The **MED-GOLD** Living Lab

Turning climate-related information into added value for traditional food systems

May 25, 2020

“HOW CLIMATE CHANGE THREATENS COFFEE PRODUCTION AREA IN COLOMBIA”

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Coffea genus trees

Coffea Canephora var. Quillou (Conillon) from Gabon

Coffea Arabica var. Bourbon

Coffea Arabica var. Typica

OBJECTIVE OF STUDY

Overall objective

Study the interactions between climate variability and coffee cultivation in Colombia to identify potential costs to coffee farmers from the need of greater use of inputs.

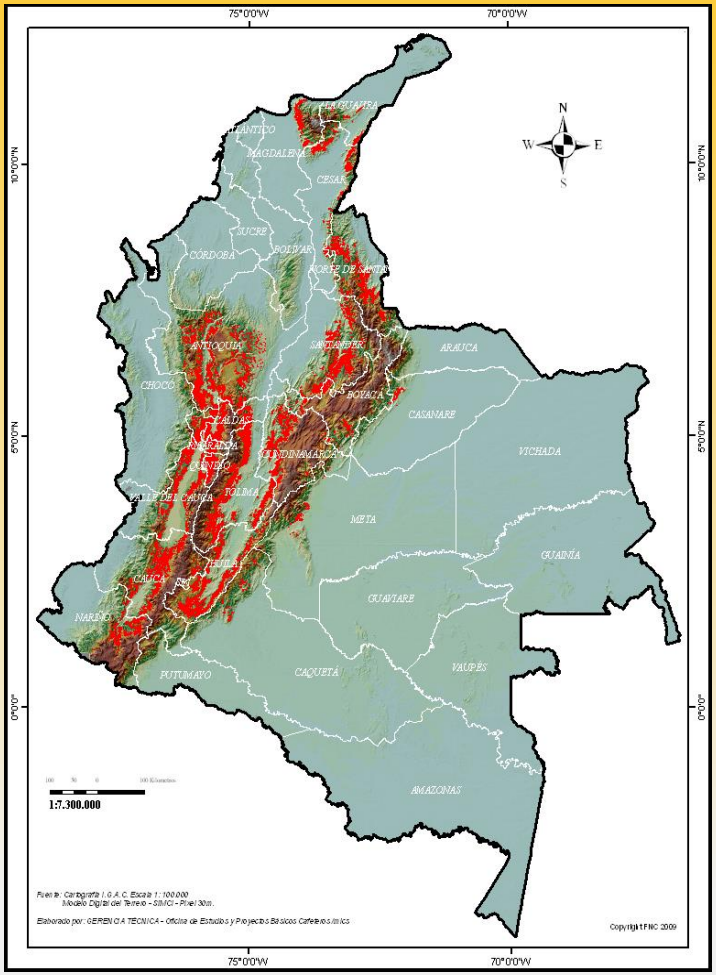
Detailed objectives

❶ Identify seasonal fluctuations of climate variables (Temperature and Precipitation) in one specific coffee production region of Colombia.

❷ Assess the impact of climate change on distribution of inputs (fertilizers and pesticides) coinciding with certain stage of crop development (flowering and fruiting).

❸ Implement an easy-to-use method from farmers to set adequate inputs management strategy to maintain the nutritional and phytosanitary balance of the plants, thus alleviating the deleterious effects of climate change.

COLOMBIAN COFFEE AT A GLANCE

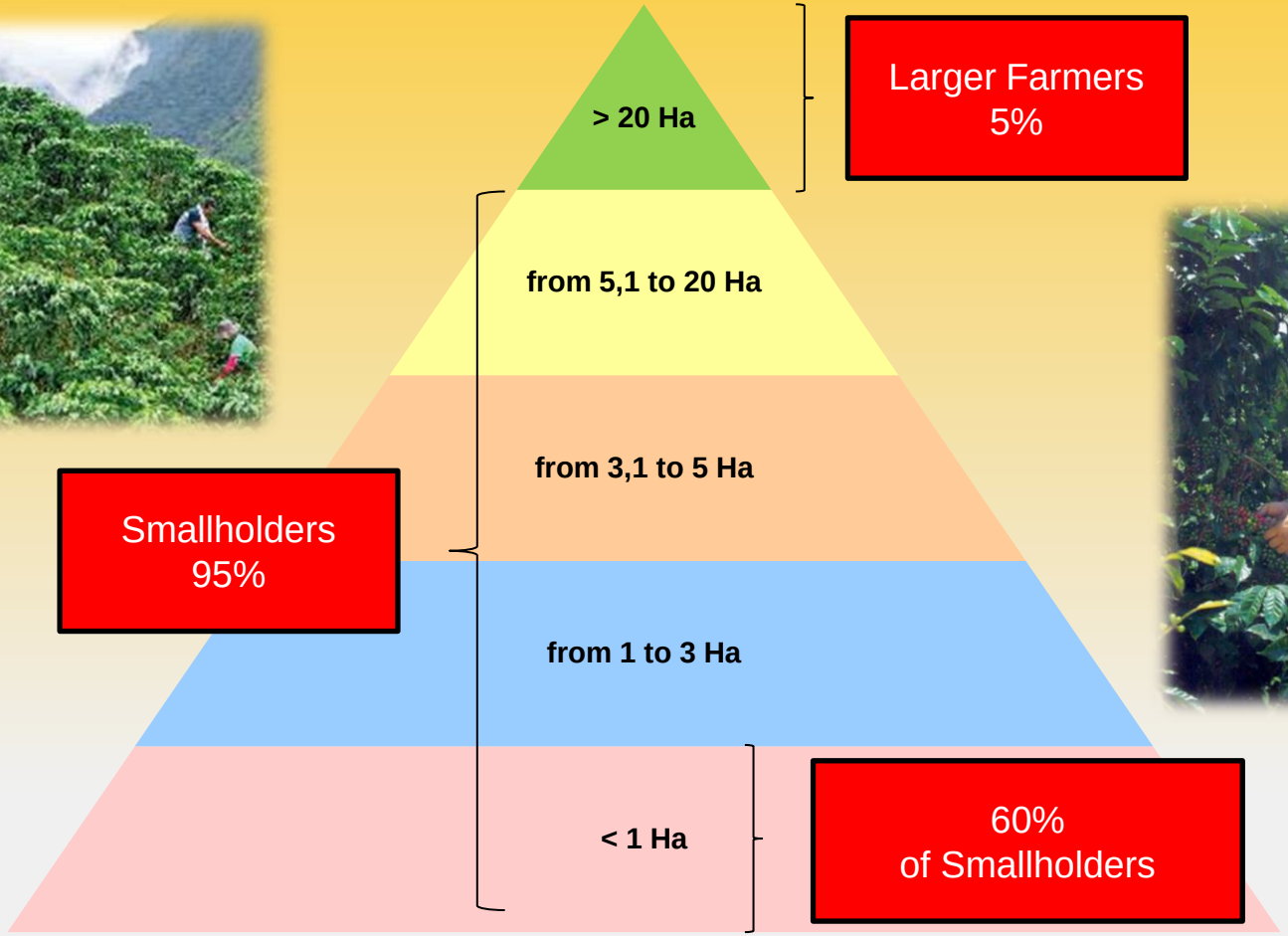


• World rank	World's 2nd largest Arabica producer
• Coffee economy	12% of GDP 8% of total Exports
• Coffee Planted Area	875,000 ha approx.
• Technified crop	780,000 ha
• Area Harvested	640,000 ha
• Coffee Municipalities	600 (53% of the total)
• Coffee Regions	14
• Huila/Antioquia/**Tolima**	46% Colombia total output
• Rural population depending on coffee farming	25% (=2.2 million people)
• Nr. of Coffee Growing Families	540,000

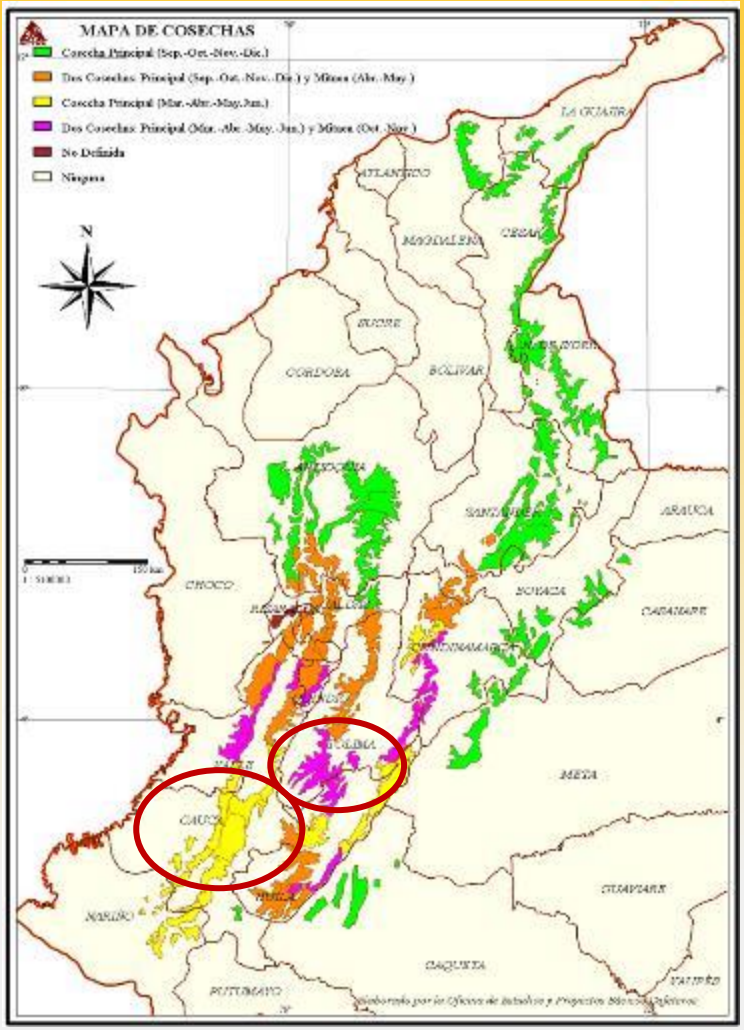
Source: FNC, USDA 2019

95% of coffee plantations are 5 hectares or less

COFFEE GROWERS COMPOSITION by coffee area



Location under investigation



Colombia is the "*land of diversity*" where coffee is harvested throughout the year

- coffee region of **CAUCA**

  one harvesting season: from March to June

  and

- coffee region of **SOUTH-TOLIMA**

  two harvesting season:

  Principal : from March to June

  Mitaca: October-November

DETAIL ON FARMERS TYPE

Type	Farm Size (ha)	Variety	Number of Farms (*)
Large farms	Large (> 20 ha)	N/A	28,000
Small farms at high altitude	Small (< 5 ha)	High (> 1,600 m)	155,000
Small farms at medium altitude	Small (< 5 ha)	Medium (1,200-1,600 m)	235,000 *(42%)*
Small farms at low altitude	Small (< 5 ha)	Low (> 1,200 m)	145,000

(*) Tot. Approx. 560.000 (FNC, 2016)

The major factors determining coffee yield and quality:

Temperature
Precipitation/duration of dry season
RHA
Solar Radiation

Table 1. Climatic conditions at Arabica coffee locations used in the analysis.

Variable	Unit	Mean	Std. Dev.	Min	Max
Annual Mean Temperature	°C	20.74	19	14.20	25.60
Mean Temperature of Warmest Quarter	°C	21.98	20	14.70	27.20
Mean Temperature of Coldest Quarter	°C	19.07	21	12.10	24.90
Annual Precipitation	mm	1875	703	754	4199
Precipitation of Wettest Month	mm	315	106	99	755
Precipitation of Driest Month	mm	40	49	0	291
Precipitation Seasonality[1]	-	67	23	8	114
Precipitation of Wettest Quarter	mm	832	277	263	1967
Precipitation of Driest Quarter	mm	142	158	2	939
Precipitation of Warmest Quarter	mm	516	194	36	1307
Precipitation of Coldest Quarter	mm	248	256	2	1332
Mean Diurnal Range	°C	11.49	17	77	181
Isothermality[2]	-	7.39	8	48	92
Temperature Seasonality[3]	-	115.83	657	118	426.2
Max Temperature of Warmest Month	°C	28.44	24	19.8	34.9
Min Temperature of Coldest Month	°C	12.76	26	4.8	19.9
Temperature Annual Range	°C	15.68	30	8.9	25.3
Mean Temperature of Wettest Quarter	°C	21.35	20	14.3	26.5
Mean Temperature of Driest Quarter	°C	19.83	23	12.1	25.7

[1]Coefficient of Variation
[2](Mean Diurnal Range /Temperature Annual Range)* 100
[3]standard deviation* 100

CLIMATE CONDITIONS OF ARABICA
(The bioclimatic variables include annual mean temperature and precipitation, and extreme or limiting factors that are ecologically important)

Effects of climate change in Colombia

(Source: FNC, 2012)

- **2008 – 2009**
  - EL NIÑO (Higher temperature – change in currents and winds in the Pacific Ocean)
    - Non typical dry weather in Colombia » Increased berry borer
  - Low Fertilization
  - Lower production as of 2009

- **2009 – 2010 – 2011 – 2012 (1st. sem.)**
  - LA NIÑA (Lower temperature in the Pacific Ocean, affecting climate in Asia and America)
    - Rain above normal levels

      Less (16%) than sufficient sunlight and high humidity (28%)

      » No hydric stress to induce flowering

      » Low and / or delayed flowering

      » Increase in coffee rust
    - Older trees and non-resistant varietals
    - Less coffee production

Climate change increase occurrence of coffee pests and diseases

Dorsal view (**a**) and detail (**b**) of an adult female **Coffee Berry Borer**. Female adult on a coffee berry (**c**). Damage caused by larval feeding on the coffee bean (**d**). *(from L. H. Ziska et al., Agronomy, 2018)*

The major factors contributing to the incidence and severity of plant pests and diseases:

- Temperature,
- Relative Humidity,
- Precipitation.

CBB boring a hole at the tip of the cherry

CBB lays eggs inside the beans and larvae will feed with endosperm

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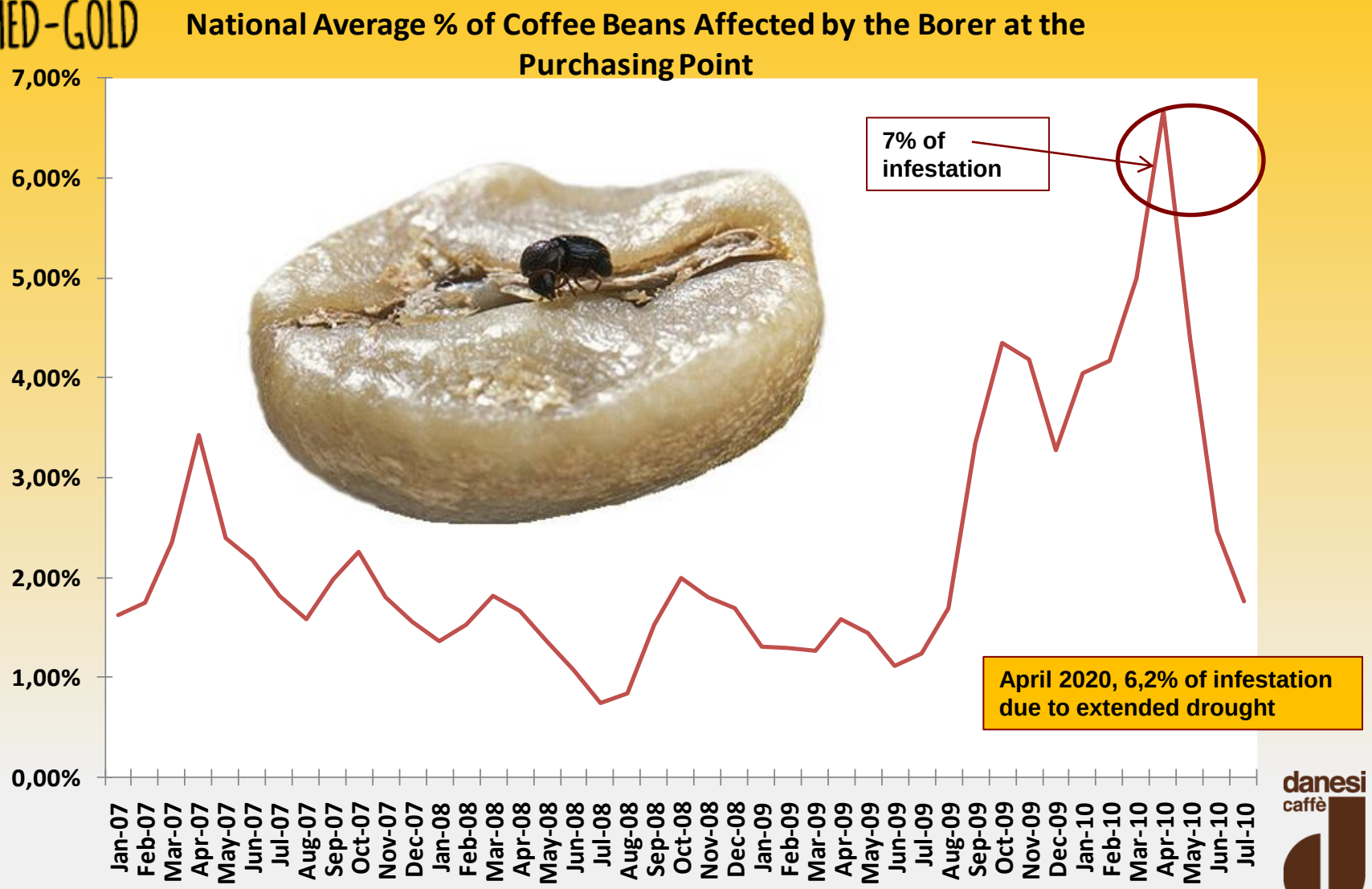
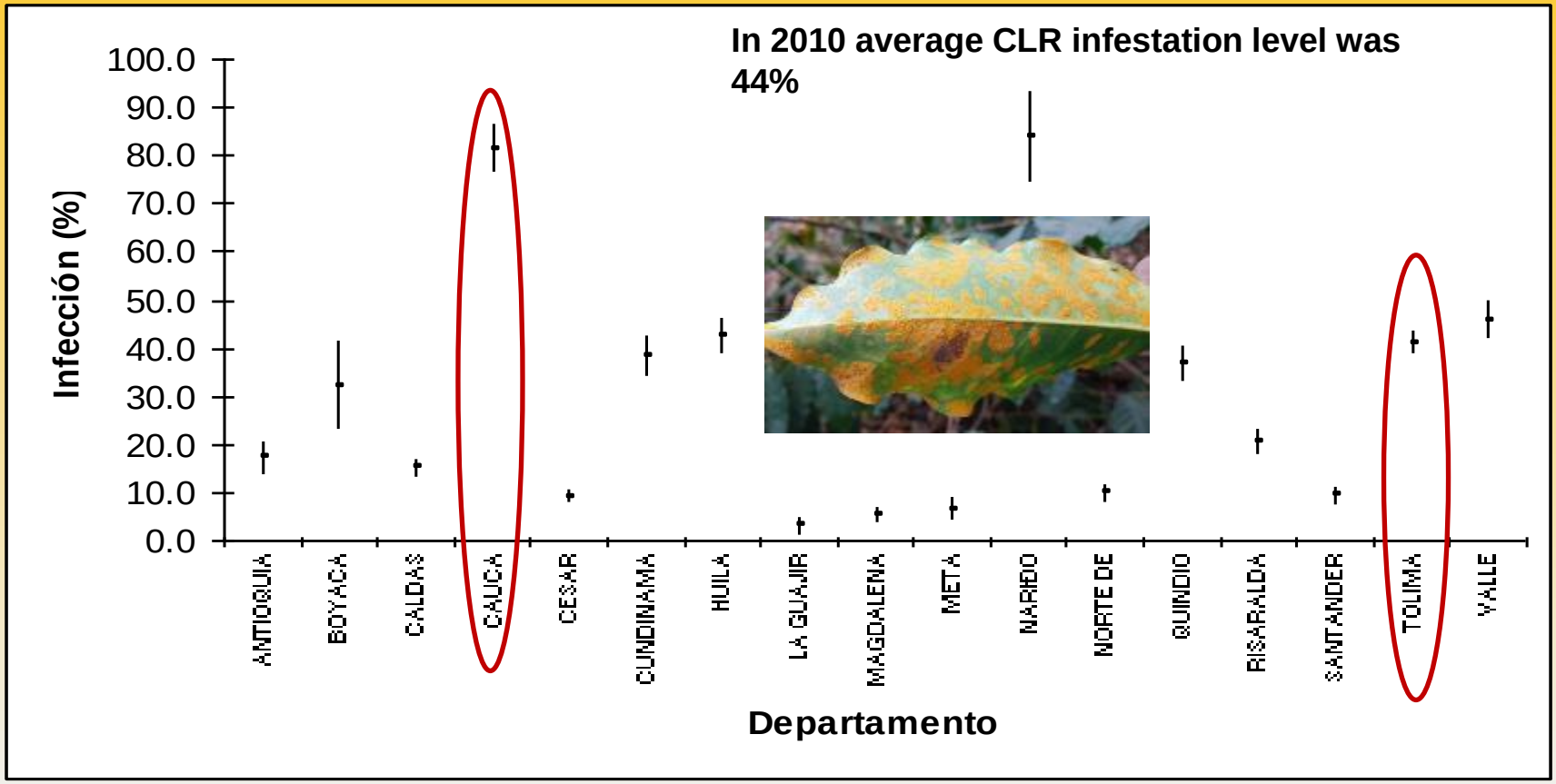
Higher temperatures in 2009 increased CBB infestation *(Source: FNC, 2012; USDA 2020)*



High humidity levels and non-resistants varietals increase Leaf Rust infestation, a foliage disease



(Source: FNC, 2012)

Climate Change increases coffee production cost – inputs and labor cost

Necessity to assess new fertilizers and pesticides management strategies and to introduce “better practices"

- ✓ change input distribution along the crop cycle trying to optimize the plant feeding to decrease losses by evaporation and leaching;
- ✓ change the timing of fertilizers application in a way that their application coincide with certain physiological events and phenological stages (flowering, fruit setting, ripening).

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Some keys action in the short and longer-term to the future of coffee farming :

- to improve farmers individual existing knowledge
- to build institutional capacity
- accelerate farmers (millions of remote smallholders) ***knowledge and technology transfer enabling more efficient use of inputs***
- enable financial mechanisms for credit access
- address land degradation
- implement ***early warning systems***

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Thank you

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