common mulch materials include:

- Grass clippings.
- Leaves.
- Pine needles.
- Wood chips.
- Yard debris.

Mulching Guidelines

- Mix approximately three parts wood chips with one part nitrogen-rich material when composting woody materials.
- Apply ½–1 inch of grass mulch around trees and shrubs.
- Apply 2–4 inches of woody mulch around perennial plantings.
- Avoid excessive mulch depth that may create anaerobic conditions.

TURNING IN CROP WASTE

Crop residues may be left on the soil surface or incorporated into the soil.

Benefits include:

- Erosion reduction.
- Improved soil organic matter.
- Moisture conservation.
- Improved soil health.

RETHINK YOUR LAWN

Reducing lawn size can decrease maintenance requirements and reduce waste generation.

Alternative landscapes include:

- Ground covers.

- Woodland gardens.
- Native plant landscapes.
- Eco-lawns.

ECO-LAWNS

Eco-lawns are mixed-species turf systems designed to reduce inputs and maintenance.

Benefits include:

- Reduced irrigation needs.
- Reduced fertilizer requirements.
- Lower maintenance demands.
- Improved sustainability.

COMPOSTING IN THE WASTE HIERARCHY

The waste hierarchy identifies preferred management strategies:

1. Prevent waste.
2. Reduce consumption.
3. Reuse materials.
4. Recycle materials.
5. Recover energy.
6. Dispose in landfills as a last resort.

Composting supports waste diversion, methane reduction, soil health improvement, and resource conservation (EPA, 2025).

SIGNS COMPOST IS READY

Finished compost typically has:

- Dark coloration.
- Crumbly texture.
- Earthy smell.
- No recognizable food scraps.

TROUBLESHOOTING

Bad Odor

Cause: Excess moisture or too many greens.

Solution: Add browns and turn the pile.

Dry Pile

Cause: Insufficient moisture.

Solution: Lightly moisten materials.

Pests

Cause: Exposed food scraps.

Solution: Bury scraps and cover with browns.

Slow Decomposition

Cause: Poor balance or insufficient airflow.

Solution: Adjust materials, turn, and moisten.

CONTACT INFORMATION

Connect with Indigenous values and continue working together to preserve the earth for future generations.

Bio-Waste Technologies LLC

Facebook, YouTube, and Instagram: @bio-waste technologies

Email: biowastetechnology@gmail.com

Phone: (541) 240-9031

REFERENCES

Feeding America. (2025). *Hunger and food insecurity statistics*. <https://www.feedingamerica.org>

Institute for Local Self-Reliance. (2025). *Community composting resources*. <https://ilsr.org>

Oregon Department of Environmental Quality. (2024). *Material recovery and waste generation rates report*. <https://www.oregon.gov/deq>

Oregon State University Extension Service. (2025). *Composting and yard debris management resources*. <https://extension.oregonstate.edu>

Recycling 101 Curriculum. (2025). *Organic waste reduction and composting education materials*.

ReFED. (2025). *Food Waste Monitor and Insights Engine*. <https://refed.org>

U.S. Composting Council. (2025). *Benefits of compost*. <https://www.compostingcouncil.org/why-compost>

U.S. Department of Agriculture. (2025). *Food loss and waste*. <https://www.usda.gov/foodlossandwaste>

U.S. Department of Agriculture Natural Resources Conservation Service. (2025). *Soil health*.
<https://www.nrcs.usda.gov>

U.S. Environmental Protection Agency. (2025). *Composting at home*.
<https://www.epa.gov/recycle/composting-home>

U.S. Environmental Protection Agency. (2025). *Food recovery hierarchy*.
<https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy>

U.S. Environmental Protection Agency. (2025). *Sustainable management of food*.
<https://www.epa.gov/sustainable-management-food>

Comprehensive Guide to Bokashi, Hot, Cold, Worm, and Anaerobic Composting

Composting is the biological transformation of organic materials into stable organic matter that improves soil health, fertility, water retention, microbial activity, and plant growth. Regardless of the method used, the primary goal is to convert organic wastes into a valuable soil amendment that supports healthy ecosystems and sustainable agriculture. ([US EPA](#))

Why Compost Matters

Organic wastes placed in landfills generate methane, a potent greenhouse gas. Composting diverts these materials from disposal, recycles nutrients, reduces greenhouse gas emissions, and creates a beneficial soil amendment that improves agricultural productivity and environmental quality. ([US EPA](#))

1. Bokashi Composting











What It Is

Bokashi is a Japanese fermentation system that uses Effective Microorganisms (EM), including lactic acid bacteria, yeasts, and photosynthetic bacteria. Unlike traditional composting, bokashi is primarily an anaerobic fermentation process rather than aerobic decomposition. ([ADEQ](#))

Materials Accepted

- Fruits and vegetables
- Cooked foods
- Bread and grains
- Coffee grounds
- Meat
- Fish
- Dairy products
- Small bones

Unlike most compost systems, bokashi can safely process meat and dairy products because the acidic fermentation environment suppresses pathogens and odors. ([ADEQ](#))

Process

1. Food waste is layered into an airtight bucket.
2. Bokashi bran is sprinkled over each layer.
3. The container remains sealed during fermentation.
4. Fermentation typically lasts 2–4 weeks.
5. Fermented material is buried in soil or added to a compost pile for final breakdown.

([ADEQ](#))

End Product

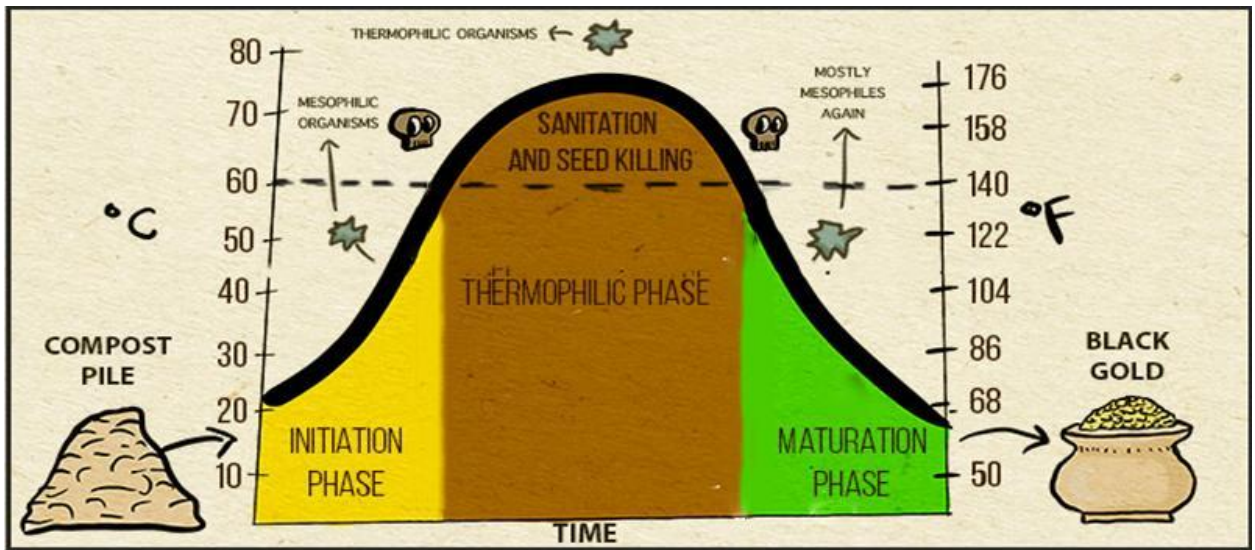
The material is not fully composted when removed from the bucket. It becomes a pre-compost that rapidly converts into humus once incorporated into soil or compost. ([ADEQ](#))

Soil Benefits

- Increases microbial diversity
- Improves nutrient cycling
- Enhances root development
- Increases organic matter
- Supports soil carbon storage
- Accelerates decomposition in soils
- Improves moisture retention

2. Hot Composting









What It Is

Hot composting is an aerobic process that relies on thermophilic microorganisms. Internal pile temperatures commonly reach 131°F–170°F (55°C–77°C). These temperatures destroy many pathogens and weed seeds. ([AMS](#))

Ideal Conditions

- Carbon-to-nitrogen ratio: 25:1–40:1

- Moisture: 40–65%
- Adequate oxygen
- Regular turning
- Sufficient pile size for heat generation ([AMS](#))

Feedstocks

Browns (Carbon)

- Dry leaves
- Straw
- Wood chips
- Cardboard
- Paper

Greens (Nitrogen)

- Food scraps
- Grass clippings
- Fresh plant materials
- Manure

Process

Thermophilic bacteria rapidly consume organic materials, producing heat. Properly managed piles may finish within six to eight weeks. ([OSU Extension Service](#))

End Product

A stable compost rich in humus, nutrients, beneficial microorganisms, and organic matter.

Soil Benefits

- Improves soil structure
- Reduces compaction
- Increases water infiltration
- Improves nutrient retention
- Suppresses some soil diseases

- Increases crop yields
- Reduces erosion
- Supports carbon sequestration ([US EPA](#))

3. Cold Composting











What It Is

Cold composting is passive aerobic decomposition that occurs without actively managing temperature. Materials break down naturally over several months to years. ([OSU Extension Service](#))

Characteristics

- Minimal labor
- Little or no turning

- Lower temperatures
- Slower decomposition
- Lower equipment requirements

Suitable Materials

- Leaves
- Yard debris
- Garden waste
- Fruit and vegetable scraps

End Product

Finished compost with many of the same soil-building qualities as hot compost, though it may contain weed seeds because temperatures generally remain too low for seed destruction. ([OSU Extension Service](#))

Soil Benefits

- Builds soil organic matter
- Improves water holding capacity
- Encourages microbial activity
- Improves soil aggregation
- Reduces erosion

4. Vermicomposting (Worm Composting)











What It Is

Vermicomposting uses earthworms, primarily red wigglers (*Eisenia fetida*), along with microorganisms to convert food scraps and organic materials into nutrient-rich worm castings. ([OSU Extension Service](#))

Conditions

- Temperature: 55–80°F ideal
- Moist bedding
- Good aeration
- Protection from direct sunlight ([US EPA](#))

Acceptable Inputs

- Fruit scraps
- Vegetable scraps
- Coffee grounds
- Crushed eggshells
- Cardboard
- Paper bedding

End Product

Vermicast (worm castings), among the most biologically active soil amendments available. Worm castings contain beneficial bacteria, fungi, protozoa, plant nutrients, enzymes, and growth-promoting compounds. ([OSU Extension Service](#))

Soil Benefits

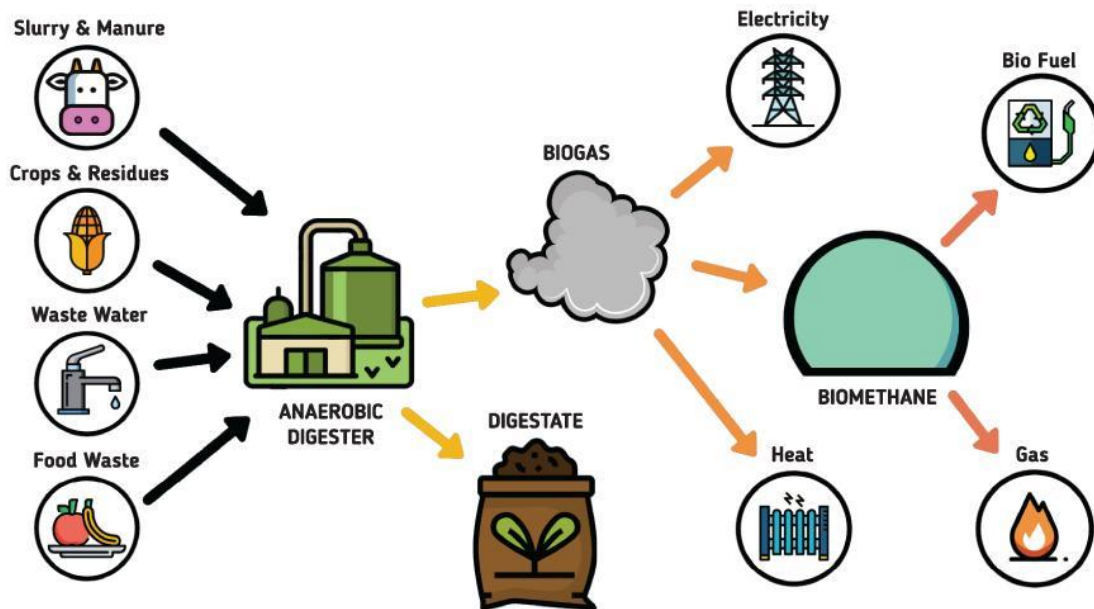
- Increased microbial populations
- Enhanced nutrient availability
- Improved root growth
- Increased soil aggregation
- Better moisture retention
- Improved seed germination
- Enhanced disease suppression

Research consistently shows vermicompost can improve plant growth beyond nutrient effects alone due to biological activity and plant-growth-promoting compounds. ([OSU Extension Service](#))

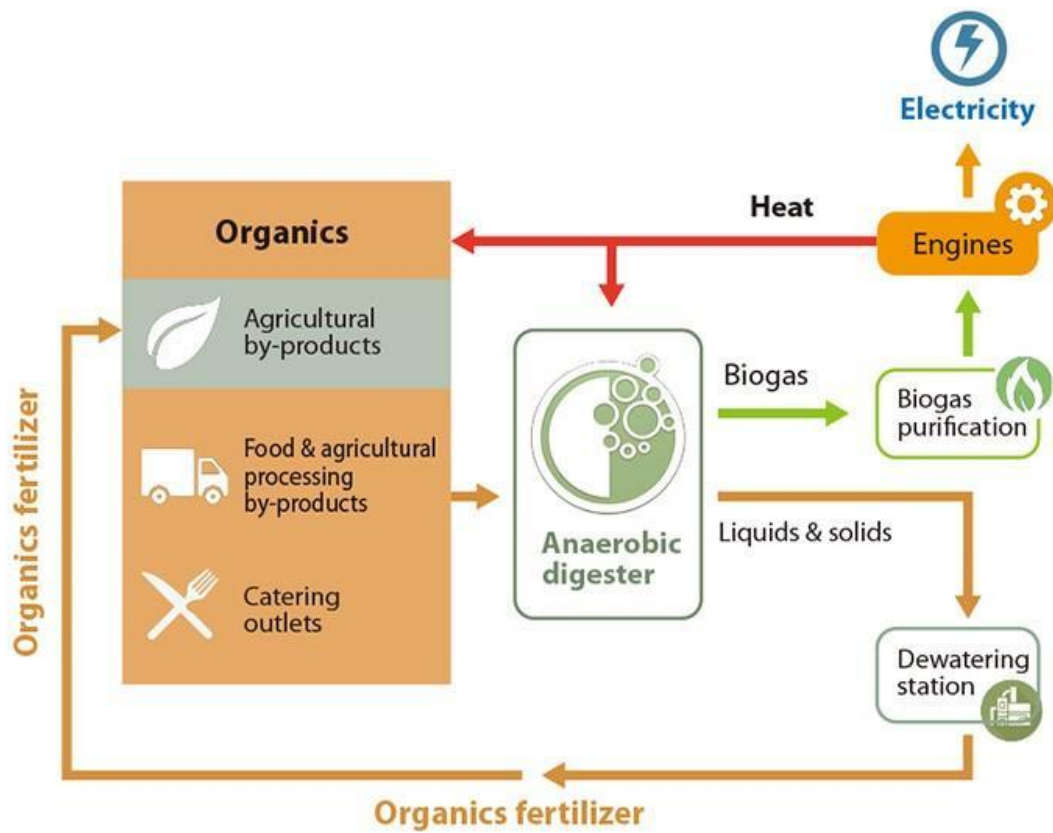
5. Anaerobic Composting and Digestion



FOOD WASTE Anaerobic Digestion









What It Is

Anaerobic digestion occurs in oxygen-free environments where microorganisms convert organic matter into biogas and digestate.

Biogas consists primarily of:

- Methane (CH_4)
- Carbon dioxide (CO_2)

Digestate is the nutrient-rich residual material remaining after digestion.

Feedstocks

- Food waste
- Animal manure
- Agricultural residues
- Fats, oils, and grease
- Energy crops

End Products

Biogas

Can be used for:

- Cooking fuel
- Electricity generation
- Heating
- Renewable natural gas

Digestate

Can be applied as:

- Soil amendment
- Fertility supplement
- Compost feedstock

Soil Benefits of Digestate

- Provides nitrogen
- Provides phosphorus
- Provides potassium
- Adds organic matter
- Supports microbial activity
- Improves nutrient cycling

Many operations compost digestate after digestion to create a more stable final product.

Comparison of Composting Methods

Method	Oxygen	Time	Meat/Dairy	Pathogen Reduction	End Product
Bokashi	Anaerobic	2–4 weeks fermentation	Yes	High acidity suppresses pathogens	Fermented pre- compost

Hot Compost	Aerobic	6–12 weeks	Usually No	Excellent	Finished compost
Cold Compost	Aerobic	Months–Years	No	Limited	Finished compost
Vermicompost	Aerobic	3–6 months	Limited	Minimal	Worm castings
Anaerobic Digestion	Anaerobic	Days–Weeks	Yes	Variable	Digestate + biogas

Soil Benefits Shared by All Compost Systems

According to EPA and USDA sources, properly produced composts and organic amendments provide the following benefits: ([US EPA](#))

Physical Benefits

- Improved soil structure
- Reduced compaction
- Increased porosity
- Better aeration
- Enhanced root penetration
- Improved aggregation

Chemical Benefits

- Increased nutrient retention
- Slow-release nutrients
- Improved cation exchange capacity
- Improved nutrient availability
- More stable soil pH

Biological Benefits

- Increased microbial diversity
- Increased beneficial fungi
- Increased beneficial bacteria
- Improved nutrient cycling
- Enhanced disease suppression

Water Benefits

- Increased infiltration
- Improved water retention
- Reduced irrigation requirements
- Reduced runoff
- Increased groundwater recharge

Environmental Benefits

- Reduced landfill waste
- Reduced methane emissions
- Increased carbon sequestration
- Reduced erosion
- Reduced dependence on synthetic fertilizers
- Improved ecosystem resilience to drought and flooding ([US EPA](#))

Primary References

- [U.S. Environmental Protection Agency – Benefits of Using Compost](#)
- [U.S. Environmental Protection Agency – Approaches to Composting](#)
- [U.S. Environmental Protection Agency – Composting at Home](#)
- [U.S. Environmental Protection Agency – Environmental Value of Applying Compost](#)
- [USDA People’s Garden – Composting](#)
- [Oregon State University Extension – Composting with Worms](#)
- [Oregon State University Extension – Slow Composting Works When You Have More Time Than Labor](#)
- [USDA Agricultural Marketing Service – Soil Building: Manures and Composts](#)
- [Arizona Department of Environmental Quality – Bokashi Compost Guide](#)

Food Waste, Emotions, Accountability, and Community Well-Being

Introduction

Food waste is often discussed as an environmental, economic, and agricultural issue. However, food waste is also deeply connected to human emotions, cultural values, accountability, and social behavior. Across many cultures, including Indigenous communities, food represents labor, relationships, land stewardship, and respect for natural resources. When food is wasted, people may experience emotions such as guilt, shame, regret, frustration, denial, or avoidance. These emotional responses can influence how individuals and communities respond to waste and whether they take responsibility for reducing it.

Research shows that emotions play a significant role in food waste behavior and can motivate both positive change and defensive reactions.

Food Waste as an Emotional Issue

Food is more than nutrition. Food represents:

- Time spent growing, harvesting, and preparing meals
- Financial resources
- Family traditions
- Cultural teachings
- Relationships with the land
- Community sharing and reciprocity

When food is wasted, people often perceive that something valuable has been lost. Studies have found that guilt, regret, and other negative emotions are among the strongest psychological drivers influencing food waste reduction behavior.

For agricultural communities and Indigenous peoples, wasting food may feel especially significant because of traditional teachings emphasizing gratitude, stewardship, and respect for resources.

Understanding Guilt

Guilt occurs when a person believes they have done something inconsistent with their values or responsibilities.

Examples include:

- Throwing away edible food
- Over-purchasing food that spoils
- Failing to use leftovers
- Wasting food during events or gatherings

Research consistently shows that feelings of guilt can motivate people to:

- Waste less food
- Plan meals more carefully
- Compost food scraps
- Reuse leftovers
- Participate in recycling programs

People who feel responsible for food waste are often more likely to adopt behaviors that reduce future waste.

Understanding Shame

Although guilt and shame are often confused, they are different emotional experiences.

Guilt

Focuses on behavior:

"I wasted food."

Shame

Focuses on identity:

"I am a wasteful person."

Research suggests that shame can sometimes motivate change but may also cause people to become defensive or avoid discussions about waste altogether. Personal norms regarding food waste often create feelings of guilt and shame when individuals believe they have violated their own standards of stewardship and responsibility.

Avoiding Accountability

When individuals feel uncomfortable about waste, they may avoid accountability through various psychological responses.

Examples include:

Denial

- Minimizing the amount of food wasted
- Ignoring waste generation

Rationalization

- "It was only a little."
- "Everyone does it."

Blame Shifting

- Blaming stores, suppliers, or other people exclusively

Avoidance

- Refusing to discuss waste
- Avoiding measurement or tracking

Dishonesty

- Underreporting waste quantities
- Misrepresenting disposal practices

Psychologists describe these behaviors as defensive coping mechanisms that help people avoid uncomfortable emotions associated with responsibility and accountability. Excessive blame and guilt-based messaging can sometimes increase these defensive reactions.

Why People Sometimes Lie About Food Waste

People generally do not lie about waste because they enjoy deception. More often, dishonesty arises from:

- Fear of criticism
- Fear of embarrassment
- Fear of punishment
- Concern about reputation
- Desire to avoid conflict

Research on accountability suggests that when people feel their behavior is being evaluated, they may either improve their actions or attempt to protect themselves from negative judgment.

Creating supportive environments focused on learning and improvement often produces better outcomes than environments centered solely on blame.

The Emotional Cost of Food Waste

Food waste can create emotional burdens that extend beyond guilt.

People may experience:

- Anxiety about wasting money
- Frustration about poor planning
- Sadness when food spoils
- Stress from household management challenges
- Moral discomfort when others experience food insecurity

Research indicates that emotional reactions to food waste are closely linked to personal values, social expectations, and environmental awareness.

Food Waste and Community Relationships

Food waste can affect social relationships.

When food is wasted:

- Community resources are lost
- Volunteer efforts may be diminished
- Farmers' labor may be undervalued
- Cultural teachings may be overlooked

In communities that emphasize sharing and reciprocity, reducing food waste can strengthen collective responsibility and reinforce positive social norms.

Studies show that a sense of community and awareness of consequences are associated with stronger food waste reduction behaviors.

A Positive Approach to Accountability

Research suggests that accountability works best when paired with:

- Education
- Transparency
- Measurement
- Supportive feedback
- Practical solutions

Effective accountability asks:

- What happened?
- Why did it happen?
- What can we learn?
- How can we improve?

Rather than focusing solely on blame, successful food waste reduction programs encourage responsibility, problem-solving, and continuous improvement.

Composting as a Positive Emotional Response

Composting transforms feelings of waste into actions that restore value.

Benefits include:

- Returning nutrients to the soil
- Supporting food production
- Reducing landfill methane
- Creating visible environmental benefits
- Strengthening stewardship values

For many people, composting creates a sense of purpose and responsibility by ensuring that food scraps continue contributing to the natural cycle instead of becoming waste.

Conclusion

Food waste is not only an environmental problem; it is also an emotional and social issue.

Feelings of guilt, shame, regret, accountability, and responsibility influence how people respond to wasted food. While guilt can motivate positive change, excessive shame and blame may lead to denial, avoidance, or dishonesty. Research suggests that the most effective approach combines accountability with education, community support, and practical solutions such as composting, food recovery, and improved planning.

When communities view food as a gift from the land and recognize the labor required to produce it, reducing food waste becomes more than a waste management strategy—it becomes an act of stewardship, respect, and responsibility toward future generations.

References

- Antecedents of Consumer Food Waste Reduction Behavior: Psychological and Financial Concerns through the Lens of the Theory of Interpersonal Behavior. *International Journal of Environmental Research and Public Health*.
- Bringing Habits and Emotions into Food Waste Behaviour. *Resources, Conservation and Recycling*.
- Drivers of Food Waste Reduction Behaviour in the Household Context. *Food Quality and Preference*.
- The Effect of Self-Conscious Emotions of Guilt and Regret on Consumers' Intentions to Reduce Food Waste. *Journal of Sustainable Tourism*.
- Understanding Consumers' Food Waste Reduction Behavior—A Study Based on Extended Norm Activation Theory. *International Journal of Environmental Research and Public Health*.
- Household Food Waste—How to Avoid It? An Integrative Review. *Springer Nature*.
- Consequences of Food Waste: The Role of Internal Attribution and Guilt. *European Marketing Academy Proceedings*.
- How to Understand the Psychological Drivers of Household Food Waste. *Trends in Food Science & Technology*.

Modular 1:

Where Our Waste Comes From and Where It Goes

The Big Picture

Everything we use comes from natural resources, and when we are done with it, it becomes part of the waste stream.

- Products come from materials taken from the land, water, forests, and minerals.
- Understanding the life cycle of materials helps us reduce waste and conserve resources.
- Waste management starts long before something reaches a landfill.

Waste Generation in the United States

The United States is one of the largest waste-producing countries in the world.

- The average American generated **4.9 pounds of waste per day** (EPA, 2018).
- The U.S. produced about **12% of the world's municipal solid waste** while making up only **4% of the world's population**.
- Higher consumption generally leads to higher waste generation.
- More waste means greater pressure on landfills, recycling systems, and natural resources.

Waste Generation in Oregon

Oregon generates millions of tons of waste each year, showing why waste reduction and recycling matter.

- Oregon generated **6,091,756 tons of waste in 2022**.
- That equals more than **12 billion pounds of waste annually**.
- Oregon produces over **30 million pounds of waste every day**.
- Average waste generation was **8.34 pounds per person per day**.
- Waste generation decreased **6.2% from 2021 to 2022**.

Why Oregon's Numbers Look Higher

Waste statistics can vary because agencies count materials differently.

- Oregon DEQ includes **construction and demolition debris** in its calculations.
- EPA municipal solid waste data does not include many construction-related materials.
- Understanding what is included in the data is important when comparing statistics.

History of Garbage and Landfills

As populations grew, communities needed organized ways to manage increasing amounts of waste.

- Early communities often dumped waste close to where they lived.
- Modern landfills were developed to better contain waste and protect public health.
- Population growth continues to increase waste management demands.

Understanding the Waste Stream

Looking at what is in our trash helps identify opportunities for recycling, composting, and waste prevention.

- Waste studies measure what materials are thrown away and recycled.
- Data helps improve recycling and recovery programs.
- Understanding waste composition helps reduce landfill disposal and recover valuable resources.

Oregon Waste Studies

Oregon uses statewide studies to track waste trends and improve recycling systems.

- The **2022 Material Recovery and Waste Generation Survey** tracks statewide waste generation.

- The **2016–2017 Oregon Solid Waste Characterization and Composition Study** analyzed what Oregonians throw away.
- New statewide waste and recycling studies began in **2025**.
- Studies include:
 - Disposed Waste Composition Study
 - Inbound Commingled Recycling Study
 - Outbound Commingled Recycling Study
- Study results help guide future recycling, composting, and waste reduction efforts.

Oregon's Waste Management System

Oregon manages waste through laws, regulations, recycling programs, and disposal facilities.

- Residential and commercial waste are regulated.
- Recycling and material recovery help reduce landfill disposal.
- Statewide waste data helps guide policy and infrastructure decisions.
- Waste prevention is often the most effective way to reduce environmental impacts.

Environmental Justice and Waste

Waste facilities and environmental impacts should be managed fairly so no community carries an unequal burden.

- Environmental justice focuses on fair treatment and meaningful involvement of all people.
- Communities should have a voice in waste management decisions.
- Access to clean environments and waste services should be equitable.
- Waste management decisions can affect public health, air quality, and quality of life.

Key Statistics to Remember

- **4.9 pounds** of waste generated per American per day.
- **12%** of global municipal solid waste comes from the U.S.
- **4%** of the world's population lives in the U.S.
- **6,091,756 tons** of waste generated in Oregon (2022).
- **12+ billion pounds** of waste generated annually in Oregon.
- **30+ million pounds** of waste generated daily in Oregon.
- **8.34 pounds** of waste generated per Oregonian per day.
- **6.2% decrease** in Oregon waste generation from 2021 to 2022.

Resources

- U.S. Environmental Protection Agency (EPA) – Facts and Figures About Materials, Waste, and Recycling
- Oregon Department of Environmental Quality (DEQ) – Material Recovery and Waste Generation Survey
- Oregon DEQ – Waste Composition Study Program
- Oregon DEQ – 2016–2017 Oregon Solid Waste Characterization and Composition Study
- Association of Oregon Recyclers Conference – DEQ Waste Study Results Presentation
- Oregon DEQ – Recycling and Materials Management Program

<https://olis.oregonlegislature.gov/liz/2021R1/Downloads/MeasureDocument/SB582/Enrolled>