

AFRICAN CIRCULAR ECONOMY NETWORK

CIRCULAR FOOD SYSTEMS FOR RWANDA

TRAINING MANUAL
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Producing Organic Fertilizer with Vermicomposting Technology

A Technical Training Manual for Agri-Food SMEs

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About This Manual

As part of the **Circular Food Systems for Rwanda** (CIRF) programme — a four-year initiative funded by the IKEA Foundation to accelerate the transition to circular agri-food systems in Rwanda — specialized Technical Assistance Providers (TAPs) were engaged to deliver tailored, on-the-ground support to participating small and medium enterprises (SMEs). TAPs conducted Gap and Needs Assessments with each SME to identify circular economy opportunities specific to their business, and used these findings to customize solutions that enhance circularity while empowering staff and highlighting the economic benefits of adopting circular practices.

For agri-based SMEs engaged in diversified farming such as greenhouse cultivation, open-field production, and fish farming, the effective management of organic waste is a common challenge. Many farms generate significant quantities of crop residues, vegetable waste, and other organic by-products, but lack efficient systems to convert these materials back into productive resources. Without a closed nutrient loop, farms miss the opportunity to enhance soil fertility naturally and continue to rely on purchased external inputs such as chemical or organic fertilizers.

Vermicomposting addresses this gap directly. It is a **practical, low-cost, and scalable** approach to converting organic farm waste into high-quality fertilizer, closing the nutrient loop and strengthening the farm's circular economy model. This manual is designed to be a step-by-step guide for any agri-food SME seeking to set up, manage, and scale a vermicomposting system.



Sections

§	TOPIC	WHAT IT COVERS
1	**Introduction to Vermicomposting**	What vermicomposting is, why it matters, and the benefits for agri-food SMEs.
2	**Understanding Worms**	Suitable worm species for vermicomposting and the conditions required for their health and productivity.
3	**Setting Up a Vermicomposting System**	Choosing a container, preparing bedding, and introducing worms.
4	**Feeding the Worms**	What to feed, what to avoid, quantities, and feeding schedules.
5	**Maintaining the System**	Moisture, aeration, temperature control, and ongoing management.
6	**Harvesting Vermicompost**	When and how to harvest, including the Pile Method and Sifting.
7	**Troubleshooting Common Problems**	Identifying and resolving the most common issues: odors, pests, slow activity, and worm escape.

INTRODUCTION TO VERMICOMPOSTING

01 What vermicomposting is and why it matters for agri-food SMEs.

1.1 What is Vermicomposting?

Vermicomposting is a natural and efficient process that uses earthworms to convert organic waste into nutrient-rich compost, known as **vermicast**. This method leverages the digestive abilities of worms — particularly species like *Eisenia fetida* (red wigglers) — to break down organic matter rapidly. As worms consume organic waste, they excrete castings that are rich in essential nutrients and beneficial microorganisms, making vermicast an excellent organic fertilizer for plants.

1.2 Why Vermicomposting?

Vermicomposting converts organic farm waste — crop residues, vegetable scraps, and other by-products — into valuable compost that enhances soil quality and promotes healthy plant growth, reducing reliance on chemical fertilizers. For SMEs, it is one of the **most accessible entry points** to a circular agricultural model: it requires minimal infrastructure, can be started small and scaled over time, and produces a resource that directly reduces input costs.

1.3 Benefits of Vermicomposting

- **Produces Nutrient-Rich Compost (Vermicast).** Rich in nitrogen, phosphorus, potassium, trace elements, and growth-promoting substances — improving soil fertility and stimulating robust plant growth.
- **Reduces Organic Waste On-Farm.** Converts organic waste into compost on-site, decreasing unused by-products and reducing both fertilizer purchase costs and environmental impact.
- **Minimizes Greenhouse Gas Emissions.** Processes waste aerobically, preventing the methane emissions associated with uncontrolled organic decomposition.
- **Increases Soil Fertility and Moisture Retention.** Humus-rich vermicompost enhances soil structure, promoting aeration, water retention, microbial activity, and improved plant resilience.
- **Supports a Closed Nutrient Loop.** Converts on-farm waste directly into a soil input — creating a circular resource loop and reducing dependence on external fertilizer suppliers.

02 Species selection and optimal conditions for worm health and productivity.

Selecting appropriate worm species and maintaining optimal living conditions are the foundations of a productive vermicomposting system. Not all earthworms are suitable for composting — specific species thrive in decomposing organic matter and efficiently convert waste into valuable vermicast.

2.1 Types of Worms for Vermicomposting

Red Wigglers *(Eisenia fetida)*
The most widely used species. Surface dwellers that consume up to half their body weight in organic material daily, breed quickly, and adapt well to a broad range of conditions.

European Nightcrawlers *(Eisenia hortensis)*
Less common but effective. Their larger size handles bigger organic pieces, and their burrowing behavior aerates the compost, enhancing oxygen flow and microbial activity throughout.

2.2 Optimal Conditions for Worm Health

Moisture
Maintain bedding at 60–70% moisture — similar to a wrung-out sponge. Avoid waterlogging, which creates anaerobic conditions harmful to worms.

Temperature
15°C–25°C is optimal. Below 10°C slows worm metabolism; above 30°C can be lethal. Relocate the bin if ambient temperature fluctuates outside this range.

pH Level
Worms prefer pH 6.0–7.0 (neutral to slightly acidic). Monitor regularly and avoid adding highly acidic or alkaline substances.

Minimal Disturbance
Limit handling and agitation — light surface aeration once per week is sufficient. Keep the bin covered to maintain a dark, stable environment.

KEY CONDITIONS AT A GLANCE

- **Moisture:** bedding feels like a wrung-out sponge (60–70%)
- **Temperature:** 15°C – 25°C optimal; below 10°C slows activity; above 30°C is lethal
- **pH:** 6.0 – 7.0 (neutral to slightly acidic)
- **Light:** keep system covered and dark at all times
- **Disturbance:** minimal agitation; light surface aeration only once per week

SETTING UP A VERMICOMPOSTING SYSTEM

03 Container selection, bedding preparation, and introducing your worms.

3.1 Choosing a Container

Wooden containers are recommended for their insulation and breathability. Size the container to match your anticipated waste volume, starting with a small pilot and scaling up as the system matures.

Good Drainage
Small holes at the bottom allow excess moisture to escape, preventing waterlogging and anaerobic conditions.

Adequate Airflow
Additional holes on the sides and lid enhance ventilation and prevent foul odors from building up.

3.2 Preparing the Bedding

Bedding serves as both habitat and food source. Use straw or composted leaves— rich in carbon and balanced with nitrogen-rich food scraps.

- **Avoid chemically treated wood shavings** — they may contain toxins harmful to worms.
- **Moisten the bedding** until it feels like a wrung-out sponge. Add water if too dry; add dry material if too wet.
- **Fill with approximately 15cm of bedding**, giving worms space to burrow and escape light.

3.3 Adding Worms

STEP 1 **Determine the quantity.**
Add 500–1,000 red wigglers per square foot of composting surface.

STEP 2 **Source from a reputable supplier.**
Ensure worms are healthy and suited to composting conditions.

STEP 3 **Introduce gently.**
Place worms on top of the bedding— they will naturally burrow down to escape light.

STEP 4 **Allow adjustment time.**
Wait 1–2 days before adding large amounts of food waste.

FEEDING THE WORMS

04 Selecting the right foods, adjusting quantities, and maintaining a regular schedule.

4.1 Suitable Foods

- **Fruit and vegetable scraps** — peels, cores, and trimmings.
- **Crushed eggshells** — supply calcium, aid pH balance, and support worm digestion.
- **Grains** — cooked rice, pasta, and cereals in moderation.

4.2 Foods to Avoid

FOOD TYPE	REASON TO AVOID
Meat and dairy products	Produce foul odors and attract pests due to slower decomposition.
Oily foods	Coat the worms' skin, hindering their ability to breathe.
Spicy foods (e.g. hot peppers)	Irritate and harm the worms.
Processed foods	Preservatives, additives, and high salt content can be toxic to worms.

4.3 Quantities & Schedule

- Feed **0.5 kg of food per 1 kg of worms per day**, 1–2 times per week. Start small and adjust based on observed consumption — reduce if excess remains, increase if food disappears quickly.
- **Always bury food scraps** under the bedding to minimise odors and deter pests. **Rotate feeding locations** within the container to encourage even worm distribution.

MAINTAINING THE SYSTEM

05 Consistent attention to four key factors ensures a healthy, productive system.

Maintaining a healthy vermicomposting system requires consistent attention to four key factors: moisture, aeration, temperature, and pest and odor management.

Moisture

The bedding should remain moist but not waterlogged, similar to a wrung-out sponge. If the bedding dries out, gently add water to rehydrate it. If it becomes too wet, incorporate absorbent materials such as shredded newspaper or dry leaves to absorb excess moisture.

Aeration

Lightly stir the bedding once a week to maintain proper airflow without overly disturbing the worms. Adequate aeration prevents anaerobic conditions that lead to unpleasant odors.

Temperature

Regularly monitor the bin's temperature to ensure it stays within 15°C to 25°C. In extreme weather, relocate the container to a more stable environment to protect it from harmful fluctuations.

Odor & Pest Management

Odors are usually caused by overfeeding or poor aeration — reduce food added and stir the bedding to improve airflow. Deter pests by avoiding meat, dairy, or oily foods, keeping scraps covered with bedding, and avoiding overfeeding.

WEEKLY MAINTENANCE CHECKLIST

- Check bedding moisture — adjust with water or dry material as needed.
- Lightly aerate the top layer of bedding without disturbing deep layers.
- Monitor for odors — reduce feeding quantity if present.
- Check temperature — relocate container if outside the 15–25°C range.
- Inspect for pests — ensure food is buried and the container is well-covered.

HARVESTING VERMICOMPOST

06 Collecting finished vermicompost while preserving the worm population.

Vermicompost is typically ready for harvesting within **2 months**, once the bedding material has been largely decomposed and transformed into a dark, soil-like substance rich in nutrients. This indicates that the worms have efficiently processed the waste and the vermicompost is suitable for application to crops.

6.1 Harvesting Methods

Pile Method
Move the contents to one side and add fresh bedding and food to the empty side. Over several days, worms will naturally migrate to the area with fresh food, allowing finished vermicompost to be collected from the vacated side without harming them.

Sifting Method
Use a mesh or screen to separate worms from the compost. Sift the material so that fine vermicompost falls through, leaving worms on top. This method efficiently separates worms for reuse and yields clean, ready-to-use compost.

Both methods preserve the worm population for ongoing vermicomposting. The harvested vermicompost can be applied directly to vegetable beds, greenhouse crops, and open-field cultivation to enrich soil and support plant growth naturally.

APPLICATION TIPS

- Apply vermicompost as a top dressing around the base of plants.
- Mix into soil at a ratio of 1 part vermicompost to 4 parts soil for potting mixes.
- Use vermicompost leachate (liquid run-off) as a liquid foliar fertilizer.
- Store harvested vermicompost in a cool, shaded area to preserve microbial activity until use.



Finished product: Harvested vermicompost bottled and ready for application — a direct output from the farm's organic waste stream.

TROUBLESHOOTING COMMON PROBLEMS

07 Diagnosing and resolving the most frequent vermicomposting challenges.

Problem 1: Foul Odors

Likely cause: Overfeeding or insufficient oxygen in the container.

- **Aerate the bin** — gently stir or fluff the bedding to enhance airflow and oxygenation.
- **Reduce feeding quantity** — cut back on food scraps until the worms catch up with consumption.

Problem 2: Fruit Flies

Likely cause: Exposed food scraps or insufficient coverage.

- **Always bury food waste** under at least 8 cm of bedding material to minimise attraction.
- **Install a container lid with fine mesh ventilation** to prevent fruit flies from entering while maintaining airflow.

Problem 3: Slow Worm Activity

Likely causes: Inadequate moisture, improper temperature, or insufficient food supply.

- **Check moisture levels** — ensure bedding is moist but not saturated.
- **Monitor temperature** — maintain a consistent environment between 15°C and 25°C.
- **Assess food quantity** — provide sufficient food but avoid overfeeding; adjust based on observed consumption rates.

Problem 4: Worm Escape

Indicator: Worms attempting to leave the container signal unfavourable living conditions.

- **Evaluate moisture** — adjust if bedding is too wet or too dry.
- **Regulate temperature** — ensure the container is within the optimal 15–25°C range.
- **Test pH levels** — should be neutral to slightly acidic (6.0–7.0); add crushed eggshells if pH is too low.
- **Address disturbances** — minimise vibrations or disruptions that may stress the worms.

Conclusion

Vermicomposting is an eco-friendly and highly effective method for agri-food SMEs to recycle organic waste and create a closed-loop agricultural system. By converting crop residues and other biodegradable materials into nutrient- rich compost, farms reduce waste, lower fertilizer costs, enhance soil fertility, and support healthier crop production — all while minimising their environmental footprint.

For the vermicomposting system to thrive, proper set up, diligent maintenance, and consistent feeding routines are essential. Providing optimal conditions for the worms — including appropriate moisture levels, temperature control, and adequate aeration — ensures their health and maximises the efficiency of the composting process. Regular harvesting sustains continuous compost production, prevents overcrowding in the worm beds, and supports ongoing worm reproduction.

With practice and experience, operations can be scaled up to meet expanding needs — whether for increased waste management capacity or larger agricultural outputs. Vermicomposting is a versatile solution that adapts to farm growth while maintaining sustainability goals, and represents one of the most accessible and impactful steps an agri-food SME can take toward a circular farming model.

ABOUT THIS PUBLICATION

Prepared by Green Resources. Submitted to ACEN for the Circular Food Systems for Rwanda (CIRF) programme. This manual may be freely copied, translated, and adapted by TAPs, SMEs, and practitioners.

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