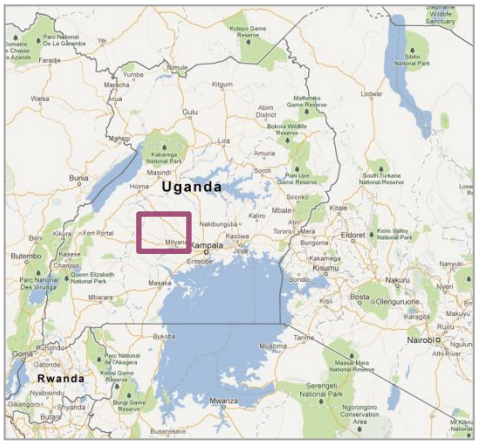
coffee & climate
enabling effective response

Case Study – Bottle Drip Irrigation

Case Study Background Data		
Tool Category: Adaptation on the farm		**Detail:** Plant Density: ⦸ 1,111 trees/ha Soil Type: Loamy soil Shade Regime: No shade Farming System: Coffee Banana farming system Yield Range (kg cherry/ha): - ⦸ rain: 900 – 1300mm/year
Variety: Robusta		
Climatic Hazard: • Prolonged dry spells and high temperatures		
Expected Outcome: • Improved coffee seedling survival and growth rate during the dry season		
Implementation Date: Dec 2014 – March 2015 & June2015 – August 2015	**Altitude:** 1,074 m **GPS:** 0.831087˚N 32.496865˚E	**Slope of plots:** Modest to flat slope ⦸ **Age of trees:** 0 – 1 year
No. farmers: 5 demo plots	⦸ **Area under coffee:** 0.8ha/farmer	Tested on demo plots

Results

Coffee production is severely affected during the dry season when most of the newly planted coffee seedlings dry out. Young coffee trees are more vulnerable to drought and high temperature because the root systems are still poorly developed. The dry spell normally lasts from December to March and from June to August every year. The survival of the coffee seedlings depends on the possibility of providing adequate soil moisture during the dry months. This can be done using water bottle drip irrigation units.

To make drip bottle irrigation units, use plastic bottles that once held drinking water, fill them with water and plant them alongside individual plants with the bottle opening into the soil next to a coffee plant. The dense soil hinders the water from leaving the bottle immediately, instead, it gets released slowly and directly besides the roots, so it is available to the plant for a longer time and the water doesn't evaporate directly.

In the study, the bottle irrigation system gave overall better performance with respect to coffee seedling survival and growth rates. All host farmers reported almost 100% survival rates on the coffee plots where they applied bottle irrigation and reported as low as 30% survival on plots where bottle irrigation was not applied.

Pros & Advantages + Learnings	**Cons & Disadvantages + Things to take into account**
• Relatively inexpensive as empty water bottles are readily available • Does not require technical expertise to implement • Can be implemented in short span of time	• Clogging of emitters • Plant root activity is limited to the soil bulbs wetted by the water bottle emitter • With many seedlings the method is labor intensive

• Has higher water use efficiency • Achieved balanced soil moisture in the active root zone • Adapted to any terrain and soils • It is easy to scale up its use for smallholder, resource poor farmers		• The method is limited to only seedlings and not effective for old coffee trees	
Acceptability	High	**Effectiveness**	High
Affordability	High	**Timing / Urgency**	High

What is the objective of applying the adaptation option and how do we expect the objective to be met?

Through focus group discussions in the FFS, prolonged dry spells were identified as the major climatic hazard affecting smallholder coffee farmers in Luwero District. Prolonged dry spells leads to high mortality and slow growth of coffee seedlings. The objective of this adaptation option is to provide supplemental water to coffee seedlings during the dry season to increase the survival and growth rate of newly planted coffee seedlings.

How is the adaptation option applied?

Nr.	Step	Picture
1	Focus group discussions in FFS, farmers identified the climatic hazard affecting coffee production in their area. They decided on a range of actions which they could undertake to address issues relating to impacts of climate change to their coffee production. One of the adaptation options decided on is using drip bottle irrigation to reduce seedling mortality during the dry season.	

2	Selection of host farmers with newly planted coffee seedlings The experiment was replicated 5 times each with 2 treatments: bottle irrigation and no bottle irrigation.	
3	Installation of bottle irrigation system	
4	Re-filling of emptied bottle and other management activities	
5	Observation, recording and discussion of the results during the dry season. To find out to what extent bottle irrigation can support the coffee seedlings	 Coffee seedling with bottle irrigation  Coffee seedling with no bottle irrigation

Implementation framework

The study was conducted in Luwero district at GPS 0.831087°N 32.496865°E and at an altitude of 1,074m above sea level, under the Global Climate Change Alliance Project implemented by Hanns R. Neumann Stiftung Africa, funded by the European Union and coordinated by the Food and Agriculture Organization of the United Nations.

The area receives an average annual rainfall of between 1,500 – 2,000mm. The rainfall pattern is bimodal with the long rains in March to June and short rains in October to December. The average annual temperature range is 15°C -25°C. The soils are loamy, deep and well-drained.
The experiment started in the middle of the dry season when no rainfall was expected. It was hosted by farmers who had access to water for irrigation and had newly planted young coffee seedlings spaced at 10ft within and 10ft between rows. Five replications were made in different farmer plots, each composed of 50 coffee seedlings. The study aimed at finding out the contribution of bottle drip irrigation to the growth and survival rates of coffee seedlings during the dry spell.
The experimental design consisted of two treatments; T1 – coffee seedlings with inverted water bottle with water and T2 – coffee seedlings without a water bottle to act as a control.
To make drip bottle irrigation, use plastic bottles that once held drinking water, fill them with water and plant them upside down next to the coffee tree with its neck into the soil next to a plant. The dense soil hinders the water from leaving the bottle immediately. Instead, it gets released slowly and directly besides the roots, so that it is available to the plant for a longer time and the water cannot evaporate directly. The water bottles were refilled whenever water was used up. Seedling growth analysis and survival rate were monitored monthly by undertaking physical measurements of the growth rate to evaluate the performance of drip bottle irrigation system.

Measurement strategy for effectiveness

Indicator	Survival rates and seedling growth analysis
Definition	Survival rate – Percentage of surviving seedlings Seedling growth analysis: i) Height of seedlings ii) Number of leaves per seedling iii) Colour of leaves on the seedlings iv) Rolling and wilting of seedling leaves
Purpose	Survival rate – To determine the number of coffee seedlings that survived through the dry season Seedling growth analysis: Height of seedlings and number of leaves show rate of seedling growth

	Colour of leaves and rolling & wilting show availability of water
Data Collection	Host farmers and farmer group members made observations for indicators and a Field Officer interviews the host farmers. Plant height (cm) was measured from the ground to the growing apex of the main stem. At the same time of measuring the plant height, the number of leaves formed on the main branch were counted and recorded.
Tool	Designed data collection template
Frequency	The indicators were monitored/assessed every month
Responsible	Host farmer, FFS members and Field Officer
Reporting	Host farmer/FFS members to Field Officer
Quality Control	Replication, close/regular monitoring, training of host farmer and farmer group on recording template, comparison of results from different host farmers.

Main findings of case study

- Coffee seedlings were in good health when the study commenced. In the course of the study the seedlings which were not irrigated showed signs of wilting (which ultimately resulted in completely drying out of the coffee seedlings in some cases).
- Introduction of bottle irrigation reduced the percentage of seedling mortality.
- By comparison, the growth rate for coffee seedlings bottle irrigated were higher than those not irrigated. In all assessed periods, the average height and number of pair of leaves on the coffee seedlings were higher on bottle irrigated seedlings compared to non-irrigated seedlings planted at the same time.
- Coffee leaves on coffee seedlings with bottle irrigation were shiny, elliptical and more dark green compared to coffee seedlings which were not bottle irrigated.
- Drip bottle irrigation minimizes moisture stress which leads to faster and vigorous growth of newly planted coffee seedlings.

In conclusion, bottle drip irrigation can effectively enable coffee farmers vulnerable to drought to improve the growth and survival rate of their coffee seedlings particularly in areas that have low water supply in a dry season.

Acceptability					
Leading Question: To what extent did farmers readily accept this tool as useful for implementation and implement it as planned?					
High	X	**Low**		**Don't Know**	
High: Farmers readily accepted this tool for implementation and through trainings in FFS many are implementing it in their fields beyond the trial.					

Please Comment:	
If there was resistance to adopting this tool, why?	No resistance.
If farmers discontinued tool implementation later on in the process, even though they initially accepted it, why?	Farmers who are applying this technology only discontinued it at the end of the dry season.
Did this tool have any external issues or impacts (positive or negative) which influenced its acceptability? (Community, value chain?)	Low cost drip irrigation system.
Any other comments:	Farmers are readily accepting the tool because of the prolonged drought seedling survival rates are very low.

Affordability					
Leading Question: Are the costs of the tool affordable to farmers taking into account the initial investment, maintenance costs and the availability of inputs?					
High	X	**Low**		**Don't Know**	
High: Installation and maintenance cost of this tool are affordable to all farmers since the empty water bottles are freely available and the water needed to fill the bottles is very little.					

Please Comment:	
Are there any external costs? (to society or environment?)	No external costs associated. What is needed is time to collect and install the bottles.
If costs are high because inputs are not available, what inputs? And why?	-
Any other comments:	This technology needs extensive publicity among coffee farmers for future adoption because it can be afforded by everyone.

Effectiveness					
Leading Question: Does the tool provide the expected benefits to farmers?					
High	X	**Low**		**Don't Know**	
High: Farmers who adopted this technology are registering high survival rates for the seedlings.					

Please Comment:	
What benefits did farmers expect from this tool?	Increased survival rates for newly planted coffee seedlings through the dry season.
If the objective has not been met, why?	-

Have there been any significant external issues which influenced the effectiveness (positive or negative) of this tool? Please explain.	-
Any other comments about effectiveness	The method uses very little water compared to the flood irrigation method.

Timing / Urgency					
Leading Question: Is the amount of time that this tool takes to implement (from starting implementation until benefits accrue) reasonable to farmers?					
High	X	**Low**		**Don't Know**	
High: The tool takes a short time to implement.					
Please Comment:					
If implementation takes too long why?	-				
Any other comments about timing:	-				