AgroforesTreeAdvice: an advice aggregator for tree species selection for agroforestry systems

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Tree species selection is a crucial step in the design of agroforestry systems, for which farmers expressed the need for decision support systems (DSS). A quick search among the partners of the DigitAF Horizon Europe project (https://digitaf.eu) allowed us to identify several such DSS, which had been developed independently, in different countries and for different agroforestry systems. These include DENTRO (tree selection for silvoarable and silvopastoral systems in Flanders), ShadeTreeAdvice (shade tree selection for coffee and cocoa agroforestry systems), SCSM (soil and climate suitability model for a range of trees and shrubs worldwide), Deciduous (fruit tree rootstock selection in France) and a Czech trees characteristics database. In this presentation, we present our joint efforts to develop a common framework in which these tools could all fit, in order to increase their i) findability (all tools are gathered in the same place), ii) accessibility (a common interface allows users to query the tools with interfaces having the same look and feel), and iii) interoperability (API requests can be used to query all tools).

Our hypothesis was that all tree selection tools work by matching tree traits to selection criteria defined by the user in order to provide a suitability score for each tree species, and that the selection criteria, although being different between different tools, could be organised in a structured way to make comparisons between tools possible. We considered that tree suitability depends on i) adaption to local conditions and ii) efficiency at providing the desired benefits (tree products and/or ecosystem services (ES). Based on the trait-function-service framework (Violle et al. 2007), we organized the data according to two types of tree traits: response traits (causing the response of the tree to its environment, and so driving its adaptation to local conditions) and effect traits (allowing the tree to perform functions leading to the production of ES, e.g. fulfilling the farmer's objectives). Criteria linked to the provision of ES (and therefore the matching effect traits) were organized following the CICES 5.1 classification (Haines-Young and Potschin 2018) at the highest levels, and subsequent levels were added when more details were needed (e.g. distinguishing between different uses of wood). In the absence of internationally recognized classification of criteria linked to the adaptation to local conditions, these criteria were organized as adaptation to soil, climate, biotic context, constraints at plot scale, constraints at farm scale and constraints at socio-economic level. As for ES, we classified these criteria in a hierarchical manner, allowing different levels of details according to the focus of each tool. Finally, we developed a shiny app using this common framework to interface with several tree selection tools.

Initial work on the five species/rootstock selection tools mentioned in the introduction proved that the idea is feasible: the criteria used in each tool were categorized according to the common framework. Table 1 shows the number of criteria of each top category in each tool. The shiny app aggregates the advice of these five tools. It allows users to define their site conditions and objectives, compute the adaptation and efficiency scores of each tree species and visualize the results in graph or table form; it also supports URL requests. It is available in six languages and can be tested at https://agroforestreeadvice.sk8.inrae.fr/.

After the proof of concept is done, we aim at enlarging the tool contributors beyond the limits of the DigitAF project. Therefore, we created a repository under EURAF GitHub account (https://github.com/euraf/agroforestreeadvice). The code is open-source and we welcome contributions (adding new languages, adding new tools, improving code). The tool will be tested and further improved within DigitAF Living Labs.

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Keywords
ecosystem services, online tool, climate, soil characteristics, Agroforestry system, trees, design, Plant species selection

Aditional Attachment I.

criteria		Tool					
type	category	Dentro	ShadeTreeAdvice	SCSM	DECIDUOUS	Czech	Total
effect	provisioning	6	16	1	7	106	136
	regulation	9	29	4		4	46
	other			2			2
response	climate	10	3	2	2	5	22
	soil	4			3	2	9
	biotic context	2					2
	constraints at plot level		1				1
	constraints at farm level				2		2
	constraints at socio-economic level						0
Total		31	49	9	14	117	220
Tree species		80	215	383	27	59	

Table 1 : Number of criteria of each type in each tool

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