ANCILLARY BOTANIC GARDENS IN LEBANON – EMPOWERING LOCAL CONTRIBUTIONS TO PLANT CONSERVATION

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ABSTRACT

Botanic gardens are integral to the process of plant conservation and development, but international conservation targets set down in the Global Strategy for Plant Conservation are unlikely to be met in countries such as Lebanon, where land is limited, real-estate value is high, conservation as a national priority is low and scientific botanical knowledge is not prevalent.

This paper proposes the recognition of a complementary category of gardens, ancillary botanic gardens (ABGs), which formalise local garden initiatives and facilitate options to tackle space limitations. ABGs are informal, deregulated gardens for the conservation of plant diversity and cultural plant knowledge; they are established by local communities in open sites which have existing levels of land protection owing to their primary purpose as archaeological sites, educational institutions, religious landholdings, private institutions and touristic sites.

THE CHANGING ROLE OF TRADITIONAL BOTANIC GARDENS

Early botanical gardens catered for the understanding of plants and their usefulness to medicine. Plants were collected, grown and their medicinal properties studied as part of medical training, later regulated as part of a doctor's undergraduate education (Garrod *et al*., 1993; Soderstrom, 2008). One of Britain's oldest botanic gardens, the Royal Botanic Garden Edinburgh, was initially established as a physic garden for the cultivation and provision of medicinal plants for study. During the colonial era, botanic gardens began to play an important role as venues for the transfer of economically important plants from one part of the globe to another. In the British Empire, the Royal Botanic Garden, Kew's main function was the cultivation and distribution of economic crops such as quinine (Desmond, 2007), tea, coffee, rubber and spices (Garrod *et al*., 1993). Empires gathered information on traditional plant knowledge, spread plant genetic resources in colonies to boost their economic powers and established European-style botanic gardens at home and in the colonies for the purpose of studying and displaying exotic floras

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(Forbes, 2008; Heywood, 2011). In North America in the 19th century, botanic gardens served as a venue for providing local environmental education (Heywood, 1987). Later, botanic gardens started leveraging their assets, including herbarium collections, live plant specimens, educational outreach activities and research programmes, to contribute to education and scientific advancement in many fields related to the conservation of plant diversity in response to the recent global agenda calling for the conservation and sustainable use of biodiversity as an underpinning activity for sustainable development (Crane *et al*., 2009; Donaldson, 2009). By then, botanic gardens were no longer limited to collections and displays. The traditional priorities revolving around horticulture and taxonomic research were supplemented and modified to address biodiversity conservation and species and habitat recovery (Havens *et al*., 2006). More recently, botanic gardens have been called upon to make use of two key areas of strength: namely baseline data provision and *ex situ* conservation to explore their potential contribution to climate change mitigation by forging interdisciplinary partnerships (Ali & Trivedi, 2011). Botanic gardens are also encouraged to renew their involvement in plant introductions and breeding by making use of their skills and experience of growing, establishing and propagating plants (Heywood, 2011).

THE NEED FOR NEW BOTANIC GARDENS

Botanic gardens have become centres for plant conservation. Under the terms of the Convention on Biological Diversity (CBD) and the new Global Strategy for Plant Conservation (GSPC) 2011–2020, nations have international obligations to document and conserve their globally significant plant diversity and the associated cultural knowledge of their native plants. Botanic gardens directly contribute to Target 8 of the GSPC which demands that 75 per cent of threatened plants are in accessible *ex situ* collections, preferably in the country of origin.

Today there are more than 2,500 botanic gardens in 165 countries and these vary widely in size, purpose, design, features and ability to attract visitors (Botanic Gardens Conservation International, 2012). A general overview of their geographic distribution, however, shows that the largest number of botanic gardens are in the European Union, and that many of those outside the EU were established following the colonial tradition of creating European-style botanic gardens (Table 1). These findings suggest that despite global calls for *ex situ* conservation measures, the establishment of botanic gardens remains rather limited geographically. One reason may be that the perceived importance of a botanic garden and the resulting intellectual, political and financial support necessary to establish and sustain it is rooted in a historical colonial Eurocentric culture that is not globally shared or adopted. For example, countries of the Arab League, of which Lebanon is a member, have the lowest number of botanic gardens, the lowest number of gardens per total area and the lowest number of gardens per number of individuals. This discrepancy in the number of botanic gardens has also been noted for other tropical regions of the world, which are under-represented considering the high

Country	Number of botanic gardens	Area (km^2)	Population	Number of individuals per botanic garden	Number of botanic gardens per area km^2
Arab League	33	7,420,402	345,050,000	10,456,061	224,861
Argentina	48	2,780,400	40,700,000	847,917	57,925
Australia	131	7,692,024	22,300,000	170,229	58,718
Brazil	40	8,515,767	197,000,000	4,925,000	212,894
Canada	105	9,984,670	34,500,000	328,571	95,092
China	151	9,706,961	1,344,000,000	8,900,662	64,285
European Union	807	4,346,198	491,000,000	608,426	5,386
India	131	3,287,263	1,241,000,000	9,473,282	25,094
Russia	109	17,075,400	143,000,000	1,311,927	156,655
USA	760	9,826,675	314,000,000	413,158	12,930

Sources: garden statistics http://www.bgci.org/garden_advanced_search.php; population and areas http://data.worldbank.org, http://www.nationsencyclopedia.com, http://www.countryreports.org

Table 1 Comparative statistics for botanic gardens around the world by region or country, size and number of people and/or area served per garden

biodiversity they harbour in contrast to countries in temperate-zone climates which have the largest concentration of botanic gardens (Pinheiro *et al*., 2006). Furthermore, the species richness in many tropical gardens is low and does not reflect the natural biodiversity richness of the tropics, hence the necessity to better sustain botanic gardens in the tropics (Parmentier & Pautasso, 2010). These findings highlight the need to broaden participation in *ex situ* conservation and encourage the establishment of botanic gardens worldwide. This paper explores how the establishment and management of botanic gardens can be better aligned with local expectations and cultural perceptions. In order to achieve this we investigate plausible reasons that have prevented the establishment of botanic gardens worldwide using Lebanon as a case study.

A BOTANIC GARDEN FOR LEBANON? A CASE STUDY

Located on the eastern shores of the Mediterranean Basin, Lebanon is a predominantly mountainous country, consisting of a narrow coastline and two mountain chains, the Lebanon and the Anti-Lebanon (up to 3,087m), running parallel to the Mediterranean coast and separated by a high plateau, the Bekaa. The country contains botanical elements from temperate, arid and tropical biomes creating what are recognised as typical Mediterranean plant communities, and forms part of the Mediterranean Basin Global Biodiversity Hotspot, with an estimated 3,000 plant species (Post & Dinsmore, 1933; Mouterde, 1970; WWF and IUCN, 1994; Khouzami *et al*., 1996; Blamey &

Grey-Wilson, 1998; Blondel & Aronson, 1999; Myers *et al*., 2000) (Figs 1–6). Whilst Lebanon has taken steps towards *in situ* conservation through the establishment of nature reserves and protected areas (Ministry of the Environment, 2012), the country currently lacks *ex situ* plant conservation collections, an important component of the plant conservation matrix. In line with the global agenda of the CBD, to which Lebanon is a signatory, the country's National Biodiversity Strategy and Action Plan calls for the establishment of botanic gardens in addition to *in situ* measures (NBASP, 1998). The role of botanic gardens in supporting plant conservation through education and research is undisputed. Yet it is difficult to justify the need for a botanic garden in Lebanon where land and financial resources are limited, real-estate value is high, political instability is high and *ex situ* conservation as a national priority is low. Given this national reality, and the difficulty the country is already experiencing in sustaining the protection and management of declared protected areas, alternative venues need to be examined to encourage the establishment of botanic gardens.

Establishing a botanic garden is a major undertaking that is different now from in the past when lands were readily available and gardens were started with little thought of financial sustainability or community participation and support. Today, the idea of appropriating land to establish botanic gardens and dedicate financial resources to operate such institutions is considered to be a foreign and unjustifiably expensive initiative. Yet such gardens are important to help safeguard Lebanon's floristic diversity because the country is witnessing rapid and systematic destruction of its native flora and remnant semi-natural habitats.

DECONSTRUCTING AND RECONSTRUCTING BOTANIC GARDENS

For botanic gardens to be established and sustained by Lebanon and the Lebanese, there is a need to deconstruct the traditional concepts of a botanic garden and recreate institutions based on new components that are culturally acceptable.

Land – Dealing with limited availability of land: botanic gardens as a secondary function of sites

To establish a botanic garden, there is a need to appropriate land for this purpose. In Lebanon, land value is very high in cities, and in more remote areas, priorities are given to urban development projects including tourist resorts. Accordingly, a botanic garden is not enough of a priority to set aside land specifically for this purpose as it cannot compete with other land use options that may be more lucrative. An alternative is to look for lands where urban and agriculture expansion options are restricted and where a botanic garden is one of the few possible land uses.

One such example is the peripheral lands of archaeological sites. Despite land limitation and high-value real estate, Lebanon, which is a cradle of ancient civilisations, has taken national measures to appropriate lands to conserve its archaeological

Fig. 1 Rocky coast, altitude 20m, Thermomediterranean vegetation zone, Anfeh, North Lebanon. Photo: Lama Tawk.

Fig. 2 Pine forest, altitude 300m, typical Thermomediterranean vegetation zone, Bentael, Mount Lebanon. Photo: Lama Tawk.

Fig. 3 *Juniperus excelsa* is a pioneer tree in the Presteppic Supramediterranean vegetation zone,Yammouneh, Bekaa, altitude 1,200m. Photo: Lama Tawk.

Fig. 4 Wine grape farms, altitude 1,600m, Presteppic mountainous Mediterranean vegetation zone, Ainata, Bekaa. Photo: Lama Tawk.

Fig. 5 Mixed oak forest, altitude 1,800m, typical mountainous Mediterranean vegetation zone, Mazraat Kfardebian, Mount Lebanon. Photo: Lama Tawk.

Fig. 6 Mountaintop flora, altitude 2,800m, Presteppic Oromediterranean vegetation zone, Qornet El Sawda, North Lebanon. Photo: Lama Tawk.
See Talhook (2008) for an explanation of the vegetation zone characteristics.

heritage. All the archaeological sites in Lebanon, with the exception of Byblos, consist of an excavated area and a protective 'buffer zone'. These protective areas, which are peripheral to the excavated sites, consist of lands that are sheltered from urban and agricultural encroachment and they harbour undisturbed semi-natural landscapes that often provide refuges for native plants and animals (Shepherd, 1992).

The protected status of the lands surrounding excavation sites and their presence in proximity to towns and villages represent a unique opportunity to establish botanic gardens as appended entities that do not interfere physically or functionally with archaeology, the primary site function. With botanic gardens established on their peripheries, archaeological sites can acquire an additional function of serving local communities, which may add value at least in terms of a local sense of ownership of the site as a whole and thus ensure a local willingness to conserve it. This is especially applicable to rural areas where excavation of archaeological sites may await any activity for tens of years. Today local communities living near these sites consider them to be abstract non-functional cultural landmarks that provide no tangible value, neither as local cultural heritage nor as a protected open space.

By establishing botanic gardens on peripheral areas of archaeological sites the botanic garden institution becomes a secondary attribute to the land that has already been assigned a primary function and use – archaeology – and has been protected for this purpose. This paradigm shift is important because by shifting land assignment from primary to secondary, the gardens are no longer a burden taking away land area from other possible uses but are seen as a value-added opportunity, providing a complementary function to an already assigned and protected land.

Taxonomy – Dealing with taxonomic impediment: enabling local knowledge to manage botanic gardens and spread ecological knowledge

Colonialism has left Lebanon with a number of comprehensive national floras, produced by French (Mouterde, 1966), and British (Post & Dinsmore, 1932) scholars; however, no botanic gardens were established in the country during this period. Accordingly, Lebanon did not 'inherit' the Eurocentric botanic garden legacy expertise in taxonomy and horticulture which provide the standard employment opportunities created by botanic gardens. Today, formal plant taxonomic knowledge in Lebanon is a bottleneck monopolised by a limited number of national experts, most of whom lack horticultural expertise. Given this lack of human capital, any intent to establish a botanic garden that follows international benchmarks will require formally trained botanists and will thus exclude the potential of engaging all the taxonomically illiterate Lebanese, some of whom are highly knowledgeable about native plants, their cultivation, use and relation to local culture. Such grassroots exclusion is likely to decrease general enthusiasm and support for botanic gardens and confine the perception of a botanic garden as a scientific luxury rather than a necessity for future community and environmental health.

The CBD highlights the importance of local ecological knowledge. It states that each contracting Party should as far as possible conserve and maintain the knowledge and traditional lifestyles of local communities which are relevant for the conservation and sustainable use of biological diversity (Article 8(j)). The newly agreed GSPC 2011–2020 contains a number of targets relevant to the issue of local, sustainable use of biodiversity including Target 13 'Indigenous and local knowledge innovations and practices associated with plant resources, maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care', and Target 14 'The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes' (Sharrock, 2012).

A key consideration in the preservation and transmission of local cultural knowledge is the terminology which is used to engage people in Lebanon and the Arab world in general. Whilst scientific plant nomenclature is vital for providing a stable international standard for communicating information about plants, local naming is equally important for engaging and enthusing local people who are largely unfamiliar with a culturally alien system of Aristotelian types and Linnaean binomials. Local language is a fundamental, yet often overlooked, aspect of traditional ecological knowledge and is crucially important for its preservation (Maffi, 2001; 2005). In Lebanon, local information about ecological resources is encoded in the local language, Arabic, on at least three primary levels: lexicon, grammar and discourse (Zent, 2009). The local lexicon of ethnobiological names, toponyms and biotic community classifications is integral to local subsistence, resource management and landscape perception. The employment of local nomenclature in the botanic garden (from taxon to landscape scales) is vital for effective local communication and engagement, both of which are fundamental in developing the necessary enthusiasm for plant conservation (GSPC Target 14).

ANCILLARY BOTANIC GARDENS – A NEW CATEGORY OF BOTANIC GARDENS

We propose the recognition of a new category of botanic gardens termed 'ancillary botanic gardens' (ABG). Synonyms of the term ancillary include 'secondary', 'additional' and 'supporting'.

Ancillary botanic gardens are *secondary* on a spatial level in that they are established on peripheral areas of sites already assigned a primary purpose. These sites are managed and accessible to the public but are practically restricted and protected through specific legislation and policies. Once a peripheral land opportunity is identified the objectives guiding the planning, design, and establishment of an ABG include no or minimal interference with the primary function of the site.

At the social level, ABGs have an additional contribution in that they engage new constituencies, due to their informal structure led locally by taxonomically illiterate communities who rely on local nomenclature to sustain the transfer of traditional and ethnobotanical knowledge and facilitate the link between plants and people.

ABGs could play an important supporting role because they act as 'custodians' for

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traditional land management practices and ethno-ecological knowledge. They would be decentralised entities designed to inspire and comfort visitors and contribute to local pride in biodiversity. ABGs could be dispersed throughout the country providing a diversity of environmental conditions in which plants' response to climate change can be monitored along altitudinal gradients and thus contribute to global change research.

A key aspect of ABGs is that unlike botanic gardens, their roles and scope are not benchmarked against international standards (Botanic Gardens Conservation International, 2012). This however should not lead to the conclusion that ABGs are 'mere' public parks or pleasure gardens because they are implemented following a locally driven mission. Besides the reasonable degree of permanence and openness to the public, ABGs can have a level of outreach and educational opportunity but they need not have a scientific basis for the collections or proper documentation, regular monitoring, 'adequate' labelling and strategies to communicate with other gardens, or undertake any research activities. As such the mandate of these 'deregulated' entities can be defined by immediate stakeholders.

In summary, ABGs are secondary in the space they occupy. They are planned and managed by local citizens, their establishment is negotiated and regulated between local groups and primary site function owners, and their mandates, defined by immediate stakeholders, are flexible rather than prescriptive.

Sites presenting opportunities for the establishment of ABGs

ABGs take advantage of primary site functions or land-use types that offer, within their boundaries, unbuilt land or open spaces that are maintained by current users; preserved due to societal need or significance; or protected due to legislation. In Lebanon, these categories include archaeological sites, educational facilities, religious land holdings and institutional and touristic sites. These are characterised by having unbuilt land or green spaces that support the primary site function and by their extensive geographic distribution in urban and rural areas.

Archaeological sites: Lebanon's archaeological sites are abundant, under-utilised and well distributed across different eco-geographic zones. The sites span historical periods from the Neolithic age to the more recent Medieval and Ottoman fortified sites. These sites are not only found in the main cities but are also interspersed between towns and villages and are part of the villages' daily life encounter and scenery, providing an opportunity to engage different social groups and communities. Lebanon has around 350 archaeological sites, 200 of which have been excavated, exposed to shallow or deep soundings, or surveyed. The potential lies in the buffer zones that are within the site limits protecting the archaeological remains. The establishment of ABGs on these buffer zones provides an opportunity to draw attention to the country's national cultural heritage by encouraging site visits driven by another purpose, the visit to a local botanic garden.

Educational institutions: University campuses are sites where young people in both rural and urban areas spend the majority of their young formative lives. Educational institutions provide an excellent opportunity to sensitise young people to ecological processes through ABGs. In support of a global agenda towards a more sustainable world, universities are using their campus grounds to promote the use of native and naturalised plant species. These efforts are further additions to formal gardens founded by these universities, and the new interventions to promote native plants and sustainability provide high visibility as they are established at the entrances of buildings and along main campus walkways. Examples of such gardens include a number of student naturalisation projects conceived and implemented across the University of Waterloo, Canada; guidelines and policies elaborated by the University of Victoria, Canada, to promote the establishment of natural open spaces; the strategic plan of Georgia Southern University which includes the use of native plants to promote the economic, cultural and natural history of the region; and the establishment of a native plant garden around the Bucknell University Environmental Center.

Strategies to plant and manage vegetation in university campuses have effectively become an integral component of the campus development (Beauvais, 2009). These efforts would benefit greatly by the presence of departments that offer specialised degrees in botany, plant taxonomy, landscape horticulture, landscape architecture and ecosystem management. However, the dissemination of the concept of ancillary gardens can greatly increase the number and diversity of the university 'communities' that may be driven to support the implementation of such gardens. For instance, ancillary gardens can be designed and implemented in front of business schools to showcase examples of corporate social responsibility; engineering schools to highlight the importance of green designs; archaeology departments to display plants used by ancient civilisations; history departments to showcase plants that feature in mythology; and nursing schools to promote horticulture therapy. These would be ancillary gardens that link professions to traditions, cultures and identities, and would benefit from the protected open areas of campuses and the existing management and outreach infrastructures.

Religious landholdings: Religious landholdings or waqf are endowed lands that are owned by religious communities or charitable trusts (Abou el Rousse-Slim, 2007). They are managed by individuals assigned by the group of owners or by the community. In Lebanon, some waqf lands consist of large woodlands or agricultural lands. The users of waqf are often members of the community and include farmers, shepherds and entrepreneurs who secure access to the land through formal rentals and agreements or through informal customary practice or usufructs. The permanent nature of waqf lands has resulted in the accumulation of waqf properties interspersed throughout Lebanon and the region (Forni, 2003). The establishment of ABGs on waqf falls within their social and philanthropic objectives (Kahf, 2003). While all these sites may be opportunities for ABGs, religious holdings that include agricultural land, woodlands and non-designated functions for open degraded lands would qualify to become ABGs with a focus on food heritage. In addition to promoting traditional agricultural production and non-wood forest products, ABGs would be focused on the reintroduction of traditional varieties and wild edible plants. Production in future may be in the form of food production based on traditional methods of processing and preparation, ultimately employing local people in the vicinity of these religious holdings. Religious holdings provide an opportunity to further advance the understanding of *ex situ* botanical gardens through the emphasis of food production and direct interaction with the surroundings and within the site communities. Activities planned in ABGs can not only target educational purposes but also seek to achieve social agendas such as helping to develop the aesthetics of the area and respect for property, and support a sense of belonging to a community. The centrality of the garden within the community makes it more viable and more easily integrated into the participants' daily lives (Morgan *et al*., 2009).

Private institutions and touristic sites: Businesses and enterprises which include a front area or open spaces with lavish displays of landscape plants present opportunities to showcase and embrace native plants for their aesthetic value. ABGs within these locations will seek to maintain the primary site function which is a highly visual and aesthetically pleasing space that promotes corporate identity. At the same time they would transform these spaces into an aesthetic display of sustainable technologies and species conservation, thus contributing to changing perceptions of botanic gardens and landscape sustainability when it comes to their aesthetic value (Maunder, 2008). Affluent institutions with relatively significant financial means may be interested in demonstrating corporate social responsibility and in informing and inspiring their stakeholders through the establishment of ABGs on their premises; ABGs formed by private institutions seeking visibility can focus on innovative ways to relay conservation messages and to alter people's attitudes and behaviour. In this case ABGs can become sites for art, a practice that has always occurred in botanic gardens to boost interpretation and marketing (Maunder, 2008).

LANDSCAPE PLANNING AND DESIGN GUIDELINES FOR ABGS

Ecological landscape planning and design tends to prioritise conservation by integrating ecological principles and balancing people's use of sites, across natural reserves and urban contexts (Ahern & Le Duc, 2006; Leitao *et al.*, 2006; Perlman & Mildor, 2004). As defined in this paper, ABGs balance conservation principles and human use, thus prompting ecological landscape design and planning as a suitable framework for their implementation. Two overarching principles contribute to ABG guidelines: the multi-scalar aspect of the resulting ABG network (Forman, 1995; Benedict & McMahon, 2002) and the multi-functionality of individual sites (Makhzoumi & Pungetti, 1999).

The value of singular sites is evident in providing local benefits of plant conservation and social involvement in themselves. At the regional scale, a series of ABGs representing one specific potential site type or ABGs located within the same climatic condition may form a localised network and provide a unique end-user experience or targeted conservation of species communities. A regional or national network of ABG sites extends these benefits to ensure country-wide conservation, boosting nationwide ecotourism and increasing the value of reference sites for scientific research and monitoring. A national scale system may not necessarily be formalised into a plan, but the piecemeal identification of sites would build up towards a nationwide system, a bottom-up approach, defining a holistic vision that constitutes a diversity of locations, climatic conditions, social and cultural contexts, and species richness – in other words, envisioning the network at the national scale and implementing at the local or site scale (Forman, 2008).

The building blocks for a national network depend on the selection and design guidelines of individual sites. The concept of multi-functionality captures the essence of a singular ABG. Multi-functionality is defined as the contribution of multiple benefits from a singular entity or location (Benedict & McMahon, 2006). For ABGs, this means compatibility between the primary and secondary uses; environmental benefits in the form of biodiversity conservation and the resulting increase of biomass; and the social and cultural benefits through the preservation of local knowledge and empowerment of communities. To ensure multi-functionality at the network and site scales, the role, location and distribution of ABG sites is contingent on two factors: the extent and diversity of contribution to the national ABG system, and the extent of contribution to local conservation and community.

When identifying potential ABG sites, the contribution of each location to conservation across the country depends on selecting sites based on diversity of geographic distribution, climatic contexts, social communities and for the potential of ecological redundancy.

Redundancy (Salt & Walker, 2006) of sites, or selecting several sites with similar characteristics, may prove to be a very effective conservation strategy to ensure species and social communities' resilience. This becomes relevant when accounting for the impacts of risks associated with future climate change, water scarcity and fast-paced urbanisation. Redundancy of sites across the network will ensure perpetuity of scientific value through singular and comparative studies within and across sites as part of a process of monitoring, assessment and evaluation.

Upon identifying potential sites across the network, specific site guidelines are proposed to further refine the identification of relevant ABG sites to ensure they are meaningful within their immediate context. ABG sites are intended to achieve local community buy-in and empowerment through a participatory and inclusive planning process; to maintain balance between conservation objectives and accessibility needs to natural and cultural resources; to preserve local ecological knowledge; and to generate new scientific understandings. To meet these objectives, it is prudent that three legal, social and spatial criteria are simultaneously met. First is the proactive interest of the legal owner or guardian of the premises to entertain an ABG within the site. This is critical and a first step in ensuring perpetuity of ABGs. Such a commitment is intended to be completely voluntary from the guardian. The second is the willingness of stakeholders or communities within or in proximity to the site to participate and engage in the process and become custodians of the ABG. Third is the extent of available unbuilt surfaces of land or open space that can be dedicated for secondary use within a specific potential site. The ratio of undeveloped to developed land within a site is vital to ensure that sufficient open space is available to establish an ABG. The ratio of undeveloped to developed (ratio of U-to-D) land surfaces generally increases as we move along the urban-rural gradient (Abunnasr & Hamin, 2012). While smaller pockets of land (i.e. with a smaller ratio of U-to-D) within potential ABG sites play a role in biodiversity conservation, sites with a higher ratio of U-to-D land will provide better potential for biodiversity protection through larger interior patches and edge conditions (Perlman & Mildor, 2004). When choices are available, potential ABG sites with a higher ratio of U-to-D land and surfaces that are more contiguous provide the ideal condition to establish an ABG (Forman & Godron, 1986).

Once sites are identified and deemed suitable for an ABG, site designs should merge principles of botanical garden design and landscape design approaches. The guidelines for the botanical garden in San Luis Obispo, California (The Portico Group, 1997) provide a clear direction on how these two design approaches may be merged. The purpose is to integrate in a compatible manner primary and secondary uses on site while maintaining local community aspirations to ensure stakeholder commitment and community involvement.

CONCLUSION

A network of ancillary gardens would play an important role in a national *ex situ* strategy. Target 8 of the GSPC demands that 75 per cent of threatened plants are in accessible *ex situ* collections, preferably in the country of origin. Ancillary gardens sited throughout a country could provide an opportunity for a decentralised *ex situ* conservation network to complement the traditional one-garden-suits-all approach where the ecological requirements of target species are perhaps not easily or cheaply met. As the ABGs are situated across a range of sites, the ecological and habitat requirements of target species can be more easily matched, allowing a higher percentage of native species to be grown. A network approach also provides an opportunity to preserve the maximum genetic diversity of a species by maintaining different genotypes at different sites. This not only spreads risk but also reduces the possibility of cross-pollination and the consequent breakdown of distinctive genotypes (Gardner, 1999). The *ex situ* collections need not take up a great deal of space: they could, for instance, be incorporated by enhancing semi-natural or natural habitats within the sites. This is also the case for newly established botanic gardens that tend to concentrate on the flora of their immediate surroundings (Parmentier & Pautasso, 2010). Locally derived strategies to set up botanical gardens have been proposed for regions of the world that have critical economic and political situations. Pinheiro *et al*. (2006) suggested a strategy that is more suitable to tropical regions, namely municipal botanic gardens, established on small natural vegetation remnants, especially those at the peripheries of urban settlements. The authors suggest that municipal botanic gardens can offer city dwellers an easy opportunity to understand the importance of preserving their natural resources. They also indicate that the structure should not be costly, offering ecologically derived footpaths and directly engaging the local community, thus delegating to them the responsibility of conserving their natural goods. There are limited examples of active *ex situ* conservation programmes in the Middle East and North Africa region with most of the *ex situ* collections in botanic gardens being little more than 'stamp collections' of threatened plants with little or no attempt to integrate them into wider conservation programmes. The ABG model shows how an inexpensive population-based approach is possible.

Given the proposed cultural context of ABGs, these are most likely to influence young people in terms of their relationship with plants and their construction of plant knowledge based on local identity and the role of culture in relation to nature (Sanders, 2007). ABGs are not only a venue to showcase native or traditionally used plants but they become a platform that enables information exchange and in some cases reconstruction of stories and traditions brought in from the domestic arena. According to Ballantyne *et al*. (2008), key motives for botanic garden visitors are not conservation, but are instead social and personal in nature. People seem to want to visit gardens to enjoy themselves, to find peace and tranquillity, to admire the garden's scenery, interact with family or friends and to enjoy being outdoors or in nature. By building on local initiatives to transmit knowledge and traditions, ABGs may provide a powerful informal learning format characterised by self-directed style of information sharing, activities and storytelling to enable people to link ecology and human ecology and empower them to envision the future of their community's relation with nature and develop their own story on how they perceive their own and their community's link with nature (Galbraith, 2003). Activities should aim to diffuse knowledge and preserve local flora and yet should not exceed the willingness of the public to have instruction combined with recreation (Lucas *et al*., 2006).

ABGs do not have set mandates, rather their existence is driven by local agendas which in turn are defined by local capacities and means. These can vary from ABGs with scientific contributions, in cases where local constituencies are knowledgeable in the field of plant conservation, to sites with limited scientific value but with high local visibility and outreach. Similarly, depending on local sponsorship and guardianship, technology associated with ABGs can include innovative approaches to interpretation on the sites (such as mobile phone technology) in the case of affluent institutions, to a basic oral exchange of traditional knowledge of plants in a small community.

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HORTICULTURE OF NUTMEG: GERMINATION, PROPAGATION AND CULTIVATION

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ABSTRACT

The living collection of plants in the nutmeg family, Myristicaceae, has been increasing at the Botanic Garden of Delft University of Technology (Delft BG) since 2001. Horticultural and research staff there have been exploring the horticultural requirements, molecular structure and chemical composition of these plants since then. This paper comments on the historical importance of this family and the processes required to acquire live plant material.

In recent years the significance of the mycorrhizal associations formed by the family and the consequences for their cultivation have been identified and these are described here along with the most effective methods of propagation as identified by staff at Delft BG.

INTRODUCTION

The Botanic Garden of Delft University of Technology (Delft BG) was founded in 1917 and was the very first garden in the world which focused on economically valuable plants, providing trees for wood, fibres, dyes, resins, gums, latex and other secondary metabolites and herbs for fibres, dyes and oil for industry. The early 1900s were a time of rapid change and industrial development (Van Mourik & Van der Veen, 2008) and many plants and their potential for human use were unknown. As a consequence of its economic focus, the Garden has strong historic links to Indonesia and its adjacent areas as this is where many of the plants that became economically important either originated or were farmed. Among the collections of useful plants which Delft BG now cultivates, there are several genera in the nutmeg family, Myristicaceae. These are *Myristica*, *Knema*, *Horsfieldia*, *Brochoneura* and *Gymnacranthera*. The five genera grown at Delft BG are only a small representation of this family as there are 16 other genera which occur in tropical Asia and the Pacific basin. Staff at Delft BG believe that due to the chemicals and compounds present in these plants, their potential value to science is not fully known, and it is for this reason that new horticultural research is being undertaken. Furthermore, molecular information for the family is not well known either. The genera listed above are known to be difficult plants to grow and are therefore rarely seen in botanic gardens. Staff at Delft BG identified opportunities to explore the cultivation of these genera in order to contribute knowledge to the horticulture, molecular structure

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