

Assessment of urban forest species preference and nursery use practice in Pokhara Metropolitan City

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Pokhara is one of the rapidly urbanizing cities with declining trees and green spaces. It has become imperative to develop effective plans and strategies to maintain greenery in the city. There is little knowledge about the individual choice of urban tree species and how it shapes up the urban green spaces. This study was conducted in the Ward-17 of the Pokhara Metropolitan City to assess the people's preferences and factors influencing their choices. Data collection was done through nursery survey (n=15), household survey (n=60), and site observation (n=12). The observed sites were parks, religious sites and streets of Ward-17 of the Pokhara Metropolitan City. Majority of the household were found to be practicing home gardens with exotic species which were more preferred than the indigenous ones. Altogether, 15 major species were recorded from the households, with Dhupi (*Juniperus indica*) being the most frequent species followed by Guava (*Psidium guajava*). A total of 48 tree species were recorded during site observation, with a maximum frequency of Sissoo (*Dalbergia sissoo*). Among the six major factors for species selection, use and benefits derived from the species were detected as the most responsible ones. Nurseries provide seedlings mostly for individual purposes; however, financial and technical assistance should be provided to all the interested households with emphasis on the preferred type of species required for further development of urban forestry in the Pokhara Metropolitan City.

Keywords: Greenery, people's response, plant nurseries and urban forest species

Urban forests are the areas inside cities and urban centers that are planted or naturally occurring vegetation that varies from any combination of trees, shrubs, and grasses (Konijnendijk, 2018). Generally, urban forestry is the conservation and management of urban forests to enhance the urban landscape, and this concept also advocates the role of trees as a critical part of the urban infrastructure (FAO, 2006). It was developed to address the issue of urban forestry.

Urbanization is considered as the greatest threat to biodiversity (Aronson *et al.*, 2017). However, cities can play a significant role in the preservation

of native biodiversity, particularly through the management, planning, and conservation of urban green spaces (Ives *et al.*, 2016). The migration from rural to urban areas in the current decades is increasing, and more than half of the world's population are living in towns and cities, which is expected to increase to 70 percent by 2050 (Salbitano *et al.*, 2016).

Nepal is also one of the top 10 urbanizing nations, which has led to a number of issues with pollution, flooding, and social disorders in both the environment and human life (Bakrania, 2015). Managing urban population and environment has been one of the most important challenges.

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However in Nepal, urban forestry is still in its infancy. Through a number of initiatives, such as the “Forest Decade Program (2014–2023)” and the “Nepal Clean Environment Campaign 2075 AD,” the Nepal Government has placed an emphasis on urban forestry (Goutam, 2018).

Urban vegetation provides a wide range of advantages, addressing the physiological, sociological, educational, and economic demands of urban residents (Kwartnik-Pruc & Droj, 2023). According to Virtudes (2016), the availability of green spaces has particular importance in a city due to their influence on the quality of life of its citizens, and the integration of plants affects the urban environment favorably. The vegetation is a climate moderator that helps to reduce the imperviousness of soil, contributes to storm-water management and improves the air quality through the production of oxygen (Goutam, 2018).

Urban forestry will play a larger role in providing various commodities and in improving the urban living environment (Khan *et al.*, 2020). Urban people’s psychophysical and social requirements are regarded to be considerably aided by forests, trees, and other green places. Urban forests, which are made up of trees and related plants in cities offer co-benefits to city residents as multifunctional green infrastructure (Lyytimaki *et al.*, 2017). Urban forests provide a range of ecological services for local economic growth, improved social and educational opportunities, climate mitigation and adaptation, and physical and mental health (Barron *et al.*, 2021).

Trees in urban environments have unusual growth conditions due to fragmented landscapes, challenging site constraints, fluctuating meteorological conditions, and disturbance regimes (Warn & Adamo, 2015). However, in many developing nations, forest managers responsible for managing urban tree populations do not possess the knowledge necessary for appropriate species selection, care, and maintenance, and lack information on street trees, including basic data such as city street surveys that are appropriate to that locality and environment (Chen & Cheng, 2022).

In the context of Nepal, urban forestry is still in the primitive stage (Goutam, 2018). Due to rapid unplanned urbanization, and commercial development along with population pressure, the overall city environment is getting worsened seriously day by day (Fort *et al.*, 2018). Because of this, there is a severe need for the assessment of household’s preferences in species selection in the city areas. This paper aims to find out the urban people’s preferences and the factors influencing their choices of tree species in the Pokhara Metropolitan City (PMC).

Material and methods

The study was carried out in the Ward No. 17 of the PMC in 2020. With an area of 123 km², this ward is located between 83.75°–84.25° E longitudes and between 28.2°–28.6° N latitudes in the central region of Nepal, and is about 200 km west of Kathmandu. The elevation of the terrain ranges from 505 m (Kotre) to 2650m (Armala) above the mean sea level. The total area of the PMC is 464.94 km², which represents 23.01 % area of the Kaski district and 0.31 % area of the country. The city exhibits a humid subtropical type of climate; however, the elevation keeps temperatures moderate; the average temperature in summer fluctuates between 25–35 °C while it varies from -2 °C to 15 °C in winter. Pokhara and nearby areas receive 4851mm of rainfall per year (Lamichhane & Thapa, 2012).

A survey was carried out in the randomly selected 15 local private nurseries within the PMC (Figure 1). Information on the nursery locations were obtained through the Floriculture Association of Nepal (FAN), Kaski. Both open and closed-type of questionnaires were used for interviewing the nursery respondents. Similarly, a total of 60 households: 10 households with plants from 6 toles (localities), were surveyed (Figure 2). Semi-structured questionnaire were used for the purpose. Direct observation was done alongside the major road sections (3), parks (3), riverbanks/canals (3), and religious places (3) with a total of 12 such sites located within the Ward so as to assess and list out the plant species to express those in terms of frequency percentage. Species with a frequency percentage less than 1.5% are

not mentioned here. Information on the available sites were further supplemented with the help of the Ward Profile.

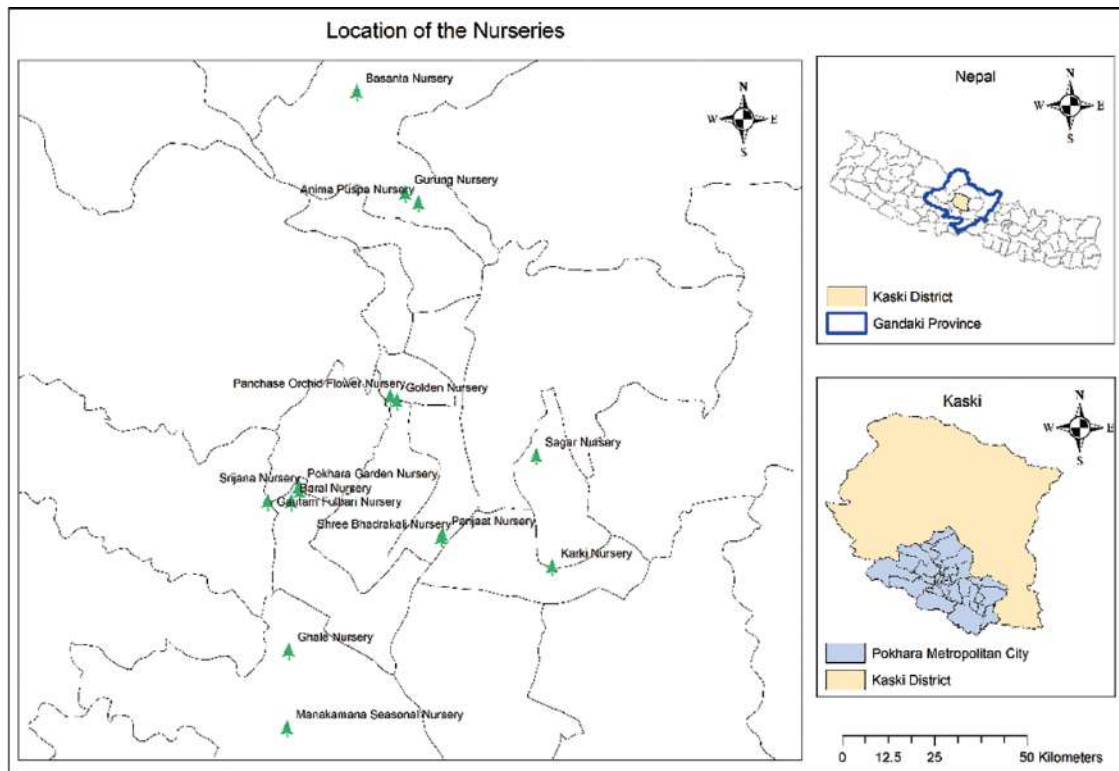


Figure 1: Map showing the locations of the selected nurseries within the PMC

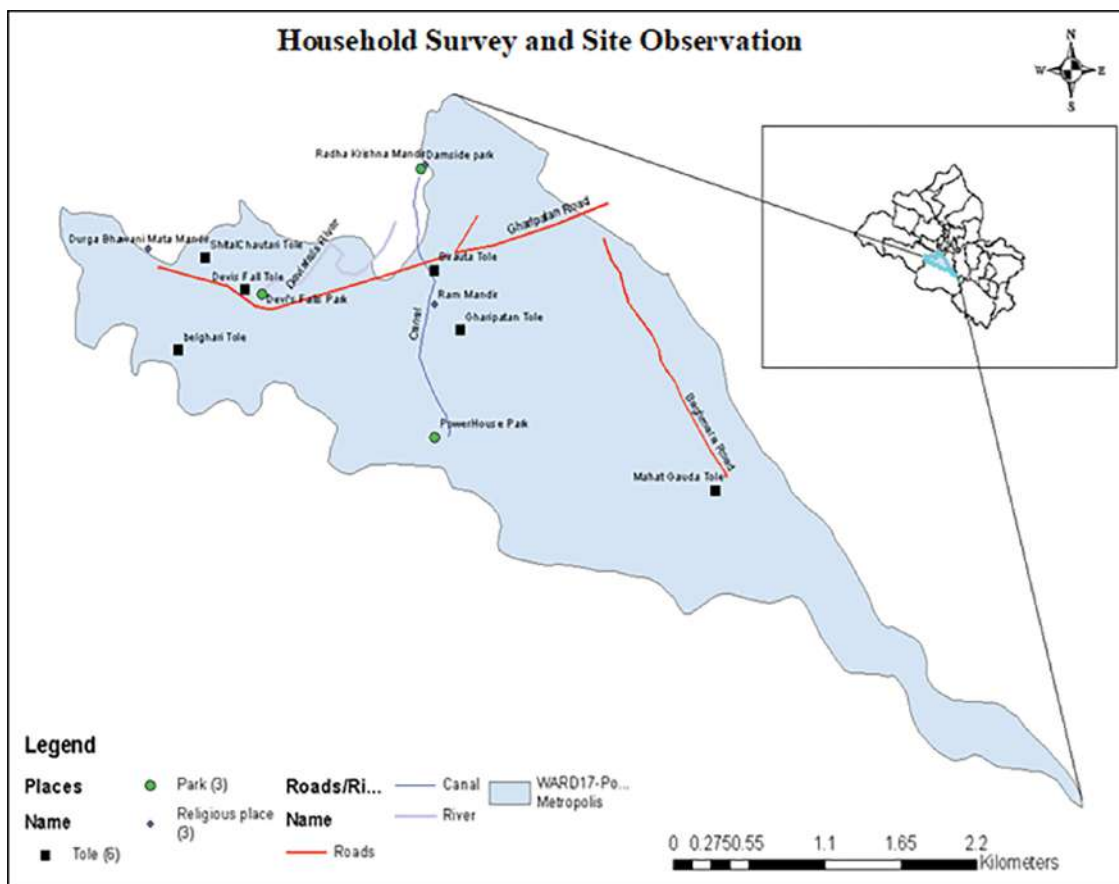


Figure 2: Map showing the area set aside for HH survey and site observation within Ward No. 17

Calculation of weighted mean

The following formula was used to calculate the weighted mean to understand about the factors influencing the species selection and plantation:

$$\text{Weighted mean} = \frac{\sum(w_i \times x_i)}{\sum w_i}$$

Where, w_i = Respondents response in %, and

x_i = Value assigned to “strongly agree” to “strongly disagree”.

Results

Household preference

A total of 40 % of the household-respondents belonged to the age between 30–45 years, and most of them (56.7 %) were female. Among them, majority (77 %) of the households had developed their yards as home gardens. Plants

were observed on the balconies and the rooftops of the houses. Moreover, some households had indoor plants. The practice of hanging plants on the walls was also noticed for decoration purpose. Out of the total number of households surveyed (60), 42 % were found to have planted indigenous species while 58 % had exotic ones. Introduction of the ornamental plants and several fruit trees of outside origin had resulted in a higher number of exotic species (Table 1).

Factors influencing species selection and plantation

The respondents ranked the major factors influencing the species selection in order of importance as shown in Table 2. The “use and benefits derived from the species” were ranked first with a mean rank of 2.25 followed by others, which indicated that the people were more concerned about the use of the species and less about their price.

Table 1: Major 15 species planted in the yards of the households

S.N.	Species (Local/English Name)	Scientific Name	Frequency (%)	Remarks
1.	Dhupi	<i>Thuja</i> spp.	7.2	Ornamental tree, native
2.	Guava	<i>Psidium guajava</i>	6.9	Fruit tree, exotic
3.	Banana	<i>Musa</i> spp.	6.8	Fruit tree, exotic
4.	Papaya	<i>Carica papaya</i>	5.7	Fruit tree, exotic
5.	False Ashoka/Indian Mast Tree	<i>Polyalthia longifolia</i>	4.8	Ornamental tree, exotic
6.	Peach	<i>Prunus persica</i>	4.6	Fruit tree, native
7.	Mango	<i>Magnifera indica</i>	3.9	Fruit tree, exotic
8.	Tejpat	<i>Cinnamomum tamala</i>	3.4	Fruit tree, native
9.	Christmas Tree	<i>Araucaria columnaris</i>	3.3	Ornamental tree, exotic
10.	Bottle Palm	<i>Hyophorbe lagenicaulis</i>	3.1	Ornamental, exotic
11.	Sugarcane	<i>Saccharum officinarum</i>	3.1	Cash crop, native
12.	Monkey Puzzle	<i>A. araucana</i>	2.8	Ornamental tree, exotic
13.	Lalupate\Poinsettia	<i>Euphorbia pulcherrima</i>	2.7	Ornamental tree, native
14.	Bakaino	<i>Melia azedarach</i>	2.4	Fuelwood/Fodder tree, native
15.	Pomegranate	<i>Punica granatum</i>	2.3	Fruit tree, exotic

Table 2: Factors influencing species selection and plantation

Factors influencing species selection and plantation	Tole/ Locality						S.D.	Mean	Rank
	1	2	3	4	5	6			
Environmental suitability of species	9	14	18	8	9	2	1.378	3.00	3 rd
Availability of space in residence	18	15	16	7	2	2	1.307	2.43	2 nd
Policies and regulations	0	5	7	15	12	21	1.303	4.62	5 th
Availability of seedlings in nursery	5	10	6	7	15	17	1.712	4.13	4 th
Money/Price of plant	1	3	6	14	18	18	1.246	4.65	6 th
Use and benefits derived from plant species	27	12	7	8	5	1	1.445	2.25	1 st

Site observation

From our site observation, a total of 48 different species were recorded. Table 3 below shows the highest composition of major 15 species. Among them, Sissoo was the most frequently species observed with a frequency of 15.1%.

Table 3: Species with the highest composition as observed from the sites

S.N.	Species (Local/ English Name)	Scientific Name	Frequency (%)
1.	Sissoo	<i>Dalbergia sissoo</i>	15.10
2.	Kapoor	<i>Cinnamomum camphora</i>	14.90
3.	False Ashoka/Indian Mast Tree	<i>Polyalthia longifolia</i>	10.00
4.	Simal	<i>Bombax ceiba</i>	4.90
5.	Kalkiphool	<i>Callistemon viminalis</i>	4.86
6.	Bottle palm	<i>Hyophorbe lagenicaulis</i>	4.05
7.	Birendraphool	<i>Jacaranda ovalifolia</i>	3.78
8.	Bans	<i>Dendrocalamus</i> spp.	3.51
9.	Peepal	<i>Ficus religiosa</i>	3.50
10.	Sami	<i>F. benamina</i>	2.97
11.	Lalupate	<i>Euphorbia pulcherrima</i>	2.16
12.	Dhupi	<i>Thuja</i> spp.	1.62
13.	Gulmohar	<i>Delonix regia</i>	1.60
14.	Tooni	<i>Cedrella toona</i>	1.60
15.	Painyu	<i>Prunus cerasoides</i>	1.50

Nursery survey**Seedling production in the nurseries**

Out of the total number of nurseries surveyed (60), the owners/informants of the two nurseries reported that they used to grow seedlings of their own. Similarly, the owners/informants of the four nurseries

informed that they did not grow seedlings by themselves, rather they used to bring seedlings from outside. The owners of the remaining nine nurseries used to bring some seedlings from outside apart from growing on their own. They informed that they had to import the perennial plants from India while the seasonal flowering plants and other tree species used to be brought from other places of our country as they did not have enough space in their own nurseries to grow plants due to high commercial value and cost of the land within the PMC.

Types of species produced in the nurseries

On an average, the surveyed nurseries had the highest number of the seedlings of fruit/medicinal plants (34) followed by those of fodder/fuelwood tree species (33), ornamental plants (24), and the plants with religious value (7).

Supplies of seedlings from the nurseries

As per the nursery respondents, the seedlings produced at their nurseries were mostly supplied to the individual/private users (with rank 1.2, the highest; see Figure 3). Similarly, the seedlings were supplied to the different organizations (with mean rank 2.3), hotels and restaurants (with mean rank 2.7), and parks (with mean rank 3.8). Besides, some seedlings were also supplied for roadside plantation (with mean rank 2.7, the least).

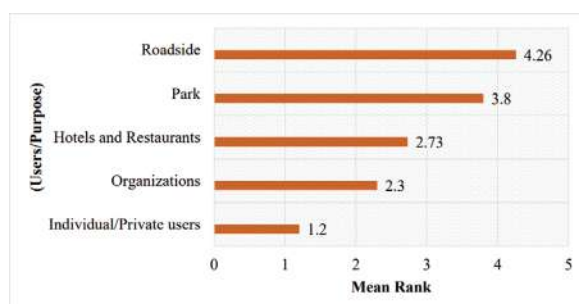


Figure 3: Supply ranking of the seedlings for various purposes

Discussion

According to the Report of UNDESA (2014), the urban growth rate in the PMC was found to be 5.21 percent in between 2010–2015, and is

expected to be increasing in the years to come. It is estimated that Pokhara had 6.2 percent of the urban population in 2015, which will be rising to 6.7 percent in 2030. The practice of planting trees was noticed in many other areas too. However, majority of the previous tree planting had been done on an ad hoc basis without a comprehensive city-wide master greenery plan, a problem that can also be found even in some U.S. cities (Beatty & Heckman, 1981).

Private households maintain their trees according to their own principles. Trees on urban matrices contain a significant proportion of wild indigenous species with relatively high species diversity though not as high as the original natural vegetation of seasonal tropical rain forests (Kidane & Kejela, 2021). This does not match with the findings of our study as more exotic plants were recorded in the private compounds. Planting can be done at open spaces, along road-sides, along canal/stream/river-sides and roof-top gardens. Furthermore, private individuals living in houses with gardens in a few low-density residential zones frequently plant trees on their own initiative (Xue, 2016). We also noticed the practices of home gardening, rooftop gardening, and fostering hanging plants during our site visits.

Forty cultivated street-trees were recorded along the streets of Hong Kong (Jim, 1987). We had recorded 48 species with 15 major ones from our site observation. A similar study conducted by Khanal *et al.* (2021) with the sample sites along the Balkumari–Shankhamul Road in Kathmandu had recorded 30 plant species belonging to 13 families. Similarly, a study conducted by Pandey & Luitel (2020) had recorded a total of 2531 individual trees of 61 woody species belonging to 28 families in the Kathmandu Valley. To a limited extent, the floral diversity demonstrated relatively higher diversity (Biodiversity Index: 0.024, Simpson Index: 18, Shannon Index: 3.36). However, the species chosen for roadside plantations in this area appeared to be unprofessional and haphazard, which were almost similar to our study site. Mainly, Poplars (*Populus* spp.), Birch (*Betula alnoides*), Willow (*Salix* spp.), and *Jacaranda mimosifolia* were found to be planted (Pandey & Luitel, 2020), which were

different than our recorded species. This might be due to the difference in the environmental conditions of the two places.

Baral & Kurmi (2005) recorded 202 species of wild ornamental plants growing in Godawari and Phulchoki sectors. They had recommended 306 indigenous species for the Kathmandu Valley. The recommended species included 66 trees, 80 shrubs, 42 climbers, 87 herbs, and 31 orchids. People's preferences for purchasing trees from nurseries are also likely to be a major determinant of urban tree structure and composition (Avolio *et al.*, 2018), which is true in the case of our study area.

Similarly, a preliminary census published by the Central Bureau of Statistics in 2078 revealed that the population of the PMC was 518,452, the 2nd highest of Nepal with a population density of 1100 km² (CBS, 2022). This means that there are limited areas suitable for implementation of urban forestry in the city. This coincides with our findings where the respondents ranked the availability of space as a factor influencing the plantation.

According to Lamichhane & Thapa (2012), the local people living in the urban areas were aware of the importance of trees in the urban context and quite positive about their benefits. They found that 42 % of the urban respondents were aware about the aesthetic benefits of trees/plants, 26 % were aware about their importance for food/fruits, 17 % were aware about their importance for environmental cleanliness, and the remaining 15 % were aware about their importance for ecological balance. These findings coincided with our findings as the major preference for plantation was given for the use and benefits derived from the trees. Of the total species listed, 42 % were found to be indigenous and 58 % exotic. This proportion of indigenous and exotic species was similar to that of (Gyawali, 2015) who recorded the percentage of indigenous as 47 % and exotic as 53 %. Our study found that, on an average, a household possessed four seasonal plants, three non-woody perennial plants, and two woody perennial plants.

Of all the 60 nurseries surveyed, only three had started producing flowers themselves in addition to the seasonal flower seedlings. To meet the rising demand in the PMC, enormous quantities of seedlings of various seasonal flowers and plants were reported to be imported from Kathmandu and India. This indicated that there were limited domestic production and lack of communication between domestic growers and clients (Kunwar & Bist, 2021). So, market linkage should be developed through a formal communication network. Hotels, travel agencies, foreign missions, government offices, NGOs/INGOs, banks, business organizations, pilgrims, resorts, and the general public are the primary customers of nursery products (Pun Magar & Baniyar, 2021). In the case of our study, the major supplies were for the private users followed by organizations, hotels, parks and road sides.

Recommendations

In the PMC, the majority of the households were found to be developing their own yards as home garden with plants ranging from fruit trees to ornamental plants to different seasonal flowers. Exotic species were mostly preferred rather than indigenous ones. People need to be encouraged to use native species. "Use and benefits derived from plant species" was found to be the major factor in the selection of plants in residential areas. The local residents were found to be least concerned about the price/money of the plants while choosing species for plantation in their yards. While observing the different sites within the study area, a total of 48 different species were recorded with Sisoo (*D. sissoo*) having the highest frequency followed by Kapoor (*C. camphora*) and False Ashoka (*P. longifolia*). Mainly, ornamental and fruit species were preferred by the people for household purposes. Most of the perennial plants and seasonal flowering plants had to be imported from India whereas other tree species were brought from other parts of our country. The nurseries used to supply seedlings mostly for individual household use and least for roadside plantation.

Conclusion

The urban forestry in the PMC is still at its infant stage. Therefore, there is a need of strong provisions and regulations regarding the availability of open areas and plantation of forest trees and plants in order to boost it in the PMC. Besides, rooftop and balcony plantation should also be encouraged, which can be a good means for maintaining greenery levels in the city. Furthermore, educating people and nursery owners through urban-forestry-related research, trainings and publications by the concerned organizations and media is essential for improving the status of urban forestry in the PMC.

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