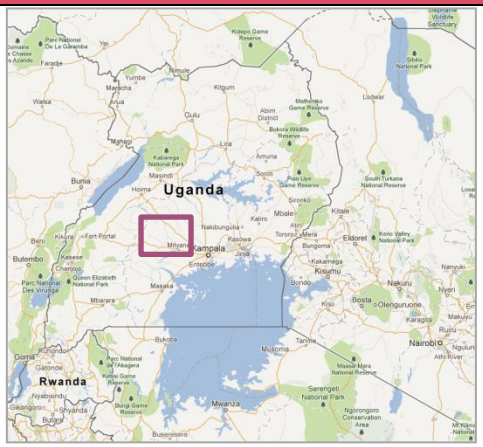
coffee & climate
enabling effective response

Case Study - Cover Crops

Case Study Background Data		
Tool Category: Adaptation on the farm **Variety:** Robusta **Climatic Hazard:** • Prolonged dry spells **Expected Outcome:** • Reduction of evaporation losses of soil moisture from soil surface.		**Detail:** Plant Density: 1,082 /ha Soil Type: Loamy soil Shade Regime: - Farming System: Coffee Banana farming system Yield (kg cherry/ha): 2,060 ⃠ rain: 900 – 1300mm/year
Implementation Date: Aug. 2014 –Dec. 2015	**Altitude:** 1,074 m **GPS:** 0.831087˚N 32.496865˚E	**Slope of plots:** Modest to flat slope ⃠ **Age of trees:** 5 – 10 years
No. farmers: 5 farmers	⃠ **Area under coffee:** 0.8ha/farmer	Tested on demo plots

Results

Cover crops are crops planted primarily to improve soil fertility, control soil erosion and reduce soil moisture evaporation losses from the soil surface. In this experiment, three different legume cover crops were planted with the objective of increasing soil water availability in coffee fields by improving rain water infiltration and conserving soil moisture by reducing soil moisture evaporation losses from the soil surface to prevent drought stress on coffee trees during the dry season. These were: Lablab purpureus, Mucuna purpureus and Desmodium intortum.

Results showed that Lablab and Mucuna provide early and better ground cover to the coffee intercrop than Desmodium. Lablab and Mucuna also exhibited less wilting of the coffee leaves in young coffee trees. Mucuna intercrop retained the most soil moisture content of all three cover crops. Overall, soil moisture content was highest in plots planted with Mucuna followed by lablab and least Desmodium.

There were significantly fewer weeds in legume cover crop plots, especially in Lablab and Mucuna cover crop plots compared to the control plot which had no legume cover crops. Desmodium was slow to establish and not effective in weed control at early stages of development but was very effective later when it had fully established and developed a dense ground cover.

Pros & Advantages + Learnings	**Cons & Disadvantages + Things to take into account**
• Conservation of soil moisture due to the mulching effect of cover crops • Increased infiltration of rainfall by decreasing runoff • Increased organic matter which increases water holding capacity • Reduced soil erosion • Can be used as fodder by livestock farmers • Improved soil fertility • Suppresses weed growth	• Dependence on external seeds of cover crops • Constantly creeps on the coffee trees • Mucuna and Lablab are susceptible to pests like the caterpillar which can also attack coffee

Acceptability	Low	**Effectiveness**	High
Affordability	Low	**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 discussion in the FFS, prolonged dry spells were identified as the major climatic hazard affecting smallholder coffee farmers in Luwero. These prolonged dry spells caused wilting of coffee plants and hence affected their development and productivity. Intercropping legume cover crops in coffee were expected to improve infiltration of rainwater and reduction of soil moisture evaporation loss from the soil surface. Therefore, different cover crops were planted in coffee plots with the objective of improving soil water availability due to reduction of evaporation losses of soil moisture from the soil surface. The full potential of cover crops to conserve soil water can be achieved when cover crops are planted just at the onset of the rainy season.

How is the adaptation option applied?

Nr.	Step	Picture
1	During 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 intercropping cover crops in their coffee gardens to reduce soil water loss through evaporation.	

2	Host farmers were identified and sites for the trial selected.	
3	Fields were prepared and legume cover crops were sown along the length of rows, halfway between rows of coffee trees keeping at least 0.5m clear between the cover crop and the coffee trees.	 Nursery bed for Desmodium  Newly planted Lablab
4	Cover crop management	 Coffee intercropped with Lablab  Coffee intercropped with Desmodium
5	Monitoring and recording the legume cover crops throughout the growing season for evaluation of their effect on soil moisture conservation.	

Implementation framework

The study was conducted in Luwero district in central Uganda, 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 between 900 – 1,300mm. The rainfall pattern is bimodal with long rains in March to June and short rains from September to November. The average annual temperature range is 17°C - 28°C. The soils are loamy, deep and well-drained.

The experiment was conducted between October 2014 and December 2015. The legumes were intercropped with mature Robusta coffee at a spacing of 3m by 3m. Three legume species were sown in October 2014 in the coffee fields with recommended spacing.

The experiment was replicated five times on different farmer coffee plots. For each treatment, the plot size was 10m long and 5m wide, separated by 3m, each surrounded by 8 coffee plants. A separate coffee plot without cover crops was established adjacent to the coffee-legume intercrop and maintained throughout the experiment to act as a control. The different treatments were designated as follows: T1 - Coffee + Lablab, T2 - Coffee + Mucuna, T3 - Coffee + Desmodium and T4 – Coffee alone with no cover crop.

During the dry season, the host farmer together with the FFS members closely supervised by Field Officers, collected data and made observations on the effect of cover crops basing on the selected indicators. Soil moisture content was determined in plots of sole and intercropped Mucuna, Lablab and Desmodium every month.

Measurement strategy for effectiveness

Indicator	Soil moisture, plant and cover crop growth analysis
Definition	Plant growth analysis: i) Rolling and wilting of leaves ii) Colour of leaves Cover crop growth analysis: Early ground cover Soil moisture: Percentage of wetness of the soil
Purpose	Rolling and wilting – Helps to rate water stress of coffee plant during prolonged dry spell Colour of leaves– Shows level of nutrients and moisture in the plant Soil moisture – Helps to show the amount of water available for coffee plant root uptake for growth during the dry period Early ground cover – Helps to show the effectiveness of covering the ground surface for soil water conservation

Target	Reduced crop stress, healthier looking coffee plants and higher degree of soil moisture compared to those who are directly exposed to climatic hazards.
Data Collection	Host farmers and farmer group members make observations on indicators and host farmers are interviewed by Field Officers
Tool	Designed data collection template
Frequency	Once a month
Responsible	Host farmer, FFS members and Field Officer
Reporting	The results of the comparison are discussed during Farmer Field School meetings and c&c trainings within the farmer groups on the demo plots.
Quality Control	Replication, close/regular monitoring, comparison of results from different host farmers

Main findings of case study

- Mucuna pruriens and Lablab purpureus are the fastest growing ground cover. Mucuna can reach 100% ground cover in 2 to 3 months after planting. Desmodium intortum is slow in establishment. It is able to achieve 100% ground cover after about 6 months after planting but has high sustained ground cover compared to Mucuna and Lablab.
- There were significantly fewer weeds in legume cover crop plots, especially in Lablab and Mucuna cover crop plots compared to the control plot which had no legume cover crops. Desmodium was not effective in weed control at early stages of development but was very effective later when it had dense ground cover.
- Soil in the coffee plots intercropped with cover crops maintained higher moisture content during long dry periods compared to uncovered plots. The difference in soil moisture content among the legume cover crops varied depending on the ground cover. Overall, soil moisture content was highest in coffee plots planted with Mucuna, followed by Lablab and least in Desmodium of all three cover crops.
- There was less wilting of the coffee leaves in young coffee trees under cover crops compared to plots which were not intercropped with cover crop.

In conclusion, legumes have been found useful as cover crops in coffee for preservation of soil moisture. Legumes that are good at preserving soil moisture are those that are excellent forage and those that spread rapidly to provide complete soil cover between the established coffee trees.

Acceptability					
Leading Question: To what extent did farmers readily accept this tool as useful for implementation and implement it as planned?					
High		**Low**	X	**Don't Know**	
Low: Farmers have not rejected this tool but its implementation right now is still only limited to the demo host farmers.					

Please Comment:	
If there was resistance to adopting this tool, why?	Lack of cover crop seeds.
If farmers discontinued tool implementation later on in the process, even though they initially accepted it, why?	Some farmers complain that the cover crops keep trailing on the coffee trees. Desmodium takes long to establish but a good ground cover.
Did this tool have any external issues or impacts (positive or negative) which influenced its acceptability? (Community, value chain?)	Some farmers widely accepted cover crops because they served other purposes for them like acting as fodder for livestock.
Any other comments:	There has been criticism from outside that cover crops use soil water while growing. This can lead to competition with the intended crop.

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		**Low**	X	**Don't Know**	
Low: Cover crop seeds especially Desmodium are very expensive.					

Please Comment:	
Are there any external costs? (to society or environment?)	Cost for cover crop seedlings.
If costs are high because inputs are not available, what inputs? And why?	Cover crop seeds are not locally available.
Any other comments:	The cover crop seeds can be expensive at the beginning, but the farmers can reproduce the seed for the subsequent planting and also give some to other farmers.

Effectiveness					
Leading Question: Does the tool provide the expected benefits to farmers?					
High	X	**Low**		**Don't Know**	
High: The objective of the tool has been met for the farmers.					

Please Comment:	
What benefits did farmers expect from this tool?	Reduced crop failure due to prolonged dry spells and increased coffee yields and quality due to reduced coffee tree drought stress.
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.	Cover crops were a new adaptation technology to many farmers and the host farmers were eager to learn from it.
Any other comments about effectiveness:	Timely planting of cover crops results in good establishment and more biomass production compared to late planted cover crops. Mucuna however would require training by cutting off its tips to control trailing on coffee.

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 reasonable amount of time to implement.					
Please Comment:					
If implementation takes too long, why?			Taking into account the cover crop growing season, land preparation, planting and time to maturity.		
Any other comments about timing:			-		