ALiSEA
AGROECOLOGY LEARNING ALLIANCE IN SOUTH EAST ASIA

CDEA

**ALiSEA Practice Brief**

ALiSEA Small Grant Facility 2022

# INSTALLATION OF A SOLAR DRYING DOME TO OPTIMISE AGRICULTURAL PRODUCTION

## KEY TAKEAWAYS

- This case study showcases a solar drying dome system that helps smallholder farmers to reduce post-harvest losses, especially in tropical climates like Laos.
- Solar drying improves product hygiene, nutrient retention, storability, and marketability, including potential for export markets.
- The dome uses renewable solar energy and has a drying capacity of 2.5 tons every 2 days, making it suitable for scaling across communities.
- This guide provides a step-by-step manual based on field experience, offering a replicable, low-cost solution for rural food processing and value addition.

### Promotion of renewable energy into agriculture post harvesting for smallholders

📍 Location: Xaythany District, Vientiane Capital out skirt, Lao PDR
📅 Duration: May 2023 - Dec 2024
🤝 Implemented by: CDEA &Thongmang organic agricultural cooperative

- Agricultural system: Lemongrass, bamboo shoots, chilies, rice, meat, fish and others
- Temperature: av. Max 38°C- Min 17°C
- Rainfall: av.1400 mm/year

Agroecology Principles:

Recycling · **Input Reduction** · Soil health · Animal Health · Connectivity · **Biodiversity** · Economic Diversification · **Synergy** · Co-creation of Knowledge · Land & Natural Resource Governance · Social Values & Diets · Fairness · Participation

ALiSEA Knowledge Product Categories:

Animal health · **Biodiversity** · Climate · Collaboration · Economy and income · Equity · **Input reduction and recycling** · Integrated systems · Knowledges and values · Natural resource governance · Nutrition and diets · Seed management · Soil health · Supportive policies · Sustainable food system · Water management

## CONTEXT

Food loss and waste are major challenges in Laos, driven by the tropical climate, population pressure, and limited post-harvest infrastructure. Farmers often lack safe and efficient ways to dry and store their products.

This case study presents a solar drying dome, a low-cost, energy-efficient solution originally developed by Silpakorn University in Thailand and promoted by Covestro Inclusive Business. Made from durable Covestro's Markolon polycarbonate, the dome protects food from dust, insects, animals, and microbial contamination, while preserving its nutritional quality and appearance.

Solar drying improves hygiene, shelf life, and market access, allowing smallholder farmers to reduce losses and produce value-added goods using renewable energy. With a capacity of 2.5 tons every 2 days, the dome is scalable and suited to rural settings.

The project initially benefits 30 families, with potential to expand to nearby communities. Part of the income generated supports community development funds. It was implemented under the CDEA Project (2023–2024), in partnership with Thongmang Organic Agriculture Cooperative.

## Drying Results and Yields

***Figure 1:*** *potato crisp drying process*

As part of the solar dome experimentation, various agricultural products were tested to assess drying efficiency, duration, and weight loss. Below is a summary of the results:

- **Bamboo Shoots:** 24 kg of raw bamboo shoots were dried for 2 days at 55–60°C, yielding 9 kg of dried product — a 62.5% weight loss.
- **Sun-Dried Meat:** 2.5 kg of prepared meat were dried for 1 day at 55°C, yielding 1.7 kg — 32% weight loss.
- **Bananas:** 2 kg of ripe bananas were dried for 2.5 days at 55°C, yielding 0.8 kg — 60% weight loss.
- **Cassava:** Dried for 3 days at 55–60°C, resulting in 35% final moisture content (i.e., 65% dryness).
- **Paddy Rice:** Dried for 2 days, resulting in 25% final moisture content.
- **Lemongrass:** 36 kg of sliced lemongrass were dried for 3 days at 55°C, yielding 10 kg — 72.2% weight loss (i.e., 27.8% final weight).
- **Sun-Dried Fish:** 10 kg of prepared fish were dried for 1 day at 55°C, yielding 6.8 kg — 32% weight loss.
- **Rice Crackers (Khao Krieb):** 4 kg of rice cracker dough were dried for 2 days at 55°C, yielding 2.3 kg — 42.5% weight loss.
- **Local Herbal "Tea":** 3 kg of sliced herbs were dried for 2 days at 55°C, yielding 1.3 kg — 56.7% weight loss.
- **Butterfly Pea Tea:** 1 kg of butterfly pea flowers were dried for 2 days at 55–65°C, yielding 0.4 kg — 60% weight loss.

## STEP 1: BUILDING THE CONCRETE SLAB

Solar dome dimensions: 830 cm x 830 cm x 350 cm
Slab dimensions: 900 cm x 900 cm x 50 cm

Slab Construction process:

1. Excavate the area to a depth of 30 cm where the concrete slab will be poured.
2. Fill the excavation with sand and pour water over it until fully saturated
3. Lay a plastic sheet over the compacted, wet sand to act as a moisture barrier.
4. Place a steel reinforcement mesh on top of the plastic sheet.
5. Mix sand, gravel, and cement, then pour the concrete mixture over the surface.
6. Apply a heat-insulating liquid on top of the concrete slab once poured.

## STEP 2: CONSTRUCTING THE STEEL FRAME

Frame dimensions: 8.30 meters in total length, divided into 4 compartments:

- The first and last compartments (at each end of the dryer) are 2.0 meters long
- The two middle compartments are 2.1 meters long to match the width of the polycarbonate sheets (2.1 m including the frame)

Materials:

- Galvanized box iron, 4 x 4 cm, 1.2 mm thick
- Total frame length: 8.30 meters

***Figure 2:*** *construction of the steel frame, CDEA*

Instructions:

- Assemble the frame according to the technical design drawings.
- Ensure all measurements are precise and align with the dimensions of the polycarbonate roofing.
- Weld all joints carefully to form a strong and stable structure.
- Once welding is completed, smooth all weld points and apply anti-rust paint to protect against corrosion and to avoid tearing the polycarbonate sheets during installation or handling.

## STEP 3: BENDING THE ROOF BEAMS

The dome roof is constructed using 5 galvanized steel beams, each bent into a parabolic shape.
How to bend the steel beams:
Use either a bending machine or bend manually. In both cases, bend slowly and evenly to maintain symmetry. The

final distance between the two ends of the bent beam should be exactly 5.04 meters (504 cm) to fit the dome structure correctly.

***Figure 3:*** *Bending the roof beam, CDEA*

## STEP 4: INSTALLING THE ENTRANCE DOOR

The entrance is located at the front of the dome and consists of a double sliding door system, measuring 2.1 meters high by 2.0 meters wide.

- The outer door is made of aluminum with a glass frame and includes a locking mechanism.
- The inner door is made of aluminum and fitted with a stainless steel insect-proof net (to be supplied from Vietnam).

## STEP 5: INSTALLING THE AIR INLETS

Two air inlets are installed at the front of the dome to allow fresh air to enter during the drying process.

- Each inlet is positioned 33 cm above ground level and measures 30 cm high by 130 cm wide.
- To create a rain cover, the worker cuts three slits into the polycarbonate sheet and folds it outward.
- An insect-proof net is then installed over each inlet to prevent pests from entering the dome.

***Figure 4:*** *the air inlets placement, CDEA*

## STEP 6: INSTALLING THE VENTILATION FANS

Ventilation fans are installed at the back end and in the middle of the drying dome, positioned 2.10 meters above the ground. They should sit directly on an iron bar to ensure a stable and secure foundation.

- Use a knife or drill to cut a round opening in the polycarbonate wall, matching the size of the fan.
- Secure the fans to the polycarbonate wall using screws.
- Connect the power wires: positive to positive, and negative to negative.
- Ensure the protective grill of each fan is fully positioned inside the dome to maintain safety and airflow efficiency.

***Figure 5:*** *the ventilation fans, CDEA*

## STEP 7: INSTALLING THE SOLAR PANEL AND ELECTRICAL SYSTEM

The solar panel should be placed behind the dome, in an open area free of shade to maximize sunlight exposure.

- Install the panel at a 15-degree angle facing southeast for optimal solar capture.
- Connect the power output from the solar panel to the solar converter, and then to the ventilation fans.

***Figure 6:*** *the solar panel, CDEA*

Connection flow: Solar Panel → Solar Converter → Fans
⚠ Important: The system uses direct current (DC) electricity. Correct wiring is essential:

- From the solar panel to the converter:
  - Hot wire (+) = yellow
  - Cold wire (–) = black
- From the converter to the fan:
  - Fan hot wire = red
  - Fan cold wire = blue
  - Make sure to match each wire correctly: yellow to red (+), black to blue (–) to avoid damage.

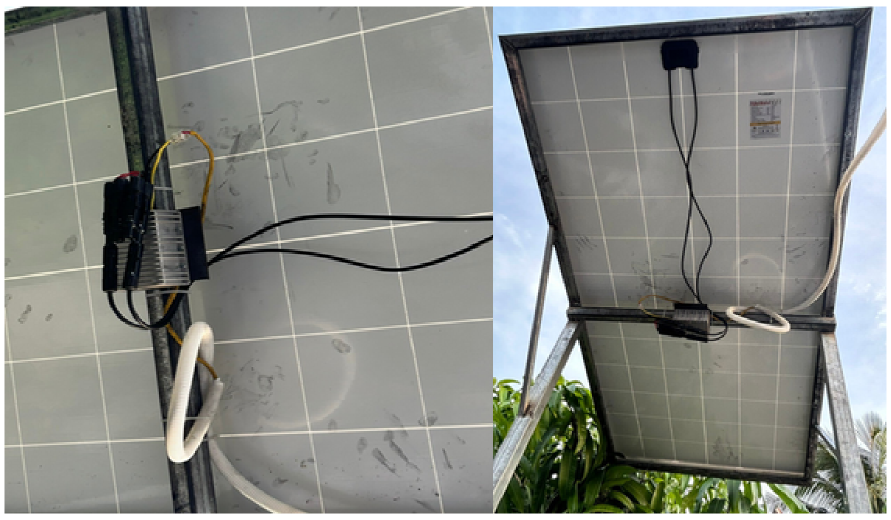


***Figure 7:*** *the electrical system, CDEA*

# STEP 8: INSTALLING THE POLYCARBONATE SHEETS

## MATERIAL SPECIFICATIONS AND HANDLING

- Polycarbonate Markolon sheet dimensions: 2.1 m × 11.8 m, hollow core, UV protection on printed side
- Printed side must face outward
- Handle carefully to avoid scratches or cracks
- Remove the inner (non-printed) plastic before installation, and the outer plastic film after full installation

## CONNECTION AND CLAMPING SYSTEM

- Use aluminum clamps to connect the polycarbonate sheets
- The clamp is 12 meters long, 5 cm wide, and has two side grooves to insert rubber gaskets before installation
- This ensures a sealed and durable connection

## INSTALLATION STEPS

### Step 1: Front and Rear Sides (door and fan sides)

- Install the polycarbonate sheets vertically
- Use scissors or a blade to cut to the required size
- Peel off the inner (non-printed) plastic layer before installation
- Do not remove the outer printed layer until the entire installation is finished
- Measure and vertically cut the panels to fit the frame
- Start by installing one central panel (directly above the door or fan), then continue with the two side panels
- Make sure the joint between two sheets aligns with the center of a box iron bar to allow secure screwing. If not aligned, trim the sheet accordingly
- Insert the aluminum clamping bars and fix with screws

### Step 2: Middle Compartments

- Use one full sheet per compartment to cover the two center sections

### Step 3: First and Last Compartments

- Peel off the plastic cover on the inside before installing (non-printed side)
- Install correctly, making sure the edges of the poly sheet are in the middle of the iron frame, then fix with clamping and screws
- Cut off the excess at both ends, making sure the polycarbonate sheet reaches the concrete floor
- Use silicone to adhere tightly to the concrete floor, ensuring it is sealed

***Figure 7:*** *the solar dome, CDEA*

## SCREWING THE POLYCARBONATE SHEETS

- Use galvanized screws and rubber gaskets
- Short screws are used to screw the poly sheet directly onto the iron frame; use the included black rubber washer
- Make it tight enough:
  - If it's loose, it will cause water leakage
  - If it's too tight, it will deform the poly sheet
- Long screws are used to fix the braces to the iron frame no rubber washer needed
- The distance between screws is 50–70 cm
- Do not use too many screws (too thickly), as it will increase the risk of water seepage

## SEALING WITH SILICONE

- Use neutral silicone only
- Apply the silicone in the following positions:
  - Around the base (where sheets meet the concrete)
  - Around the front and back walls
  - Around the fan base and hole to install the fans
  - Around the air inlet cut
- Make sure no water can leak into the dryer

***Figure 8:*** *the solar dome, CDEA*

## CONCLUSION

The solar drying dome has shown strong potential as a **practical, low-cost solution** to address post-harvest losses and support rural livelihoods. It enables farmers to preserve a wide variety of products while **improving hygiene, extending shelf life, and increasing market value.**

The pilot in Thongmang village demonstrated not only the technical feasibility of the dome, but also the **importance of community organization to ensure long-term operation.** A revenue-sharing system was established to make the model sustainable:

- **50%** of the income goes to the **service provider**
- **25%** is reserved for **maintenance and repairs**
- **20%** supports the **cooperative** managing the dome
- **5%** goes to the **general supervisor**

This model ensures that drying services benefit individual users, the wider community, and the system's sustainability. While the installation process required importing materials and training local technicians, the experience also built skills and revealed how this technology can be replicated elsewhere. With proper local planning and support, the solar drying dome can become a **valuable asset in strengthening rural food systems and improving farmers' income.**

## RECOMMENDATION

To ensure the long-term success and replication of the solar drying dome model, several priority actions should be considered:

- Strengthen **technical skills**

- Secure access to materials and equipment

- Construction components like polycarbonate sheets, aluminum clamps, or solar panels are often difficult to source locally. Projects should anticipate procurement challenges, identify **reliable suppliers** early, and consider **regional collaboration or shared purchasing** to reduce costs. Complementary tools such as drying wheels should also be included in initial planning

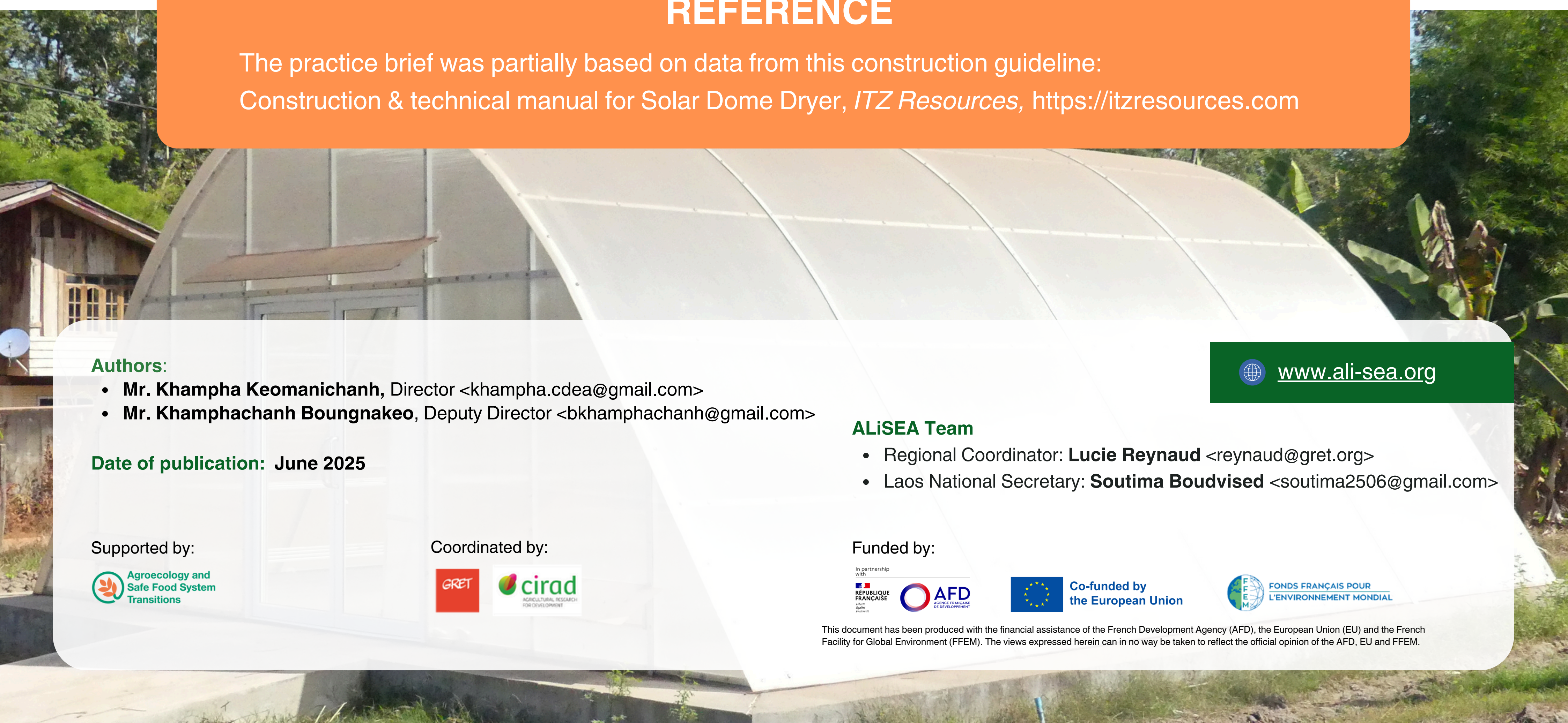
- Farmers and operators need **training** not only in the installation and maintenance of the dome, but also **in drying techniques**—such as adjusting temperature, managing drying time, and handling different product types. As seen in Thongmang, it often takes several attempts before achieving consistent, high-quality results.

- Develop **community-led management models**

- **Involving local cooperatives, women's groups, or producer associations** helps ensure fair access, maintenance accountability, and broader local ownership. The revenue-sharing system tested in Thongmang is one possible model, but it should be adapted to local contexts.

- Create a **maintenance and repair fund -** Even low-maintenance systems like solar domes require occasional repairs. A dedicated fund, financed by a percentage of the income from drying services, allows for quick response and avoids service disruption.

- **Document and share experiences -** Pilot cases like this one offer valuable insights for future adopters. Project teams should document technical steps, cost structures, and community processes to support replication in other villages.



## REFERENCE

The practice brief was partially based on data from this construction guideline:
Construction & technical manual for Solar Dome Dryer, *ITZ Resources,* https://itzresources.com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