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Profitability of food trees planted in urban public green areas

Marième Lafontaine-Messier[a], Nancy Gélinas[b,*], Alain Olivier[a]

[a] Département de Phytologie, Université Laval, Québec G1V 0A6, Canada
[b] Département des Sciences du Bois et de la Forêt, Université Laval, Québec G1V 0A6, Canada

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ABSTRACT

Planting food trees within local parks and other public urban green areas is starting to gain in popularity as a strategy to enhance the sustainable development of cities. However, the financial opportunity that it could represent has barely been studied. This paper investigates the financial potential of the establishment of food trees in urban public green areas of Villa El Salvador, Peru, with the help of local inhabitants. Net present value (NPV), benefit-cost Ratio (BCR), and equivalent annual cash flow (EACF) were calculated to evaluate the financial performance of two designs of productive tree systems drawn to scale for two local public parks. Results provide evidence that the involvement of a small group of local producers in the maintenance and care of public green areas could be translated, for a municipality, into financial benefits. For the producers, the possibility to harvest edible products also led to financial benefits, but only if the time invested in the productive activities was not taken into account. Thus, the use of food trees in green public areas appears to be a financially valuable alternative for both a municipality and its local inhabitants.

1. Introduction

Food trees are defined as trees producing seeds, fruits, leaves, forage or other edible goods (FAO, 2001). Their use as part of urban forestry programs gains attention as a tool for the creation of multifunctional urban public green areas (Lovell and Johnston, 2009; Lovell, 2010; Clark and Nicholas, 2013). However, the potential of food trees to convert the urban tree cover into a financial opportunity for a city and its population has, to our knowledge, barely been studied to date.

Urban forestry is generally described as "the art, science and technology of managing trees and forest resources in and around urban community ecosystems for the physiological, sociological, economic, and aesthetic benefits trees provide society" (Helms, 1998 p. 193). Urban forests are increasingly recognized for their ecosystem services and the multiple social and environmental benefits related to them: decreased urban heat, reduced air contamination, improved mental and physical health, and enhanced quality of life within cities, among others (Nowak and Dwyer, 2007; Carreiro, 2008; Seamans, 2013; van den Berg et al., 2015; Miller et al., 2015). But they also gain attention for their potential to foster food security (Valaski et al., 2008; Clark and Nicholas, 2013).

In the past years, food trees have been successfully introduced in urban forestry community projects to help improve food security, while enhancing wildlife conservation, and strengthening community bonds (see, for example, the *Chicago Rarities Orchard Project,* in Chicago; *Cityfruit.org* and the *Beacon Food Forest*, in Seattle; *Fallen Fruit*, in Los Angeles; and *The Orchard,* in Glasgow).

Among the scientific community, the potential of urban trees to offer edible products is starting to draw researcher's attention. The production of non-timber forest products such as fruits, wild berries, edible mushrooms, or edible plants is increasingly advocated (McLain et al., 2014; Clark and Nicholas, 2013; Poe et al., 2013; Eludoyin et al., 2015; Hurley et al., 2015). Fruit trees have been inventoried in urban homegardens (Madaleno, 2000; Makumbelo et al., 2002; Semedo et al., 2007; Shillington, 2013), and in some cases on public areas (Lourdes, 2009; McLain et al., 2012). McLain et al. (2012) estimated the value of the food production potential and social benefits of a public urban forest in Seattle.

However, to our knowledge, the financial opportunities related to the use of food trees in cities have, to date, not been studied. Therefore, this paper tackles urban food production under the innovative approach of modeling the potential profitability of implementing food trees productive Systems in urban public parks. It focuses on the financial benefits expected from two standpoints: first, a small group of local producers, participating in the tree care and management activities, and, second, a municipality adopting this planting strategy as part of its urban forestry program. Two hypotheses were evaluated: (1) for small groups of local producers

* Corresponding author.
E-mail addresses: marieve.lafontaine-m.1@ulaval.ca (M. Lafontaine-Messier), Nancy.Gelinas@sbf.ulaval.ca (N. Gélinas), Alain.Olivier@fsaa.ulaval.ca (A. Olivier).

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involved in the management and care of the tree systems, the possibility to harvest edible products leads to financial benefits for them and their families; (2) the involvement of the local inhabitants in the maintenance and care of public green areas allows a municipality to avoid expenses in human resources and inputs, which can be translated into financial benefits.

2. Method

2.1. Description of the studied area

This research project was conducted in Villa El Salvador, a district of 381,790 inhabitants located in the southern metropolitan area of Lima, the capital city of Peru. This district is generally described as chaotic, unsafe, and offering severely degraded living conditions, with a poverty rate reaching 21.9% (INEI, 2009). Villa El Salvador offers very few or no local job opportunities and most workers have to travel to other districts to earn incomes.

Food is abundant in the local markets of Villa El Salvador, brought to the city from the agricultural areas surrounding Lima and in the Andes. However, the severe financial restrictions faced by many households make it difficult for them to buy the food they need to feed their families. Those who wish to cultivate their own food are limited by the small size of their private lands. The population increase and the resulting densification of Villa El Salvador lead to a shortage of vacant pieces of land, submitting urban agriculture activities to severe conflicts on land use. As a result, many are forced to resort to local food banks or collective kitchen to fulfill their needs, getting meals that are generally poor in nutriments and vitamins.

Product of a carefully planned urban development, the city's territory has been clearly divided into four different areas: an agricultural area, an industrial area, a seaside area, and a residential area (Fig. 1a). In 2010, the residential area was formed of nine sectors, each one divided into 20–30 residential groups (Fig. 1b). Each group included 16 blocks of 380 private lots comprising at least one public green area (Fig. 1c).

Due to the scarcity of the city's financial and human resources strongly limiting its capacity to provide each residential group with a flourishing green area, tree planting and long-term care of the residential public parks rely heavily on the involvement of the local community. In seeking to compensate for this limitation and foster the development of residential green areas, local environmental committees have been created by the population in several residential groups. As part of their activities, these committees organize tree planting initiatives, maintain the cleanliness of the parks, and develop environmental education activities. These parks can be accessed by everyone, free of charge.

The research activities included in this project were held on two public green areas of Villa El Salvador. The first one was located on the 0.5 ha public park in the heart of sector VI, residential group 2 (287640.97° E/8649398.17° S) (Fig. 2a). The second area was a 0.5 ha plot of land located in the central area of the mildly transited Avenida El Sol (288691.74° E/8647597.24° S), that was intended for pedestrian and cycling circulation and was completely free from buildings or any type of infrastructure (Fig. 2b).

2.2. Methodological approach

Research activities were conducted in three main steps (Fig. 3).

2.3. Workshops

Two workshops were held in each studied area to develop hypothetical food tree systems to be cultivated by a local group of producers.

The selection of participants to the workshops was done under the recommendations of the NGO *IPES/Promoción del desarrollo sostenible*, working since 2002 in Villa El Salvador on urban agriculture and forestry projects. Four local community groups were approached *via* their person in charge and chosen for their committed work for the sustainable development of their residential groups: two environmental groups, one community-based entrepreneurship project fighting poverty through the production of tree saplings, and one collective kitchen part of a nationwide food security program financed by the Peruvian federal government. An open invitation was sent to all their members and the participants were selected based on their motivation to engage in the research activities.

The first workshop aimed at creating two designs of productive tree systems. Trees were chosen considering the following criteria: resistance to pests and diseases, drought and salinity tolerance, and low intensity of care (pruning) required. A strong emphasis was put on selecting native trees. The second workshop was dedicated to the identification of the costs and benefits to be included in the financial analysis.

2.4. Parameters for the financial analysis

Two levels were adopted for the financial analysis: (1) the municipality, and (2) a group of ten producers joining forces for the maintenance of each tree system.

Because urban greening is under the municipality's responsibility (as mentioned in the 2nd strategic line of Villa El Salvador's Integral and Concerted Development Plan to 2021 (Villa El Salvador, 2006)), the financial implications related to planting and maintenance of an ornamental tree system was the comparative baseline. Thus, at municipal level, the financial analysis in this study only considered the incremental cost, if any, generated by the planting and maintenance (fertilization and irrigation) of food trees instead of ornamental trees. In the same way, since the plantation of food trees is expected to lead to a transfer of responsibilities for the maintenance of the trees (labor and inputs) from the municipal workers to a group of producers (hypothesis 2), the savings generated for the municipality were considered as benefits in this financial analysis.

For producers, the costs considered were the expenses associated with their involvement in the planting and maintenance of the food trees. Benefits were calculated for each year (y), multiplying the expected yields of each product harvested ($U_1, U_2, \ldots U_x$) by its price on the local market of Villa El Salvador in 2010 (Formula (1)) (Ricker et al., 1999; Yousefpour and Hanewinkel, 2009).

$$R_{U_x y} = F_{U_x y}\,(1 - L)\,P_{U_x} \quad (1)$$

where $R_{U_x y}$ = Expected incomes for the commercialization of the product harvested U_x, at year y

$F_{U_x y}$ = Yields expected for the product U_x, at year y.

L = Loss factor

P_{U_x} = Price per kilogram for the product U_x, paid on the local market of Villa El Salvador in 2010

y = Year considered (1–30). For tree planting, $y = 0$.

A loss factor (L) of 30% was considered to take into account the expected robberies, the potential lack of care of the trees, the replacement of damaged or dead trees and the expected yield reduction caused by the austere growing conditions created by the urban context. This is a conservative value based on the experience of local peri-urban fruit tree growers. Different values of this loss factor were compared as part of the sensitivity analysis conducted in this study.

Calculations were made over a period of 30 years to make sure that a productive plateau was reached for every species. We considered that all the products from the tree systems were sold on