

Solar Dryers for Food Preservation: Main lessons learned from Concern Worldwide's experience in Afghanistan

Context

Afghanistan remains one of the world's most complex humanitarian emergencies. Recent political, social and economic shocks have resulted in a massive deterioration of the humanitarian situation. After decades of war, displacements, corruption, and natural disasters, Afghans are especially vulnerable to food insecurity, social and economic upheaval.

The crisis, which has affected Afghanistan since 2021 has exposed the already-vulnerable communities to a combination of economic recession, job losses and inflation. 80% of the population relies on agriculture for their livelihood, with the majority being small-scale farmers, primarily growing wheat (the staple food crop) as well as rice, maize, pomegranate, apple, grapes, tomatoes and potatoes. Despite their critical role in sustaining both their families and local communities, these small-scale farmers face increasingly severe climate challenges, including prolonged droughts and devastating floods. In recent years, such extreme weather events have severely damaged Afghanistan's already fragile agricultural sector. Yet, these men and women remain the backbone of Afghan society, playing a vital role in ensuring food security and community resilience.

Following unprecedented levels of food insecurity during the 2021 to 2022 lean season, a combination of increased poverty, reduced harvests and high food prices has led to continuing high levels of food insecurity throughout the post-harvest period. Between March and April 2025, an estimated 12.6 million people (27 percent of the total population) faced high levels of acute food insecurity, were classified in IPC Phase 3 or above (crisis or worse) and in urgent need of humanitarian food assistance (IPC 2025). The crisis was further exacerbated by the international isolation of Afghanistan since the takeover by the Islamic Emirate of Afghanistan (IEA, or the 'Taliban') in 2021. Since then, Afghan woman and girls have experienced increased restrictions on their lives. A barring of women working outside the homes (with few exceptions), or girls studying beyond Grade 6, has resulted in an effective erasure of females from public space.

Programme Overview

Funded by the European Union, the Inclusive Livelihoods Recovery and Community Resilience in Afghanistan (FARAGIR) is a 3-year programme (January 2023 to December 2025) implemented by Concern Worldwide, Welthungerhilfe, Handicap International and lead local partner, Afghanaid in 6 of Afghanistan's 34 provinces. Concern is working in 2 of these provinces, Takhar and Badakhshan in the Northeast of the country, across 45 communities.

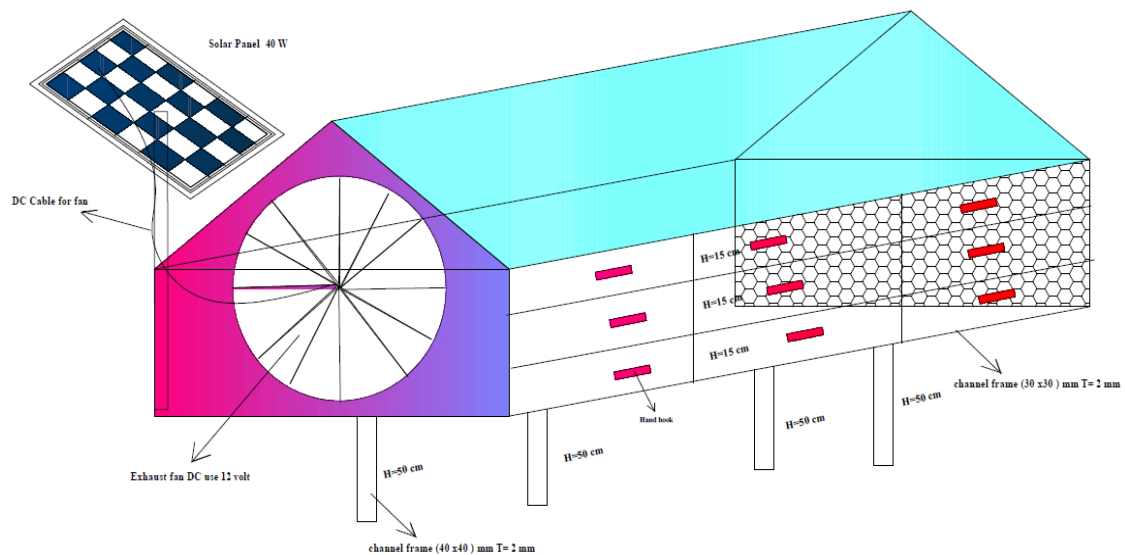
FARAGIR's overall goal is to safeguard the livelihoods and food security of the Afghan population and mitigate the impact of the humanitarian crisis in the country, preventing increased instability with severe security and migratory spillover effects for neighbouring countries and the wider region. The project aims to achieve the following objectives: 1) To strengthen and increase community-based employment, income-generating opportunities, and opportunities for micro and small businesses, particularly for women and people with disabilities and 2) To enhance food security in rural communities through improved climate sustainable production and processing capacity, and enhanced watershed and natural resource management.

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Concern has established 90 self-help groups (SHG) encompassing one male and one female, working with 2,000 target beneficiaries. These include men, women, youth, people with disabilities and IDPs (internally displaced persons). The 45 communities were selected based on pre-established criteria, prioritizing those that have not benefited from development projects in the last two years, demonstrate capacity for value chain activities and are identified in coordination with government authorities. Beneficiaries were also selected based on criteria developed by consortium members through a process involving local steering committees, household wellbeing analyses conducted with community participation, beneficiaries' verification and scoring. The selection balanced both vulnerability and capability.

In August 2024, as part of the FARAGIR programme, Concern distributed solar dryers to 70 households (headed by 51 female and 19 male) in 4 target districts: Chahab, Rostaq, Yawan and Shahribuzarg. The households were selected based on a set criterion; wellbeing analysis, local steering committee engagement and beneficiary verification. The overall purpose of the solar dryer distribution is for the preservation of fruit and vegetables to increase household income, food security and mitigate postharvest losses.

The function



The fruits and vegetables are placed on 9 trays within the solar dryer, which are secured with a locked door. Each tray has the capacity of 6 to 7kg of fresh commodities. The drying chamber, covered with transparent glass to maximize sunlight absorption and enhance internal heat, features an iron sheet on one side with 20 to 25 small holes to facilitate fresh air circulation, while an exhaust fan powered by a 40-watt solar panel to extracts internal moisture and heat. As the commodities shrink to 50 to 60% of their original moisture content, the trays from the upper layers are exchanged with those from the lower layers. The drying process duration varies based on the water content of the commodities, slice thickness, and sunlight availability, typically taking 2 to 3 days during summer and 4 to 5 days in winter. Each solar dryer package cost 18000 AFN; approximately \$250.

Following the solar-drying process, the fruits and vegetables are cooled prior to storage. Using clean, moisture-free containers including glass jars, metal cans, or freezable plastic containers with tight lid, resistant to rodents. These containers of dried food are then stored in a cool, dry and dark place. Processing and storing the fruit and vegetables in this way provides a shelf-life of 1 year at 60°F and 6 months at 80°F.

Both prior to and post solar dryer distribution, a Concern male facilitator conducted 2 trainings on the importance of solar dryer usage and its drying capacity for the preservation of fruit and vegetables. This included using organic and environmentally friendly processing techniques including grading, sorting, washing, peeling, slicing, hygiene processing, and packaging. A location with optimal sunlight exposure was then identified by each household with support from Concern staff. Programme participants also trained on routine maintenance, safety practices, and hygiene protocols to ensure effective and safe usage of the equipment for long term use.

Benefits of solar drying for food preservation:

Aspects	Traditional Drying method	Solar Drying Method
Quality of Dried Products	Uneven result if not monitored regularly.	Improved control over drying conditions can enhance product quality and reduce spoilage. The dryer protects the produce from contaminants including flies, pathogens and environmental dust. In turn this results in better texture, flavour and nutritional value, leading to increased income for farmers. The dryer also prevents discoloration, helping to retain the natural colours of the fruits and vegetables.
Flexibility	Need a large empty ground surface area.	Dryer is space efficient and can be used in remote areas without access to electricity; batteries allow for extended drying times. It is also versatile; suitable for a variety of climates, locations and type of produce.
Reduced risk of contamination	Open systems may expose products to dust, pests, and weather conditions.	Enclosed solar dryers can minimize exposure to pest and contaminants, maintaining product quality.

Sustainability	The system relies on clear, sunny weather with minimal wind and no precipitation	Environmentally friendly, reducing carbon footprint and promoting renewable energy use.
Temperature Control	Products can only be dried on sunny days.	Usable in rainy weather; it is battery-operated exhaust fans keep the drying process going during cloudy or rainy days.
Cost effectiveness	Costly, needs labour to collect the products at evening times and spread again tomorrow	The solar dryer represents a one-time investment, with a cost of \$200. It can also be built using local materials, making it affordable for small-scale farmers
Use of chemicals	Uses sulphur dioxide chemical utilization.	Avoids harmful chemicals including sulphur and acetic acid, ensuring healthier products.



A recipient of the solar dryer lays out her produce to begin the drying process. Photo: Concern Worldwide.

The impact

The solar dryers are having a significant positive impact on the agricultural commodities in the Badakhshan and Takhar provinces, where 80% of the population relies on farming for food and income. Farmers are drying the following vegetables: tomato, okra, eggplants, garlic, spinach, coriander, mint, green and bulb onion, pumpkins and chillies, and the following fruits: melon, pear, apple, peach, apricot, plum, cherries, grapes and fig. These commodities were being grown prior to Concern's intervention and are commonly dried in the target areas.

By introducing solar dryers, the project addresses critical challenges faced by farmers who previously used the traditional methods of open-air drying either on rooftops or on the ground, and sulphur dioxide chemical utilization, which often resulted in poor quality (losing of colour, taste, and aroma) contamination, and health risks.

The innovative three-layer solar dryers ensure products are clean and free from dust and insects, improving the quality (colour maintenance, nutritional value, taste, and fragrance) and safety of dried fruits and vegetables. This advancement not only enhances marketability but also allows farmers to meet sanitary standards, increasing household consumption and income potential. Additionally, the solar dryers provide access to a variety of dried produce during winter months when fresh options are limited, thereby supporting food security and economic stability.

for the farming community. Overall, the project is significantly improving post-harvest conservation¹, contributing to better livelihoods and nutritional outcomes for rural families.

Main challenges

Transportation costs of solar dryer components are high particularly in the mountainous target areas of the project. Furthermore, finding a qualified and expert supplier to manufacture such designs in the local bazaars is a challenging task. Additionally, the beneficiaries initially lacked sufficient knowledge and transitioning from traditional drying methods to new technologies takes time. In Afghanistan's Takhar and Badakhshan provinces, the production period for fruits and vegetables is typically 5 to 6 months, while usage during the remaining months is limited. The project focuses on areas far from markets, making it hard to sell their organic products at good prices because of limited access to provincial favourable market. Consequently, adopting new technology at community level will require additional time and efforts.

Lessons learned

Building on experience from the Irish Aid Multi Sectorial Resilience Programme (January 2017-December 2022) in which solar dryers were also distributed, the following lessons have so far been identified as part of the FARAGIR programme:

Increased capacity: Concern initially supported beneficiaries by providing a single-layer solar dryer with a capacity of 25 kg drying inputs. However, verbal feedback, during the MSRP programme, expressed the need for a larger structure. In response to this request, the single-layer dryer was upgraded to a three-layer model with a drying capacity of 60-70 kg of fresh inputs, significantly increasing the drying capacity.

Participatory design process supports contextual relevance and promotes sustained utilisation of new technologies: Initial distribution of single-layer solar dryers revealed high demand for greater drying capacity. Based on community feedback, Concern upgraded to three-layer solar dryers, increasing the capacity from 25kg to 60-70kg. Involving communities in the design decisions helps to tailor solutions to their needs, leading to better adoption and impact.

Environmentally friendly drying methods improve food safety and reduce harm: The solar dryers eliminate the need for chemical preservatives such as sulphur dioxide and acetic acid. Utilising solar helps to retain nutrients and improve the flavour and colour of produce, while reducing health risk and pollution.

Solar solutions enhance adaptive capacity within fragile food systems: The use of solar energy enables preservation of produce in off season and rainy periods, using battery powered fans. This reduces post-harvest losses, extends food availability and provides income opportunities in lean months, thereby supporting both food security and livelihoods.

Conclusion

- The adoption of solar dryer technology is particularly effective in reducing post-harvest losses while ensuring high-quality organic products that command favourable market prices. This support is essential for farmers who have sufficient agricultural production but lack the knowledge to maximize their income. By focusing on environmentally friendly drying practices, the project not only enhances the economic stability of farmers but

¹ Concern MEAL onsite progress report Yawan district 2025

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- also contributes to sustainable agricultural practices, reduces environmental impact, and promotes healthier ecosystems.
- Concern has a strong commitment to environmental sustainability; a priority reflected in most activities under the FARAGIR project. These initiatives include watershed, Farmer Managed Natural Regenerations (FMNR), homestead gardening, the use of bio-fertilizers and bio-pesticides, orchard establishment, solar dryers, solar churning machines, and the promotion of drought-resistant crops. These environmentally sustainable practices have enhanced agricultural productivity while minimizing any negative environmental impacts of the project's activities. Expanding this initiative could significantly strengthen food security and enable farmers to achieve optimal outputs from their agricultural products, ultimately contributing to improved livelihoods and community resilience.



FARAGIR project Agriculture Trainer conducting practical sessions to farmers. Photo: Abdur Rashid/Concern Worldwide.



Testimonials

Sabira, a programme participant and mother of 8 children from, Chahab district (Takhar Province), has a small garden that she shares with her husband. Sabira uses the solar dryer to dry fruits and vegetables for both home consumption and market supply to meet her household needs. Homestead gardening is common in Afghanistan with most households owning 300 to 500 square metres of land.

"Before receiving the solar dryer, I struggled to dry fruits and vegetables properly. I could only sell fresh products as the drying method I used caused a lot of waste. The open-air drying wasn't hygienic, and my dried products didn't meet market demands. With the solar dryer, I can dry okra, tomatoes, grapes and melons in just 3 to 4 days and products are clean, nutritious and ready to be sold. This has helped me increase my income by 3,000 AFN each month, allowing me to save and buy stationary for my children's education. I am grateful to Concern Worldwide for providing this great opportunity, it has helped us see a return on our assets and learn new things to improve our lives."

Zamira, a programme participant from Shahre-Bozorg District also has a garden that she relies on to feed her family. *"I have plenty of vegetables including okra, pumpkin, green pepper, onion, and tomatoes. Before Concern's intervention, I had no proper way to dry them, so they were not good enough to sell in the market. Now, with the solar dryer, I can dry 20 kilos of tomatoes in just 3 days. This means I can process more and sell them at a higher price. The quality is much better, and I can store them for a longer time."*

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