INTEGRATING AGROFORESTRY INTERCROPPING SYSTEMS IN INTENSIVE AGRICULTURAL LANDSCAPES: A SWOT-AHP ANALYSIS OF STAKEHOLDERS' PERCEPTIONS

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Introduction

In recent years, agroforestry intercropping systems combining trees and crops have been introduced in Quebec as an alternative to monocropping systems. Landscape trajectory theories have identified physical and human interactions as key driving forces of land use change (Ruiz and Domon 2009). Within the scope of human interactions, local stakeholders' perceptions are likely to play a crucial role in landscape dynamics (Place et al. 2012). In this context, our study pursued three objectives: identify local stakeholders' perceptions of the driving forces influencing agroforestry intercropping systems implementation, 2) assess the potential of three agroforestry intercropping system alternatives according to these driving forces, and 3) compare the answers across various categories of stakeholders.

Methodology

The study was conducted in the Les Maskoutains regional county municipality. Located in the St. Lawrence lowlands, Les Maskoutains has 86 148 inhabitants and benefits from a mean annual temperature of 5,0-7,0°C and an annual rainfall of 850-1050 mm. From the 1 310 km^2 it covers, 1 257 km^2 (96%) are dedicated to agricultural purposes. In 2011, Les Maskoutains had 1 060 farms (CANSIM 2011), including oil seed and grain, hog and pig farming and dairy cattle and milk production. Les Maskoutains has a forest cover of 16%, 98% of which is on private land.

In February 2015, 10 stakeholders from five different categories (farmers, forestry advisors, farm advisors, urban planners and local authorities) were recruited using a purposive sampling method to participate in a focus group. Following the Strengths, Weaknesses, Opportunities and Threats Analytical Hierarchy Process approach (SWOT-AHP) (Saaty 2010), the participants were first asked to identify, by consensus, three local strengths, three local weaknesses, three external opportunities and three external threats impacting their decision to integrate agroforestry intercropping systems in their landscape. Then, participants quantified the 12 decision factors' relative importance by making pairwise comparisons using a rating scale. Finally, they compared three agroforestry alternatives developed by the research team (**Table 1**) on their relative potential to exploit each strength and opportunity and their relative potential to bypass each weakness and threat.

Table 1: The agroforestry intercropping system alternatives

No pictures were shown to participants to limit visual bias. The computer software Excel 2013 was used to analyze data generated from pairwise comparisons and ratings.

	« Crop » alternative	« Tree » alternative	« Landscape » alternative
Main objective	Crop yields	Tree production	Landscape aesthetics
Possible crops	Cereals Forage	Pasture Forage	Cereals Pasture Forage
Crop management intensity	High	Low	Medium
Tree row spacing	Wide (25-40m)	Narrow (15-20m)	Wide (25-40m)
Trees	Deciduous	Deciduous Conifers	Deciduous
Tree products	Timber (main) Nuts (marginal)	Pulp (main) Paper (main) Timber (marginal)	Nuts (main) Fruits (main) Timber (marginal)
Establishment sites	Cultivated plots or Abandoned plots	Tree plantations or Abandoned plots	Create sight lines Hide disturbing features

Results

The stakeholders identified the biophysical conditions, the presence of human resources and the local interest in ecological services provision as the three major local strengths (**Table 2**). The main weaknesses are the use of very intensive agricultural practices, the negative perception of trees on farms and the lack of knowledge on agroforestry systems. The presence of a research network, the social pressure towards the use of conservation practices and ongoing pilot trials in nearby areas are seen as the most influential opportunities. The short-termed agricultural support programs, the agrochemical lobby pressure towards immediate productivity and the uncertain profitability of the agroforestry systems stand as the main threats.

Table 2: SWOT decision factors for local stakeholders in Les Maskoutains

Strengths	**Weaknesses**
S_a : Conducive biophysical conditions.	W_a : Intensive agricultural systems and habits.
S_b : Human and organizational resources availabilty.	W_b : Negative perceptions on the role of trees on farm.
S_c : Local interest in landscape aesthetics and provision of ecological services.	W_c : Lack of knowledge on agroforestry intercropping systems.
Opportunities	**Threats**
O_a : Research network and expertise.	T_a : Incompatibility with most agricultural support programs
O_b : Social acceptability of conservation practices.	T_b : Lobby pressure towards high productivity.
O_c : Pilot trials generating trustable results.	T_c : Lack of knowledge on economic viability

Table 3 shows the relative weight of each decision factor according to stakeholders. Globally, the most important decision factor is the incompatibility of agricultural support programs with agroforestry intercropping systems (0,140) followed by the biophysical conditions of their area (0,116) and the presence of intensive agricultural systems and habits (0,103). However, strong differences appear between stakeholder groups when the three most important factors for each group are considered. For instance, the farmers (a conventional gain grower and an organic vegetable grower) were the only group to identify the social acceptability of conservation practices (0,169) as one major driving force.

The ranking of the agroforestry intercropping system alternatives shows also major differences between stakeholders' perceptions (**Fig. 1**). While farmers and forestry advisors chose the "landscape alternative" as the best suited for their area, the urban planners and local authorities preferred the "crop" alternative.

Discussion

According to all stakeholders, external opportunities and threats would have, globally, more influence on the decision to integrate agroforestry intercropping systems in the landscapes than local strengths and weaknesses. Human factors such as negative perceptions of trees, social pressure or concerns and agricultural habits also appear to have a strong influence in the decision-making process. These results support previous findings on the importance of the global context and human interactions in agricultural landscape changes (Ruiz and Domon, 2009).

The relative priority given to the agroforestry alternatives reveals major differences between stakeholders' categories. As the "crop" alternative is rated as the best suited for their area by urban planners and local authorities, farmers and forest advisors gave the best relative score to the "landscape" alternative, the only alternative not oriented towards productivity. This apparent paradox might be explained by the divergences in the priority given to the decision factors by stakeholders and by the perception that agroforestry intercropping systems can't be as productive and profitable as conventional production systems.

Table 3: Overall priority of factors by stakeholder category in Les Maskoutains

	Overall priority of factors by stakeholder category					
	All stakeholders n=10	Farmers n=2	Farm advisors n=3	Forestry advisors n=2	Urban planners n=2	Local authorities n=1
Strengths	**0,243**[a]	**0,271**	**0,209**	**0,213**	**0,291**	**0,254**
S_a [b]	0,116[a]	0,062	0,137	0,108	0,143	0,062
S_b	0,058	0,102	0,037	0,034	0,099	0,023
S_c	0,070	0,107	0,035	0,071	0,049	0,169
Weaknesses	**0,221**	**0,205**	**0,256**	**0,223**	**0,153**	**0,281**
W_a	0,113	0,164	0,124	0,024	0,063	0,210
W_b	0,048	0,019	0,097	0,047	0,011	0,054
W_c	0,061	0,023	0,036	0,151	0,079	0,016
Opportunities	**0,291**	**0,328**	**0,244**	**0,333**	**0,278**	**0,298**
O_a	0,111	0,105	0,120	0,053	0,079	0,232
O_b	0,088	0,169	0,064	0,115	0,048	0,033
O_c	0,093	0,055	0,060	0,165	0,151	0,033
Threats	**0,245**	**0,196**	**0,291**	**0,231**	**0,278**	**0,167**
T_a	0,140	0,100	0,153	0,149	0,102	0,115
T_b	0,073	0,082	0,119	0,018	0,118	0,031
T_c	0,032	0,014	0,019	0,064	0,057	0,020

Note. Numbers in bold are scale parameters (values) of each SWOT group and numbers underlined are the highest three factors under respondent categories. The max consistency ratio calculated was 0,26. [a] The scale parameters were calculated using the relative importance given to each SWOT category by participants using the five-intensity scale. [b] Refer to Table 2 for the signification of abbreviations.

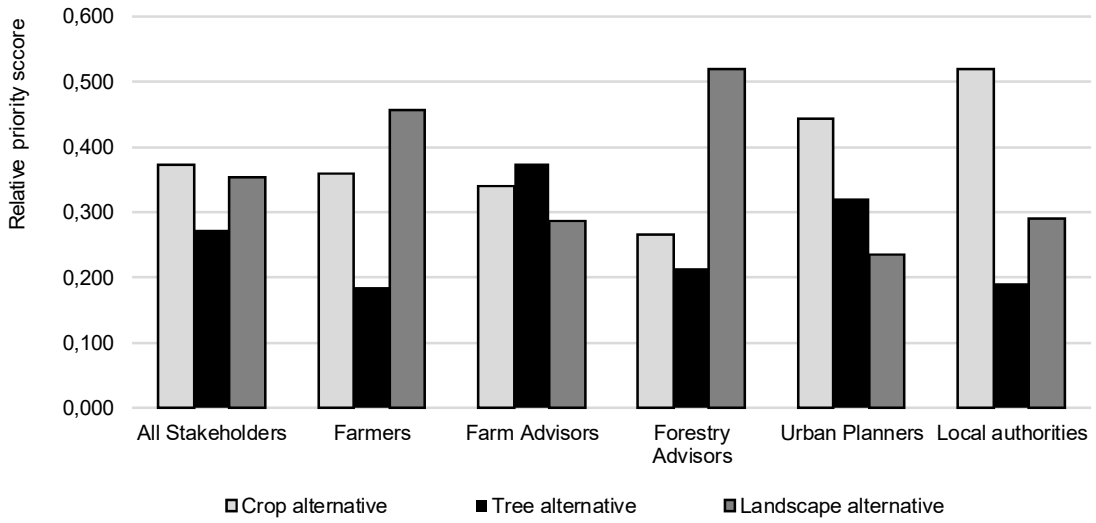

Figure 1: Agroforestry intercropping systems alternatives' relative priority score for each stakeholder category and for all stakeholders in Les Maskoutains.

Conclusion

In the Les Maskoutains intensive agricultural area, the decision of integrating agroforestry intercropping systems in landscapes seems to be mostly encouraged by conducive local biophysical conditions and strongly limited by agricultural policies and social perceptions. Stakeholders involved in the study do not give the same importance to these decision factors and do not share the same vision regarding which system might be the best to integrate in their specific context. These results, although based on a small sample, urge further development in presenting agroforestry systems as productive ones to facilitate their integration in this specific agricultural landscape.

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