coffee & climate
enabling effective response

Use of cover crop (*Crotalaria juncea*) like practice soil manage and adaptation to climate change in coffee.

Case Study Background Data		
Tool Category: Adaptation on the farm		**Details:** Planting Density: - Soil Type: Solos francos Shade Regime: No shade Farming System: Intense intercropping system Yield Range (kg cherry / ha) >10000 ⦸ rain : 1400 mm/y
Variety: Arabica		
Purpose: • Soil management • Water holding • Drought resistance		
Climatic hazard: • Drought • Rain • Temperature		
Implementation Date: 01.07.2017- 30.06.2015	**Altitude**: 1100m **GPS**: 22° 0'57.51"S; 45°25'15.79"W	**Slope of plots:** - ⦸ **Age of trees**: <5 years
No. farmers: 20	**Area under Coffee:** 0,5 ha/farmer	Tested with smallholders

Results

1. Use of cover crops improved the content of different nutrients in the soil and improved their balance - enhance soil fertility.
2. Increase the percentage of organic matter.
3. Observations in the field showed that soil covered with permanent crops (cover crops) maintains moisture over longer periods after a rain event.
4. For the weed control treatment, farmers needed two rounds of weeding with small machines and one with herbicide in preparation for the harvest.

Pros & Advantages + Learnings	**Cons, Disadvantages + Things to take into account**
• Increase of moisture into the soil. • Improve the content of nutrients and organic matter. • Reduce the use of herbicide. • Reduce cost of weed control.	• Dependence of external seeds of crotalaria (bi-annual crop). • Still requires some weed control • Need more successful case studies to adjust the practice for each context.

Acceptability	High	**Effectiveness**	High
Affordability	Don´t know	**Timing / Urgency**	Don´t know

Description of fieldwork

Nr.	Step	Picture
1	**Participative diagnostic.** Farmers identify their local problems and choose the main one to be studied through participatory experimentation.	
2	**Design of demo plot.** Farmers select the most feasible practice out of the different available alternatives in the locality. In the present case the use of a legume was selected and planted between the coffee rows. The design includes the definition of variables and indicators.	
3	**Installation on the field.** According to the experimental design, the farmers plant the seeds of crotalaria. They provided the initial sample of soil to analyze and contrast with the final analysis, after crotalaria has finished its cycle.	

4	**Management of crop.** During the FFS sessions, farmers attend the growing crop. It was necessary to do a weed control and to frequently observe the weeds for further managing decisions.	
5	**Evaluation.** After crotalaria finished its cycle (cut and incorporated into the soil at the flowering stage), farmers evaluate the effects with the help of a second soil analysis.	

Appendix

Implementation Framework

The study was implemented for a group of Farmer Field School (FFS) of "Barba de Bode", in Lambari Municipality. The FFS is a participatory methodology that was developed to improve the local capacity of the farmers. The goal is to identify their problems and search for solutions through experimenting. This experimentation has the objective to help farmers to understand the agro ecological processes and manage the system to achieve best results. The observation, the analyses of the problems and the decisions taken are key processes in the methodology.

The Hanns R. Neumann Stiftung Association from Brazil is promoting the application of FFS as a methodology of extension and strengthens the local capacities for the sustainable management of coffee.

Twenty farmers from *Barba de Bode* community identify climate change as one of the most important problems to be resolved. Use of cover crops as practice for improving the resilience of the coffee system was analyzed as a viable technology.

Case Study Methodology

- For the first year of testing, farmers collected information of the initial and final content of soil nutrients by analyzing soil samples sent to the laboratory. Others groups of FFS and leaders of the communities have responded to the experiment and are using another cover crop: *Brachiaria brizantha*.
- Farmers in the FFS met monthly to observe, analyze and to decide on the management of the study.
- Farmers follow the whole crop cycle of crotalaria, and compare initial and final analyses for the purpose of completing the study.
- Systematically, the facilitator asked the farmers about their impressions and implications for the use of this practice.

Main Findings of Case Study

	Final	Initial	Difference
pH in water	5,6	5	**+0,6**
P mg/dm^3	27,66	19,74	**+7,92**
K mg/dm^3	228	180	**+48**
Ca++ Cmoldc/dm^3	4,1	1,9	**+2,2**
Mg++ Cmoldc/dm^3	1,2	0,3	**+0,9**

Al++ Cmoldc/dm^3	0	0,5	**-0,5**
H+Al Cmoldc/dm^3	3,81	5,8	**-1,99**
Sb Cmoldc/dm^3	5,88	2,66	**+3,22**
t Cmoldc/dm^3	5,88	3,16	**+2,72**
T Cmoldc/dm^3	9,69	8,46	**+1,23**
m %	0	15,82	**-15,82**
V %	60,72	31,44	**+29,28**
O.M. dag/kg	2,7	2,3	**+0,4**
B mg/dm^3	1,8	0,8	**+1**

According to ALVAREZ. Victor Hugo, et al (1999), an appropriate range of acidity of soil between 5,5 to 6 is considering *Good*. Values down of 5,4 are considered *Low* and *Very low* and over 6,1 are considered High. *Crotalaria juncea* incorporated to the soil improved the range from low to good changed the acidity from 5 to 5,6.

Interpretation of phosphorus shows that ranges ≤4 mg/dm^3 are considered *very low*, 4,1-8,0 mg/dm^3 *low*, 8,1-12,0 mg/dm^3 *medium*, 12,1-18,0 mg/dm^3 *good* and >18,0 mg/dm^3 *very good*. *Crotalaria juncea* improved the content of phosphorus from 19,7 to 27,7 mg/dm^3.

Calcium ranges: v*ery low* (≤0,4 cmol$_c$/dm^3); *low* (0,41-1,20 cmol$_c$/dm^3); *medium* (1,21-2,4 cmol$_c$/dm^3); *good* (2,14-4 cmol$_c$/dm^3) and *very good* (>4,00 cmol$_c$/dm^3). *Crotalaria juncea* improved the range of calcium from 1,9 cmol$_c$/dm^3 (medium) to 4,10 cmol$_c$/dm^3(Very good).

MATIELLO, J. et al (2009), the ideal level of H+Al is between 2,0 - 4,0. Crotalaria helped to decrease values from 5,8 to 3,8 and there was a rise of organic matter in 0,4%, favoring general soil condition. Boron was raised to over 1 mg, eliminating the requirement to amend this element through fertilization.

The value of the sum of bases (Sb) increased, reducing the need for liming. MALAVOLTA, E. (1989)

Acceptability					
Leading Question: To what extent did farmers readily accept this tool as useful for implementation and implement it as planned?					
High	☒	**Low**	☐	**Don't Know**	☐
High: Farmers readily accepted this tool for implementation and continue to implement it as planned.		**Low:** Farmers generally did not accept this tool; *Or* the tool was met with resistance later on, even though farmers initially accepted it.			

Please Comment:	
If there was resistance to adopting this tool, why?	No, there was not. Farmers are interested to multiply the use of cover crops and crotalaria.
If farmers discontinued tool implementation later on in the process, even though they initially accepted it, Why?	Farmers are adopting the practice and apply the principle of covering and protecting the soil with the use of crotalaria, brachiaria and native grass.
Did this tool have any external issues or impacts (positive or negative) which influenced its acceptability? (community, value chain?)	There are some studies in progress in the research institutes about the use of cover crops. Generally this topic has been of major research interest in recent years.
Any other comments:	

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**	☐	**Don't Know**	☐
High: The initial investment and the maintenance costs of this tool are affordable to farmers from their regular operations and the time it takes to recover the investment is reasonable to farmers. *Inputs (e.g. labor, electricity..) are available when they are necessary so that no extra costs are incurred from timing related issues.*			**Low:** The initial investment or the maintenance costs of this tool go beyond what is affordable to farmers from their regular operations or the amount of time it takes to recover the investments are unreasonable to farmers.		
Please Comment:					
Are there any external costs? (to society or environment?)			Just the cost of seeds. It can be expensive at the beginning, but the farmers can reproduce the seed for the new crops.		
If costs are high because inputs are not available, what inputs? And why?					
Any other comments:					

Effectiveness					
Leading Question: Does the tool provide the expected benefits to farmers?					
High	☒	**Low**	☐	**Don't Know**	☐
High: The objective of the tool has been met for the farmers.			**Low:** The tool did not fulfill its objective entirely.		
Please Comment:					
What benefits did farmers expect from this tool?			Protect the soils against climate events (strong rains and drought); improve the organic matter and other nutrients of the soil; management of weed; reduce the necessity for the weed control and use of herbicide.		

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	

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	☒	**Low**	☐	**Don't Know**	☐
High: The tool takes a reasonable amount of time to implement (taking into account the coffee growing season, inputs necessary, preparation time and implementation time); *And* this tool accrues the effects expected within a reasonable amount of time.		**Low:** It takes too long to implement this tool (taking into account the coffee growing season, inputs necessary, preparation time and implementation time); Or it simply takes too long for this tool to accrue benefits.			
Please Comment:					
If implementation takes too long why?		The tool shows results in a short period. For the second year we expect analyzes about the impact on the yield of coffee.			
Any other comments about timing:					