

# ASSESSMENT OF TREES OUTSIDE FORESTS (TOF) AS POTENTIAL FOOD SOURCE IN SECOND DISTRICT, MAKATI CITY

Jan Joseph V. Dida<sup>1</sup>, Khristoffer Ryan F. Quinton<sup>2</sup>, and Nathaniel C. Bantayan<sup>3</sup>

<sup>1</sup>Environmental Remote Sensing and Geo-Information Laboratory, College of Forestry and Natural Resources, University of the Philippines Los Baños, College, Laguna 4031, Philippines

Email: jjvdida@gmail.com

<sup>2</sup>Department of Geodetic Engineering, College of Engineering, University of the Philippines Diliman, Quezon City 1101, Philippines

Email: kr.quinton@gmail.com

<sup>3</sup>Makiling Center for Mountain Ecosystems, College of Forestry and Natural Resources, University of the Philippines Los Baños, College, Laguna 4031, Philippines

Email: ncbantayan@gmail.com

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**ABSTRACT:** Urban trees provide important ecological, aesthetic, social, and economic benefits to the communities with the expanding urban areas and population needing more food. The Trees Outside Forests (TOF) present potential contribution to food security and complement the services provided by intact forests hence, there is the need to identify them in the urban areas like Makati City. The study aims to identify and assess the TOF covered in the urban areas and determine the extent of potential food sources. Google Earth Imagery was used to digitize the other lands and assessed the TOF based on the FAO decision tree algorithm. Field assessment was done to identify the edible fruit-bearing trees and validate the tree height in the TOF criteria. Following the GIS-based Assessment, Monitoring and Evaluation (Bantayan, 2006) grid system, cells containing edible fruit-bearing TOF were marked. Results show that the extent of cells with TOF as potential food source are scattered throughout the district. Most of the identified TOF are utilized by the communities for direct consumption. The assessment of TOF in urban areas can be used to account for the services it provides to the community. Planting of fruit-bearing trees and management of TOF using high-resolution images in urban areas should be promoted to improve food access.

## 1. INTRODUCTION

Urban trees provide various ecosystem services to urban areas that affect its physical environment. Ecosystem services and benefits include air quality improvement, water flow and quality, noise abatement, public health and community well-being (Nowak, 2010). The urban areas do not qualify as Forest Lands and Other Wooded Lands based on the Food and Agriculture Organization (FAO) definition hence they are considered as Other Lands (de Foresta, 2013).

The trees, shrubs, and palms within the Other Lands that are predominantly for urban use are classified as Trees Outside Forests (TOF). Trees are said to be TOF if the height is at least 5 meters and the Other Land where TOF are found span more than 0.5 hectares and have at least 5% canopy cover for trees or 10% for trees, shrubs, and palms combined. Trees and shrubs are grown in association with annual or permanent farm crops plus animal husbandry activities throughout heavily populated areas in the tropics (Bellafontaine, et.al, 2002). These TOF are important as it presents a potential contribution to food security and complements the services provided by intact forests. Urban areas such as Makati City with a total population of 529,039 as of 2010 will benefit from the services provided by urban TOF. There is the need to establish more of these as green spaces are said to have decreased in number and area due to urbanization (Ruangrit & Sokhi, 2004).

As part of the urban design proposal in the city Comprehensive Land Use Plan for 2013-2023, the local government aims to increase the parks and open spaces with multiple uses. Hence, the assessment of trees is needed in order to plan the green spaces in the city as well as promote the benefits of TOF for the improvement of food access. It is also now being argued that the role of TOF in food, wood and fuel to rural masses is substantial and needs inventory (Anubha, et.al, 2012).

The study generally aims to assess the Trees Outside Forests of second district in Makati city. Specifically, the study aims to; (1) identify and map the urban TOF that are fruit-bearing and edible, and (2) determine the extent of the edible fruit-bearing TOF and its importance as potential food source.

## 2. METHODOLOGY

The study area is located in the National Capital Region bounded by Pasig river on the north, municipality of Pateros on the east, Taguig city on the southeast, Pasay city on the south and southwest, and Manila city on the northwest (Figure 1). The total land area of Makati city is 27,355,600 sq. meters composed of thirty three barangays distributed between two legislative districts. It has the largest concentration of commercial activities in the Philippines and has a primary link to international finance (Comprehensive Land Use Plan, 2013-2023). The second district which covers thirteen barangays has a total land area of 10,458,500 sq. meters and has an existing land use of mixed-use zone and residential.

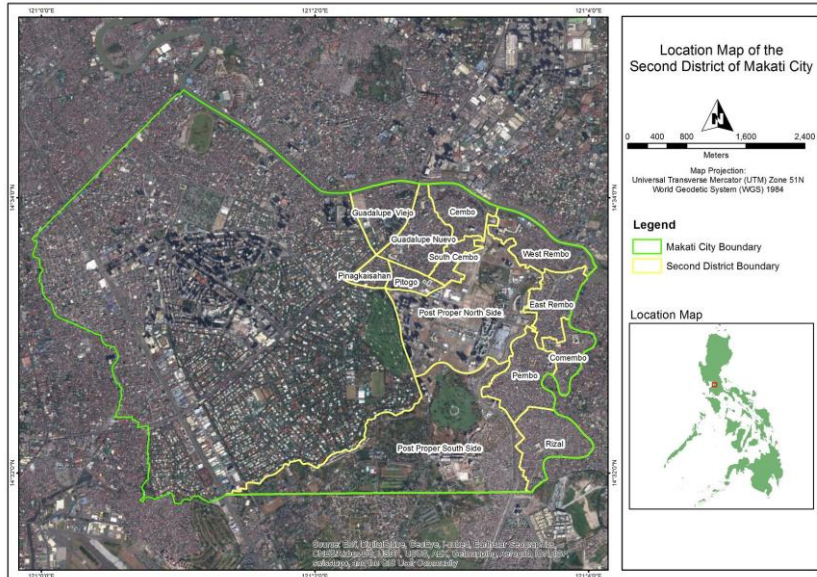


Figure 1. The location of Second District, Makati City.

### 2.1 Delineation of Trees Outside Forests (TOF)

The Makati city boundary from the National Mapping and Resource Information Authority (NAMRIA) and Google Earth imagery was used as reference in the delineation of TOF. Trees, palms and shrubs within the second district of Makati city were digitized and exported to a shapefile format. The identification of TOF among the digitized features was guided by the decision tree algorithm for TOF (Figure 2). Area and crown cover were verified using Geographic Information Systems (GIS) software measuring tools.

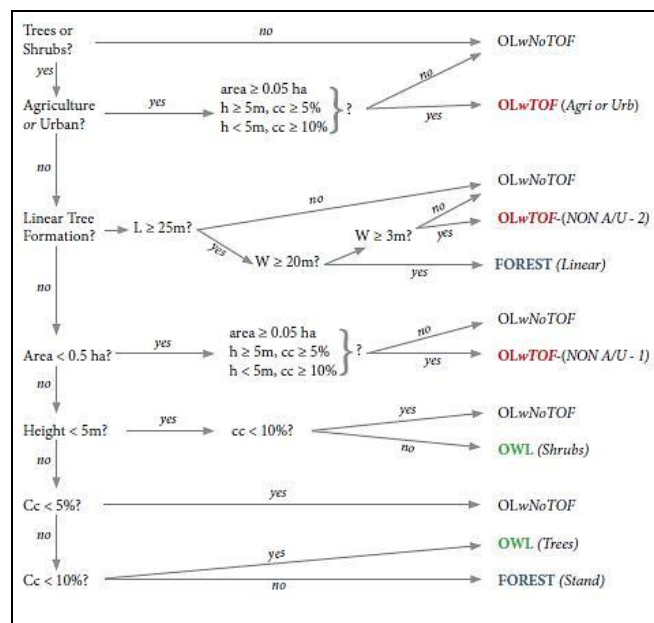


Figure 2. Decision Tree Algorithm (de Foresta, 2013).

## 2.2 Assessment of TOF as Potential Food Sources

A field assessment was conducted to identify and describe the edible fruit-bearing trees among the identified TOF within the second district. Identified TOF were geotagged and saved as point features in GIS geodatabase format. The heights of identified TOF were also verified to match with the criteria in the decision tree algorithm during the field assessment.

Edible fruit-bearing TOF were marked and stored in a Grid-based Assessment, Monitoring, and Evaluation (GAME) model that follows different levels of analysis based on its area (Bantayan, 2006). Using a GIS software, square-grid vector layers with standard sizes: Grid (1,000,000 sq.m.), Quadrant (250,000 sq.m.), and Cell (10,000 sq.m.) were generated for the study area. The generated vector layers were intersected to form a Cell-level GAME model with a size of 100 x 100 meters and area of 10,000 sq. meters. In order to show the relative distribution of potential food sources in the district, each Cell that covers edible fruit-bearing TOF were marked.

## 3. RESULTS AND DISCUSSION

Based on the TOF delineation following the decision tree algorithm and field assessment, there are 1,589,147 sq. meters of urban TOF in the second district (Figure3). The trees in were found to have an average height of more than 5 meters and areas dominated by trees have attained the minimum crown cover of more than 5 percent. Areas with trees, shrubs, palms, and bamboo combined attained a minimum crown cover of 10 percent. All sample areas are more than 0.05 hectares as prescribed by the decision tree on TOF classification.

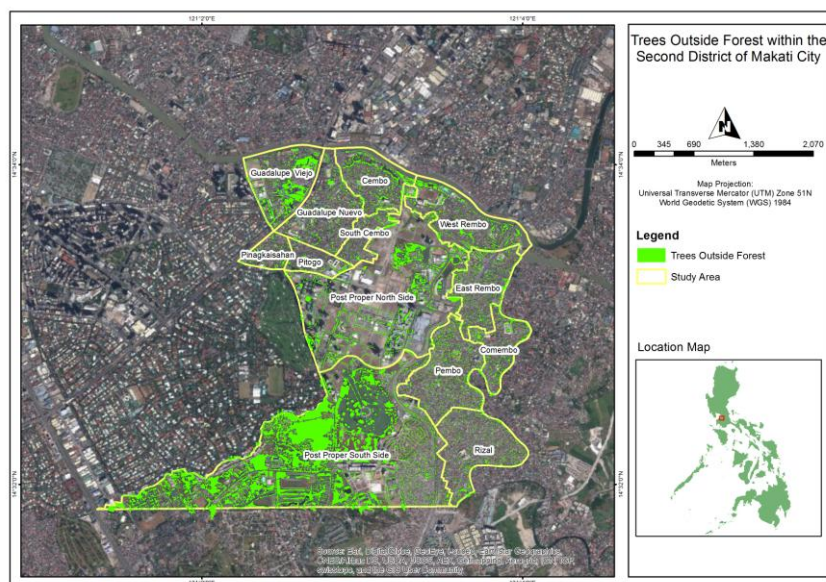


Figure 3. Urban Trees Outside Forest in the Second District of Makati City.

In terms of the extent of potential food sources, a total of 153 Cells with approximately 1,530,000 sq. meters area out of 2,000 Cells were found to have edible fruit-bearing TOF (Figure 4). The common species found based on the field assessment are Manggo (*Mangifera indica*), Coconut (*Cocos nucifera*), Rambutan (*Nephelium lappaceum*), and Star Apple (*Chrysophyllum cainito*). The concentration of these TOF is mostly in the areas designated for residential land use zones where they are utilized for direct consumption.

The presence of abundant edible fruit-bearing TOF is important since it is noted that food scarcity is primarily caused by inadequate distribution and lack of purchasing power (Sunderland, 2013). These TOF are potential food sources in the form of edible fruits that provide additional micronutrients. A study conducted by Ickowitz, et.al in 2014 shows that there is a statistically positive relationship between tree cover and consumption of Vitamin A rich fruits and vegetables. The inclusion of edible fruit-bearing TOF in the proposed urban greening and open and park spaces of Makati city will benefit the community in terms of food access. In a study in Para, Brazil, fruit productivity rose from 7.3-12.2 t/ha/yr in secondary forest to 13.7-18.2 t/ha/yr in home gardens (Bellafontaine, et.al, 2002). It is important identify and describe benefits of urban trees in order to gain support for urban forestry programs which will increase the green spaces of the city (Dwyer and Miller, 1999). Government and NGOs also play an important role in creating awareness among the communities to introduce the species in their respective lands.

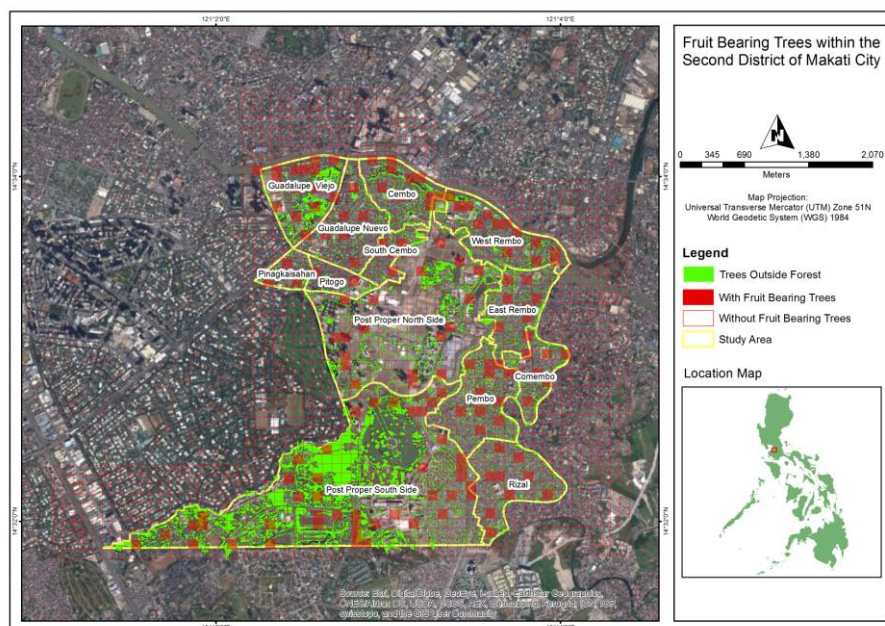


Figure 4. Distribution of edible fruit-bearing TOF in the Second District of Makati City.

#### 4. CONCLUSION

The assessed urban TOF that are potential food sources are mostly distributed throughout the residential land use zone of the second district. The identified TOF are mostly used for direct consumption and the assessment of these can be used to account for the services it provides to the community. In preparing micro-plans for the selection of species, the choice of the residents must also be considered (Anubha, et.al, 2012). Urban TOF impact the quality of life in urban areas hence the need to establish more as part of the increase in open spaces and parks. Recent developments in technologies have allowed the accurate and comprehensive assessment of urban tree benefits (Dwyer and Miller, 1999). High-resolution images like the Google Earth should be utilized more so as to carefully plan the establishment of TOF in the area and improve food access by having more edible fruit-bearing species. The use of drones for mapping and establishment of urban TOF must also be integrated in the Comprehensive Land Use Plan preparation and zoning.

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