International Journal of Advanced Scientific Research | IJASR
International Journal of Scientific Research in Technology, Applied Sciences & Health Studies | IJSRTASHS
ISSN Print: 2579-1036 | ISSN Online: 2579-1044 | Volume 2, Number 2 December, 2017

Sustainable Urban Green Spaces: Optimizing Users Benefits through Planting Techniques and Use of Plants

[1]Dantong Jack-Sam Dalyop & [2]Sati Yohanna Chanle
[1&2]Department of Architecture University of Jos

Abstract

The use of urban green spaces, especially increasing the benefits, has become a hot topic for many green space managers during the past few years as the assumed link between sustainable urban green spaces and sustainable urban development is becoming more visible. Increasingly, urban green space is seen as an integral part of cities providing a range of services to both the people and the wildlife living in urban areas. Up to this time, there is little systematic information about urban green space including the knowledge of plants and their planting systems. Greenspaces play crucial roles of social, economic, wellbeing and environmental aspects of sustainable development. The aim of this paper is to promote sustainable urban green spaces in our cities in order to optimize user's benefits. To achieve this, the study seeks to address the correct use of plants and Planting Techniques that will ensure the sustainability of the desired urban green spaces.

Keywords: *Integrated approach, Planting system, Socio-economic value, Sustainable environment, Urban green spaces.*

Corresponding Author: Dantong Jack-Sam Dalyop

Background to the Study

Sustainable development of cities and that of urban green spaces are very important, since almost half of the world population now live in urban area where the pace for rural-urban migration and pressure from international migration in developed countries is still high, as most of the immigrants live in central or big cities of the country. (Asiya, Nafisa & Iskander, 2014).Urban green spaces can be a comprehensive tool for long term protection of environmental sustainability through improving the quality of life and air, increasing property value due to their amenity, aesthetic characteristics and reducing the energy costs of cooling buildings. Urban green spaces also can provide ecosystem services in which the recreation and relaxation facilities are especially available to urban dwellers and tourists too. To confirm the multiple roles played by green spaces, this project sort to study and compile the possible obtainable benefits.

Fore front factors that will optimize benefits of green spaces are the planting techniques, correct use of plants and the distribution in our cities as desired to meet the world's best practices, incorporated effectively into the environmental sustainability agenda. According to Shah (2011), an integrated approach regarding the planning, monitoring, designing and maintaining of urban green spaces is required for improving the environmental conditions in cities. Sati (2016) pointed out that the beauty of building forms and images and the visual quality of metropolitan areas are dependent on the quality and quantity of green spaces. When harmony exists between metropolitan buildings and green spaces, it is simply functional, liveable, amenable and enjoyable. Moreover, it is an urgent need to improve the lifestyles of urban people especially the developing countries can rely on such to strive. There should be a special focus on the consideration of environmental impact of human activities by raising awareness to the rational use of energy, water and food consumption and natural resources for environmental sustainability. Therefore, the role played by green spaces in our urban environments can no longer be ignored by today's policy makers.(Haifeng, Wenbo, & Wei, 2015).

Lack of community and public access to safe open and green space is a critical area of concern.(Greens pace Scotland, 2011).Consider the challenges in developing countries usually coming from socio-economic factors, culture, population growth, inadequate management, lack of proper implementation of environmental policies and excessive unplanned rural-urban migration. (Haifeng, Wenbo, & Wei, 2015).

Objective of the Study

The study seek to proffer a Sustainable Urban Green Spaces by optimizing user's benefits. This project focused on local and integrative approaches to planting systems, types and relevant uses of plants in a bid to maximize these benefits. The methodology is basically qualitative review from literatures and oral interviews. Topography, nature of soil and even climatic-weather conditions are put into consideration all in a bid to ensure functional and sustainable urban green spaces for urban dwellers, users or tourist.

Literature Review

Green Space is a plot of undeveloped land separating or surrounding areas of intensive residential, institutional or industrial use that is maintained for recreational enjoyment and is known as urban Green Space. (Lexicon Dictionary 2014).Shah (2011) defined Green space as

any vegetated land or water within an urban area; this includes: parks, gardens, playing fields, children's play areas, woods and other natural areas, grassed areas, cemeteries and allotments. Green corridors like paths, disused railway lines, rivers and canals derelict, vacant and contaminated land which has the potential to be transformed are also regarded as green spaces.

Mitchell, (2013) and Asiya, et al. (2014) revealed that green space can also be defined functionally by how people use them. Introduction of urban green spaces as an important contributor and a significant part of sustainable development is agreed on by architects, ecologists, economists, social scientists and planners. This professionals view it as public and private open spaces in urban areas, primarily covered by vegetation, which are directly (e.g. active or passive recreation) or indirectly (e.g. positive influence on the urban environment) available for the users.

Greens pace Scotland Standards, (2011) came up with a more radical definition, a resilient approach that Green Open spaces are the 'green lungs' of our towns and cities which contribute to improving people's physical and mental health by providing places for informal recreation - walking, cycling, sitting, socializing and children's play - and 'breathing spaces' to take time out from the stresses of modern life. They bring the countryside into our towns and cities, and make it accessible from our 'backdoors'. Green spaces also create safe and attractive places where people want to live and businesses invest.

'Open Space' must not be confused with 'Green Space.'Open space as defined by Urban Environmental Program in New England (2016) as any open piece of land that is undeveloped (has no buildings or other built structures) and is accessible to the public. Open space can include: Green space (land that is partly or completely covered with grass, trees, shrubs, or other vegetation), green space includes parks, community gardens, and cemeteries, also schoolyards, playgrounds, public seating areas, public plazas and vacant lots.

Figure 1: Scenes of Open Green Spaces: NambaParks (Osaka City)
Source: Developing the BGCI database on botanic gardens and their collections worldwide (2016).

Sustainable Urban Green Spaces and Sustainable Development

To understand Sustainable Urban Green Spaces which is an environmental development we need to first understand Sustainable Development: According to Liam, Andy, Paul, James, Lin, Sarah, Hepu, & Felicity, (2013);Sustainable Development is a process for meeting human development goals while sustaining the ability of natural systems to continue to provide the natural resources (to include open green spaces) and ecosystem upon which the economy and society depend. While the modern concept of sustainable development is derived most strongly from the 1987 Brundtland Report, it is rooted in earlier ideas about sustainable forest management and twentieth century environmental concerns. As the concept developed, it has shifted to focus more on economic development, social development and environmental protection. Environment protection playing a vital role in this shift, Sustainable Urban Green Spaces needs to be tackled seriously.

Sustainable development has been described in terms of three dimensions, domains or pillars. According to Scerri & James, (2010) and Mitchell, (2013) revealed that in recent years social, economic and environmental considerations have led to a revaluation of the factors that contribute to sustainable urban environments. Increasingly, urban green space is seen as an integral part of cities providing a range of services to both the people and the wildlife living in urban areas.

Within the sphere of environment and ecology Sustainable urban Green Spaces as defined by Lynn, & Eda, (2014) and Liam (2013) is the practice of maintaining processes of productivity indefinitely natural or human made by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems.

Benefits of Open Green Spaces

The basic benefits that urban open green space provides to People can be broken into five (5) categories; Social/Psychological, Recreation/Wellbeing, Human Health, Environmental and Aesthetic/Economic Benefits. Urban open space is often appreciated for the recreational opportunities it provides. This may include active recreation (such as organized sports and individual exercise) or passive recreation.

Figure 2: Recreational: a park in Bratislava (Slovakia)and Forsyth Park at Savannah District Georgia.
Source: Developing the BGCI database on botanic gardens and their collections worldwide (2016).

Social and Psychological Benefits

i. Psychological Benefits: According to Shi (2002) cited in Sati. (2016) from the view of chromatics, blueness and vegetation greenness belong to impassive colors that make people calm down. If there is not enough blueness and greenness but full of exciting redness in the metropolis, there will be no peace environment for the residents. Therefore, it can be seen that people must appreciate and live together with nature.

ii. Individual Scale: Psychological benefits gained by visitors to urban green spaces increased with their biodiversity (Astell-Burt, Thomas, Xiaoqi, & Gregory (2013) indicating that 'green' alone is not sufficient; the quality of that green is important in delivering the health benefits.

iii. Improve Focus: Interacting with nature can have a restorative effect on focus levels, through providing the brain a break from overstimulation. (Berman, Marc, Jonides, & Stephen (2008).

iv. Strengthen Immunity: A research study showed that women who spent six hours in the woods for two days showed an increase in white blood cells. This increase was also recorded to have stayed for seven days afterwards. (Astell-Burt, 2013).

v. Faking It: There are benefits from nature that can be manipulated as well. People who were shown pictures of scenic, natural environments had increased brain activity in the region associated with recalling happy memories, compared to people that were shown pictures of urban landscapes. (Kim, 2010).

vi. Physical Activity: When the physical activities are coupled with green space environments. Such coupling leads to decreased levels of stress, lowers the risk for depression as well as increases the frequency of participation in exercise. Bowler, Buyung, Knight, & Pullin, 2010 and Astell-Burt, et al. 2013. The degree of intensity of exercises doesn't impact degree of benefit from green space. Casual group walks in a green environment (nature walks) increase one's positive attitude and lower stress levels as well as risk of depression. (Mitchell 2013). Hunter, (2015) In another study on "The Impact of Interventions to Promote Physical Activity(PA) in Urban Green Space" and the studies showed positive effect to support PA programs or PA programs combined with a physical change to the built environment, for increasing urban green space use and users of PA.

Improvement in Cognitive Development Associated with Surrounding Greenness, Particularly with Greenness at Schools. According to Dadvand, (2015) findings provide policymakers with evidence for feasible and achievable targeted interventions such as improving green spaces at schools to attain improvements in mental capability at population level. Another study conducted in Helsinki, Finland by Neuvonen, Sievanen, Susan & Terhi (2007 cited in Shah 2011) indicated that nearly all (97%) city residents participate in some outdoor recreation during the year. Urban green spaces serve as a near resource for relaxation and provide emotional warmth (Heidt & Neef 2008).

Recreation and Wellbeing Benefits

i. Wellbeing: Russel, (2013) in his study of "humans and nature and how knowing and experiencing nature affect well-being" came up with the balance of evidence indicates conclusively that knowing and experiencing nature makes us generally happier and healthier people.

ii. Communal Scale: A large epidemiological study Mitchell & Popham (2008) concluded that wealthier individuals were generally healthier than individuals with a lower income, explained by the pattern that wealthier individuals reside in areas more concentrated with green space. There was a positive correlation with increased green space and improvement in health. Also, from equal exposure to green space, everyone benefited but the lowest income group benefited the most.

Human Health

Grahn & Stigsdotter (2003) research as cited in Sheh (2011) declared that people who were exposed to natural environment, the level of stress decreased rapidly as compared to people who were exposed to urban environment as their stress level remained higher. In the same review, patients in an hospital whose rooms were facing a park had a 10% faster recovery and needed 50% less strong pain relieving medication as compared to patients whose rooms were facing a building wall. Sheh (2011) in another research showed that the more time people spend outdoors in urban green spaces, the less they are affected by stress.

i. Public Health: Despite improvements in medical technology that allow humans to heal from numerous diseases and medical conditions, research shows that contact with the green environment still offers great benefits to mental health and psychological well-being. (Bos, 2016). A 2010 meta-analysis in BMC Public Health have found that, compared to walking or running in "synthetic environments," doing so in green spaces led to decreased anger, fatigue and feelings of depression in addition to increased attention levels. White, M., Alcock, I., Wheeler, B. & Depledge, M. (2013) on a fixed-effects analysis of panel data of psychological science, researched to know if people are happier living in a greener urban area. The results revealed that, "on average, individuals have both lower mental distress and higher wellbeing when living in urban areas with more green space.

Hystad, P. (2014) researched on "Residential Greenness and Birth Outcomes: Evaluating the Influence of Spatially Correlated Built-Environment Factors." The result was that increased residential greenness was associated with beneficial birth outcomes. In another study Mitchell, R. & Popham, F. (2008) had an observational population study on the effect of exposure to natural environment on health inequalities: The result shows that there was no effect for causes of death unlikely to be affected by green space, such as lung cancer and intentional self-harm. Interpretation:

ii. Physical Mental Health: A 2011 systematic review on use of urban green space concluded that "the balance of evidence indicates conclusively that knowing and experiencing nature makes us generally happier and healthier people." Cohen, Hannah, Eric, & Glen E.; (2015) conducted a study to do with Green Space and Mental Health among Adult Twin with the aim to examine the association between access to green space and mental health among adult twin

pairs. The results suggest that greater access to green space is associated with less depression. In another study Lee, A.C.K. & Maheswaran, R. (2010) came up with results that the use of urban green spaces benefits everyone particularly the aged, reducing stress and mental problems.

Environmental Benefits

i. Ecological Benefits: Having the opportunity to be within a natural urban green space people gain a higher appreciation for the nature around them. (Bos, Meulen, Wichers & Jeronimus 2016). (Heid, 2008). Bolund& Sven (1999) as cited in Shah (2011) researched on what he called "Urban Heat Island Effect" (UHIE)which is caused by the large areas of heat absorbing surfaces, in combination of high energy use in cities. UHIE can increase urban temperatures by 5°C but conclude that, adequate forest plantation, vegetation around urban dweller's house and management of water bodies by authorities can help to mitigate the situation.

ii. Pollution Control: Urban greening can reduce air pollutants directly when offensive smell, dust and smoke particles are trapped by vegetation. Research has shown that in average, 85% of air pollution in a park can be filtered (Bolund& Sven 2008) and (Huang& Wang 2009).

iii. Biodiversity and Nature Conservation: Biodiversity and natural conservation of green spaces do function as protection center for reproduction of species and conservation of plants, soil and water quality. Urban green spaces provide the linkage of the urban and rural areas. They provide visual comfort and relief, seasonal change and link with natural world (Francis 1997 and Lou res, & Santos 2007).

Economic and Aesthetic Benefits

i. Aesthetic Value: The aesthetic value of urban open spaces is self-evident. People enjoy viewing nature, especially when it is otherwise extensively deprived, (Eysenbach, 2008). Aesthetic value of urban open spaces influences positive attitudes like walking, cycling etc. Catharine, (2013)

ii. Energy Savings: Using vegetation to reduce the energy costs of cooling buildings has been increasingly recognized. (Heidt et al. 2008). Plants improve air circulation, provide shade and they evapotranspire. This provides a cooling effect and help to lower air temperatures. A park of 1.2 km by 1.0 km can produce an air temperature up to 4 km away. Similarly a study in Chicago has shown that increasing tree cover in the city by 10% may reduce the total energy for heating and cooling by 5 to 10% (Heidt 2008).

iii. Property Value: Areas of, the city with enough greenery are aesthetically pleasing and attractive to both residents and investors. (Sorensen, Smith, Barzetti & Williams 1997). Still, indicators are very strong that green spaces and landscaping increase property values and financial returns for land developers, of between 5% and 15% (Heidt, 2008).

Other values of urban open space

i. Jesdale, Morello, & Cushing, (2013) Land cover was associated with segregation within each racial/ethnic group, which may be explained partly by the concentration of racial/ethnic minorities into densely populated neighborhoods within larger, more segregated cities. In anticipation of greater frequency and duration of extreme heat events, climate change adaptation strategies, such as planting trees in urban areas, should explicitly incorporate an environmental justice framework that addresses racial/ethnic disparities.

ii. Branas, C. C. (2011) study on "A Difference-in-Differences Analysis of Health, Safety, and Greening Vacant Urban Space." The findings of the regression-adjusted estimates showed that vacant lot greening was associated with consistent reductions in gun assaults across all four sections of the city and consistent reductions in vandalism in one section of the city.

In view of the afore-mentioned benefits of urban green spaces derived from assorted plants and the distribution of different type of open spaces, there is therefore every need to not only conserve these plants but to ensure their best planting methods and propagation as discussed in the following chapters. The source is qualitative from literatures and oral interviews.

Planting Techniques and Plants Care

According to NC Cooperative Extension Resources (2015) a properly planted tree, shrub or grass will be more tolerant of adverse conditions and require much less management than one planted incorrectly. Planting technique impacts water quality as it minimizes water, fertilizer and pesticide use. When making decisions on planting techniques, one should consider how the plant was grown in the nursery, the plant's drainage requirements, the soil type and drainage characteristics and the availability of irrigation water. The plant should be specifically appropriate to the site, or the site should be amended to specifically fit the plant.

Trees, shrubs and grassing add beauty and value to residential, institutional and commercial property. Michael (2014) pointed out that they help modify microclimates around buildings and outdoor living areas. To achieve success with landscape trees and shrubs, correct plant selection, proper timing of planting, and correct planting techniques should all be employed. Selection includes choosing the proper species for appropriate use and selecting the appropriate root condition for successful planting. Timing the planting operation can be crucial to the survival of many tree and shrub species. It is all a matter of knowing what, when, and how to plant for success. According to Kiml (1997) and Marianne & Puyallup (2013) a properly planted tree or shrub will be more tolerant of adverse conditions and require much less management than one planted incorrectly.

Planning

According to Wadsworth, (1914), a green space distribution map is used for landscape pattern analysis. An urban green space system planning map, showing layout of urban traffic planning, pedestrians walkways, drainages, existing structures and all topographical features. Green spaces can be classified into two types: natural green space and cultivated green space. Eco-green spaces, woodland for landscape, parts of green space of waterfront, and parts of shelter greenbelt integrated into natural green space. The cultivated green space includes habitats, such as urban parks (relaxation sports), gardens, and street green spaces. Bos, (2016)

pointed out that it is important to also note while planning that simplified land use classification scheme was adopted for the purpose of assessing the spatial characteristics of the major human modifications to natural or semi-natural landscapes, and for understanding the general patterns of their interactions.

Surveying the Planting Site

Before planting, it important to survey the site for potential hazards to plant growth. Wadsworth, (1914) pointed out that new construction sites are often littered with pieces of mortar, plaster or limestone, creating an alkaline soil condition and inhibiting a plant's ability to absorb nutrients. Similarly chemical spills, such as motor oil or gasoline, can also impair plant growth. Poorly drained, compacted and water logged soils inhibit root and plant growth. It may be necessary to remove the top 50 to 150mm of soil and replace it with a good grade of topsoil. Compacted soils also inhibit root growth.

Figure 3: Ornamentals can be grown on poorly-drained soils if they are planted on raised beds.
Source: Developing the BGCI database on botanic gardens and their collections worldwide (2016).

The Challenge

Horticulture researchers have estimated that 75% of the roots may be lost when digging field-grown nursery stock. (Kim, 1997) revealed that cultural practices by the nurseryman, such as root pruning, irrigation, fertilization, root-ball configuration, and digging techniques, influence the percentage of harvested roots. Water stress, due to removal of most of the water-absorbing roots, is the primary cause of transplant failure. Most water absorption capability within a transplanted root-ball results from very small diameter roots. These fragile roots are the first to suffer from excess water loss in newly transplanted landscape plants.

Plant Selection

The selection of any plant for a landscape should be based on the functional role the plant will play in the overall landscape. Aspects such as a plant's mature size, canopy form, environmental requirements, and root growth pattern are all important. According to Wadsworth, (1914) the condition of the root system at transplanting is a critical characteristic to consider when choosing a plant for your landscape. The root condition will determine how the plant should be handled. Trees and shrubs are usually nursery grown, and such plants are pruned and trained to develop strong canopy forms and root systems. They most often succeed in their new location. Plants from the wild seldom transplant successfully.

According Abraham of Luji garden Jos; these plants should have healthy, vigorous tops and white feeder roots on the outer edge of the root ball and not to be timid about inverting a few

plants, removing their pots and examining their roots. Container-grown plants generally transplant well throughout most of the year with minimum shock, although fall and winter months are the best time to transplant. Always purchase fresh, high-quality plants.

Fig. 4: Woody ornamentals for the landscape are commonly sold three ways: container-grown (left), balled-and-burlapped (center) and bare-rooted (right).
Source: Horticulture, University of Georgia.

Sources of Plant Material
Plants are grown by various production methods, e.g. bare-root, balled and burlapped, fabric container and plastic container.(Figure 3.3.1)According to Wadsworth, (1914) advantages of planting bare-root plants are mostly economical. Each of these harvesting and growing techniques is acceptable, but requires a specific planting and management technique.(Kim,1997).Large trees and shrubs grown in the field are often sold balled-and-burlapped, because a large portion of the root system is destroyed during digging.(Williams 2011).

Size of Plant to Choose
Smaller plants live better and establish faster than large plants and are more economical. Many consumers, on the other hand, want the "instant" landscape look. Demand for large, landscape-size trees has certainly increased over the last decade. With large mechanical digging equipment, 6- to 8-inch diameter trees can be moved.(Kim 1997 and Dana 2015).

Preplant Operations and Plant Care
Begin plant care immediately upon receipt of stock. Protect roots and crowns from mechanical damage, drying, and overheating. It is best to plant as soon as possible. Balled and burlapped or containerized plants should be handled only by the soil ball or pot. Never lift such a plant by the trunk or crown. If planting is delayed, place plants in a cool, sheltered area. Water as needed usually once per day to keep the ball or container soil moist. Do not allow the root ball or the container to stand in water. Bare-root plants may be held for several days in a cool, sheltered location. Cover roots with a moist mulch material such as sawdust or sphagnum moss, and water daily.(Michael, 2012).

Holding Plants Until They Are Planted
If plants cannot be planted right away, place them in a shaded area and keep the roots moist. If balled-and-burlapped or bare-root plants must be held several days before planting, cover their roots with sawdust, pine straw or soil to conserve moisture. Avoid placing the roots in water or buckets for long periods of time because they will suffocate. Container plants may need daily watering. Make sure plants are well watered before planting and ensure the root ball is thoroughly wet. A dry root ball is difficult to rewet after transplanting. (Williams, 2002).

Soil Preparation

To assist in establishing vigorous root growth, soil preparation is an important step in the planting operation. According to Micheal (2012) provision for adequate drainage and soil aeration, is usually the goal. According to Abraham the Horticulturist; on well-drained sites, increasing the soil's water-holding capacity may be important. Azila from the school of forestry Jos pointed out that soil types vary, not only between regions, but also between areas of a single site. Fill soil, used to alter grades in new construction, can result in drastic changes in soil conditions within a short distance. Soil conditions must be considered before planting. Michael (2012) maintained that subsurface drainage can be checked by digging a hole and filling it with water. If the water doesn't drain away within two hours, subsurface drainage is inadequate and should be improved. Improving soil drainage and aeration on a large scale is difficult and expensive. Filling and re-grading water collecting areas, installing drain tiles, or incorporating organic matter in conjunction with deep spading or Plowing are suggested treatments. Williams (2011) pointed out that; if extensive site preparation is not possible, be sure to select plant species that can tolerate soggy or clayey conditions. In this soil condition avoid plants that are totally unable to withstand "wet feet". With enough effort, species of shrubs or small ornamental trees requiring good drainage can be established on poorly drained sites. Follow guidelines in the section ("Planting in Heavy Soil.").

a. Some commonly used landscape plants that do not tolerate wet soils ("wet feet")

These plants can be planted along rocky terrain and places where there is difficulty in watering. They are best planted in the dry season. Scientific and Common Names (Dana (2014): Abiesconcolor/*White Fir*, Acer saccharum/*Sugar Maple*, Circidiphyllumjaponicum/ *Katsura tree*, Cladrastislutea/*Yellowwood*, Cornusflorida/*Flowering Dogwood*, Fagus spp. /*Beeches*, Hedera helix /*English Ivy*, Pinusstrobus/*White Pine*, Quercusrubra/*Red Oak*, Rhododendron spp./ *Rhododendrons & Azaleas,* Taxus spp. /*Yews*, Tiliacordata/*Littleleaf Linden*, Tsuga Canadensis/*Canada Hemlock* and Vincamino/*Myrtle.*

b. Other Plants that can be used generally in the Open Green Spaces

Scientific and Common Names of plants that can be used generally on Green Spaces as recommended by Azila the Horticulturist at the School of Forestry Jos; Acer rubrum/*Red Maple,* Betula spp./*Birches,* Chamaecyparisnootkatensis/*Nootka False Cypress,* Cornus florida/*Flowering Dogwood,,* Crataegus spp./*Hawthorns,* Koelreuteriapaniculata/ *Goldenrain Tree,* Liriodendron tulipifera Tulip Tree,/*Tulip-poplar,* Magnolia spp./*Magnolias,* Nyssa sylvatica /*Black Gum,* Populus spp. /*Poplars,* Prunus spp./*Stone Fruits(Peach, Cherry, etc.),* Pyruscalleryana/*Callery Pear,* Quercus alba /*White Oak,* Quercuscoccinea/ *Scarlet Oak,* Quercusmacrocarpa /*Bur Oak,* Quercusphellos/*Willow Oak,,* Quercusrobur/*English Oak,* Quercusrubra/ *Red Oak*, Salix spp. / *Willows,* Tiliatomentosa/ *Silver Linden*andZelkova serrate/ *Japanese Zelkova.* Desirable and marginal transplanting times vary according to specific plant type and different root conditions.

Planting Procedures

Correct planting technique begins with the loading of the plant at the nursery or garden center. Home gardeners and landscapers should be very careful with plant material. Always protect the roots, stems and foliage during transport. According to Michael 2012) the plant

tops should be shielded from winds. Never pick up a plant by the trunk. Trees are particularly vulnerable to damage if growth has started. In the spring the bark is easily injured. B&B trees are very susceptible to this type injury because of the weight of the root ball. Lift plants from underneath the root ball with the appropriate equipment. Container-grown plants should be handled by the container and never by the tops of the plant. If plants must be held or stored on the landscape site, it is best to place them in a location protected from the wind and sun. Do not let the roots freeze or dry out during this time. If the delay in planting is more than a few days, one should "heel in" B&B material by covering the roots with bark or some other mulch. Supplemental irrigation is critical for the nursery stock during the growing season.(Dana 2015).

Transplanting

Occasionally there is a need to move a tree or shrub from one location in a yard to another. Root pruning should be carried out over a two-year period before the plant is moved. Nevertheless, relocation of large trees is best left to professional nurserymen. To transplant trees, measure out 9 inch (250mm) for each inch(mm)of the trunk diameter measured at your waist height. That gives you the depth and width to excavate.(Wadsworth, 1914).

The Planting Hole

A current trend in landscape design is to plant trees and shrubs in large beds. When this design concept is followed, preparation of the entire plant bed area and not just individual holes is recommended. In many urban areas, gardeners will find that the soils are compacted and sometimes poorly drained. In these situations one should create a good root zone by amending the beds with sandy-loam topsoil and aerifying the soil as deep as possible. The addition of organic matter provides little or no advantage to the planting hole in good soils. Backfill should, in most cases, be the soil removed from the planting hole: "what comes out...goes back in." The organic matter, e.g. compost or composted pine bark, is uniformly mixed with the soil. This makes room for future growth and increases aeration to the backfill.

In very poorly drained soils, drain tile under the beds is necessary. If a trench drain or tile drain is installed, be sure that it drains downhill at a 2% minimum slope and there is an outlet on the downhill side. When setting plants, be certain to plant them high. If the poor drainage condition cannot be corrected, don't plant a tree or shrub in the area, unless it can tolerate these conditions.

The old adage "never put a ten-dollar tree in a two-dollar hole" applies when planting individual trees and shrubs in individual holes. Research at the University of Georgia has shown that a large planting hole – at least twice as wide as the root ball – encourages rapid root growth and plant establishment. Dig the planting hole only as deep as the root ball. If the hole is dug deeper, backfill it with soil as necessary and tamp it firmly to prevent settling. Make certain the top of the root ball is level with the soil surface. (Dana 2015).

Figure 5: Dig the planting hole two times wider than the root ball. Make certain the top of the root ball is level with the soil surface

Figure 6: This balled-and-burlapped plant, with the cord cut from around the trunk and the burlap pulled back, is ready for planting.

Source: Horticulture, University of Georgia

Research has also shown that it is not necessary to add organic amendments, such as peat moss, compost or leaf mold, to the planting hole. Organic matter can act like a sponge in the planting hole, absorbing and holding too much moisture and causing the roots to stay too wet. When planting just one plant, it is best to backfill with the same soil removed from the hole. Be sure to break apart any clods and remove stones or other debris before refilling the hole.(Wadsworth, 1914).Before planting balled-and-burlapped plants cut any wire or cord from around the trunk and pull back the burlap from the top one-third of the root ball. This will allow newly formed feeder roots to grow into the new environment. When planting on poorly drained soils, remove the burlap completely. When planting trees or shrubs grown in fabric bags, remove the entire bag before planting. To eliminate air pockets, water the planting site as the backfill soil is placed in the hole. Use your hand, not your foot, to gently firm the soil around the roots. Water thoroughly when finished and water again several hours later.

Finally, uniformly apply a 3-inch layer of mulch over the soil surface. Mulches promote rapid rooting by maintaining uniform moisture levels and temperatures in the soil and by preventing weed competition. Landscape fabrics can be placed under the mulch to help prevent weeds and to conserve moisture.

Planting in Excessively Sandy or Light Soil: For extremely sandy soil, use some sphagnum peat moss, and prepare a backfill mixture of one part sphagnum peat and two parts original soil. It is often advisable to dig the hole larger than ordinarily recommended, but set the plant no deeper than it had originally been placed. Backfill with the prepared mix, as recommended previously, and add at least a 3-inch layer of mulch outward from the trunk to a point 500 – 1000mm beyond the width of the planting hole. Water thoroughly once a week. Be sure to include water-soluble fertilizer in the initial watering and again once or twice during the first season. Watering in succeeding growing seasons may be essential.

Figure 7: The raised bed method of planting plants that will not tolerate heavy, poorly-drained soils.

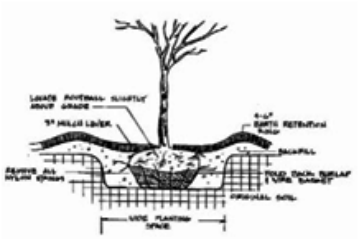

Figure 8: Planting technique for B&B trees.

Source: Kim Powell Spec (Commercial Landscaping) Horticultural Science (1999).

Planting in Heavy Soil

The best solution to the problem of planting in heavy soil is proper plant selection. The long-term plant survival with minimal maintenance should be the best choice. Avoid any backfill amendments when planting in heavy soil. A light, amended soil mix placed where it is surrounded by heavy soil too often results in trapped water, suffocated roots, and a dead plant. Make certain the plant is not deeper in the soil in the new location than it was when growing in the nursery field, or container.

Planting from Containerized Stock

Handle containerized stock with similar procedures and care as for B & B material. Avoid planting too deep! Do not remove the container until the hole is prepared. However, the container must be removed completely if it is metal or plastic. Container removal should be done very carefully to prevent a breakup of the root ball, especially if the plant is actively growing. Metal or plastic pots are most often used for container grown plants, or plants that have been in the pot for at least a full-growing season. Tapered metal or plastic containers can be removed by turning the plant upside down and giving the rim a sharp tap on a raised surface. Cut straight-sided metal cans on two sides, pull away from the roots, and lift the root ball out. Most nurseries will cut metal cans for you. Prior to placing the root ball in the prepared hole, cut any long roots that completely encircle the root ball.

Containers made of paper wrap may be removed; however, the root ball in such a pot is not dense because the plant has not been in the pot a full growing season. The soil of these potted or field-potted plants is likely to fall away from the roots if the pot is removed. Thus, the best planting method is to position the pot in the prepared hole, at the correct depth. Proper planting of a container-grown plant in well-drained soil. Roots of container-grown stock usually bind the soil. However, careful handling at planting time will prevent injury. Always remove containers before planting. Cut encircling roots when present.

Planting in Beds

A group of ornamental plants in one area of the landscape will grow more uniformly when planted in a well-prepared bed rather than in individual holes. Begin by deep tilling to a depth of 12 to 15 inches. Then incorporate about 1 pound (2 cups) of an eight to 10 percent nitrogen fertilizer, such as 8-8-8 or 10-10-10, over every 100 square feet of bed area. Only incorporate

lime into the bed if the soil test recommends it. After preparing the soil, follow the planting procedure recommended for planting in individual holes.(Figure 4.5.3)

Figure 9: when planting a group of ornamental plants in the landscape, prepare a good bed by deep tilling to a depth of 12 to 15 inches (300 to 450).

Figure 9: Plant annuals and perennials on raised beds to ensure good drainage and improved visibility.

Source: Horticulture, University of Georgia

Planting Annuals and Herbaceous Perennials and Grasses

To achieve the best color displays, annuals and herbaceous perennials must have good drainage, adequate nutrients and available water at all times. Begin by deep tilling the native soil to improve its structure and to ensure good drainage. Then, elevate the bed (150-300mm) by adding soil amendments. A raised bed not only ensures good drainage, but also improves the visibility of the color display. (Michael 2012)

The type and quantity of soil amendments used depends on the structure and texture of the existing soil, and whether amendments have been previously added to the site. A combination of composted organic matter, composted animal manure and large-particle sand, such as Lithonia granite, are frequently used to amend bed incorporate it to a 50- to 100mm depth. An ideal soil is moist, yet well drained.

Care of Newly Planted Ornamentals

Watering

The most important factor in caring for newly planted trees and shrubs is watering. According to George & Ray (2002) regular watering is critical during establishment of newly planted trees and shrubs. Keep the root system moist, but not too wet, for the first six to eight weeks after planting. Water application depends on the soil type and the type of plant. Trees and shrubs may require watering twice a week when there is no rain. If a heavy rain occurs, additional watering may still be needed the following week, not in two weeks. Using a lawn sprinkler, can be adequate for lawns and group of plants.(Marianne (2013).George & Ray (2002) lay emphasis on special attention need for Water Loss from the Soil, Soil-Water-Air Relationships Water Penetration, Time Required, Compaction and Thatch, Plants in containers, Trees, shrubs, and landscape plants and Conservation of Water.

a. Soil-Water-Air Relationships: Watering too often or too much is likely to exclude the necessary oxygen from the soil pore spaces. Without enough oxygen, plant roots suffocate and

die, preventing water uptake. Too little water, on the other hand, does not allow the roots to replace water lost by the plant through transpiration.

b. Water Penetration: According to Abraham the horticulturist at Lugi garden Jos said soil type or texture is a major determining factor of how much water a soil will hold, or how quickly a soil can be irrigated. For example, water applied to a sandy soil will penetrate faster than loam soil, and much slower in a clay soil where percolation will be slower but retains more moisture.

c. Time Required: Sandy soils allow water to penetrate more quickly than will heavy, dense soils. Wetting the entire root zone of plants growing in heavy soils takes much longer than wetting plants growing in lighter soils. Marianne et. al(2013) gave the details that sandy-loams will accept from 1/2–3 inches of water per hour. A clay-loam may absorb only 1/10–3/5 inch of water in the same amount of time. A very dry clay-loam soil could take as long as 120 hours to completely wet to a depth of 12 inches. A sandy loam, however, might take as little as 4 hours.

d. Water Loss from the Soil: There are several ways in which water is lost from the soil. Rain or irrigated water may percolate down through the soil beyond the root zone. This water is useless to growing plants. Water also may evaporate from the soil surface, leaving it dry. Water from lower layers in the soil is drawn to the surface by capillary action and also evaporates. This continual evaporation may deplete water from quite deep in the soil. Transpiration is the process by which a plant loses water through its leaves. This is a necessary process for plant growth. Water lost from the soil by evaporation and transpiration must be replaced by precipitation or supplemental irrigation.

e. Watering where Organic Matter is used: Soils to which organic matter has been added will behave differently. For example, clay soils with added organic matter will accept water more quickly. Organically amended sandy soils hold water longer and, consequently, do not need to be irrigated as frequently.

f. Watering on Compaction and Thatched Surface: For compacted or thatch-choked areas, the best treatment is to aerate the soil by removing plugs. Wetting agents can help water soak through dry organic layers, like thatch, so that it moves into the soil. Mulches placed over the root zone of trees and shrubs help restructure the surface layer of compacted soils to allow more efficient penetration of water. Compacted soils in which a vegetable or flower garden is to be planted, should have organic matter incorporated. This allows easier water penetration after the garden is established.

Fertilization

There are many slow-release fertilizers on the market that feed plants from six to 12 months with one application. Slow-release fertilizers generally cost more than general-purpose fertilizers, but they require fewer applications. Follow application guidelines on the bag or container. (Michael 2012).

Trunk wrapping
Trunk wraps, in theory, help prevent sunscald and frost cracks on thin bark trees such as maple and birch. They also offer some protection from rodents and maintenance equipment. These injuries are usually winter injuries due to extreme environmental conditions. Wrapping material should be removed in spring. Wrapping should be repeated each fall until the bark becomes rough and corky. Start the wrap at the base of the tree, and extend it to the first limb. Spiral the wrap around the trunk with each turn overlapping the previous turn by half the width of the material. Secure the wrap with tape, twine, or by looping it. (Kim 1999)

Staking and Guying Tree
Sometimes a newly planted tree will require additional support, anchorage or protection. According to Azila, stakes should be added for one of these reasons, although an unstaked tree grows faster than a staked one. Prolonged staking not only reduces the taper of the trunk, but also creates a liability, particularly if it is not clearly flagged. Trees that were staked in the nursery may require additional support once they are transplanted. Trees planted in open, windy sites will require staking. Large transplanted "tree-spaded" trees may require heavy gauge guy wires (guying), especially evergreens such as magnolia or cedar (Figure 3.6.4a&b).

According to Michael (2012) secure the tree to the stakes with strong, 12-gauge wire. Attach the wire just above the lowest scaffold branches. Place the wire encircling the tree in a piece of old garden hose to prevent bark injury. Use three guy wires for trees larger than 100mm in trunk diameter. Give the tree some slack so it can move slightly with the breeze. Research indicates that a tree allowed some movement during establishment develops a larger root system and stronger trunk than one that is kept sationary. (Figure 4.6.4c).

Figure 10 a, b & c: A root ball staking system is an alternative to guy wires. Trees with a trunk diameter greater than 1 inch and a height exceeding 4 feet usually require staking or guying.
Source: Kim Powell Spec (Commercial Landscaping) Horticultural Science (1999)

Pruning
The traditional rationale was that reducing the top by 25% to 40% compensated for root loss and would result in better tree survival. Pruning should be done to remove damaged branches and to improve the structure of the plant. Overlapping, parallel, and crowded branches should be pruned after installation. Cosmetic pruning to improve the form and shape of the plant is also recommended. All plants may be pruned at planting.(Douglas & Everett, 2008).

According to Douglas et al. (2008) some shrubs that bloom after spring usually do so from buds which are formed on shoots that grow the same spring. These shrubs should be pruned in later winter (dry season) to promote vigorous shoot growth in spring. The following are examples of such shrubs; Abelia X. grandiflora/ *Glossy abelia,* Buddleia davidii or B. globose/

Butterfly bush, Hibiscus syriacus/*Shrub althea*, Hydrangea arborescence/*Hills of Snow,* Hypericum spp./ *St. Johnsworlth,* Lagerstroemia indica/ *Crape myrtle,* Rosa spp./ *Most shrub rose species & varieties* and Vitexagnus-castus/ *Chaste tree.*

Conclusion

Urban green spaces can be a comprehensive tool for long term protection of environmental sustainability through improving the quality of life and air quality, increasing property value due to their amenity, aesthetic characteristics and reducing the energy costs of cooling buildings. Urban green spaces also can provide ecosystem services in which the recreation and relaxation facilities are especially available to urban dwellers and tourists too. Benefits of urban green spaces were strictly gotten from literature of previous researchers. The compiled benefits numbered twenty eight (28) though grouped in to five (5) categories as Social/Psychological, Recreation/Wellbeing, Human Health, Environmental and Aesthetic/Economic Benefits. These benefits, derived from assorted plants and the distribution of different type of open spaces, call for the need to not only conserve these plants and open spaces but to ensure their best planting methods and propagation.

Fore front of the factors that will optimize these benefits are the planting techniques, correct use of plants and the distribution of these urban green spaces in our cities as desired to meet the world's best practices, incorporated effectively into the environmental sustainability agenda. The specific use of plants suggested alongside the planting techniques considering weather, topography and purpose. The planting techniques considers first the need to plan, survey the site, selection of plants, planting systems, propagation and care for the plants in a bid to optimize users benefits and sustainable urban green spaces.

Recommendations

Urban dwellers are therefore encouraged to take advantage and maximize the use of open green spaces within our cities in order to gain from the much available benefits it offers. People should be more proactive not only in terms of use but creation and distribution of more urban green spaces. Note that a successful urban green pace depends largely on the best planning, planting methods and care for these plants amongst other factors.

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