
# Negotiation-support toolkit for learning landscapes

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# 11 | Climate: using local tree influences **(CooLTree)**

**Meine van Noordwijk, Jules Bayala and Kurniatun Hairiah**

Trees have a substantial influence on windspeed, maximum temperature during the day (especially on the hottest days of the year), humidity, minimum temperature and possibly play a role in modification of rainfall. Where the actual climate for crops, livestock and people is involved, one of the most effective things that people can do is manage trees, including tree planting. However, the official climate data that form the basis for climate policy exclude such effects and scientists are only slowly coming to grips with this issue. The CooLTree method contrasts the local, public/policy and science-based knowledge.

## Introduction

People associate climate issues with trees. Tree planting as a ceremonial activity has intuitive appeal in the context of climate change and is popular among politicians who want to show that they're not just talking about climate but are willing to act. At the micro-scale, this is a logical association as we seek the shade of trees on a hot day, seek shelter under trees if surprised by a rainstorm (but some know that deep-rooted trees attract lightning), select tree-covered roads to cycle against the wind (if living in a bicycle culture) and prefer trees around our houses to buffer both the heat of summer (or the day) and the cold of winter (or the night). Yet, trees have mostly been discussed in the climate-change debate in terms of their carbon storage and the contributions they make to the global carbon balance. Their more direct effect on micro- and mesoclimate is largely absent from the debates, including that involving agriculture.

Recent discussions about 'climate-smart' landscapes are changing the paradigm that adaptation to climate change will have to primarily consist of a change of crops and crop cultivars. Active management of 'cool' and cooling trees may offer opportunities that farmers are generally aware of but that have not yet been part of climate-adaptation planning in the formal and public knowledge domains. Van Noordwijk et al (2014) posed the hypothesis, and reviewed available evidence for it, that the presence of trees increases the degree of buffering of climate variability from the perspective of an annual food crop and that retention and increases of trees in agricultural landscapes can be a relevant part of climate-change adaptation strategies.

## Objectives

1. Explore the differences and synergy between the understanding of microclimatic effects of trees in local (LEK), modellers' and hydrologists (MEK) and policy makers' (PEK) ecological and climatic knowledge.
2. Contribute to the evaluation of 'climate smartness' of current landscapes and the options to modify the quantity, quality and spatial pattern of tree cover to obtain greater buffering.

## Steps

- **LEK:** Landscape transect walk during the hottest part of the day, with focus on microclimatic differences between parts of the landscape, discussing any advantages or disadvantages associated with the tree-cover effect on climatic variables of local concern.
- **MEK1:** Instrument typical transects in the landscape with various levels of tree cover with data-loggers that record temperature, windspeed and/or humidity and relate the neighbourhood effects of trees to the annual cycle of seasons and daily variability within seasons.
- **MEK2:** Discuss with local climate experts how information on microclimatic effects of trees in the local context can be used in existing downscaling routines for climate models to explore both the effects of macroclimatic change that are beyond local control and the tree effects that can be managed and optimized locally.
- **PEK:** Discuss with development agencies, local NGOs and government agencies interested in adaptation to climate change and reduction of human vulnerability to climate extremes the options trees offer to buffer climatic variation and provide a suitable microclimate.
- **LEK * PEK * MEK interaction:** Describe discrepancies between the three knowledge systems in an effort to get PEK and MEK closer aligned to LEK, for greater chance of success of any action plan.

## Example of application

1. In a case study in the Kali Konto landscape in East Java, Indonesia, farmers expressed a strong preference to have an intermediate level of shade trees in their coffee gardens. Measurements by students from a local university quantified the daily cycle of air temperature (measured inside the standard boxes of weather stations, thus avoiding direct radiation on the thermometer, and inside the soil at different depths), as summarized in Figure 9.1. This type of MEK confirmed the farmers' opinion and preferences and could be brought into discussions of climate-change vulnerability and adaptation.

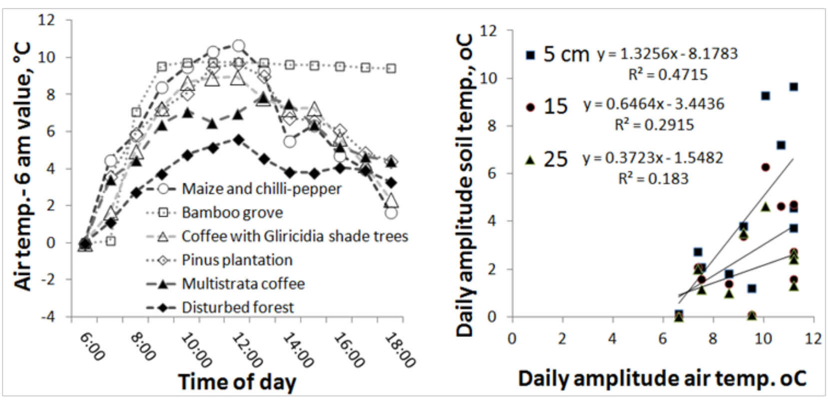


**Figure 9.1.** Daily temperature, air amplitude and soil temperature profiles for an East Java mountain location (Ngantang, Indonesia)

**Note:** A. Daily temperature profile for different land-cover types, including simple shade and multistrata coffee agroforestry systems, compared to (degraded) forest and open field agriculture (data were averaged for dry season and rainy season measurements); B. Relationship, across seasons and land-use systems, between daily amplitude of air temperature and temperature at 5, 15 or 25 cm depth of soil.

2 In the parkland agroforestry systems of West Africa, temperatures tend to be above the optimum for crop growth, at least during part of the growing season. Farmers have long since retained tree species with useful fruit in the landscape where they grow crops. The trees also provide welcome shade for domestic animals and people during the hottest part of the day. A network of microclimatic measurement with automatic data-loggers gives a quantitative idea of the effects (Figure 9.2). Temperature in the cropped zone under the tree canopy was found to be 2 $^0$C cooler but in the next circle beyond the canopy it was still 1 $^0$C cooler than in-between the trees. Further analysis will have to clarify to what extent this 'control' was influenced by the presence of trees in the wider landscape.

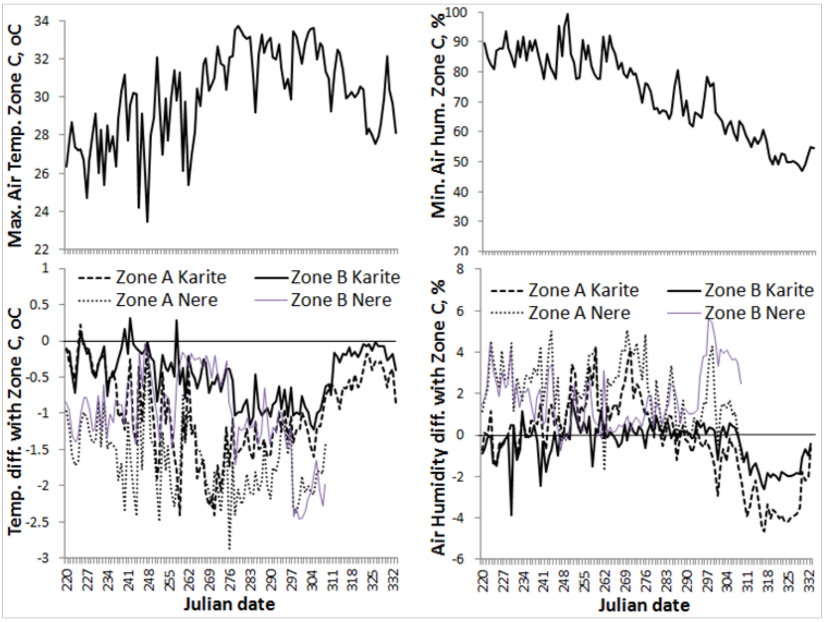


**Figure 9.2.** Effect of tree position

**Note:** Effect of position relative to a 'karité' (Vitellaria paradoxa) or 'néré' (Parkia biglobosa) tree on maximum daily temperature at crop level (left panels) or minimum air humidity (right panels) for zones A (under the tree) and B (edge of tree canopy ) compared to zone C (in-between trees) in the parkland landscape of Sapone, Burkina Faso.

**Data source:** Bayala et al 2013

As in the first case study, the immediate effects of trees on maximum temperature were found to be of a magnitude that is relevant for buffering macroclimatic change.

## Key references

Bayala J, Sanou J, Bazié P, van Noordwijk M. 2013. *Empirical data collection of tree effects on temperature and humidity at crop level.* Nairobi: World Agroforestry Centre.

Van Noordwijk M, Bayala J, Hairiah K, Lusiana B, Muthuri C, Khasanah N, Mulia R. 2014. Agroforestry solutions for buffering climate variability and adapting to change. In: J Fuhrer, PJ Gregory, eds. *Climate change impact and adaptation in agricultural systems*. Wallingford, UK: CABI.

The landscape scale is a meeting point for bottom–up local initiatives to secure and improve livelihoods from agriculture, agroforestry and forest management, and top–down concerns and incentives related to planetary boundaries to human resource use.

Sustainable development goals require a substantial change of direction from the past when economic growth was usually accompanied by environmental degradation, with the increase of atmospheric greenhouse gasses as a symptom, but also as an issue that needs to be managed as such.

In landscapes around the world, active learning takes place with experiments that involve changes in technology, farming systems, value chains, livelihoods' strategies and institutions. An overarching hypothesis that is being tested is:

> Investment in institutionalising rewards for the environmental services that are provided by multifunctional landscapes with trees is a cost-effective and fair way to reduce vulnerability of rural livelihoods to climate change and to avoid larger costs of specific 'adaptation' while enhancing carbon stocks in the landscape.

Such changes can't come overnight. A complex process of negotiations among stakeholders is usually needed. The divergence of knowledge and claims to knowledge is a major hurdle in the negotiation process.

The collection of tools—methods, approaches and computer models—presented here was shaped by over a decade of involvement in supporting such negotiations in landscapes where a lot is at stake. The tools are meant to support further learning and effectively sharing experience towards smarter landscape management.


World Agroforestry Centre

ASB Partnership for the Tropical Forest Margins

AARD

Federal Ministry for Economic Cooperation and Development

Norad

IFAD Enabling poor rural people to overcome poverty

CGIAR Research Program on Forests, Trees, and Agroforestry