Closed-loop system practices

RELOOP

Training e-Guide

SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE

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1. Introduction

What is a Closed-Loop System?

A closed-loop system is a **self-sustaining cycle** where resources are continuously reused, reducing waste and enhancing sustainability. **Rainwater harvesting** is a key component, capturing and storing rainwater for reuse in agriculture, sanitation, and household purposes.

2.5 cm of rain on an average roof can give around 2,270 litres of water

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Why Rainwater Harvesting?

✓ Promotes **sustainability and water conservation**

✓ Reduces **reliance on external water sources**

✓ **Empowers learners** with practical, hands-on skills

✓ Increases **accessibility** to clean water for marginalized communities

A simple rainwater collection system can be build for less than 100 euros.

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2. Objectives

By the end of the presentation, participants will:

✅ Understand the principles of **closed-loop water management**

✅ Learn how to **design, build, and install** a simple rainwater harvesting system

✅ Gain experience using **low-cost, locally available materials**

✅ Develop skills to **train VET learners**, including those with fewer opportunities

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3. Modules & Activities

📌 **Module 1: Understanding Rainwater Harvesting & System Design**

Session 1: Introduction to Rainwater Harvesting

•What is rainwater harvesting?

•Benefits for **agriculture, households, and sustainability**

A great way to collect and store water for the garden or other everyday needs.

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Session 2: Planning & System Components

•Identifying suitable **catchment areas** (roofs, open surfaces)

•Selecting **storage tanks & filtration systems**

•Designing a system using a **simple blueprint**

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Session 3: Material Selection & Cost Estimation

Choosing locally available materials (barrels, pipes, filters)

•Cost-effective alternatives for **low-income communities**

•Estimating the **budget** for installation

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📌 **Module 2: Practical Installation & Maintenance**

Session 4: Hands-On Construction of a Rainwater Harvesting System

Step 1: Preparing the site (positioning catchment, setting up collection points)

•**Step 2:** Installing gutters and downspouts

•**Step 3:** Connecting the filtration system (e.g., mesh filters, first-flush diverter)

•**Step 4:** Assembling and sealing the storage tank

•**Step 5:** Testing the system for leaks and efficiency

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Session 5: Maintenance & Troubleshooting

How to clean and maintain the storage tank

•**Checking filters & pipes** for blockages

•**Troubleshooting leaks & overflow issues**

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Session 6: Adapting for VET Learners & Knowledge Dissemination

•How to teach rainwater harvesting to **diverse learners**

•Making content **accessible** for learners with fewer opportunities

•Adapting the training for **urban vs. rural settings**

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6. Expected Outcomes

✓ Trainers can **confidently teach rainwater harvesting**

✓ VET learners (especially those with fewer opportunities) **gain practical skills**

✓ Partners develop **localized training plans** based on this guide

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7. Next Steps & Follow-Up Actions

📌 **Trainers replicate the workshop** in their regions

📌 **Monitoring & feedback** from VET learners

📌 **Further development** of closed-loop system applications

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Step 1: Obtain one or more water storage barrels

Step 1: Choose and Prepare Your Rain Barrel

✅ **What You Need**

•A large plastic barrel or bin (115–210 liters)

•Soapy water and a brush for cleaning

•Optional: spigot/tap, hose connector, mesh screen, drill

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Step 1: Obtain one or more water storage barrels

⚠ **Important Safety Tip**

Only use barrels that stored food or safe liquids.

Never use containers that held:

•Oil

•Pesticides

•Paint or chemicals

Toxic substances are almost impossible to remove completely, and could contaminate your rainwater.

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Step 1: Obtain one or more water storage barrels

How to Clean the Barrel

1.Rinse it out with warm water

2.Add **dish soap or biodegradable cleaner**

3.Scrub the inside thoroughly

4.Rinse again until it's clean and odor-free

This step is **very important** to keep your collected water clean and safe for reuse.

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What You will Need:

For Water Access:
•**1 standard 1-inch hose spigot** with ¾-inch pipe threads
•**1 coupling** – ¾ inch x ¾ inch
•**1 bushing** – ¾ inch x ¾ inch
•**1 adapter** – ¾-inch pipe thread with 1-inch hose connector
•**1 lock nut** – ¾ inch
•**4 metal washers**

For Assembly & Sealing:
•**1 roll of Teflon thread tape** – to seal threads and prevent leaks
•**1 tube of silicone caulk** – for waterproof sealing around fittings

For Collecting Rainwater:
•**1 aluminum "S"-shaped downspout elbow** – this will guide the rainwater from your roof's gutter into the barrel
•**1 piece of aluminum window screen** – to cover the top of your barrel and keep out **leaves, bugs, and debris**

•**For Stable Setup:**
•**4–6 concrete blocks** – to raise your barrel off the ground
(This helps water flow better and makes it easier to fill watering cans or connect a hose.)

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Step 1: Obtain one or more water storage barrels

✅ **Why These Parts Matter:**

•**Spigot & adapter:** Let you easily use the collected water

•**Screen:** Keeps the water clean and bug-free

•**Downspout elbow:** Ensures rainwater flows into your barrel

•**Concrete blocks:** Give gravity a boost for better water pressure

Next Step: Set up your barrel and connect it to the downspout.

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Step 2: Prepare the Area Near the Downspout

You need a **flat, stable surface** where the rainwater can flow easily from your gutter into the barrel.

What's a Downspout?

A **downspout** is the vertical pipe connected to your roof gutters.

It carries rainwater from the roof down to the ground. You'll be **rerouting this pipe** to flow directly into your barrel.

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Step 2: Prepare the Area Near the Downspout

How to Prepare the Spot:

1.Pick the best downspout.

1. Choose one that's **close to your garden or area where you'll use the water.**
2. This saves time and effort when watering plants later on.

2.Clear the area.

1. Remove any rocks, sticks, or clutter next to the downspout.
2. Make sure there's enough room for **all the barrels** you plan to use.

3.Level the ground.

1. Use a **shovel** to flatten the area.
2. If the ground is uneven or sloped, dig down or build up until the surface is flat.

4.On a driveway or patio?

1. If your downspout empties onto concrete or a slope, **stack plywood boards or bricks** under the low side to create a level platform.
2. Then place **4–6 concrete blocks** on top to support your barrel.

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Step 2: Prepare the Area Near the Downspout

Create a Drainage Layer with Pea Gravel

To protect your home and keep your system stable, it's a great idea to add a **layer of pea gravel** under your rain barrel setup—unless you're installing it on a solid surface like concrete.

Why Use Pea Gravel?

•Improves drainage around the barrels

•Prevents water from pooling near your home's foundation

•Keeps the area cleaner and less muddy

•Adds extra stability to your barrel base

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Step 2: Prepare the Area Near the Downspout

How to Do It:

1.Dig a shallow rectangle in the leveled area you prepared.

1. Make it big enough for the number of barrels you plan to install.
2. Dig about **12–13 cm deep**.

2.Add a layer of pea gravel.

1. Pour in **1.3 cm** of pea gravel across the whole area.
2. Spread it out evenly to create a flat, firm surface.

Next Step:
With the base ready, **install your barrel and attach it to the downspout!**

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Step 2: Prepare the Area Near the Downspout

Build a Raised Platform with Concrete Blocks

To help water flow out of your rain barrel more easily, it's important to **lift the barrel up** off the ground using **concrete blocks**. This simple step also makes it easier to fill watering cans or connect a hose.

What You will Need:

•**4–6 concrete blocks** (more if you have multiple barrels)
•A level (optional but helpful)

How to Set It Up:

1.Place the blocks on the gravel layer (or on your concrete/patio surface).

2.Turn the blocks sideways for better support and height.

3.Make sure the surface is flat and all blocks are level with each other (use a level tool or just check by eye).

4.Adjust spacing so the platform is wide and long enough to hold **all your barrels side by side**.

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Step 3: Adding the Spigot and Overflow Valve

Part A: Installing the Spigot (Water Tap)

Where to Drill:

•Choose a spot **near the bottom** of the barrel — but **high enough** to fit a **watering can or bucket** underneath.

•Mark the spot and **drill a ¾-inch (1.9 cm) hole**. If your spigot is a different size, adjust the hole size to match!

Step-by-Step:

1.Seal the hole with caulk.

1. Squeeze a ring of **silicone caulk** around the hole (both inside and outside).
2. This helps prevent leaks.

A second barrel can be used as an overflow barrel

2.Attach the spigot:

1. Connect the **spigot to the coupling**.
2. Wrap **Teflon thread tape** around all threaded ends to seal tightly.
3. Slide a **metal washer** onto the coupling and push it through the hole from the outside.
4. Inside the barrel, slide on a **second washer**, then screw on the **bushing** to hold it all in place.

3.Tighten everything securely, but don't overtighten — this could crack the barrel or fittings.

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Step 4: Assembling the Collection System

Part A: Cut and Connect the Downspout

1.Place the barrel on the platform next to your downspout.

•Make sure it's **close enough** to reach with your downspout elbow.

2.Mark the downspout about **2.5 cm (1 inch) below the top of the barrel**.

3.Cut the downspout at the mark using a **hacksaw**.

4.Attach the downspout elbow to the cut end.

•Make sure the elbow bends downward and points **into the barrel**.

•Use screws to fasten it tightly.

✅ The end of the elbow should sit **inside the barrel**, not above it — so water flows in neatly.

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Step 4: Assembling the Collection System

Part B: Connect the Barrel

1. **If your barrel has a lid**, use a saw to cut a hole just big enough for the elbow to fit through.
2. **Cover the opening with metal mesh** or a screen.
    - This keeps out **leaves, bugs, and debris**.
    - You can secure it with duct tape, clips, or staples.
3. **Optional:** Place a **filter** or mesh screen at the top of the downspout before the elbow to catch extra debris.

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Step 4: Assembling the Collection System

Part C: Add More Barrels

If you want more water storage:

1. Place **additional barrels** side-by-side on the same raised platform.
2. Use **hose connectors or linking kits** to connect the **overflow valve or spigots** between barrels.
3. Make sure all barrels are **level**, so water flows evenly between them.

💧 This setup allows you to store **hundreds of liters** of water with multiple barrels!

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Step 5: Testing the system for leaks and efficiency

Once everything is in place

- Test all connections for leaks
- Check the efficiency of the system

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Warnings

• Rooftop water might contain chemical components from the composition roofing.

• Rainwater must be treated before drinking, but the water can be directly used to water plants, wash things, for bathrooms, etc.

•Acid rain occurs when rainwater mixes with sulfur compounds from burning coal, forming sulfuric acid. This is a global issue. The pH of the rain rises after the first five minutes of a downpour, and the acid concentration is generally low.

•Check with your local city officials to ensure that you have all the documents needed before installation

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