RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

CGIAR CCAFS

Info Note

The Shade Tree Advice Tool

An ICT solution to advise coffee and cocoa farmers on shade tree selection

Just van der Wolf, Gil Gram, Hannington Bukomeko, David Mukasa, Onno Giller, Enoch Kirabo, Charles Angebault, Philippe Vaast, Richard Asare, and Laurence Jassogne

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Key messages

- Climate change adaptation for coffee and cocoa farming requires low cost and multipurpose solutions, such as shade trees.
- Selecting appropriate shade trees is paramount for maximizing tree-based ecosystem services while minimizing disservices.
- The shade tree advice tool presented here guides coffee and cocoa farmers on choosing shade trees whose ecosystem services will best meet their needs, based on fellow coffee farmers' local knowledge in their region.

Coffee and cocoa are major cash crops in Sub-Saharan Africa (SSA). Globally, areas suitable for coffee and cocoa production are predicted to shrink as temperatures increase and precipitation patterns shift. In Uganda, areas suitable for coffee production are also projected to reduce but Uganda will continue to produce coffee if farmers adapt to climate change (Bunn et al., 2015). If farmers do not adapt, Uganda risks losing the livelihoods for 3.5 million Ugandans directly involved in the coffee value chain (UCDA, 2012) and foreign export earnings from coffee exports, which was equivalent to $415 million in 2015/2016 (UCDA, 2016).

Effective adaptation to climate change among coffee farmers requires low cost and multipurpose solutions. In certain conditions this can be agroforestry, a practice of intercropping coffee and cocoa with trees (Vignola et al., 2015). Appropriate tree-selection is necessary, as shade trees provide both services and challenges. Services include the provision of shade, yield enhancements, food, timber, among others, while challenges include competition for nutrients and the increase in occurrences of pests and diseases. There is a lack of documentation of farmers' local knowledge, and the farmers also lack the tools and technical support to summarize such information to guide on-farm tree selection.

More often than not, shade tree recommendations only focus on the crop, yet farmers also keep trees for other purposes than to provide services to the cash crop. This research developed a prototype of a shade tree advice tool, which includes various selection criteria for suitable tree species that provide a variety of ecosystems services (ES). It thus also takes into consideration ES that are broader than ES focussing only on the cash crop, as the performance of the cash crop is but an element of the recommendations. These ES are geared for both livelihoods and climate change adaptation in different local environmental conditions. Since coffee and agro-forestry trees have long life spans (>50 years), the current trees will live long into the changing climates predicted for the next 30 years. Therefore, trees for adapting to the harsh climate in the future, as rainfall is becoming more erratic and temperatures are increasing, should be planted soon. The tool advises farmers upon the best set of trees to suit their priority ES.

This brief presents results of an investigation into developing 1) shade tree recommendations based on local knowledge and 2) a tool to bring these recommendations to stakeholders. It will first go through how the data was collected in order to build the database that the tool depends on to give advice. Then it will go through the various important functionalities that a prototype of the tool has built in, and how a farmer or intermediary can ask for specific advice tailored to their needs.

Data collection: building a database

The first case study to build up a database on shade tree recommendations, based on local knowledge, was done in Greater Mbale in Uganda. Figure 1 shows how suitability for growing coffee changes in time in Uganda, as well as how it changes up the altitudinal gradient in Mbale. The changes in suitability highlight a need for differentiated approaches to adaptation, based on the

site-specific constraints. There is thus a need for site-specific shade tree recommendations, not only based on the farmer specific needs or desires.

The data for the first prototype of the shade tree advice tool were collected across the altitudinal gradients in the Greater Mbale district in Eastern Uganda (see Figure 1). First, 150 coffee farming households were randomly selected, with representation from the three altitude gradients found in Greater Mbale. Thus 50 of these households where selected from the low, medium and high altitude zones respectively. An inventory of on-farm tree diversity was taken, noting down both names in the local language (Lugisu) and the botanical names in Latin. Based on this inventory, technical sheets with photos of the species were made.

Second, we surveyed 300 households, which included the 150 households from the first step, with an equal representation of 100 households per altitude. In the first part of the survey, farmers ranked the importance of the various tree-based ES (e.g. coffee yield increase, quality shade for coffee, food provision, among others) for their household in their altitude gradient. The second part of the survey consisted of presenting the farmer with the technical sheets of the 20 most abundant species of trees in their respective altitude gradients, and asking them to pick 10 trees with which they were most familiar. In the final part of the survey, the farmers were asked to rank these 10 trees in order of suitability to provide the 12 priority ES (Gram et al., submitted for publication).

In the next step, the data was analysed and compiled into a data set, which comprised of three subsets, one for each altitude zone corresponding to different climate exposures. After input from the user, the database generates advice for farmers, which is specific to the needs of the farmer in terms of ES and in the altitude zone where they are farming. To make the data easily accessible, a tool is being developed. In the next section a prototype of the tool is highlighted.

The Shade Tree Advice Tool: a prototype

To make the recommendations readily available, a prototype tool was developed (van der Wolf et al., 2016) and the prototype can already be found online (http://www.shadetreeadvice.org/) The intended users of this tool are public and private extension agents that are assisting the farmer with on-farm advice. The steps, from top to bottom, on how to use the tool are highlighted in Figure 2 (next page). As an example of how this tool can be used, a hypothetical set of choices by a coffee farmer in Greater Mbale is used.

The first step is narrowing down the location of the farm, from country down to the altitude zone in Greater Mbale. Then the user indicates their priority ES and assigns the weight of importance to each of these ES. The tool then generates a list of the top ten trees, with the top tree being the most relevant to the choices made by the user, moving down to the least relevant. The user can then find more information on the trees that have been recommended.

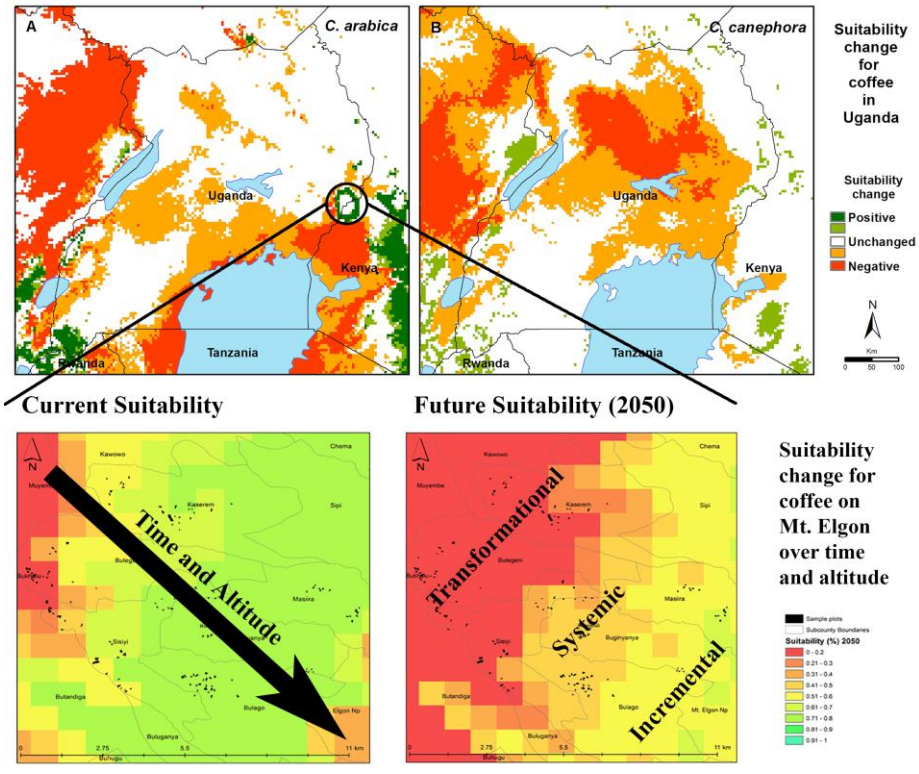

Figure 1: The maps depict how the different needs for adaptation change over time and up the altitude gradients on Mt. Elgon (based on data from Bunn et al., 2015).

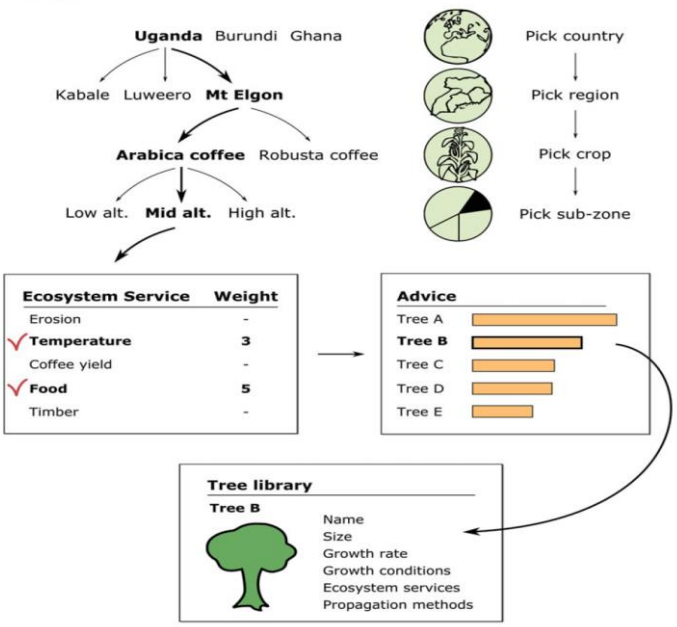

Figure 2: Flow chart of the shade tree advice tool (IITA, 2016).

Figure 3 shows the output of the prototype, where the user has asked for shade tree advice in the middle altitude range in Greater Mbale. The user is looking for a shade tree that: (i) regulates microclimatic temperature (weight 5); (ii) enhances coffee yield (weight 4) and; provides timber (weight 3). The advice shows that the most relevant tree given these requirements is Mukebu (*Cordia africana*).

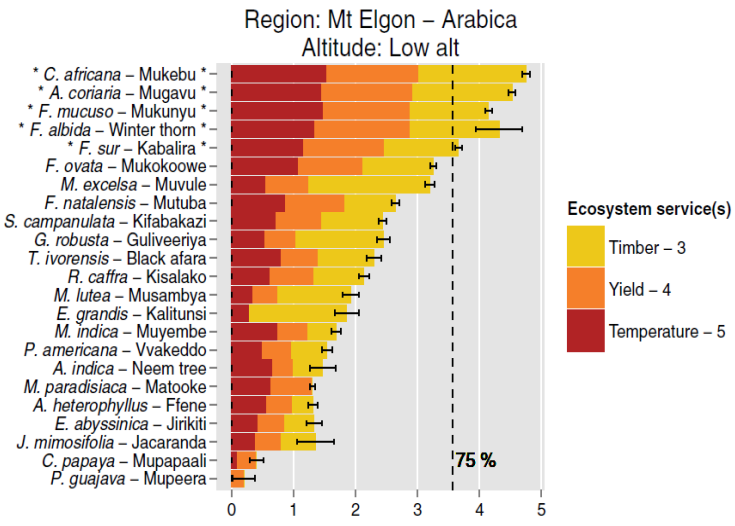

Figure 3: Shade trees advised to an Arabica Coffee farmer in low altitude sub zone of mountain Elgon region if their choice of Ecosystem services was timber provision, yield enhancement and temperature regulation weighted at 3, 4 and 5 respectively. The x-axis shows the 'score' given to the trees in terms of applicability to the weights that were given as input. The 75% is highlighted to identify the top species that fit the criteria (IITA, 2016).

As the tool is currently a prototype, it will continue to be worked on to make it more user friendly. As such, an offline application that can be installed on mobile phones is being developed. It is not only restricted to Uganda or coffee. Data on shade tree advice for cocoa in Ghana and coffee in China have also been collected and uploaded into the prototype. The tool is meant to be universal and applicable to all shade tree recommendations in perennial agroforestry systems. Therefore, similar data for other crops or regions can be easily included in the data base and added to the user interface. Please contact Laurence Jassogne for more information.

Conclusions

Appropriate shade tree selection is critical to maximize tree services and minimize tree disservices within coffee, cacao and other perennial agroforestry systems. This shade tree advice tool aims to address through integration of farmers' local knowledge into a readily accessible database to guide farmers' selection processes. Through repetition of the data collection methodology across coffee and cocoa farming systems in different regions, the tool has the capacity to give context-specific advice on shade tree that fits farmers' priorities. Future work needs to be done to compile more data in the database, as well as fine-tune the tool from the current prototype.

Recommendations

- Continue the data collection across coffee and cocoa systems (through sharing of the methodology) and compile them in the tool, in order to scale up the usability of the tool at a global level.
- Fine-tuning of the tool through continued development of the web tool, as well as development of an off-line application for installation on smartphones.
- Once the tool has been refined and launched, it can be used directly by farmers, as well as an extension tool by stakeholders that are directly involved in advising and training farmers. Within coffee and cocoa farming systems, this is a combination of public and private stakeholders

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Research led by

*For further inquiries contact **Laurence Jassogne** (L.Jassogne@cgiar.org)*

***Just van der Wolf** is a systems analyst and data expert, who worked at IITA as a consultant during the project.*

***Gil Gram** is a natural resource manager and PhD candidate based at IITA in Uganda.*

***Hannington Bukomeko** is an agroforestry consultant and PhD candidate at IITA in Uganda.*

***David Mukasa** is an agronomist specialising in coffee-based systems at IITA in Uganda.*

***Onno Giller** is an environmental anthropologist and a PhD candidate based at IITA in Uganda.*

***Enoch Kirabo** and **Charles Angebault** work for Metajua, who specialise in data storage and streamlining using ICT solutions.*

***Philippe Vaast** is a coffee and cocoa eco-physiologist and agroforestry specialist at CIRAD and a senior researcher seconded to ICRAF.*

***Richard Asare** is a cocoa scientist and an agroforestry specialist based at IITA in Ghana.*

***Laurence Jassogne** is a systems agronomist based at IITA in Uganda, and the project coordinator.*

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The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). CCAFS brings together the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security.

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