



Rooftop water collection, drip irrigation and plastic mulching in home garden conditions in drought prone areas of Cambodia

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Summary

The impact of natural hazards on the agriculture sector can be devastating. To reduce the effects of climate change, farmers use strategies to counter effect the influence of a natural disaster. For example saving rooftop rainwater can help during draught, and mulching help maintain soil moisture.

In this good practice, first, steps and requirements for rainwater collection are explained. Building on water harvesting, drip irrigation system is explained which is crucial for water saving during irrigation in the dry seasons.

Third, mulching methods are described. Mulching is a technique that is used to cover and to keep soil moisture for a better plant growth, and finally a cost-benefit analysis of their combined application is presented.

Description

Cambodia is highly vulnerable to natural hazards, primarily floods and drought, which heavily impact the agriculture sector. As a result, the lives and livelihoods of many smallholder farmers are severely affected. Through livelihood diversification, home gardens help to reduce the adverse impacts of natural hazards. Families are able to grow different fruits and vegetables to supplement

their unbalanced diets, which currently mainly consist of consuming staple foods such as rice.

When combined with rooftop rainwater harvesting, drip irrigation and plastic mulching, water is used effectively and efficiently, and provides considerable time savings especially for women and children often responsible for water collection. The water from the rooftop containers can also be used for various household needs, freeing time for other activities.

Home gardening can help farmers, and women in particular, to reduce the impact of dry spells and drought, which enables them to generate additional income, diversify their livelihoods and contribute to the food and nutrition security of their families.

1. Rooftop rainwater harvesting to reduce risk during the dry spell and drought

Rainwater collection has been practiced sustaining Cambodian families through the dry season in the past, and traditional methods were improved to ensure sufficient access to water in order to reduce the impact of drought and dry spells. The water is collected using a rooftop rainwater system, where



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rainwater falls on metal or tiled roofs and is then collected in containers at the edge of the roof or channelled to a storage system via gutters and plastic pipes. The rainwater is channelled into a covered storage tank which protects the water from contamination. The storage has been improved to include assembled cement rings that could store in capacity such as 2 000, 3 000 and 5 000 litres of water.

Through the use of rooftop rainwater collection, families are able to collect enough rainwater in the rainy season and conserve it for the dry season or an unexpected drought. This technique reduces adverse impacts of dry spells and droughts and enables farmers to increase and diversify the crop and animal production to generate additional income.

1.1 Identification of a suitable storage

1.1.1 Determination of the size of the tank

The size of the storage tank depends on the utilization purposes which include household consumption or household consumption plus vegetable or animal production. Based on experience, it is recommended that for household consumption, the calculation to determine the size of the tank is based on the number of household members, assuming a consumption of 15 litres per person per day. For vegetable production, 1 m² of garden needs an average of 2 litres of water each day under the climatic conditions of the tested area.

1.1.2 Choosing the right tank

There are various options available for the construction of these tanks with respect to the shape, size and the material of construction. Currently, three types of tanks are available in Cambodia: the

Jumbo Jar (see Figure 1), the Cement Ring Tank (see Figure 2), and the Ferro Cement Tank. The Jumbo Jar tanks are the most popular ones due to their lower prices. Cement ring jars are the second favourable ones.

Figure 1. Traditional water containers called Jumbo jars



Figure 2. Modern water collection tanks, also called ring tanks



1.2 Construction of the rainwater harvesting system

The rainwater harvesting system may be constructed as per instruction below. The



Table 1. Characteristics of the different water container solutions

Jumbo Jar	Cement Ring Tank	Ferro Cement Tank
<ul style="list-style-type: none"> • Storage Capacity: 1,000, 2,000, 2,500, and 3,000 liters • Prize: USD 165 plus installation • Availability: Locally available 	<ul style="list-style-type: none"> • Storage Capacity: 1,000, 2,000, 2,500, 5,000, 10,000 liters • Prize: USD 20 - 160 plus installation • Availability: Locally available 	<ul style="list-style-type: none"> • Storage Capacity: 2,500, 3,200, 3,800, and 4,600 liters • Prize: USD 800-1500 plus installation • Availability: May not be available for some areas

Source: FAO 2017

construction requires techniques and skills in the Water and Sanitation (WATSAN) sector.

1.2.1 Catchment surface

The catchment surface of a water harvesting system is the surface which directly receives the rainfall and flows water to the container. The catchment surface is usually the roof of the house or animal shed.

To ensure clean and safe water, the collection area of roofs can be constructed with a range of materials, including galvanized corrugated iron, aluminium cement sheets, tiles and slates. It is recommended to build the catchment surface adjacent to the home garden if farmers want to combine with drip irrigation system.

1.2.2 Gutters and down piping

Gutters and down piping serve to get the water from the roof during raining to the storage container. Gutters should be installed under the roofing on both sides of the roof and channelled with pipes to the tank. The most commonly used material for this purpose in Cambodia is plastic piping, which costs approximately

USD 30 for a water harvesting system covering the roof of one farm house or similar building.

1.2.3 Cover of the water tank

It is also very important to cap or cover the water storage tank at all times. Wooden or cement covers are used. Covering the tank prevents debris and dirt from contaminating the water and also keeps out mosquitoes and other pests that may contaminate the water and provide health risks to humans and animals.

Therefore, the cap or cover should closely fit on the opening of the tank to avoid small animals such as lizards or mice from falling into the water tank. It is useful to install chicken wire before the inlet pipe to avoid animals that enter the pipe from the roof to end up in the water tank.

1.2.4 First-flush System

The first-flush system is used to ensure clean water. During the dry season dirt and debris may collect on the roof and wash into the storage tank. The first-flush system discards the first bit of flowing water and ensures that the water being collected is clean. A simple first-flush system is made from attaching a vertical pipe to the down



pipe that delivers water into the tank. A valve is put in place below the junction where the pipes come together. This way, the initial water may be sent out through the extra pipe and will not send dirt and debris into the tank. It is important to regularly check and clear the pipes and make sure that the first rain will be washed out to avoid dirty and contaminated water.

Drip irrigation systems require maintenance to prevent the clogging of gutters. Key maintenance interventions include periodic inspection of gutter lines, flushing of the system as well as the application of an orderly irrigation plan.

1.3 Capacity building

It is important to train families in the use and maintenance of the system to ensure sustainability. The training may also include how to manage water usage and sanitation techniques to ensure families have sufficient and clean water throughout the dry season. Additional trainings on farming technique may be required for them if the system is installed for the purpose of increasing agricultural production and livelihood diversification.

2. Drip Irrigation a drought resilient technique for vegetable cultivation

Irrigating crops can be a challenge for farmers during the dry season or in times of drought. Crop failure has detrimental effects on the livelihoods of families and their food and nutrition security. Access to sufficient as well as efficient use of water resources is highly important, in particular during the dry season.

Lack of water increases the work burden of women and children, who have to travel sometimes long distances to meet the household water needs. For households

without stored water, water shortages in the dry season limit the production from homestead vegetable gardens. Unlike many other irrigation techniques, drip irrigation enables a watering regime that provides slow, regular and even soil wetting.

In drip irrigation, water is directed through a series of plastic pipes directly to the plant roots, enabling plants to effectively use most of the available water, thereby limiting the amount of water lost to deep drainage, evaporation and runoff. In addition to efficient and effective use of water, less fertilizer is washed away and as a result, the cost of inputs needed is lower.

The more controlled water release also results in fewer weeds, which means less labour is required also for watering to raise crops. Time is saved not only from collecting water, but also in having to water the crops. Therefore, drip irrigation holds promise as a means for increasing water use efficiency, reducing labour requirements, and improving harvest quality and quantity.

The use of rooftop rainwater collection as a valuable water source for drip irrigation can help farmers cultivate vegetables around the homestead. Vegetable cultivation is often done by women. As a result, this can help them to reduce the impact of drought and enable them to increase numbers of crops grown a year, which helps to generate additional income, diversify livelihoods and contribute to food and nutrition security.

Simple, low-cost drip irrigation kits are available in Cambodia and are suitable for use by farmers with small or large plots of land. In general, two kinds are available and suitable for areas from 40 m² to 500 m². A drip irrigation system is composed of the following elements: a water container that aliments the system and a main tube



that brings the water from the tank to the garden. Some farmers install cement rings as the water container as it is easy to set up and materials are locally available. Five assembled cement rings have a capacity of 5 000 litres of water. The other option can be using simple water tanks or jars. Water tanks or jars are placed near the plot of land, generally within 2 to 3 m.

It is raised by 1 m to ensure water flow by gravity. Farmers generally have to purchase the cement container separately as they are not part of the irrigation kits. A tap controls the water flow from the water container. The water first passes through a filter to make sure debris is removed so that the pipes will not be clogged. The water then flows through the sub-main pipe to the lateral pipes in the garden.

The lateral pipes are laid over the crops parallel to the rows. The water flows into these pipes and is then distributed to the plant roots via emitters (micro-tubes). This process is illustrated in Figure 3 below:

2.1 Preparation of the system

The land must be levelled and prepared in rows so that the watering pipes may be

installed (see sample Figure 3). Then, the water container must be set up and holes must be made in the sub-pipes using a needle.

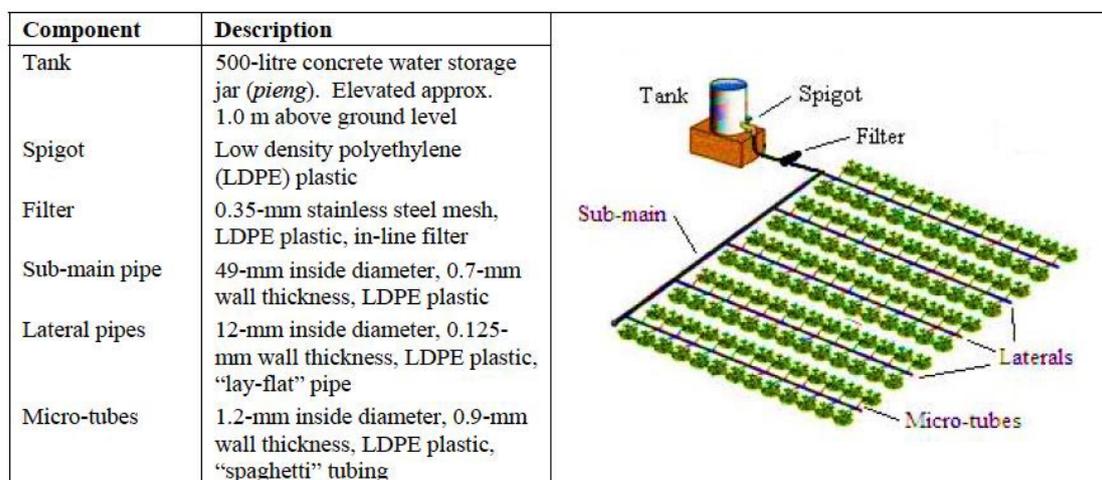
In general, a kit covering 40 m² takes about two hours to install. Along with the installation, the orientation on basic instruction of the installation and management of small-scale drip irrigation systems should be provided so farmers will know how to maintain the drip irrigation system themselves.

After installation, the same kit may be used for three to four crop production cycles. After three to four cycles, it will need to be removed to check the quality and to replace the broken parts while allowing farmers to prepare the land for next cropping.

2.2 Possible water sources for a drip irrigation system

Any source of water such as rooftop rainwater collection container, pond or a well may be used for a drip irrigation system as long as it provides water pressure (for example through gravity) and has an attachment suitable to connect to the drip irrigation system.

Figure 3. Components of drip irrigation



Source: Roberts, M.S. & Long, A., 2006



Figure 4. Drip Irrigation installation for vegetable production



2.3 System layout

The system's design needs to be done according to the crops to be irrigated as well as the spacing of the crops. An emitter will be placed close to each plant. Plants that require more water may need two emitters. These emitters are attached to the main water system.

2.4 Filling of the water container

The water container should be filled with rooftop rain water by gravity or with a pump tapping other water sources. For a water container with a capacity of 5 000 litres a home garden of 40 m² can be irrigated for around two months during the rainy season and for 15 to 30 days during dry season. As the plants mature, water will need to be irrigated two times each day.

2.5 Testing of the drip irrigation system

Turn the valve on and ensure that the water successfully runs from the water tank to the emitters. Adjust the water flow to allow the emitters to slowly release the water as water should dribble onto the soil near the plants.

2.6 Check for leaks

After adjusting the water flow, turn the valve off. The water should stop running. If this is not the case, this means that

there are leaks in the drip lines due to an incorrect adapter. Use only threaded hose adapters. It is possible to fix small leaks by wrapping thread seal tape around the area.

2.7 Perform regular maintenance

It is important to routinely check for leaks and clean the filter regularly about every two weeks.

Figure 5. Drip irrigation installation with elevated water containers



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3. Plastic mulches in vegetable cultivation for enhanced resilience to drought and soil erosion

Mulching is a technique that has been used by vegetable growers for many years. Mulches are used to cover and to keep soil moisture for a better plant growth. Traditionally, natural mulches such as rice straw and water hyacinth have been used.

However, since the creation of synthetic materials, plastic sheet has been introduced as a means to provide the same benefits. Plastic mulches are impermeable and therefore, prevent the evaporation of



moisture from the soil. They limit losses of water and reduce soil erosion better than natural mulches do. In addition to conserving water, plastic mulches also help with weed control. That allows farmers to improve and maximize their production.

Plastic mulching is a good practice to ensure crop production during dry spells and droughts. This is especially true if plastic mulching is used in conjunction with drip irrigation (see drip irrigation above). This practice saves labour time (such as for weeding) and other resources (such as fertilizer, herbicide and pesticide input), increases yields and thereby contributes to people's food and nutrition security.

Furthermore, plastic mulches are easily acquired and provide flexibility for utilization. However, they are more expensive than natural ones. Plastic mulches can be used at least three crop cycles in terms of quality especially in combination with drip installation.

Plastic mulches require farmers to have skills in vegetable growing. The introduction of plastic mulching must, therefore, be accompanied with adequate training and/or a Farmer Field School programme on vegetable production, including cleaning, land preparation, lime application, composting, harrowing, making beds, applying mulch, drip irrigation, and drainage.

3.1 Land preparation

Clean and plough the land to a depth of 30 cm. Remove all bushes, rocks, and weeds. Plow the soil into tiny pieces.

3.2 Application of lime

The lime increases soil pH, corrects soil acidity and provides calcium and magnesium which are important for vegetable growth. In addition, it makes

more nutrients available to plants. Lime will also help reduce soil borne diseases and pests. However, lime should not always be used especially when plants are grown on soils that are already high in pH/ alkaline. Therefore, if you are unsure about the pH of your soil, do a pH test first before applying lime.

Apply lime on the surface of the soil. Practically, use 5 to 10 kg of lime for 100 m² of land size. Spread the lime across the land covering it with an even thin layer of lime. When applying lime, put on a mask and wear gloves to protect yourself.

Figure 6. Cleaning and land preparation



3.3 Compost and harrowing

Cover completely the lime with a layer of compost. Use 2 to 3 kg of compost for every square meter of land (see compost fertilizer). Harrow or rake the compost twice into the land to ensure that the compost is well mixed into the soil. The compost is rich in nutrients, which helps to increase soil fertility as well as to retain moisture. Therefore, this mix helps crops grow healthy and strong.

3.4 Preparation of beds

Build the beds parallel to the land's longest side considering the slope of land,



accessibility, and water source. Bed should be 30 cm high and 60 to 90 cm wide for rainy season; this is wide enough for most crops. Make sure the beds will drain effectively.

3.5 Application of mulch

Pull the plastic mulch, silver side up, tightly over the beds. Put some soil on the plastic mulch to hold it in place (see Figure 6). Plastic mulch helps protect the soil against weeds and decreases the mobility of pests. If possible, use reflective plastic films, which can also repel certain kinds of insects. One vegetable bed of 10 m length needs around 10.5 m² of plastic sheet.

For commercial gardens from 500 to 2 000 m², it costs approximately USD 60 in Cambodia. For home gardens from 300 to 400 m², it costs about USD 12.5. About USD 4.5 for 40 m².

Figure 7. Application of plastic mulch



3.6 Preparation of drainage

Next, dig 20 cm deep canals between the beds for irrigation tubes. Dig two primary canals towards the lowest point of the garden.

To avoid soil erosion between the beds and to get a fast and shallow canal, dry rice straw, rice husks or rice ash could be used. They can flow off the land slowly.

4. Lesson learnt from demonstrations of rooftop rainwater collection systems

4.1 Economic and social feasibility

4.1.1 Benefits

- Rooftop rainwater collection is the most suitable practice for rural farmers and considered as the coping strategy for dry spells or drought.
- Rooftop rainwater harvesting can assist household water needs with good quality water and more constant water supply in the dry season.
- The combination of rooftop rainwater harvesting, and drip irrigation can save water and time significantly, and also reduce the women's work burden to fetch water from large distances.
- The combination of the technologies of rooftop rainwater harvesting, drip irrigation, plastic mulch and home gardening could save time, water and labour; and farmers can gain higher yields than with the conventional practices.

4.1.2 Cost

- The initial investment costs are high, hence, low-income families may not be able to afford this system without support.
- It is labour intensive to install cement rings.

4.2 Increase resilience

4.2.1 Benefits

Water is collected during the rainy season and conserved to use in the dry season. Two cement stands (with 10 assembled cement rings) can store about 5 000 litres of water.

This amount of water can last for at least one month for consumption and household use for an average five family



members and irrigation of 60 m² home garden.

5. Lessons learned from the drip irrigation system demonstrations

5.1 Economic and social feasibility

5.1.1 Benefits

- Significant labour-saving times for women of up to three hours per day.
- Water is applied only where needed, and is not wasted or lost through evaporation or runoff.
- Reduced amount of washed away fertilizers, so it helps to reduce the cost of inputs.

5.1.2 Cost

- Installation costs of around USD 60 for home garden from 300 to 400 m² could be high for farmers.
- In case of damage or extension of the system, farmers may struggle to find locally available suppliers to support the installation or fix the damage.

5.2 Increase resilience

5.2.1 Benefits

- Efficient water-saving technique, uses four times less water than the conventional technique. For instance, a 10 m long vegetable bed of 60 to 90 cm wide using drip irrigation requires around 15 litres of water per day, whereas conventional practices using water tanks may take up to 60 litres of water.

5.3 Environmental suitability

5.3.1 Cost

- Drip irrigation systems and plastic mulch can have negative effects on the environment as they are made of plastic. If farmers use big systems the waste may end up being discharged on landfills

without proper management and with long-term threats to groundwater. It is therefore suggested to train farmers on waste management and the supplier of the drip irrigation systems should collect the old drip kits for recycling purposes.

5.4 Additional considerations

- To combine drip irrigation systems with other practices such as rooftop rainwater collection, plastic mulch, compost and botanical insecticide to improve soil composition and soil moisture.
- Properly fence the farms to protect crops from animal encroachment.
- Be precautious of damages of the system while harvesting and make sure that the plastic tubes are stored in a safe place between crop cycles.

6. Lessons learned from plastic mulching demonstrations

6.1 Economic and social feasibility

6.1.1 Benefits

- Labour and time is saved since farmers, particularly women, have more time to monitor pest and diseases on vegetables and scale up the production.
- The amount of fertilizers washed away by rain is reduced, so it helps to reduce the cost of inputs.

6.1.2 Cost

- It might be difficult for some farmers living in remote areas to have access to the plastic mulching suppliers and it might be expensive.
In this case, organic mulches such as rice straw and water hyacinth can be a good alternative for farmers as they are cheap and easy to find after the harvesting of rice and vegetables, and the organic mulches buried into the soil additionally serve as organic fertilizers.



6.2 Increase resilience

6.2.1 Benefits

- Plastic mulches maintain soil moisture for longer than no-mulching. The plastic cover acts as an insulator to keep moisture from evaporation during hot times or dry spells.
- Plastic can also prevent weed to grow, hence it reduces the competition between weeds and crops for water and fertilizers.
- Can maintain the shape and level of vegetable beds in the rainy season. It also prevents vegetables from waterlogging, reducing the incidents of root rot and other diseases
- Works efficiently when combined with drip irrigation. The combination of these practices could save water up to four times.

6.2.2 Cost

- Plastic waste has a negative effect on the environment if farmers use big amounts of plastic mulches and throw the waste on land without proper management. The environmental costs of producing plastic mulching sheets needs to be considered before shifting from traditional mulching materials to plastic. It is suggested to train farmers on waste management and the suppliers of the plastic mulch should collect the old plastic mulch for recycling purposes.

6.3 Additional considerations

- Beware of possible damage caused by animals if the plot is not properly fenced.
- Beware of damage to plastic mulch and tubes during harvesting.
- Beware of the increased temperature of soil while using plastic mulch. It can scorch young plants.

- Remove the plastic mulch between production cycles and keep it properly for the next crop cycle.

7. Cost-benefit analysis

The results of the qualitative and quantitative analyses conducted based on field demonstration data are summarized hereafter.

The performance of the combined GPOs was assessed at farm-level in Cambodia based on quantitative data collected during the monitoring period. The net benefits obtained from the application of these practices were measured through a cost-benefit analysis (CBA), and compared to the net benefits obtained from traditional practices.

The CBA projects the cumulative net present value of benefits obtained from 1 acre over a period of 11 years (10 percent discount rate is applied to express the future value of costs and benefits in present terms), as well as the benefit-cost ratio (BCR), which is the ratio between total discounted benefits and total discounted costs over the appraisal period.

The graph in Figure 8 shows that the net benefit over 11 years is 115 percent higher in farms that adopt the GPOs combination, as compared to non-adopters. The cost-benefit ratio of the good practice is higher than that of the existing local practice.

Although the good practice requires more input and labour (especially for maintenance), the increase in yield due to a more balanced water supply, weed management and soil water retention more than compensated the additional input cost.

Figure 8 below shows the average annual costs and benefits per m² of the good practice compared to the local practice.



7.1 Cost assumptions are as follows:

- Labour cost only includes hired labour. Family labour is not included.
- Seeds costs are considered as upfront capital costs, not seasonal costs (first purchase, then saved from cycle to cycle).
- Operation and maintenance costs are not included due to possible double counting with other costs such as labour.

Assuming a 10 percent discount rate, capital costs are fully repaid after seven years. To overcome upfront investment barriers, access to credit should be facilitated.

From a strictly economic point of view, the GPO yields very limited benefits. However, relevant positive impacts of GPO implementation arise from qualitative evaluation:

7.2 Food Security and Nutrition

The GPO allows two cropping cycles, hence, it enhances food security and diversification of diets.

7.3 Access to safe water

70 percent of the farmers said that the GPO improved their access to clean and safe water.

7.4 Knowledge

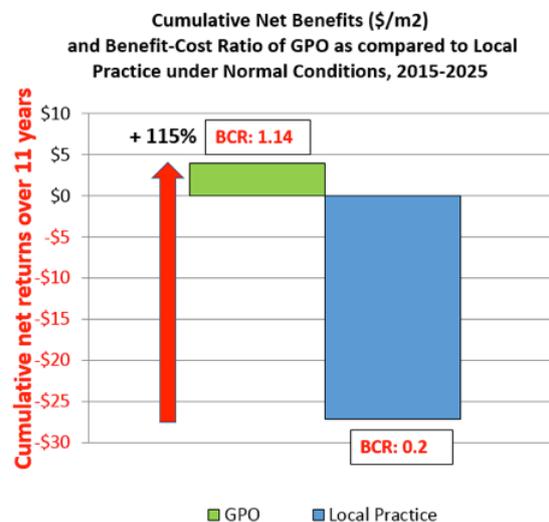
All interviewed farmers considered that they acquired new knowledge by taking part of the project and implementing the GPO.

7.5 Sustainability

All interviewed said they would replicate the GPO in the coming seasons.

Given the relatively high capital cost required to start the good practice, adequate access to credit for farmers would facilitate adoption.

Figure 8. Cumulative net benefit cost ratios of good practice and local practice(USD per m²)



Source: FAO 2017

8. Validation of the practice

8.1 Geographical area of validation

A total of 50 demonstrations of rooftop rainwater collection were tested in combination with drip irrigation and plastic mulching under vegetable home garden conditions in the Kampong Speu province, Cambodia.

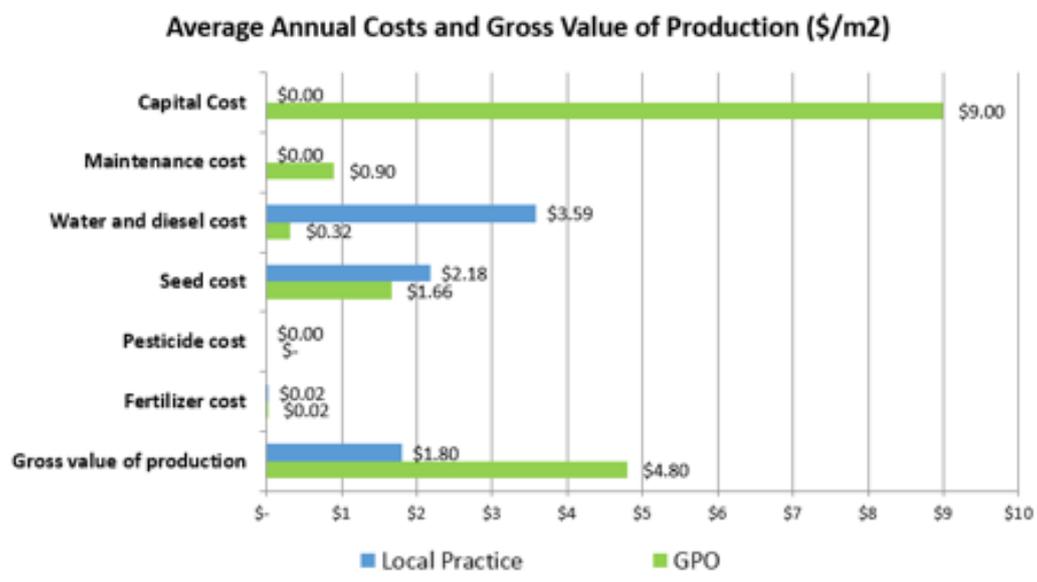
8.2 Field reports

8.2.1 Field report of a female famer using the water harvesting system

“At the beginning, I found it was a bit costly and time consuming to install the cement rings. My son is a construction worker and he helped me with the installation. With the new system, I do not have to fetch water daily to store in the small cement jars for my children and grandchildren to use. It was unfortunate that there was a dry spell from June to August which caused a deep concern for me regarding shortage of water. Later, when the rain falls, the ten cement rings provided by the project can store about 5 000 litres of water, so I decided to buy two



Figure 9. Average annual cost and benefits per m2 of the good practice compared to the local practice



Source: FAO 2017

more rings to add into the system, so now the three stands can have the capacity to store about 6 000 litres of water. There are five members in my house and everyone is bathing, washing clothes, cooking and drinking with water from the stands. The 6 000 litres of water in the cement containers can last for 45 days for my family consumption and the irrigation of 150 m² vegetable home garden”.

Ms. Nou Phorn, a 58-year-old widow woman in Srah Thol village, Yuth Samaki commune, Odong district, Kampong Speu province

8.2.2 Field report of a female famer using the drip irrigation system

“Before, I used a pair of small water buckets of around 40 litres to water a 10 m long vegetable bed. I have many vegetable beds, so I had to carry several buckets of water every day. With the drip irrigation system, I found that it saves lots of water, time and labour. On a dry and hot day, I water about an hour/day using

the drip system, maybe around ten litres of water for a 10 m long vegetable bed. So this system saves water about four times because the drip system lets water flow straight to the stem of the plant and there is no run-off water like when I was using the water buckets. Most importantly, I don’t need to carry heavy water buckets to water my crops anymore and I can have more time to take care of my children and for monitoring the presence of pests and diseases on my crops”.

Ms. Em Lim, 38 years old with three children, in Kraing Chek village, Kraing Chek commune, Odong district, Kampong Speu province

8.2.3 Field report of a farmer using plastic mulches

“It was raining heavily for three days, and my home garden is always affected by waterlogging, yet with plastic mulch my vegetables still looked fresh and healthy. Normally, the vegetables rotted and died whenever the garden was waterlogged.



Plastic mulch is not only preventing vegetables from rotting, but it also helps to prevent fertilizers from washing away by runoff water and prevents weed growth. In comparison to my conventional way, the yield of my vegetable crops such as yard long bean, tomato and cucumber was doubled using plastic mulch.

I am interested in this practice and willing to use my own investment in the future. My relatives and neighbours are also interested in my garden where I use rooftop rainwater collection, drip irrigation and plastic mulch and I am also willing to share my experience with them”.

Mr. Mr Moeung Chea, a 61 years old living in Thmor Matey village, Yuth Samaky commune, Odong district, Kampong Speu province.

8.3 Context of implementation

8.3.1 Social - Target group

Smallholder farmers.

9. Minimum requirements for the successful implementation of the practice

- Possess the financial means to acquire the necessary materials to build the rooftop water harvesting system, a drip irrigation system, plastic mulching and seeds.
- Farmers, normally, would need capacity development (for example through Farmer Field Schools) to learn how to construct and maintain those solutions.
- As a general rule, rainfall should be over 50 mm/month for at least half a year or 300 mm per year (unless other sources are extremely scarce) to make rainwater harvesting feasible.
- Maintenance of the drip irrigation system should be conducted in order to prevent clogging of the drippers.

10. Further reading

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11. Agro-ecological zones

- Tropics, warm

12. Objectives fulfilled by the project

12.1 Women-friendly

This practice helps women farmers in saving rain water and take off the burden of fetching water daily. Constructing the rooftop rainwater harvesting system may require some men help.

12.2 Resource use efficiency

Water can be saved and used in dry season which is crucial for agriculture products success and consequently the nutrition of the farmers' family.

12.3 Pro-poor technology

This practice helps reduce the effects of climate change which improves safety, health and food security, contributing to poverty alleviation.