IMPLUVIUM + SUNLIGHT PUMP:
A ROOF CATCHMENT RAINWATER HARVESTING SYSTEM FOR OFF-SEASON SMALL-SCALE IRRIGATION

www.AFRHINET.eu

Background

AFRHINET was a three-year project which focused on fostering the knowledge and use of rainwater harvesting technologies for off-season small-scale irrigation in rural arid and semi-arid areas of sub-Saharan Africa. As part of this project, best practices on collecting and storing rainwater for off-season small-scale irrigation have been documented and evaluated.

This case study discusses the use of an innovative and cost-efficient roof catchment rainwater harvesting system for off-season small-scale irrigation. The overall goal of this case study is to contribute to the replication and scaling up of this specific type of technology for off-season small-scale irrigation in arid and semi-arid areas.

This technical sheet has been developed in cooperation with IDE-Honduras (https://www.ideglobal.org/country/honduras) and Ennos AG (www.ennos.ch).

The technology

International Development Enterprises (iDE), has been looking for a water storage solution that is cheaper than a fiber cement tank, without having the disadvantages of fiber cement (fissures) or a water pond (mosquito proliferation and necessity to lift water before use). In Honduras, iDE found an innovative way of building a "closed" and 2 m height water tank, for driving water by gravity to crops. In regard of cost reduction per m^3, it is better to make the tank as big as possible, as it will require fewer materials to pass from 10 to 20 m^3 than from 0 to 10 m^3. Another advantage of a large tank is the capacity to store large quantities of water over a long period of time when the tank cannot be refilled - for example during dry season. iDE therefore designed and built, with locally available materials, the 23m^3 Impluvium that costs 1200$ (52$/$m^3$). The Impluvium comes with a roof and gutter system and is suitable for both productive and drinking water necessities. The Impluvium can also be used in combination with a water treatment solution to purify the water before human consumption. For irrigation, the Impluvium can be used in combination with a drip kit in order to make the most efficient and productive use of the water. The first Impluvium was developed at iDE´s tech center funded by SDC (Swiss Agency for Development and Cooperation), with additional support from RAIN Foundation.

Figure 1: An Impluvium tank. Photo: iDE-Honduras.

A large rainwater harvesting tank is even more useful if you can fill it continually after the rainy season. For that reason, it should be considered to have a pumping system that can fill the tank from another water source. In order to avoid high running costs of the pump (for diesel or electricity), it is recommended to invest in a solar-powered pump like the sunlight pump designed by the Swiss social enterprise, Ennos AG. The sunlight pump was specifically designed for smallholder irrigation and drinking water supply in developing countries. It is suitable for a broad range of applications (up to 50 m vertical lift and up to 15m^3 of water delivered per day). The sunlight pump liberates farmers from the physical burden of manual irrigation and allows those, who rely on rainfall to cultivate their few acres of land, to reduce the risk of crop failure. The sunlight pump will also allow the smallholder farmers to increase their productivity and with that to improve the income and the livelihood of the entire family. A sunlight pump with a 300 Watt panel allows to save around 135 liters of diesel and around 380 kg of CO_2 emissions per year. The excess energy from the solar panel that is not used for pumping can be stored in a battery and used for other purposes (light, phone charging, cooling etc.). Because a solar pump depends on daylight energy, it makes sense to consider a combination with a large tank like the Impluvium which plays the role of energy storage and allows farmers to irrigate during those hours of the day when evaporation is reduced. If the farmer also wants to breed fish in the Impluvium, the pump can be used to oxygenate the water.

To sum up, the Impluvium and the sunlight pump are two innovative and affordable technologies that can be very well combined.

Advantages and disadvantages

The combination Impluvium and Sunlight pump allows cultivating 1 to 3 hectares of land under drip irrigation, all year round and with close to zero operation and maintenance costs. Such an innovative irrigation system allows the users to improve their income, to increase food security and to adapt to climate change. Moreover, with the introduction of these technologies, new technical capacity, know-how and local jobs are created.

This means, in turn, that the artisans and technicians which are responsible for the installation and maintenance of these technologies have to be well trained. This is to guarantee a productive use of the technologies and to lay the foundation for the scaling-up in Central America.

In order to be suitable for a broad range of applications, the Impluvium will be offered in different sizes and not only 23 m^3. In order to reduce the construction costs and the ecological imprint of the technology, iDE is currently developing an Impluvium made from locally available bamboo in collaboration with Zamorano University.

The quality of the plastic bag depends of the precautions that take the hardware shop for transporting and selling it. So in the upcoming months, a “Jumbo” bag, like the one used for keeping cereals, will be developed and produced in the region in close collaboration with at iDE and a regional manufacturer. It will be tailored made for the Impluvium, and will contain water outlets and inlets, for making the installation easier and for having a better quality assurance.

Additional information

- **Range of storage capacities available:** Capacity of the sunlight pump of up to 15m3 per day or up to 50m3 with battery back-up; Impluvium storage capacity of 23 m^3 for the tank.

- **Covered land in hectares:** Sufficient to irrigate 1 to 3 hectares.

- **Kind of crops produced:** Corn, beans, tomatoes, cucumber, lettuce, cabbage, radish, Yuka, sweet potatoes, etc.

- **Benefits of the system:** Impluvium and sunlight pump permit to cultivate 1 to 3 hectares under drip irrigation, all year round with close to zero operation and maintenance costs. Such an innovative irrigation system allows the users to improve their income, to increase food security and to adapt to climate change. Moreover, with the introduction of these technologies, new technical capacity, know-how and local jobs are created.

Figure 2: A sunlight pump. Photos: iDE-Honduras.

- **Recommended mechanisms for financing the systems:** In order to reduce the barrier of a high upfront investment, there are micro-credit institutions and smart-subsidy programs. There are also farmers who can pay the system upfront. The Impluvium costs 1200$ and the sunlight pump between 1100$ and 1400$ (including installation service), depending on the size of the solar panel required.

- **Acceptance and scaling-up potential:** The Impluvium was introduced in Honduras four years ago. The technology has been continuously improved and different options have been tried to find the best design for the needs of the user. Today, there are more than 20 units operating in the field. People are very interested in those technologies and iDE is ready to scale-up. In addition, the sunlight pump has been extensively field-tested in several developing countries. Based on the feedback received from the users, the sunlight pump was designed to serve the needs of smallholder farmers and communities in terms of its capacity and functionality. The first demos of the sunlight pump in Africa and Central America have created great interest.

Lessons learned

1. In order to guarantee a productive use of the sunlight pump over many years, the installation has to be done by a trained expert. This is why iDE also offers an installation service. This increases the lifetime of the pump, guarantees that the pump is used at its full capacity and that the users are also well instructed.
2. The Impluvium has to be built by a certified artisan to ensure the quality of the structure.
3. The quality of bags used for the impermeability of the Impluvium has to be strictly controlled.
4. The water source needs to be sufficiently reliable and of good quality to fill the Impluvium all year round through solar pumping or gravity, without having the necessity to use the community water network, because that could create tensions.
5. Farmers need to have sufficient lands and willingness to expand their activities for fully taking advantages of both technologies as they are providing great amount of water every day.

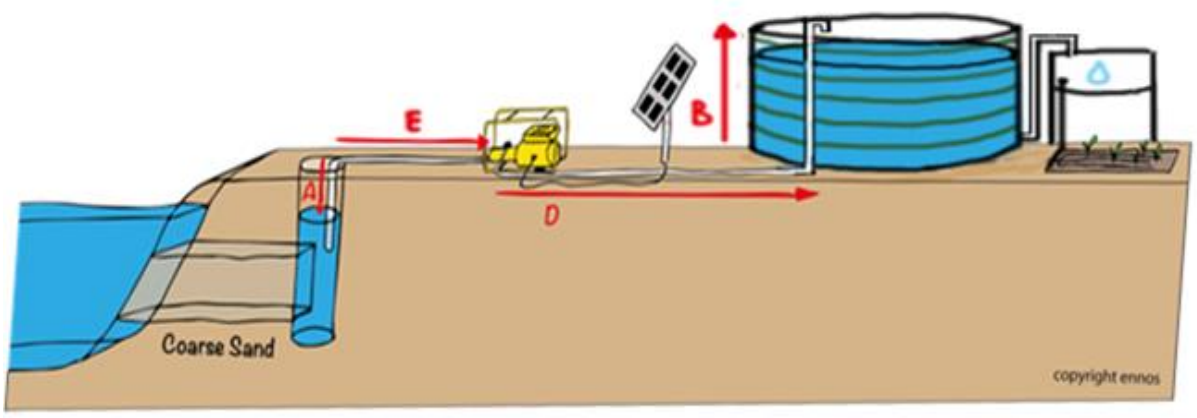

Figure 3: The Impluvium + sunlight pump system. Source: Ennos AG.

Figure 4: End result of the Impluvium + sunlight pump system. Photo: iDE-Honduras.

Publisher Hamburg University of Applied Sciences, Hamburg, Germany. Financed by the ACP-EU Cooperation Programme in Science and Technology (ACP-S&T II). A programme implemented by the ACP Group of States, with the financial assistance of the European Union.

Authors Thomas Hebrard and Carlos Urmeneta
IDE-Honduras.
Email: thebrard@ideglobal.org; curmeneta@ideglobal.org.
May 2017.

Edition Josep de Trincheria.
Hamburg University of Applied Sciences.

Partnership The AFRHINET consortium comprises of 8 organisations located in Ethiopia, Kenya, Mozambique, Zimbabwe and Germany. The contents of this technical sheet has been developed in cooperation with IDE-Honduras and Ennos.

Ethiopia	Ethiopia	Kenya	Kenya	Mozambique	Zimbabwe	Zimbabwe	Honduras	Switzerland
Addis Ababa University	WaterAid	University of Nairobi	World Agroforestry Centre	Eduardo Mondlane University	University of Zimbabwe	International Crops Research Institute For the Semi-Arid Tropics	iDE: International Development Enterprises	Ennos AG

Coordination

Hamburg University of Applied Sciences
Research and Transfer Centre "Applications of Life Sciences"
Josep de Trincheria, Prof. Dr. Walter Leal
Ulmenliet 20, 21033 Hamburg, German
Tel.: +49-40-42875-6107, Fax: +49-40-42875-6079
E-Mail: afrhinet@ls.haw-hamburg.de
Register to the AFRHINET network
at: http://www.afrhinet.eu/transnational-network.html
Visit the virtual AFRHINET research and Technology Transfer Centres
at: http://www.rainwatertechcentres.net

Hochschule für Angewandte Wissenschaften Hamburg
Hamburg University of Applied Sciences

Implemented by the ACP Group of States

Funded by the European Union

The AFRHINET Project is funded by ACP-EU Cooperation Programme in Science and Technology (ACP-S&T II).A programme of the ACP Group of States, with the financial assistance of the European Union.