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Where are they now: Native trees in the City of Malolos, Province of Bulacan, Central Luzon, Philippines

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Abstract

This study focuses on tracing the presence of native trees where the names of the barangays were derived. Also included is the assessment of the knowledge and attitudes of locals about the native trees and their attitude towards willingness to support possible conservation of trees. Tree inventory was conducted to determine the presence of native trees in the selected areas. Residents' knowledge of the native status of common tree species and related topics such as their location in the city were explored through a survey. 194 individual tree species identified and 62 of which are native trees. Only 5 *Diospyros blancoi* (Kamagong or Mabolo tree) were observed in Barangay Mabolo, while there is no presence of the native trees namely *Dillenia philippinensis* (Katmon), *Nauclea orientalis L.* (Bangkal), *Glochidion rubrum Blume* (Bagnang-pula) and *Afzelia rhomboidea* (Balayong/Tindalo) in the other selected barangays. Most common native species observed is *Adonidia merrilii (Manila Palm Tree)*. Overall knowledge was high wherein correct identification of native trees was higher than that for non-native trees. Generally, positive attitudes were expressed by most of the respondents towards native trees and were in favor of planting more native trees.

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Introduction

Urbanization modifies native habitats and creates new ones with infrastructure. These urban landscapes favor non-native and native species that are generalists. Nevertheless, cities uncover a great diversity of habitats and species. Everyday life contact of humans with plants and animals in cities represents the intrinsic interplay of social and ecological systems forming unique biotic assemblages inherent to that city. As such, this mandates the assessment of the different changes in the environment which may lead to protection, rehabilitation, and reconstruction of different areas specially heritage sites (Almas, *et al.,* 2017).

As human population is continuously growing and landscapes being accompanied by severe impacts like fragmentation, isolation, and degradation of natural habitats, support to native biodiversity is a must. Thus, landscape architects, conservation biologists, and other groups are linking landscape design with ecosystem structure and function to create and restore habitats and reintroduce native species in cities (Muller, 2013).

One way of rehabilitation is reintroducing native trees to the emerging landscapes by planting and make everyone exercise ownership and stewardship over them. However, the lack of public awareness is one reason why there is invasion of foreign or exotic species that made way into urban gardens, and parks. This is also because of the influence of trends and looks from other countries in landscaping practices which are more familiar to designers and planners (Hoyle *et al.,* 2020). There is also limited public consciousness ensuring the presence or conservation of native trees in public lands including streets or areas named after them. The demand for these foreign plants together with the scant knowledge on the use of Philippine native plants resulted in the lack of appreciation and utilization of native species in different parts of the country.

Native plants are unique kind of plants, evolving in local areas over a very long period, and to which first human knew and depended for their livelihood. Native plants have co-evolved with animals, fungi, and microbes to form a complex network of relationships (Mullaney *et al.*, 2015). These plants are the foundation of native ecosystems, or natural communities (Santos-Martin *et al.,* 2004). Moreover, native trees are better adapted to local climate a condition which makes them stronger and more resilient in the long run. They are also more effective in promoting biodiversity and are considered as high-value trees that can command good market prices and eventually alleviate poverty through livelihood for communities. In addition, native trees have a huge cultural value and ascribed symbolic functions. Particularly, these trees have a sacred status used in rituals, provide ingredients to cultural dishes, and may have symbolic importance for ethnicity, identity, and connection to a place (Lagbas, 2019).

In the city of Malolos, five (5) out of the 51 baranggays, were named after the presence of trees native to the Philippines. These include Baranggay Mabolo (*Diospyros blancoi* or Kamagong tree), Catmon (*Dillenia philippinensis*), Bangkal (*Nauclea orientalis* L), Bagna (*Glochidion rubrum Blume* or Bagnang-pula,) and Balayong (*Afzelia rhomboidea*). The use of the native trees in naming the barangays represents cultural significance giving a glimpse of history on how diverse the flora of the city of Malolos is and how these trees served as marks for identity and connection to the past. Thus, loosing these trees would diminish important aspects of life for the community as trees are strongly connected to how different cultures evolved and changed over time (MG Grath *et al.,* 2021).

This study focuses on tracing the presence of native trees where the names of the barangays were derived. It also provides comprehensive baseline information on the native tree composition for the formulation of sustainable urban forest management and implementation of effective strategy for the conservation of native species in the city of Malolos, Bulacan, Philippines. Furthermore, it also assesses the knowledge of the locals about native trees and their attitude towards their willingness to support possible conservation of these trees.

Materials and methods

Study area

Five barangays were identified as areas of the study, these are Barangay Mabolo, Catmon, Bangkal, Bagna, and Balayong (Table 1). These barangays were selected because their names were derived from native trees. Only public areas were used as research sites including streets, public parks, and elementary schools.

Table 1. Research Sites coordinates and demography.

Barangay	Coordinates
Mabolo	14.8434, 120.8263 (14° 51' North, 120° 50' East)
Catmon	14.8511, 120.8147 (14° 51' North, 120° 49' East)
Bangkal	14.8232, 120.8485 (14° 49' North, 120° 51' East)
Bagna	14.8251, 120.8226 (14° 50' North, 120° 49' East)
Balayong	14.8292, 120.8300 (14° 50' North, 120° 50' East)

Tree survey

A tree survey was conducted to determine the presence of trees in the selected areas. Trees were geotagged and was identified. This served as a baseline data for species richness on the selected areas and was used for mapping native trees present.

Residents Survey

Residents' knowledge of the native status of common tree species and related topics such as their location in the city were explored through a survey. An informed consent form was provided for the recruitment of participants before administering the questionnaire. At the start of the survey, several terms were defined to ensure a basic knowledge of each concept and consistent interpretation. The survey contained a list of 10 tree species (5 native species, and 5 commonly planted non-native species) that participants were asked to label as native, non-native, or "do not know". This only explores and is limited to a particular aspect of native tree knowledge which is the ability to identify locally native and non-native tree species based on its common name (Aspe, *et al.*, 2017; Almas, *et al.*, 2017)

The survey also asked the respondents to indicate which factors they would consider in deciding to plant a tree on their property, the current number of trees present, recent actions related to tree planting and removal, and their knowledge and actions related to their municipality's urban forest management plan if applicable. Attitude related to respondents' level of support for native tree species in urban areas was assessed using a five-point likert scale for 12 statements related to the planting and maintenance of native species.

Additionally, residents' knowledge of native tree species was gauged, with knowledge based on the number of common tree species' native status identified correctly (Almas, *et al.*, 2017).

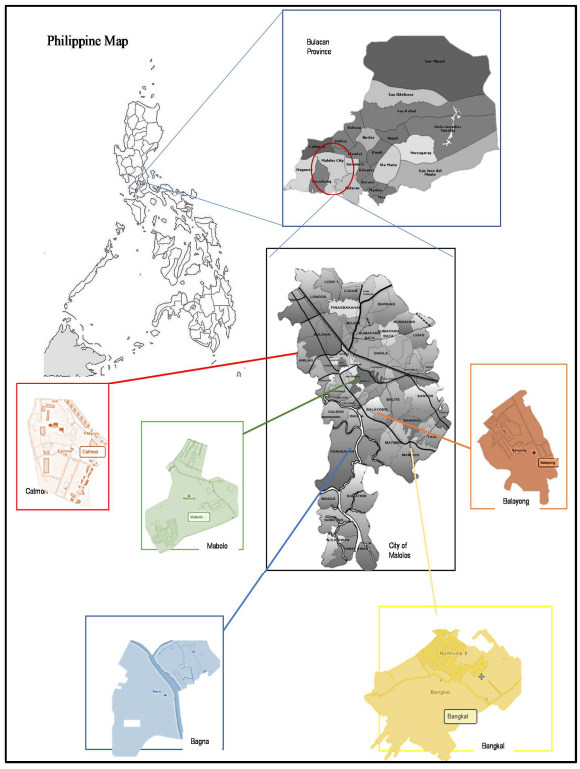

Fig. 1. Map of the Philippines showing the province of Bulacan, City of Malolos and Selected Barangays from wikimapia and googlemaps.

Results and discussion

Identified tree species

A total of one hundred ninety four (194) individuals belonging to twenty two (22) species were identified and enumerated from the five (5) selected barangay. Tree species belongs to fifteen (15) families were recorded (Table 2).

Table 2. Summary of identified tree species.

SN	Family	Common Name	Scientific Name
1	*Meliaceae*	Santol	*Sandoricum koetjape*
2	*Arecaceae*	Coconut	*Cocos nucifera L.*
3	*Moraceae*	Jackfruit	*Artocarpus heterophyllus*
4	*Combretaceae*	Talisay	*Terminalia catappa*
5	*Fabaceae*	Acacia	*Acacia confusa*
6	*Myrtaceae*	Guava	*Psidium guajava*
7	*Anacardiaceae*	Manga	*Mangifera indica*
8	*Fabaceae*	Ipil ipil	*Leucaena leucocephala*
9	*Moringaceae*	Malunggay	*Moringa oleifera*
10	*Annonaceae*	Atis	*Annona squamosa*
11	*Caricaceae*	Papaya	*Carica papaya*
12	*Fabaceae*	Camachile	*Pithecellobium dulce*
13	*Fabaceae*	Narra	*Pterocarpus indicus*
14	*Myrtaceae*	Duhat	*Syzygium cumini*
15	*Muntingiaceae*	Aratiles	*Muntingia calabura L.*
16	*Meliaceae*	Mahogany	*Swietenia macrophylla*
17	*Fabaceae*	Sampaloc	*Tamarindus indica*
18	*Arecaceae*	Manila palm tree	*Adonidia merrillii*
20	*Ebenaceae*	Mabolo	*Diospyros discolor*
21	*Sapotaceae*	Kaymito	*Chrysophyllum cainito*
22	*Moraceae*	Langka	*Artocarpus heterophyllus*

Table 3. Presence of the selected native trees in the barangays.

Barangay	Total Number of Individual Trees	Remarks
Balayong	77	No Balayong/ Tindalo Trees present
Bangkal	30	No Bangkal Trees present
Catmon	25	No Katmon Trees present
Bagna	9	No Bagna Trees present
Mabolo	53	5 Mabolo Trees present
	Total: 194	

Five (5) *Diospyros blancoi* (Kamagong or Mabolo tree) were observed in Barangay Mabolo. While there is no presence of the native trees namely *Dillenia philippinensis* or Katmon tree, *Nauclea orientalis L* or Bangkal tree, *Glochidion rubrum Blume* or Bagnang-pula and *Afzelia rhomboidea* or Balayong/ Tindalo trees (Table 3). However, seven (7) other species of Native trees were observed present in the selected barangays shown in table 14. This suggests that indigenous trees have been shown to be rapidly disappearing from urban areas, and the contributions of surviving trees have not been well recognized (Babalola, 2013).

Table 4. Native tree species found in the selected barangays.

Scientific Name	Family	Common Name	No. of individual species
Terminalia catappa	*Combretaceae*	Talisay	3
Acacia confusa	*Fabaceae*	Acacia	10
Moringa oleifera	*Moringaceae*	Malunggay	19
Pterocarpus indicus	*Fabaceae*	Narra	8
Syzygium cumini	*Myrtaceae*	Duhat	4
Adonidia merrillii	*Arecaceae*	Manila Palm Tree	13
Diospyros discolor	*Ebenaceae*	Mabolo	5
			Total: 62

Out of the one hundred ninety four (194) individual tree species identified, sixty two (62) of which are native trees (Table 4). The most represented family are Fabaceae, Moringaceae, and Araceae while the most abundant species is *Moringa* oleifera with a total number of 18 individual species (Table 4). Most common species observed is *Adonidia merrilii* seen in 4 out of the 5 barangays.

Table 5. Composition of Native Trees in the selected barangays.

Barangay	Total tree Species	Family	Total Native Species	%Relative Abundance	Dominant species
Balayong	77	4	5	6.49%	*Moringa oleifera*
Bangkal	30	3	3	10%	*Adonidia merrillii*
Catmon	25	1	1	4%	*Adonidia merrillii*
Bagna	9	3	3	33.3%	*Terminalia catappa, Acacia confuse, Adonidia merrillii*
Mabolo	53	5	6	11.3%	*Diospyros discolor, Pterocarpus indicus*
Total	194	16	18		

The population of native tree species in the five barangays is low (Table 5). Most of the tree species found in the selected barangays are either introduced, exotic, or non-native, implying that native species tend to be underutilized. Excessive reliance on a small number of native species endangers the urban forest

resilience and decrease ecosystem services (Jang,2022). Native-only planting tactics are becoming more popular in literature and policy, with the belief that native species will provide a wider range of biodiversity advantages. However, there is still a gap between theoretical arguments about the effectiveness, definition, and value of nativeness in relation to urban design practice (Berthon 2020).

Table 6. Diversity of Native Trees.

Barangay	Shannon diversity index	Evenness	Richness (number of species)	Total number of individuals	Average population size
Balayong	1.15	0.716	5	24	4.8
Bangkal	0.995	0.906	3	11	3.67
Catmon	0	0	1	2	2
Bagna	1.1	1	3	6	2
Mabolo	1.68	0.936	6	19	3.17
Overall	1.79	0.921	7	62	8.29

Diversity is a community attribute related to stability, productivity, and trophic structure also with migration (Lees, 2000). An area with high species diversity results to a more stable and productive ecosystem. Overall species diversity has a computed value of H'= 1.79 for Shannon diversity index (Table 6) indicating that native species diversity in 4 selected barangay is high. Barangay Mabolo is more diverse than other barangays while no native species were observed in Barangay Catmon. This implies that there is population decline and these species have restricted geographical range. This may be because when urban tree species are deemed to be ineffective or useless in urban forest management, they are usually removed and/or hopefully replanted (Escobedo *et al.,* 2011). Therefore, an approach to an overall management planning for the conservation of these threatened species must be taken into consideration. It is noteworthy to conduct strategic management of urban ecosystems and vegetation to generate a sustainable urban forest that is resilient to environmental disturbances.

Information on ecosystem composition and diversity aids in the better understanding of both structural and functional processes. Analyzing the diversity of species, vegetation composition, and ecosystem structure aids in the understanding of ecological systems and the development of sustainable management plans for improving and protecting the ecosystem's present tree species (Lagbas, 2019).

Residents Survey

Table 7. Summary of socio-demographics and tree planting variables, shown as percent of all respondents.

Age	
18-24 years old	44.6%
25-34 years old	11.9%
35-44 years old	16.8%
45-54 years old	8.9%
55-64 years old	14.9%
65-74 years old	3%
75 years old	None
Gender	
Male	39.6%
Female	60.40%
Connection to Malolos	
Live in Malolos, Bulacan	45.5%
Lives and work in Malolos	8.9%
Lives and owns property in Malolos, Bulacan	14.9%
Work in Malolos, Bulacan	4.0%
Owns property in Malolos	26.7%
Years at current address	
Less than 1 year	4%
1-3 years	1%
3-5 years	3%
5-10 years	5%
More than 10 years	87.1%
Planted a native tree on your property	
Yes	33.7%
No	66.3%

Respondents in this study are from 101 households (Table 7) across the selected barangays. Purposive sampling was used, and 20 households were surveyed from each barangay. 44.6% of the respondents is in between the age of 18-24, and 60.40% are female. 45.5% live in Malolos and 87.1% indicated that they have been living at their current residences for more than 10 years. Further, 66.3% of the respondents indicated that there is no native tree planted in their property.

Table 8. Percent of correct responses for native and non-native trees species.

	Percent
Native Correct	72.11%
Non- Native Correct	49.50%
Correctly identified trees	
Mabolo (Diospyros blancoi or Kamagong tree)	57.43%
Katmon (Dillenia philippinensis)	38.61%
Bagna (Glochidion rubrum Blume or Bagnang-pula)	20.79%
Bangkal (Nauclea orientalis L)	18.81%
Balayong (Afzelia rhomboidea or Tindalo)	11.88%

When asked to indicate the native status of the 6 tree species, overall knowledge was high (Table 8), while the correct status was given most frequently for *D. blancoi* (native – 86.1%), *D. philippinensis* (native – 83.2%), and *T. catappa* (native – 82%). Most of the correctly identified trees were native species, while responses for non-native species were more frequently incorrect or 'do not know'. Therefore, correct identification of native trees was higher than that for non-native trees. Also, knowledge on identifying native trees correctly using photographs of representative species used in this study was highest for Mabolo (55.43%) and lowest for Balayong (11.88%) implying that Mabolo can still be seen and observed, hence the increased familiarity for the species.

Table 9. Summary of respondents' tree planting actions.

Trees planted and removed				
Number of trees planted	1-4	5-10	10+	Total
Percentage of respondents	34.16	6.93	0.99	42.08%
Number of trees removed	1	2	3-5	Total:
Percentage of respondents	39.60	2.97	2.97	45.54%
Future actions	Plans to plant a tree 51.49%		Plans to plant native trees 47.52%	

42.08% of the respondents had planted trees on their property since moving there (Table 9). Additionally, 33.7% of respondents (Table 7) had knowingly planted a native tree on their property, meaning that nearly half of the people who had planted trees had knowingly planted at least one native species. Lastly, 51.49% of the respondents are planning to plant a tree and 47.52% plans to plant native trees for their future actions. Thus, having a good understanding of resident appreciation for urban forest will assist planting initiatives in engaging community members to be involved and to achieve planting goals.

On the other hand, it is also shown in that removal of trees remains (45.54%) and is higher than tree planting actions agreeing to the description of the trees found in Malolos as to minimal or decreasing (57.4%) across most of the community (Fig. 7). This can be connected to whether urban tree-planting initiatives can be successful in the absence of large-scale tree cutting. Tree domestication initiatives, aimed at conserving natural resources as well as providing residents with more options for income generation, need to be based on a thorough study of existing knowledge of the range of available tree species (Santos etal 2004). Having the capacity to provide residents with free or subsidized seedlings of trees would likely serve to increase planting rates for any tree planting initiative regardless of tree-cutting or tree removal programs (Goldman, 2017).

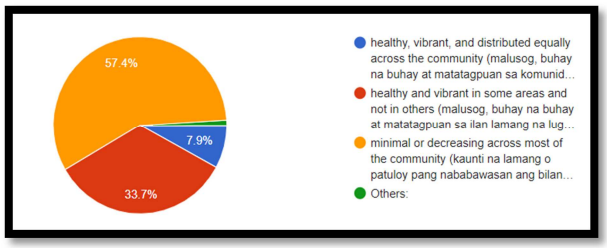

Fig. 1. Description of trees in Malolos.

Although there is already a widespread recognition of the value of native species in urban areas (Almas, 2017), only 12.9% of respondents indicated that nativeness of the tree was a primary consideration when choosing a tree to plant on their property. The most common factors were shade provision (88.1% of respondents), suits the aesthetic of their home (47.5% of respondents), and creates calming effect (46.5% of respondents). Most of the respondents attribute the value they place on trees to the aesthetic contribution in each property or in a community. This also shows the appreciation respondents have to urban forests because of its ability to characterize and differentiate spaces from another by increasing its beauty thus implying positive attitudes towards trees (Goldman, 2017).

Most of the respondents agree that their municipality should be plant more trees, planting more native trees (48.5%), homeowners should also plant more native trees (55.4%) and the municipality should plant more nonnative trees (36.6%). Moreover, 44.6% of respondents believe that the city government is responsible for maintaining their natural heritage, with 40.6% of respondents believing that there is an effective Urban forest management plan (UFMP). However, only 20% of respondents thought that all

varieties of native trees and 45.5% indicated that native trees that can pose potential hazards should not be planted also if these require extra maintenance.

The results of the survey highlight the need to engage residents and inform residents of the goals and targets of the urban forest management plan of the municipality. This is to strengthen the property-level value of planting local trees.

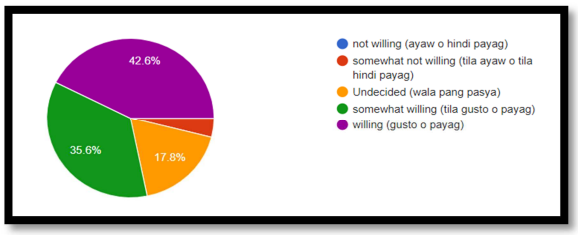

Fig. 2. Resident's engagement willingness.

Conclusions

A total of one hundred ninety four (194) individuals belonging to twenty two (22) species were identified and enumerated from the five (5) selected barangay. Tree species belongs to fifteen (15) families were recorded. Five (5) *Diospyros blancoi* (Kamagong or Mabolo tree) were observed in Barangay Mabolo. While there is no presence of the native trees namely *Dillenia philippinensis* or (Katmon tree), *Nauclea orientalis L* (Bangkal tree), *Glochidion rubrum Blume* (Bagnang-pula) and *Afzelia rhomboidea* (Balayong/ Tindalo tree). Never the less, seven (7) other species of native trees were observed present in the selected barangays. Out of the one hundred ninety four (194) individual tree species identified, sixty two (62) of which are native trees. The most represented family are Fabaceae, Moringaceae, and Araceae while the most abundant species is *Moringa oleifera* with a total number of 18 individual species. Most common species observed is *Adonidia merrilii* seen in 4 out of the 5 barangays.

Overall knowledge on native trees was high and correct identification of native trees was higher than that for non-native trees. Positive attitudes were also expressed by most of the respondents towards native trees and were in favor of planting more native trees in their barangays and in the municipality. Also, most respondents indicated that if given the choice between two trees with similar attributes, native trees will be the choice.

However, these positive attitudes did not relate to having native trees on their property or the desire to plant native species regardless of costs implying to not support this initiative if the native trees could cause hazards or higher maintenance costs. Nonetheless, the majority of the respondents are willing and somewhat willing to learn and be part of the projects or activities related to tree propagation and conservation. In general, respondents believe that native species are more beneficial than non-native species. The most common reasons include that it grows better, well or better suited to climate, chance of survival is higher, resilience, part of the native ecosystem, and non-native trees can become invasive. In contrast, the most common reasons given as to why native species are not more beneficial in urban areas were: urban areas are not native, trees are trees, so variety is helpful to adapt to climate change. Lastly, knowledge and number of trees planted and knowledge and length of residency were analyzed and was concluded that among all correlations, knowledge and length of residency has a low negative relationship, with an r coefficient value of -0.221 and it was deemed significant through the test for significance of r. (2-tailed test at 0.05 alpha). This suggests that the length of residency tends to indicate lower knowledge about native trees, which might also be attributed to a person's well-roundedness since a shorter length of residency might suggest more experience from an individual perspective.

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