

Soil regeneration for coffee agroforestry

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Climate change and desertification challenges to coffee production

The Mantiqueira region, in southern Brazil, is suffering the effects of droughts and soil degradation, the state of Minas Gerais is considered to be under desertification process accelerated by climate change. New regenerative production models, which consider soil micro-life restoration, nutrient cycle reestablishment and moisture conservation are needed so that coffee production can thrive under these harsh conditions while eliminating chemical fertilizers and agregating value.

The project implemented

A regenerative and elastic agroforestry system was designed, considering conservative soil management techniques, aiming to maximizing biological nutrient cycling and water retention, improving coffee resilience on drought slope zones in Monte Sião, MG, Brazil. Final model with explained arrangements and units is shown in illustration 1.

The ancestral method

For soil life regeneration, and water and nutrients retention, an ancestral method based on Anthropogenic Dark Earth formation was employed, mainly based on charcoal and sawdust deposition. High nitrogen fixer species were selected for alley green manure. Selection and arrangement of species considered succession, stratification, shade tolerance, treetop architecture, permeability, lifecycle, root depth, nutrition and water need. Agricultural and forestry crops are *Macadamia ternifolia*, *Coffea arabica* - Catucaí 2SL (perennial crops) and *Toona ciliata* (timber), *Musa paradisiaca* (short-cycle crop), and *Inga vera* (nitrogen-fixing, biomass-producing service species). A seed-mixture for alley biomass enrichment was composed using *Urochloa brizantha*, *Cajanus cajan*, *Helianthus annuus*, *Pennisetum glaucum* and *Crotalaria spectabilis*. Soil management and mulching method was established using a regenerative mix for nutritional fertilizing purposes, charcoal residues and ashes for raising soil CEC, coffee rusks + poultry manure (12% N) and eucalyptus sawdust for soil covering. All attributes of the design were systematized (quantitative and qualitative variables).



Illustration 2. No-tillage conservative soil management during plantation, only subsoiling along planting lines.

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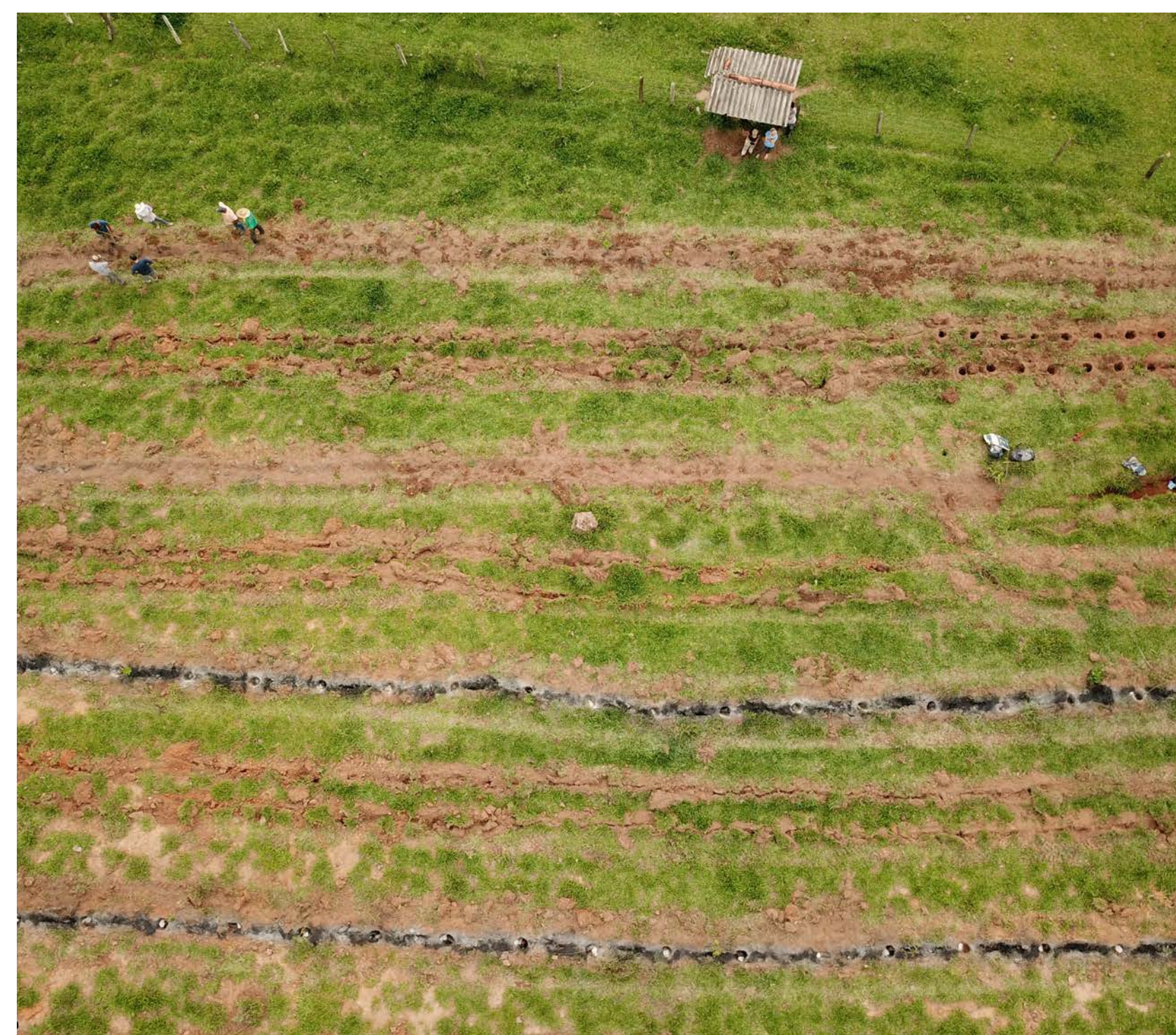


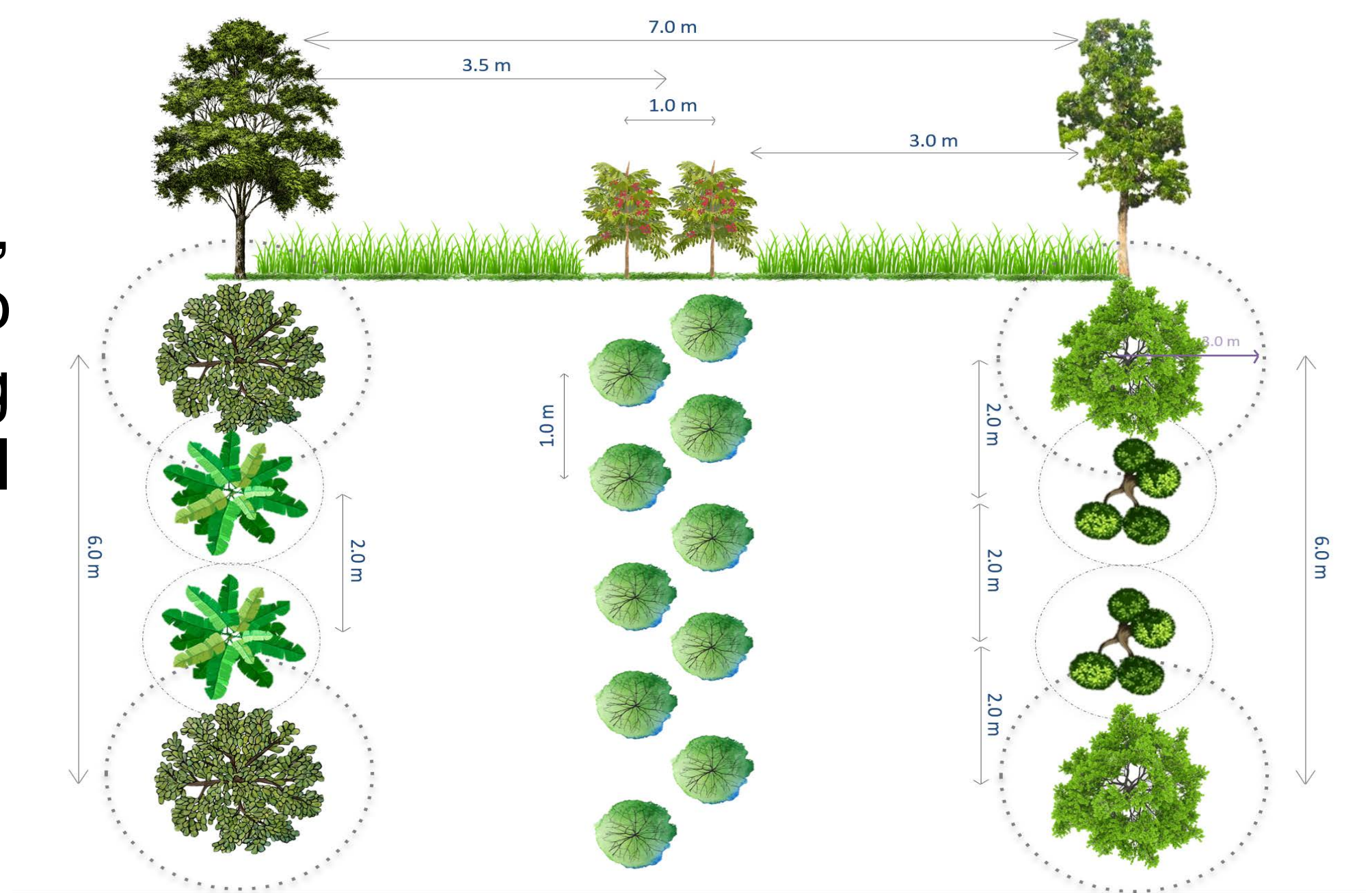
Illustration 3. Lime, ashes and charcoal added along subsoiled planting lines.

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Illustration 4. Coffee Agroforestry implemented after 10 months.

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- Macadamia integrifolia*
- Toona ciliata*
- Musa paradisiaca*
- Green manure
- Coffea arabica*
- Inga vera*

Main System		Green manure	
Species	Plant / ha	Species (seeds)	kg/ha
<i>Coffea arabica</i> (Catucaí 2SL)	2857	<i>Cajanus cajan</i>	30
<i>Toona ciliata</i>	119	<i>Helianthus annuus</i>	20
<i>Macadamia integrifolia</i>	119	<i>Pennisetum glaucum</i>	10
<i>Musa sp.</i>	238	<i>Crotalaria spectabilis</i>	10
<i>Inga vera</i>	238	<i>Urochloa brizantha</i>	30

Fertilizer		Soil cover	
Product	Kg/ha	Element	Ton/ha
Agricultural lime	893	Charcoal / Ashes	3
Agricultural Gypsum	400	Poultry Manure + coffee husk compost	30
Fertilizer 10:10:10	179	Eucalyptus sawdust	12

Illustration 1. Agroforestry design, and general quantitatives os the system. PRETATERRA © 2019

Results & Conclusions

With a cost of USD 6,316 / ha, the first 1 hectare was implemented in November, 2018 in the Farm “Café dos Contos” as a demonstrative model for local farmers, and entrepreneurs. Design, planning and economic analysis of agroforestry systems are fundamental for investment acceptance while integrated systems diversify revenues and maximize cash flow. Designing an elastic and highly acceptable agroforestry model for Mantiqueira coffee-based agriculture, will drastically improve soil conservation and crop resilience, while building a new sustainable productive paradigm.

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