

Botanic Gardens:

Using biodiversity to improve human well-being



BGCI
Plants for the Planet

Botanic Gardens: Using biodiversity to improve human well-being

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Foreword



Botanic gardens are a major force for the conservation of plants around the world. Many of the world's globally threatened plant species are represented in their living collections or seed banks which collectively provide an insurance policy supporting the maintenance of global biodiversity. It is now widely recognised that in the long term biodiversity will only be secure if the values provided by species and ecosystems are acknowledged and utilised sustainably. Plant species, including many that are threatened with extinction, are vital in this context by directly providing a wide range of resources as well as underpinning ecological services. Botanic gardens have the skills and expertise to study and manage plants in cultivation, and in the wild, as a major contribution to ecological and human well-being.

This report summarises current work undertaken by botanic gardens around the world that relates to human well-being with a focus on nutrition, healthcare, financial poverty alleviation and community support. The Global Strategy for Plant Conservation agreed by parties to the Convention on Biological Diversity in 2002 has helped stimulate a renewed commitment to saving the world's plants with 16 ambitious targets to be met by 2010. The work undertaken by botanic gardens around the world summarised in this report supports various targets of the GSPC and specifically Target 13 which calls for: The decline of plant resources, and associated indigenous and local knowledge, innovations and practices that support sustainable livelihoods, local food security and health care, halted.

The case studies presented in this report demonstrate only a fraction of the work being undertaken by botanic gardens to support Target 13. They have been selected to show the range of activities underway and the scope for future development of this work. An online database of similar projects has been developed by Botanic Gardens Conservation International (BGCI) as a result of an international survey and will be updated as new information becomes available. Support provided by HSBC through the Investing in Nature programme has been invaluable in developing over 40 projects relating to plants and human well-being.

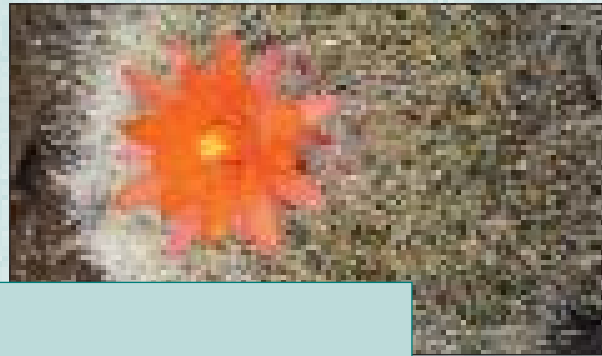
BGCI has played a key role in the development of the GSPC and is fully committed to supporting its implementation. We look forward to working with our members and a wide range of partners to secure the future of plant species vital for healthcare, nutrition and livelihoods through research, information exchange, training, provision of education and practical projects.

By publishing this report, we hope to raise awareness of the wide range of activities botanic gardens around the world are engaged in, and the important contribution this unique network of organisations is making to address the critical issue of improving human well-being.

Sara Oldfield,
March 2006

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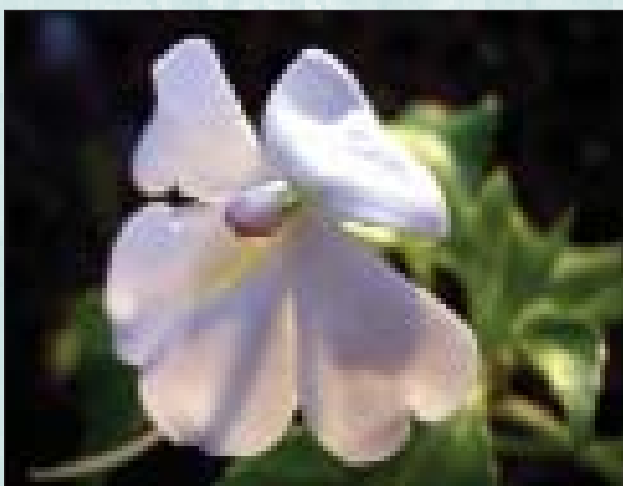
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Introduction

Two of the biggest challenges faced by human kind are the conservation of our environmental resources and the elimination of poverty. It is increasingly recognised that these challenges are interlinked, so there should be a commitment to tackling them together.

“Biodiversity is the foundation for human well-being”

Millennium Ecosystem Assessment, 2005

BGCI believes that Botanic Gardens have an important role to play in this process: this report highlights a range of activities that are using biodiversity to improve human well-being.

Biodiversity conservation needs to value people

Traditional approaches to conservation often assumed that nature must be protected from use by humans. Although this has been useful in some situations, it has not enabled us to effectively prevent the widespread degradation of our natural resources. The loss of biodiversity continues: tens of thousands of plant species are threatened with extinction (IUCN, 2004; Walter & Gillett, 1998) and today we are seeing the greatest rate of species extinction in Earth’s history (Wilson, 1992; Millennium Ecosystem Assessment, 2005a). It is now generally recognised that people are less likely to have an incentive to conserve natural resources if they do not appreciate their value (Adams *et al.*, 2004). Conservation which takes into account sustainable use is likely to be most effective and avoid negative impacts on local communities, which in the past has been an unfortunate impact of the “protectionist” approach to conservation (Colchester, 2002). If conservation is to succeed, it should take account of human needs.

“Overcoming ...environmental problems will require greater attention to the plight of the poor”

Millennium Development Goals Report, 2005

Efforts for development need to value the environment

Past efforts to alleviate poverty and improve lives through development have made only limited progress in achieving their objectives, and more than 1 billion people continue to subsist on less than \$1 a day (UN, 2005). Traditional development has also failed to properly value and take account of the vital role of natural resources, so our increasing demands on natural resources pose a challenge for further development, and even threaten the environment that our present well-being depends on. For example, about 350 million of the world’s poorest people directly depend upon forests for all their basic needs, and about 2,000 million for cooking and fuelwood (World Commission on Forestry

and Sustainable Development, 1999), whilst nearly 10 per cent of all tree species are threatened with extinction worldwide (Oldfield *et al.*, 1998). Efforts for development that value the wise use of natural resources are more likely to cause significant and sustainable improvements to the lives of the poorest people.

“Biodiversity and ecosystem services ... are essential to the well-being and livelihoods of the poor”

Shoji Nishimoto, Assistant Administrator and Director, Bureau for Development Policy, UNDP

The goods and services provided by natural resources underpin the well-being of the world’s population and are especially important for the poorest parts of society, which directly depend on them for their livelihoods (Millennium Ecosystem Assessment, 2005b). Contemporary thinking increasingly recognises that the conservation of our natural resources is necessary to succeed



What do we mean by “Human Well-being”?

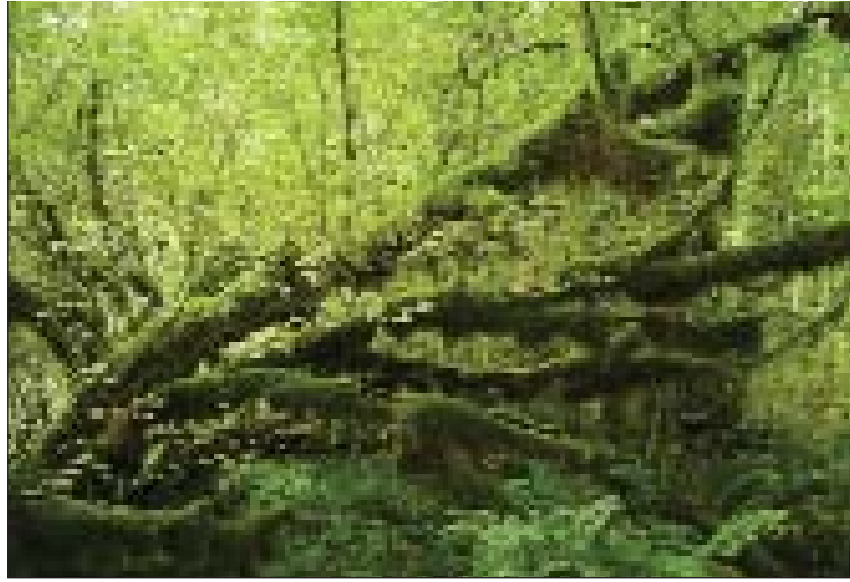
Although the term “poverty” is often associated with financial deprivation, there are many other aspects beyond a lack of money. These include the provision of food, healthcare, basic services and human rights. Some aspects of poverty, such as restriction of civil or political rights, are not exclusive to low income groups or societies. For example, societal problems such as gender inequality remain widespread (e.g. women hold only 16% of parliamentary seats worldwide).

This study therefore uses the term “human well-being” to encompass these many aspects of human welfare that must be fulfilled in order to reduce poverty and improve lives. This term is used in the same way by many organisations, international conventions, policies and programmes related to biodiversity conservation and development (for example, the Millennium Ecosystem Assessment Programme). Some other policies may use related phrases to refer to a similar concept: for example, the Millennium Development Goals refer to “reducing poverty and improving lives”.

in improving the well-being of the poor, whilst for conservation to succeed it must relate to the poor’s needs. The concept of balancing progress towards economic, social and environmental goals is now known as **sustainable development**. This has been most famously defined by the World Commission on Environment and Development (1987) as “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

Linking conservation and poverty reduction – the policy context

The concept of linking natural resources with human needs was expressed over 30 years ago at the UN Conference on the Human Environment in Stockholm. Since then, the idea has been developed and incorporated by many major international policies concerned with both poverty and the environment, and has been most recently and prominently emphasised by the **World Summit on Sustainable**



Development (WSSD) in Johannesburg in 2002. The WSSD plan of implementation committed the international community to specific goals, targets and time-bound measures to accelerate the transition to sustainable development (Secretariat of the CBD, 2002).

The WSSD’s targets reaffirmed and went beyond the **Millennium Development Goals** (MDGs). These are a set of 16 ambitious goals for tackling poverty, with concrete targets, which were agreed at the UN Millennium Summit in 2000. They represent an unprecedented commitment by the international community to tackling the persistent problems of human deprivation, and recognise the importance of environmental services for achieving this: one of the goals is to “ensure environmental sustainability”.

“The MDGs will be well served by increasing the efficiency of natural resource use... and by conserving natural resources”

*Selim Jahal & Alvaro Umana (2003),
The Environment/Poverty Nexus*

WSSD also builds on the objectives of the **Convention on Biological Diversity** (CBD). The CBD was ratified in 1992 primarily to reflect concerns for environmental degradation, but it also explicitly recognises the importance of taking into account human needs when conserving natural resources. The WSSD Plan of Implementation considers the CBD to be the key instrument for the conservation and sustainable use of biodiversity, and for the fair and equitable sharing of benefits arising from the use of genetic resources.

“Conservation and development are no longer seen as conflicting goals but as mutually interdependent”

*Secretariat of the Convention on
Biological Diversity*

In April 2002 the 187 parties to the CBD agreed the **Global Strategy for Plant Conservation** (GSPC) (Secretariat of the CBD, 2003). This is a key policy for plant conservation, with 16 targets for delivery by 2010. It explicitly recognises that plants are an essential resource for human well-being. For example, objective c(ii) “support the development of livelihoods based on sustainable use of plants, and promote the fair and equitable sharing of benefits arising from the use of plant diversity” is supported by specific targets for sustainable use and the conservation of plant resources.

Many other important policies and processes recognise the links between biodiversity conservation and human well-being: further details are given in Annex 1. These many processes are interpreted for botanic gardens’ policies and programmes by the **International Agenda for Botanic Gardens in Conservation** (IABGC). This was developed by BGCI in consultation with the many relevant parties as a framework to guide the work of botanic gardens for conservation and sustainable development (Wyse Jackson & Sutherland, 2000).

“A fundamental requirement for sustainable living is to integrate conservation and development”

Executive Summary, IABGC

The role of botanic gardens

There are over 2,500 botanic gardens, found in nearly every country across the world. They are often perceived as places for recreation alone, but they are very much more than that. They are involved in many structured activities focused in the fields of horticulture, science, education and conservation. The network of botanic gardens therefore represents an enormous and varied repository of knowledge, expertise and resources. These resources are particularly relevant to conservation, ethnobotany and our modern uses of plants. For example, botanic gardens are estimated to keep at least 100,000 species as living plants (nearly 30% of the world's plant diversity), and to maintain 250,000 seed bank accessions (Wyse Jackson, 1999). Many of these species are, or are related to, economically important species.



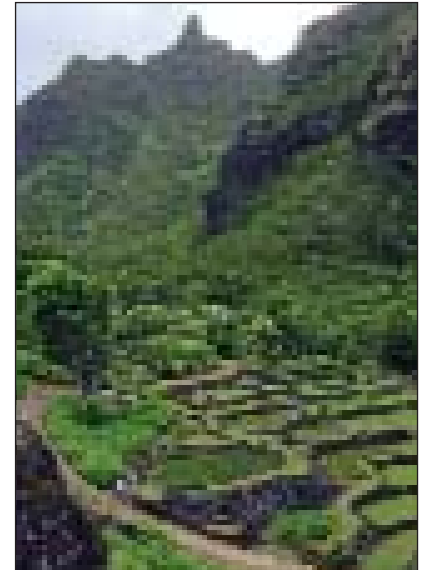
What makes a botanic garden?

There are over 2,500 botanic gardens, in nearly all countries and ecosystems. These gardens have a wide range of purposes, structures, and activities. However, it is generally agreed that botanic gardens should have a scientific basis for one or more aspects of their work: they are more than public parks. This is reflected in the recent definition used by BGCI (Wyse Jackson, 1999):

A botanic garden is an institution holding documented collections of living plants for the purposes of scientific research, conservation, display and education.

This definition is not exhaustive: Botanic gardens are also involved in activities that use biodiversity to promote human well-being. For further details on botanic garden characteristics and activities see Annex 2.

Botanic gardens play a key role in plant conservation, and their conservation network organisation, Botanic Gardens Conservation International (BGCI), is the world's largest network dedicated to plant conservation. BGCI plays a key role in empowering and supporting botanic gardens to further plant conservation, and in the creation and implementation of policies and targets relevant to this, especially the IABGC and the GSPC. BGCI promotes progress towards all of the GSPC's 16 targets, and is designated as Lead Facilitating Agent for Target 14, and for Target 8 (in conjunction with IPGRI). BGCI also provides the Secretariat for the Global Partnership for Plant Conservation (GPPC), which supports the implementation of the GSPC.



Reflecting society's priorities

Botanic gardens' activities have always reflected the needs and values of societies and even our oldest gardens owe their origins to the relationship of people and plants. The first recognisable botanic gardens were established as teaching and research facilities for physicians in medieval Europe. When European countries began to build empires in the 18th and 19th centuries, botanic gardens were set up in the new colonies to serve the needs of the empire. These gardens were used to study local plants, and used multi-national connections to introduce and develop useful plants from other regions, and so have been instrumental in the establishment of cash crops and agricultural industries that still dominate these countries. For example, the Royal Botanic Garden, Calcutta (now Indian Botanic Garden) first tested and introduced tea to India (Nayar, 1987) and other gardens played key roles in the introduction of tea, coffee, *Cinchona* and timber crops. Botanic gardens also reflected a fascination with documenting

and sorting the expanding collections of plant species being discovered, and began to play a key role in plant taxonomy research.

After two world wars and the dissolution of empires, the diversity of purposes and activities expanded to reflect the rapidly changing societies: in the Soviet Union gardens were established to develop plant varieties and uses that were of practical benefit to society, whilst some other gardens focused on non-applied research, and others on amenity values. Today, many gardens are focused on research for conservation and economic botany, for commercial and local benefits. Education on these subjects is also important. When the conservation of biodiversity began to emerge as a concern in the middle of the last century, the resources of botanic gardens were recognised to have valuable potential for *ex situ* conservation, by acting as gene-banks for useful and endangered plants (Huxley, 1984). As ideas about conservation began to develop beyond the traditional protectionist paradigm, the role of botanic garden resources has adapted, and the IABGC emphasises that botanic gardens are now focused on sustainability and the modern conservation agenda.

Mission for well-being

The use of biodiversity for human well-being is an explicit influence on botanic garden policies at all levels and in all locations. For example, in 2003 participants at the first conference of



Indian botanic gardens emphasised the importance of medicinal plants for primary healthcare, and their commitment to supporting sustainable livelihoods (NBRI, 2003). The output of this conference, the Lucknow Statement on Botanic Gardens of India, stressed “the fundamental importance of plants as the basis for all life on Earth and as an essential resource for human well-being”.

Individual botanic gardens also have goals that are related to improving human well-being. For example, the principles of sustainable development expressed during the 1992 Rio conference directly

informed the creation and aims of the Botanic Garden “ORSTOM” in the Democratic Republic of Congo (Mombeki, 2004). This garden researches domestication to provide useful species for cultivation, that allow local communities to more easily meet their food and healthcare needs, whilst protecting forests that would otherwise be destroyed in attempts to meet these needs. On the other side of the world Earth Ethnobotanic Garden, (at Earth University, Costa Rica) focuses on the conservation of medicinal plants, investigates the potential uses of plants, and communicates this information to local communities (Earth University Foundation, 2001), which reflects the aim of the whole university to balance “environmental awareness” and “social commitment” (Earth University, 2001).

Many activities of gardens are linked with aims to contribute to human well-being. Although some of these activities, such as education or research, may not appear to benefit human lives directly their fundamental importance cannot be overstated.

Education

Education is a key component of any project that wishes to inform and enable people to improve their lives. For example, in Uganda, Makerere University Botanic Garden used lectures and demonstrations to educate women and childrens groups in the usefulness of certain plants species: these groups have

“People-Plant” Origins

The **Botanical Garden of Padua** was founded in 1545 and is one of the oldest botanical gardens in the world. It was created by the Vatican Republic for the cultivation of medicinal herbs. The institution enabled students to use the garden to learn how to distinguish and use true medicinal herbs, which greatly improved the reliability of local healthcare. Similarly, the **Chelsea Physic Garden** was founded in England in 1673 by the Worshipful Society of Apothecaries, to train apprentices to identify plants, and to help in the cultivation of exotic plants for medicine.

Other gardens have been strongly identified with other plant uses. For example, the **Centre for Economic**

Botany at Royal Botanic Gardens Kew

was founded in 1847 by the first official director, to “render great service, not only to the scientific botanist, but also to the merchant, the manufacturer, the physician, the chemist, the druggist, the dyer, the carpenter and the cabinet maker and artisans of every description”.

A more recent example is **Kadoorie Farm and Botanic Garden** established in Hong Kong in the 1950s to provide agricultural aid to poor local farmers. There are currently community botanic gardens being set up around the world that are focused on addressing local needs.

For more information about these gardens please visit the BGCI Garden Search database at www.bgci.org.



now set up tree and herbal nurseries to cultivate useful species, especially those that take a long time to reach maturity and those with multiple uses (C.Kiwuka, pers.comm.). Every project described in this report uses at least one (and usually several) methods of communication to transfer knowledge and skills to community members: from formal

lectures and booklets, to workshops and ‘hands-on’ training. These rely on the educational capabilities of botanic gardens, which have been broadened over the last couple of decades in response to international processes, and now are ideally placed to play a unique role in education for conservation and sustainable development (Willison, 2004).

It is important that educators in botanic gardens are given the training and resources needed to communicate effectively the information and skills that can enhance the use of plants for well-being.

Research

Research and investigation into plants provide the knowledge for improving lives. Many gardens have a strong emphasis on research relevant to the development of useful plants, especially in the fields of agriculture and healthcare.

This research is often related to domestication and crop development: for example, Wuhan Botanical Garden in China has bred 10 new cultivars of kiwi (*Actinidia* spp.), and also developed local medicines such as “Yikanjiaolong” (Z.Cheng, survey response). Other research is focused on developing healthcare: for example the Komarov Botanical Institute of the Russian Academy of Sciences searches for plant species with antiviral or anti-microbe activities, hepato-protectors, and immuno-modulators or anti-tumour properties (Tkachenko *et al.*, 1997). Similar activities are carried out across the world: examples include the Ceará Botanical Park in Brazil, the Research Institute of Medicinal Plants in Poland, and the Guangxi Botanical Garden of Medicinal Plants in China. Other gardens, such as Botanic Garden “Fundación Xochitla” in Mexico, focus on cultivating and developing local plants with potential as ornamentals, whilst

Green Youth Farm

Chicago Botanic Garden has a community gardening department that has helped more than 300 school and community groups transform their neighbourhoods with gardens and green spaces. The Green Youth Farm programme selects youths from the deprived North Lawnsdale and Waukegan communities, where 50-98% are on low incomes, the majority are from ethnic minorities, and the school drop out rate is over 27%. This programme teaches them about crop sciences but is also important for their personal development.

There is an interdisciplinary style of teaching, which includes music lessons, cooking classes, art workshops, and leadership development. It helps students to understand themselves, and encourages them to develop a “can do” attitude. It also helps them to understand nutrition, and food policy issues: many students have gone onto campaign for better social justice, such as better food at a local homeless shelter.

Source: Mason & Benveniste (2006).



gardens in northern regions focus on finding varieties of useful plants that can withstand the harsh climate (L.Martínez González, survey response).

Much research provides information that can be directly used by local people to improve their livelihoods. For example, in the Democratic Republic of Congo, the Botanic Garden “ORSTOM” is domesticating species that are locally useful, such as a fodder plant that is suitable for local planting, and that will help improve the nitrogen content of pasture (S.Mombeki, survey response). Similarly, Kisantu Botanic Garden in the Democratic Republic of Congo has conducted trials on the popular fruit mangosteen, to enable local farmers to extend the shelf-life of the harvested fruit, and so reach a larger market (Kibungu Kemelo, 2004). Other botanic gardens perform research that has direct implications for more distant communities: the Botanical and Experimental Garden of Radboud University in the Netherlands investigates the properties of its African *Solanum* accessions (including taxonomy, morphology, nutritional qualities and alkaloid qualities) to provide an unambiguous and comprehensive guide to ‘safe to eat’ nightshades that also satisfies consumer taste preferences (G.van der Weerden, survey response). Research can also have implications for

Scouting for native plants in Buenos Aires

Pillahuinco Botanic Garden in Argentina scouts for native plants with ornamental value, prioritises the ‘top 10’ plants (including species such as *Pavonia cymablaria* and *Grindelia ventanensis*), and subjects the plants to research projects to determine their optimal propagation and cultivation conditions.

The garden teaches the local people about the ornamental value of native plants and the different techniques needed for their successful cultivation. It also trains the local population in field identification and the general importance of biodiversity conservation of the area by emphasizing natural environments and ecological services. This ongoing project has been partly supported by BGCI.



The importance of partnership

The success of many projects is promoted by appropriate collaboration between institutions that have complementary resources. This is well demonstrated by botanic gardens, and many projects featured in this report involve the partnership of gardens with local authorities, NGOs and health-care agencies. Collaboration and partnership can be particularly important for research. For example, in the USA the Botanic Garden of Smith College has collaborated with the government and pharmaceutical industry to use its large collection of yews (*Taxus* spp.) for research into Taxol. This compound is found in yew bark and leaves and is of global importance for healthcare due to its significant and unique anti-tumour properties.

In South Africa, Kirstenbosch Botanic Garden has been one of several institutions that have contributed to research on the smoke germination and propagation of *Cyclopia* spp., whose leaves and flowers are used to make a popular drink called Honey bush tea. The results of this body of research have allowed the bush to be cultivated with relative ease, so material that was traditionally wild collected is now cultivated by over 40 communities in impoverished areas where there was previously no agriculture.

Sources: Botanic Garden of Smith College (2005), de Lange (1997), van Wyke (2002).

local healthcare. For example, in Senegal the Garden for Useful Plant Experimentation (JEPUI) is inventorying, cultivating and evaluating traditional medicinal plants and their management systems, to establish a system of medicine that is sustainable and meets local needs (M.Lo, survey response).

There are many more examples of research that supports human well-being, both past and present. It is crucial that this research is not only sustained but the results actively used in practical projects to support well-being.



Action for human well-being

The following pages illustrate how botanic gardens use their resources to link biodiversity with improvements to human well-being. The examples are derived from an extensive literature review, and the information obtained from questionnaires received from botanic gardens as part of multi-lingual survey of BGCI members worldwide. It has not been possible to include all examples within this report, but a database of case studies can be found on the BGCI website, at www.bgci.org/wellbeing.



The many policies relevant to this subject categorise aspects of human well-being in slightly differently ways (Bass *et al.*, 2005). For example, the World Bank discusses “dimensions of poverty” such as lack of education or lack of access to services (e.g. Alsop, 2005; The World Bank Group, 2006), but other commentaries suggest aspects related to human rights should be as important as more material concerns (e.g. Kanburi & Squire, 1999; Satterthwaite, 2003). We have categorised human well-being into four aspects that can be easily related to other schemes: (1) improving nutrition, (2) improving healthcare, (3) financial poverty alleviation (providing opportunities for



income generation and improving financial security), (4) social and community benefits, (the non-material benefits that make significant contributions to our quality of life). BGCI believes that the international network of botanic gardens can make a significant contribution to all these aspects of well-being, so should play a key role in the global community’s efforts to achieve the goals of the modern conservation and sustainable development agenda.

“Biodiversity can indeed help alleviate hunger and poverty, can promote human health, and be the basis for ensuring freedom and equity for all”

*Statement by the heads of the five biodiversity related conventions, “Life Insurance for our Changing World”
September 2005*



Improving healthcare

Most of the world's population suffers from inadequate access to health care: for example, every year nearly 11 million children die before their fifth birthday, and half a million women die in childbirth (UN, 2005).

The protection and maintenance of human health is strongly dependent upon plant products and their derivatives. The majority of the world's population lacks access to conventional western medicine and depends upon plants for primary healthcare (Hamilton, 2004; Heywood, 1999). It is estimated that 80% of the world's population depends directly on plant based medicines (WHO, 2003) and the trade in medicinal plants is estimated to be worth about \$60 million per year in South Africa alone (Roe *et al.*, 2002). However, continued access to this global resource is threatened by environmental degradation and unsustainable collecting. Botanic gardens can play an important role, by empowering communities to safeguard and improve access to plants used in healthcare.

“Human health is strongly linked to the health of ecosystems, which meet many of our most critical needs”

Maria Neira, Director of WHO's Department for Protection of the Human Environment

Botanic gardens' projects often involve garden staff demonstrating uses of plants for healthcare, and enabling communities to cultivate such plants. The Nature Palace Botanic Garden in Uganda, for example, works with households in a local community-based conservation and development group. Participants have learnt about the cultivation and conservation of medicinal plants through workshops, field demonstrations, model farms and leaflets. They have subsequently gone on to set up individual gardens for medicinal plant cultivation, and are also planning a communal garden for this purpose (D. Nkwanga Kintu,

survey response). Gardens often work closely with local healthcare institutions to ensure local needs are met. For example, in South Africa, Garden Route Botanical Garden works with local people to facilitate their access to and use of medicinal plants: this project was started at the instigation of the Kynsna Municipal Healthcare clinic, to help them manage demand for their services (Y. van Wijk, survey response).

Careful planning and multidisciplinary thinking can help to ensure projects realise their potential. This is demonstrated by a project to promote the use of plants for self-sufficiency in basic healthcare, run by the Tropical Botanic Garden & Research Institute (TBGRI) in Kerala, India. Pushpangadan (1998) describes how the healthcare needs and socio-economic situation of four villages in the Thiruvananthapuram District were carefully examined by a TBGRI team that included botanists, Ayurvedic experts and sociologists. This team then worked with villagers to deliver a combination of lectures, seminars, demonstrations, practical training and plant supplies that enabled villagers to identify and cultivate healthcare plants. The TBGRI team also trained villagers in the preparation of compound drugs for home remedies to treat problems such as burns, wounds, sprains and diarrhoea. This project was so successful that other villages requested to become involved, and eventually over 800 families were helped.

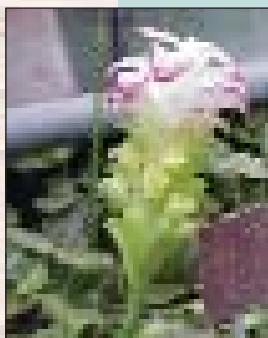
Healthcare concerns may be quite different in developed countries. For example, Kärnten Botanical Garden in Austria runs lectures and school projects based around drug plants, to educate children about the realities and dangers of drug abuse (R.Eberwein, survey response). Botanic gardens in developed countries have also been instrumental in developing the widely recognised psychological treatment “Horticultural Therapy”. This is practiced in

gardens from Irkutsk, Russia to Cleveland, USA (V.Kuzevanov, B.Holley, survey response). Although it is a less obvious application of plants and botanic gardens, it is potentially of great importance, as 25% of individuals will develop mental disorders during their life (WHO, 2001). This example clearly demonstrates the need for us to consider the full potential of plants for tackling the spectrum of healthcare issues, so that plant resources can be used most effectively.



Many gardens in developed countries have formed partnerships with institutions in other countries, to assist people in less developed countries. A good example of this is provided by the many projects in which the Royal Botanic Gardens, Kew is involved. These include a project in Uganda to develop the use of plants to tackle HIV/AIDS, and a project to use plants to tackle tuberculosis in South Africa (M.Simmonds, survey response). These projects allow expertise to be shared across countries and cultures: so for example, staff from Geneva Botanic Garden exchange information with Paraguay counterparts, some of whom then contribute to similar projects in Bolivia (R.Didier, survey response). The partnerships and collaborations involved in these projects can also build regional institutional capacity for future self-management of activities for environmentally sound development and environmental education.

Sustainable use of Zingiberaceae for health



Calicut University Botanic Garden, in the south Indian state of Kerala, is working to improve the livelihoods of local poor people, with support from BGCI. This project aims to conserve Indian Zingiberaceae, one of the most

economically important families of monocotyledons. It has involved support to local livelihoods, through empowering women in the sustainable use of their local natural resources, and also *ex situ* measures, such as enhancing the number of ginger species held in germplasm collections.

Housewives from low incomes groups participated in workshops and training programmes that were designed to enable them to use plant resources to improve their health care and financial situation. For example, the women were informed about the potential of home gardens, and trained in nursery development, maintenance and management, and were provided with saplings of plants with medicinal uses, for cultivation.

Women were also given training on the extraction of Travancore starch from the rhizomes of wild turmeric (*Curcuma aeruginosa*), which grows abundantly in the area as a wild herb. This member of the ginger family has a tradition of use stretching back thousands of years. The starch is used in health drinks and Ayurvedic medicines: for example, hot water extracts of the dried rhizome can be taken orally to reduce inflammation, and it is also classified as a 'rasayana' herb, and used to counteract ageing processes. Its products are normally quite expensive, so women who collect it from the wild have the opportunity to significantly improve their incomes.

Source: M.Sabu (survey response).

Geneva's links with community medicine in Paraguay

Since 1996 "Projet Etnobotanica Paraguaya" (EPY) has been run in the town of Asunción, Paraguay, to improve local standards of living through the use of plants, by the Conservatory and Botanic Gardens of Geneva, Switzerland in collaboration with Asunción's Centre for Conservation and Environmental Education (CCEAM). In the first phase of EPY, the use of more than 400 species of plants sold in local markets was recorded and evaluated, and a medicinal plant garden was created in the Asunción Botanic Garden to hold specimens. The data collected included the toxicity, chemical composition and taxonomy of the medicinal plants (called "poha ñana" in the local guarani language).

This information was used to make booklets and videos, and then used in targeted education campaigns in 25 local rural communities, in collaboration with the Red Cross, to encourage appropriate use and protection of medicinal plants. The collaboration of the EPY and "Tesai Reka Paraguay" (a coalition of 12 country-based organisations working for community health in Eastern Paraguay) created project "Poha Ñana". This project used local

workshops and the resources of Asunción Botanic Garden to train and support more than 20 promoter-gardeners who created and maintained community medicinal gardens within their respective rural communities. Ongoing work is investigating the market potential for several herbs, and the best application of the plants for tackling specific local diseases, such as malaria and leishmaniasis.

Source: Gaona (2002), Pinazzo (2002).



Home gardens in Ghana

Wild plants are essential for primary healthcare in Ghana as 70-80% of the population cannot access hospitals or afford conventional medicines, and so rely on wild sourced medicinal plants instead. However, this resource is in jeopardy. Communities find it increasingly hard to source their medicinal plants, and practitioners must travel ever greater distances to find them.

Aburi Botanical Garden received Darwin funding to work on a project to respond to this situation, in partnership with BGCI, the UNEP World Conservation Monitoring Centre, Royal Botanic Garden Edinburgh and the University of Ghana. This project aimed to improve communities' access to medicinal plants, and to encourage their sustainable use. It set up a 50 acre model Medicinal Plant Garden, based on community ethno-botanical surveys, which was planted with 1,361 medicinal plant seedlings, and also set up a plant nursery to hold 5,000 medicinal plant seedlings.

This garden is used to support lectures, seminars and workshops for herbalists on how to propagate and cultivate medicinal plants, to encourage stakeholder interaction, and to encourage communities to set up their own nurseries and first aid gardens. The community is involved in their management through an advisory committee.

These activities have been accompanied by the publication of two manuals on medicinal plants: one on harvesting, preparation and storage, and the other on propagation. Aburi also provides communities with seedlings (over 2 million to date), and is involved in complementary activities, such as the enhancement of schools, church yards, towns and villages, promotion of some traditional medicinal plant management systems, and the management of protected areas.

Sources: G.Owusu-Afriyie (survey response), Amponsah *et al.* (2002), Gillett (2002), Damanka & Ofosuhen-Djan (2001).



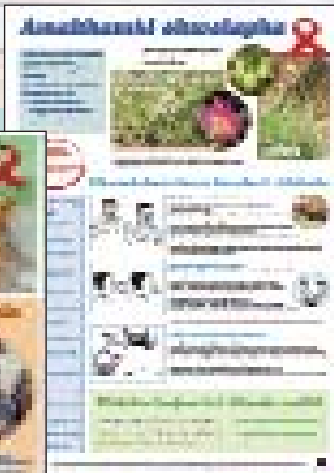
Helping AIDS sufferers in Natal

AIDS is a major challenge for societies in sub-Saharan Africa. Locally the problem is being tackled by Natal National Botanic Garden (part of SANBI, the South Africa National Biodiversity Institute), which is involved in a project to provide free healthcare support to AIDS sufferers. This is run in association with CINDI, a local consortium of NGOs, government departments and individuals that work for children affected by HIV/AIDS.

As part of this project, a local primary healthcare centre is provided with a free supply of helpful medicinal plants, which residents can then take to plant in their own gardens, and use to self-treat. Complementing this, medicinal plants posters have been developed that show care givers and AIDS sufferers how to use two indigenous plants *Bulbine* and *Carpobrotus* (sour fig) to treat skin conditions and thrush that are commonly associated with HIV/AIDS. In addition, a nutritional plants poster is being developed, to encourage the use of yellow flesh sweet potatoes and brightly coloured vegetables that are rich in vitamins in order to boost the immune systems of AIDS sufferers.

These resources are of significant benefit to people who cannot afford conventional medicine, who can now self-treat some of the common skin ailments associated with AIDS for free.

Source: J.Roff (survey response).



Horticultural therapy

Horticultural therapy is the process of using gardening activities, plants, and horticultural techniques as a psychological and physical therapy. Botanic gardens have been pioneers in developing and promoting this. The Royal Botanic Gardens Hamilton in Canada ran the first programme to teach this to Canadian therapists. This programme has now been running 37 years. In 1977, the Ontario Ministry of Health studied this programme to assess the effectiveness of the technique, and in 1980 the garden was a key founder of what is now the Canadian Horticultural Therapy Association. Horticultural Therapy is now widely accepted and is taught by many colleges in the region. Hamilton is not the only garden to have pioneered the technique: the New York Botanical Garden (NYBG) has also long offered certificate programmes in horticultural therapy.

Horticultural therapy is now widely recognised as an important tool for therapists, with much evidence that it is an effective treatment for various disorders such as Attention Deficient Disorder and many textbooks on the subject are available. It is widely taught to therapists as a tool for social development, psychological well-being and physical rehabilitation, and is commonly applied in medical and social institutions such as hospitals and correctional facilities.

Sources: D. Galbraith (pers.comm.), Park *et al.* (2004), Kuo & Sullivan (2001), Taylor *et al.* (2001) Frazel (1991), Simson & Strauss (1997).

Improving nutrition

It is obvious that human well-being depends upon a food supply that relies upon plant products. Plant diversity also supports the functioning of the supporting ecosystems, and provides genetic resources that can improve crop qualities such as disease resistance, productivity or adaptation to local conditions.

“There are close causal linkages between reducing hunger and sustainable management of natural resources and ecosystems”

FAO, 2005

A significant proportion of the world's population do not have an adequate diet: the Millennium Ecosystem Assessment (2005b) estimates that 852 million people were undernourished between 2000 and 2002, whilst *per capita* food production declined in sub-Saharan Africa. This source also projects that demand for food crops could increase 85% by 2050. To meet these human needs, we must strive to ensure plant diversity is sustained and efficiently used to provide diets that are sufficient, secure and diverse.

Many botanic gardens are involved in projects that improve the nutrition of local poor communities. These projects often involve enabling people to cultivate their own food plants in home gardens, by educating them about useful plants and their cultivation, demonstrating the techniques of cultivation, and supporting the establishment of community gardens with the botanic garden's resources and ongoing advice. Promoting home gardens is not the only way that botanic gardens can improve nutrition (as illustrated by the Bas Congo case study) but it is generally a very useful approach which is appropriate for helping both the rural and urban poor. Quite obviously, projects that encourage good nutrition benefit health. In addition, projects for



home gardens can easily encourage direct improvements in both food and healthcare through the appropriate combination of plantings, as demonstrated by gardens set up near Lucknow, India.

Promoting home gardens is especially effective when supported by the results of research and development that have focused on local needs. For example, Skeffington (2006) describes how the National Botanic Garden of Cuba works to improve the diets and self-sufficiency of Cubans. In addition to interpretative materials and education about the value of cultivating a diverse selection of organic plants, it runs a fruit tree project to experimentally develop species and varieties of tropical fruit trees for the Havana climate and soils (there are over 35 varieties of mango alone, all the common citrus fruits and many other less common species). As a result, it is able to advise on planting appropriate for Cubans with only small gardens or back yards (and its own orchards produce tonnes of fruit!).

Projects within more developed countries have to tackle the problem of unhealthy diets that provide too many calories. Innovative and diverse techniques are used in gardens' attempts to use their resources to promote healthier diets. For example, Adkins Arboretum in Maryland, USA hosts guided outdoor walks followed by a healthy meal and a nutritionist's talk, which link observations from the walk (e.g. autumnal leaf colour) with ideas about food (e.g. brightly coloured vegetables are healthiest) (S.Kaufman, survey response). Efforts for education about healthy eating are often directed towards children, often with tangible results. For example, Auckland's Pacific Island Community has one of the highest rates of obesity and diabetes in New Zealand. For the last three years, staff from Auckland Botanic Garden, in partnership with the public health service, have been teaching early childhood teachers how to grow healthy and nutritious food. This has resulted in sustainable food gardens, and a "five-plus a day" campaign to promote the consumption of fruit and vegetables (Benham, 2005).

Rural resource management in Peru

The Yanেশa are an indigenous group of the headlands of the Amazon, in Selva Central, Peru. They suffer from extreme poverty and their efforts to meet their basic needs are degrading the forest. The Centre for Conservation and Sustainable Development (CSSD) at Missouri Botanical Garden is collaborating with three Yanেশa communities, to help them to better understand and manage their natural resources, as well as improving their nutrition.

The project has established vegetable gardens where school children and teachers collaborate with the CSSD to experiment with vegetables that are not known to the Yanেশa, and to promote the inclusion of more vegetables into the diet. They work before and after school to help cultivate the gardens. There is also an experimental fruit tree nursery run within the community, where trees not known to the area are



help them manage their community lands and the threats to their reserve. The Yanেশa and the CSSD work together to review the programme's activities and identify future needs. Future plans include helping the Yanেশa develop sustainable production activities that will provide supplemental sources of income, and reduce harvesting of wild flora and fauna.

Sources: O.Montiel (pers.comm.)

introduced. When these trees are ready for transplant they are then planted in the small parcels of land that the local families have adjacent to their houses.

The CSSD conducts extensive environmental education programmes that not only encourage environmental appreciation but teach practical ways to sustainably manage natural resources, and to cultivate crops. It is also helping the Yanেশa to form an Environmental Technical Unit that will





Healthy Schools Days

Over half of the UK population is overweight. Obesity is associated with many diseases which have a significant impact on quality of life, whilst malnutrition alone costs the UK more than £7.3 billion per year. This is largely due to poorly balanced diets which do not include enough fruit and vegetables. The obesity rate is growing particularly fast in children, and so the gardens at RHS Wisley have designed special activities to tackle this. School children visit the garden for a whole day, where they take part in three sessions:

Session 1. Exploring the World of Fruit and Vegetables. This takes the children out into the gardens of Wisley, to pick and try some salad leaves, and to give them a tour of the fruit growing area (many children do not know where their food comes from). The children then play a vegetable



recognition game and learn some “weird and wonderful” facts about vegetables.

Session 2. A community chef shows the children how to cook vegetable super noodles and then helps the children make their own fruit kebabs.

Session 3. A Public Health Dietician (from the local unit of the National Health Service) works with the children to educate them about nutrition, and uses games to show how food is good for us and why a balanced diet is important.

Source: J.Chave (survey response).



Edible caterpillars in Bas Congo

Throughout Africa, wherever they are eaten, caterpillars are considered a luxury food, and they are opportunistically harvested by most people. As caterpillars are high in protein, they are also practically important: caterpillar meat has been estimated to contribute 40% of the total protein consumed in the Bas Congo, Democratic Republic of Congo. However, caterpillars are becoming scarce in some areas, and may not be easily obtained, as bush fires become more frequent, and protective traditions are ignored. For example, if caterpillars were in tree branches too high to reach, it was traditional to leave them there, but increasingly the branches are cut down.

The Kisantu Botanic Garden in Bas Congo was involved in a rural development project run by the Salvation Army at Kasangulu, Bas Congo. One of the project aims was to conserve and increase the number of edible caterpillars available to local people in several villages. The project researched the lifecycles of the caterpillars, the plants they feed on, and the best way to protect them. The National Botanic Garden of Belgium was also involved, and helped to prepare and store herbarium specimens of the caterpillars’ food plants.

As a result of the project, several villages were able to safeguard and improve their access to the valuable caterpillar resources, whilst the caterpillar food plants were protected. A reference manual was published in the local Kitandu dialect of Kicongo which clearly illustrated both the edible caterpillars and their food plants, and how to conserve them. For example, appropriate food trees could be planted near houses. The project also encouraged respect for the traditions which had previously safeguarded the caterpillars. Other activities of the overall rural development project were found to complement the caterpillar work: for example, keeping bees in the locality of the caterpillar plants was recommended to help to deter caterpillar over-harvest!

Sources: Gracia & Latham (2003), Latham (1999).

Improving urban food security in Colombia

Nearly 60% of the urban population of Bogotá, Colombia, live below the poverty line. This situation was tackled by a two year initiative by the Bogotá Botanic Garden “José Caestino Mutis” which involved botanic garden staff working with deprived local communities to teach them how to grow plants for food.

The results of this initiative were so successful that that the President of Colombia and the mayor of Bogotá are supporting a similarly themed \$500,000 project by the Colombian Botanic Gardens Network. This project aims to help 6,000 poor urban families in the “Cuidad Bolivar” suburb to cultivate food plants in home gardens and community areas. Self-cultivation will improve food security for these families, and contribute to poverty alleviation.

Source: BGCI (2005a).

Rural home gardens near Lucknow, India

Improving nutrition and healthcare of the rural population was targeted by a project by National Botanical Research Institute (NBRI) in Lucknow, supported by Indian government’s Department of Science & Technology. NBRI’s Eco-education division set up a home gardens project in a village called Amol Kalla Paschim, near Lucknow, which was especially selected for its high level of deprivation and poverty.

The activities of the project focused on women from poor or lower caste backgrounds. After collecting baseline data on the village, its society and its natural resources, the NBRI project team started awareness campaigns on sustainable resource use. Twenty-five Self-Help Groups (SHGs) of five to six women were formed, and each provided with an education kit. This contained booklets on the nutritional value of vegetables, information on how to grow vegetables, and useful stationery items. SHG members also received demonstrations and interactive training on plant cultivation practices such as composting and medicinal plant identification, and were encouraged to visit NBRI’s model home garden and herbal garden. There was also encouragement for men

to assist their wives in agricultural practices, and help in cleaning up village water.

This project resulted in a model home garden developed by each SHG, and all the SHG members benefiting from practicing the home garden techniques. Vegetables grown were consumed in the home, and some sold, whilst the seeds provided for future harvests. Some groups also developed gardens for health care: whilst others cultivated aquatic crops: each members of five SHGs earned 1,800 rupees. This project was so successful that it may be used as a model for projects in other locations.

Sources: Kulshreshtha (2005), NBRI (2005).



Financial poverty alleviation

Plants support livelihoods and provide incomes for millions of people around the world. For example, 22% of the world's population (and 46% of the total labour force) are employed in agriculture alone (Millennium Ecosystem Assessment, 2005c), timber is one of the world's main commodities (ITTO, 2004), and the trade in medicinal plants grows every year (Hamilton, 2004). Even in developed countries the direct financial benefits are huge. In the USA, the Center for Plant Conservation studied the economic potential of the 3,214 rare US plants, and found that more than 80% were directly used or had economically useful close relatives, and were worth nearly \$10 billion per year (Philips & Meilleur, 1995).

Unfortunately, overall progress towards improving this aspect of well-being is very slow: in some parts of the world the number of poor is still rising, and the gap

between rich and poor is widening (UN, 2005). Environmental degradation may worsen this situation, as it threatens existing livelihoods that depend upon natural resources (Millennium Ecosystem Assessment, 2005c). It is therefore imperative that we better realise the potential of plants to support livelihoods, and safeguard this resource for present and future generations.

“Win-win” solutions exist for both the environment and the poor”

UNDP Poverty Report, 2000

The expertise and resources of botanic gardens are well placed to use plants to improve incomes and support the financial security of poor people. This can sometimes involve the use of their own plants to directly support local income generation: for example, Peninsular Khao Chong botanic garden in



Thailand allows local people to harvest its bamboo to make chopsticks, which is a more convenient and sustainable source for harvesters than wild-harvesting (V.Chamchumroon, survey response).

Botanic gardens are most often able to contribute to income generation by educating and empowering local people in how to use plants to make useful products that can be sold. These plants products are often related to healthcare. For example, Przelewiec Arboretum in Poland runs a training programme “Frauenhände bringen Geld” to teach unemployed women how to produce natural soaps and cultivate plants for healthcare, and supports this practical knowledge with talks on management by the tax and labour offices (K.Misiak, survey response). Other projects encourage the use of plants for making handicrafts. For example, the work of local crafts-people was promoted during events for the project “Education for Conservation of the Caatinga” run by the Botanic Garden of the Belo Horizonte Zoobotanic Foundation in Brazil (Andrade, 2004).

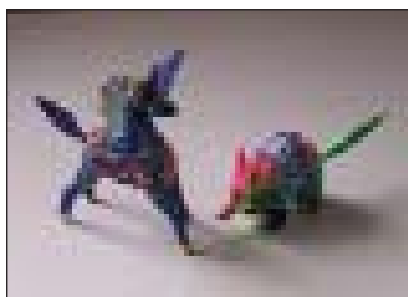
The resources of Botanic Gardens can also be relevant to improving this aspect of well-being in very distant communities, usually through working with local





organisations in less developed countries. For example, the botanic gardens of the Trento Natural History Museum, Italy, are part of a project near the Uzwanga Scarp Forest Reserve in Tanzania, in partnership with Tanzanian NGOs, forestry and park authorities and local authorities. This project “Watu na Msitu” (People and Forest) consists of environmental education activities, micro-projects for income-generation alternatives to forest exploitation, the establishment of community tree nurseries, and eco-tourism (C. Bonomi, survey response).

Botanic gardens currently run relatively few projects that contribute to this aspect of well-being compared to the work they do for improving healthcare and nutrition. However, they have the potential to make greater contributions on this topic. In addition, they receive so many visitors that they could support many more livelihoods through sale of products that directly benefit poor people. For example, the shop within Przelewiec Arboretum sells the products of 15 women from its “Frauenhände bringen Geld” programme. Similarly, Oaxaca Ethnobotanical garden in Mexico sells the work of local artisans who use certified sustainable timber to carve “alebrijes” - fantastic animals and other figures made out of *Bursera* wood and painted in very bright colours, which are very popular with tourists (A. de Ávila, pers.comm.).

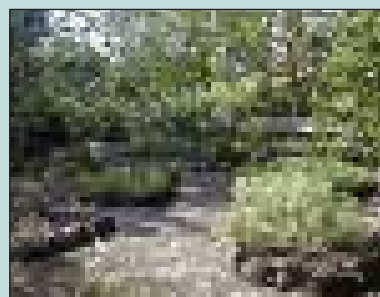


Handicrafts and Earth Botanic Garden

Earth Botanic Garden, at Earth University in Costa Rica, is running a course to teach students and local people on the many different uses of their surrounding biodiversity, and how they can use natural products to earn an income. The products developed include soaps, drinks, teas, shampoos, creams, ointments, agricultural insecticides, and dyes.

At the end of the course students gain a qualification, and can use their skills to make useful products for personal consumption. Many people also go on to sell these products, and some micro-companies have been set up to promote the use of tropical plants for medicine. This project is a long term initiative developed by the botanic garden and the university’s students, which contributes to its strategic aim.

Source: (J.Portuguez, survey response)



Helping farmers in Malabar, India

Malabar Botanic Garden in India is promoting the cultivation of the state's native medicinal plants, by giving training in relevant techniques to local farmers. Guidance is given on the medicinal plants' cultivation, storage and trade,

Malabar has also published books on this topic, and on the medicinal properties of native plants, which have been distributed to the farmers.

In the last two years over 200 farmers have been trained, and a farmers society has been formed to promote the mass cultivation and trade of medicinal knowledge. This has provided a valuable opportunity for these farmers to expand and diversify their crops, safeguarding their incomes.

Source: R.Ansari (survey response).

Multiple projects improving livelihoods at Limbe

Limbe Botanic Garden (LBG) in Cameroon runs many activities linking biodiversity research and development. Since 1992 Limbe has run a programme to domesticate some local ornamental species, such as *Clerodendrum thomsonii*, with the aim of developing low technology cultivation techniques to transfer to local communities for the cultivation of cut flowers with high value. It also runs a project to provide fuel wood for communities through nurseries that are tended by women, which improves the livelihoods and status of women, as well as ensuring sustainable fuel supplies. In 1994 the Mount Cameroon Project (MCP) was established here to focus specifically on the conservation of biodiversity and livelihood improvement for rural communities in the region.

LBG has a 'Conservation through Cultivation' programme that works for the conservation of threatened useful wild species. It has long been involved with promoting *ex situ* cultivation of Eru, to reduce pressure on wild stock and to improve the livelihoods of rural farmers through the sale and consumption of the vegetable. Eru (*Gnetum africanum* and *G.buchholzianum*) is a climbing rainforest vine of West and Central Africa that is used as a highly priced vegetable but is threatened by the

excessive pressures of wild-harvesting. Its protein content is high, so it can play an important role in preventing malnutrition, and it is also thought to have medicinal qualities. It is locally popular within Cameroon, and tonnes of it is also regularly exported to Nigeria and beyond, which supports the employment of thousands of people.

LBG developed domestication techniques for inclusion in local agro-forestry systems, using trial plots and gene banks. It then went on to train relevant community members using theoretical and practical techniques starting at the Bimbia Bonadikombo area, and books were printed for literate farmers.

LBG maintains strong link with the farmers who are involved in the cultivation of the crop, which helps with further research into its domestication. Institutional partnerships also help it to understand and spread knowledge about Eru. For example, the garden has worked with the Cameroon Ministry of Agriculture and socio-economists from a local World Bank surveys unit to provide extension support. In 2004 LBG was supported by BGCI to further extend this programme, in a project to train 30 farmers and two agricultural extension workers, and to establish two nurseries and two demonstration farms.

Sources: Ewane (2001), Otsubo (1999), Ndam & Sunderland (1997).



Community and social benefits

This aspect of well-being focuses on non-material benefits that can be hard to quantify, such as political empowerment, improved social networks and community cohesion, reduced vulnerability and a freedom from violence and conflict. Although these benefits may be hard to measure they are nevertheless key to quality of life and are often highlighted by the poor themselves as crucial to their well-being (DFID, 2006; Bass *et al.*, 2005).

Many botanic gardens have projects that directly tackle social problems, which often involve the improvement of neighbourhood environments through “greening”. The benefits of such projects are far more than aesthetic: academic research has shown that well designed projects can reduce crime, increase social interactions and improve individual feelings of adjustment (e.g. Coley *et al.*, 1997; Kuo & Sullivan, 2001; Sullivan *et al.*, 2004). Greening projects are now run by botanic gardens and healthcare institutions in many diverse locations, from South Africa to Ukraine and Brazil. In the coldest regions of Russia, these projects are especially adapted to meet the challenges of the harsh climate (Gorbunov, 2001). Botanic gardens such as that of Yakutsk State University investigate and develop plants hardy enough to withstand the harsh climate, and also research suitable combinations of plants to treat the problem of poor interior air quality of buildings that receive little ventilation throughout winter (D.Sofronovna, survey response).

Projects can be especially focused on empowering disadvantaged members of society. For example, the Mexican botanic garden “Francisco Javier Clavijero” has worked with local rural women to record their traditional knowledge of plants and their uses, and set up a permanent workshop to help them share useful ideas and knowledge (Vovides *et al.*, 1995). With the

assistance of BGCI this garden is currently supporting the development of a women’s tree nursery (Botanic Garden Francisco Xavier Clavijero, 2005). Of course, many projects that focus on other aspects of well-being can also address social problems. Home garden projects described in previous sections have often tackled inequality and discrimination by focusing on helping the poorest sectors of society and working with women.

Gardens themselves can also play a valuable role in communities. They are widely recognised as providing valuable ‘green space’ for urban residents, but they can also have very specific and significant functions for a community. The Mexican botanic garden of Charco del Ingenio, for example, provides a valuable recreational and ceremonial space for local people, and in 2004 was designated a peace zone by the Dalai Lama (BGCI, 2005b). Similarly, Hawaii’s National Tropical Botanical Garden (NTBG) at Kahanu is an important spiritual centre as it contains the massive “Pi’ilanihale Heiau”, a structure made out of lava rock and believed to be the largest ancient place of worship in Polynesia (NTBG, 2005). This role can be particularly important in countries that have experienced conflict: a botanic garden to be re-established at Kabul in Afghanistan is specifically designed as a peaceful safe haven for women and children (M.Richardson, pers.comm.).

Gardens also help record and promote cultural values and traditions that might otherwise be lost. For example, Canadian botanic gardens are involved in ‘First Nation’ projects to record and promote the traditional uses of plants by the indigenous peoples (D.Galbraith, survey response). This type of project is relevant all over the world, wherever cultures or traditions are eroding. For example, the Botanic Garden of Salvador, Brazil, surveyed native species related to



the Afro-Brazilian culture, and its education team visited local communities to identify “terreiros” whose knowledge of plant sacred properties formed the basis of a new garden promoting this culture (Oliveira *et al.*, 2005). Gardens can also help to bring communities together to build new community values: Garfield Park Conservatory (GPC), Chicago, facilitates a new Communities Program which provides the opportunity for local stakeholders (residents, businesses, city agencies, local community organisations) to participate in the development of a plan to improve the “quality of life” for the East Garfield Park area (GPC, 2005).

It is clear that botanic gardens make diverse contributions to improving social and community well-being, which reflects the diversity of their surroundings and social context. Consideration of this aspect of well-being is particularly important where societies have clear problems of inequality and minority discrimination, but also for any gardens in urban settings, where environmental quality may be poor, and traditional knowledge threatened.

Bronx Green-Up (BGU)

BGU works with individuals and community groups to improve deprived urban neighbourhoods through 'greening'. New York Botanical Garden (NYBG) has run this programme since 1987.

Community gardens are key to this project's success, and they do much more than improve the appearance of the neighbourhood: they play a key role in tackling social problems in the neighbourhood. The gardens have transformed derelict lots into attractive and safe places to socialise, improving community cohesion, whilst the process of establishing and caring for the garden has given residents a sense of empowerment and ownership, encouraging them to tackle other neighbourhood problems.

"Ours was a nasty lot, with open prostitution next to a crack house. Bronx Green-Up offered workshops for Bronx people interested in making gardens and parks in empty lots. After taking the workshops, we all worked hard to make a beautiful space. No more crack house or prostitution, only vegetables, flowers and trees, a place to work and rest."

Alfred Bailey and son, Bronx residents.



The gardens also play an important role in fighting hunger and saving money, as the retail industry has moved out of the inner city but residents find it difficult to afford transport. Numerous studies have pointed out the economic and nutritional benefits that home gardening can bring. (For example, a 1993 study estimated that a 64-square-foot plot could save a family \$600 in food purchases per year.)

BGU works hard to initiate and support the gardens, providing expertise, training and resources (such as trucks to transport building supplies to the garden sites). It also works in local schools, and liaises with government and local authorities to persuade them to deed garden lots to the community,



and to provide other public amenities like new sidewalks. BGU has now assisted hundreds of community gardens, roof gardens, school projects, tree plantings and workshops, and it is used as a model for similar programs in other cities and countries.

Source: NYBG (2005; 1996), Keller (1996).



Training for useful skills in Jerusalem

Jerusalem Botanic Garden has a programme of retraining that focuses on learning useful skills, and in encouraging participants to become contributing members of the community. This programme is designed to assist local people that lack job experience, such as the unemployed, new immigrants, and ex-soldiers. It also trains prison inmates. This programme is run in collaboration with the Israeli corrective services, the National welfare organization, and the Ministry of Labour. Some participants gain professional gardening certificates, and some go on to obtain paid employment.

Jerusalem also has a Gardening Club for disabled war veterans. Most of these veterans have head injuries or post traumatic stress disorder, and can have difficulty integrating into society. The aims of this programme include establishing a positive connection to nature, and integrating participants into the botanic garden and the wider community. The veterans make an essential contribution to the garden's operations, and participate in all internal events and social activities.

Source: Y.Ayalon (survey response).

Moroccan women in London

The Chelsea Physic Garden, London, UK, undertook a Cultural Botany project with Al Hasaniya Moroccan Women from North London. London's population is large and diverse, and includes peoples from many different ethnic backgrounds. Unfortunately, some members of these ethnic minorities, especially women, can be isolated or at a disadvantage within the new culture. This project aimed to record and present traditional knowledge amongst urban cultural communities, and to help rebuild personal self-esteem and the social fabric of the community that was severely affected by their immigration to the U.K.

The project started from the visit of a local group of Moroccan women on a guided tour, which prompted memories and reminiscences about their home country. The project developed from this outing into a diverse set of activities that focused on plant use as a basis for engaging and empowering these women. The project involved a fact-finding trip back to Morocco for some of the women from Al Hasaniya, and the establishment of discussion groups to enable the women to share and record their botanical knowledge. An ethnobotanist facilitated recording traditional knowledge, there were links with The Poetry Society, and a Moroccan garden was created near Meanwhile Gardens in North Kensington.

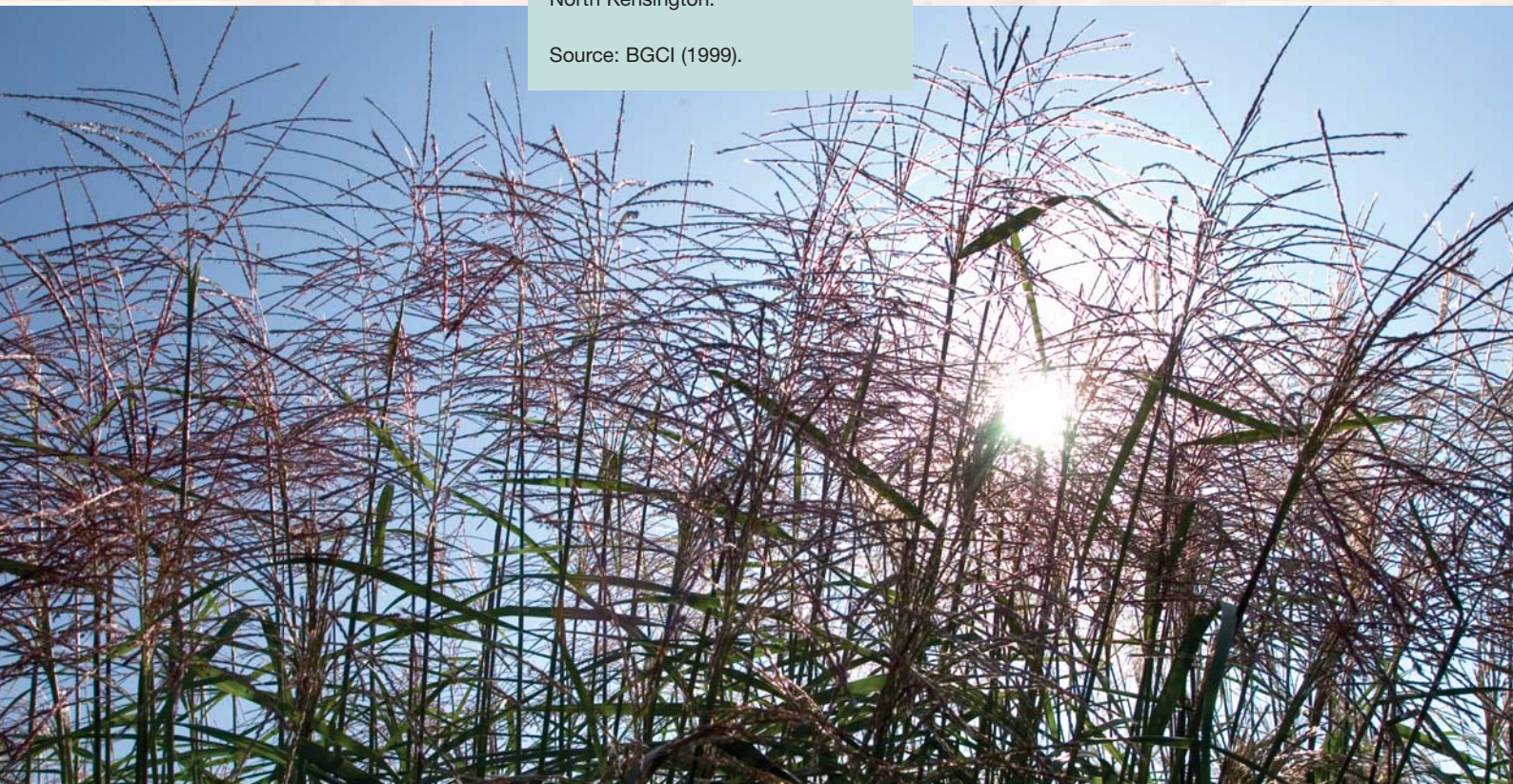
Source: BGCI (1999).

Future plans: rehabilitation in Dartmoor Prison

The Eden Project, Cornwall, UK, is working with the organisation "Business in the Community" to support prisoners in the Resettlement Unit at Dartmoor Prison. They plan to convert three areas that are currently plain paved exercise yards into productive gardens, and to develop a circulation space into a healing and herb garden. The staff at the Eden Project have used their expertise to design a planting scheme that will produce a long succession of fresh vegetables for the local community's food box scheme, and fresh vegetables for the prisoners.

The project is also designed to benefit the psychological well-being of the prisoners, and the sensory garden in particular is intended to have a calm and therapeutic effect. For example, it will be planted to attract birds, to increase contact with nature. This garden is overlooked by a block housing the most violent prisoners and it is hoped that the scheme will significantly benefit them. The construction and maintenance of these gardens will be done by prisoners, who will learn useful skills. This project is planned to start in mid 2006, subject to funding.

Source: S.Minter (survey response)



In Conclusion

This report illustrates that botanic gardens use biodiversity to improve human well-being in many ways. These include improving healthcare, improving nutrition, helping to alleviate financial poverty and community and social benefits. Many of these aspects of well-being are linked, and a well designed project can cause significant improvements to quality of life. A particular strength of gardens is linking plants to improvements in healthcare and nutrition, often through empowering communities to set up their own home gardens. Moreover, there is great potential to expand the activities of gardens in contributing to local income generation.



This report also illustrates how the various activities in botanic gardens underpin their ability to improve well-being. Education and research are core strengths of botanic gardens that need to be supported and directed to ensure gardens can continue to link biodiversity with human well-being. For example, not only should research on economic botany



be encouraged, but efforts should be made to actually use the results for practical benefits. It is also important that the information about these activities is published and effectively shared so our future efforts for well-being are based upon best practice.

Although some aspects of well-being and project types are more relevant to some areas than others, botanic gardens can act to improve well-being across all parts of the world. Sometimes this involves collaboration between gardens and in many cases the unique role of botanic gardens is complemented by partnerships and collaborations with non-botanic garden institutions. This highlights the need for effective partnerships and networking within the botanic garden and wider conservation and development community. Botanic gardens are often perceived as institutions prized only for their aesthetic values and roles in gardening and horticulture, and so seen as institutions with little relevance to the linked

conservation and development agendas. However, botanic gardens are not just a “pretty place”. Their distinctive combination of resources mean they are in a unique position to use plant diversity for human well-being.

“The real key to a sustainable future is to remember that our efforts towards poverty reduction and conservation are mutually reinforcing. In other words, our programmes should focus on ‘biodiversity for development’ not ‘biodiversity or development.’”

*Mark Malloch Brown,
administrator of the United Nations
Development Programme.*

BGCI believes that botanic gardens have an important role to play in the global community’s efforts to link biodiversity with improvements to human well-being. Given the scale of the crisis facing conservation and development efforts, it is an ethical and practical imperative that botanic gardens are mobilised for this goal.

Annex 1:

International processes that link biodiversity and human well-being

Human well-being is considered an important goal by many international policies, conventions, strategies and dependent targets relevant to conservation and botanic gardens. This is especially true of more recent policies, which recognise how biodiversity conservation and socio-economic development can be interlinked. Key processes that are related to this are listed below in chronological order. Additional information about these policies and how they relate to botanic gardens is available from the BGCI website at www.bgci.org/policies.

The Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention), 1972

This convention emphasises the need to conserve and promote both biological and cultural heritage. As such, human society and its uses of biological diversity are as valuable as the biological diversity, and the best interventions are those that promote both. For more information, visit <http://whc.unesco.org/>.

UN Conference on the Human Environment, 1972

This conference held in Stockholm was the first UN meeting that focused international attention on environmental issues, in particular those relating to environmental degradation and “transboundary pollution”. This highlighted that environmental problems do not recognize political or geographical boundaries, so require efforts by all countries and regions to deal with them.

UN Conference on Environment and Development (UNCED), 1992

This global conference (or “Earth Summit”) was held in Rio de Janeiro on the 20th anniversary of the first international Conference on the Human Environment in Stockholm, 1972 and brought together policy-makers, scientists, media and NGO representatives from 179 countries in an effort to reconcile the impact of human socio-economic activities on the environment. For more information, visit <http://www.un.org/geninfo/bp/enviro.html>.

Agenda 21: Programme of Action for Sustainable Development, 1992

This is comprehensive plan of action to be addressed globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which there are human impacts on the environment. This was a major achievement of the UNCED in the same year. It promotes balance between the socio-economic dimensions of development, and the conservation and management of resources for development. For more information, visit <http://www.un.org/esa/sustdev/documents/agenda21/>.

Convention on Biological Diversity (CBD), 1992

The CBD is one of the achievements of the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. The CBD recognises that conservation and sustainable use of biodiversity is of critical importance in meeting human needs, and that human needs must be taken into account when conserving natural resources. It aims to conserve the world’s biological diversity, but also to promote the sustainable use of this diversity, and the equitable sharing of any

benefits arising from it. For more information visit its website at <http://www.biodiv.org>.

International Agenda for Botanic Gardens in Conservation (IABGC), 1999

This was prepared by BGCI based on contributions from and consultations with over 300 institutions and individuals throughout the international botanic garden and conservation communities. It is a framework for botanic garden policies, programmes and priorities in biodiversity conservation, especially as it relates to implementation of the CBD. Part of the agenda promotes plant conservation and sustainable use, especially of those plant resources which have economic importance to human societies. For example, section 2.8 promotes the sustainable use of biodiversity, whilst section 2.18 promotes sustainable development. For more information visit http://www.bgci.org/policies/international_agenda.html.

Millennium Development Goals (MDGs), 2000

These are an ambitious agenda for reducing poverty and improving lives through environmental sustainability, which were agreed by world leaders in 2000. For each goal one or more targets have been set, usually for 2015. Most governments and international agencies have committed themselves to these goals.

Biodiversity conservation is directly addressed through MDG7 ‘Ensure Environmental Sustainability’ but reviews by international conservation bodies confirm that the resources of biodiversity are important in meeting the other goals (Satterthwaite, 2003; FAO, 2005; Koziell, 2002; Roe, 2002; WHO *et al.*, 1993). For more information visit <http://www.un.org/millenniumgoals/>.

The Millennium Development Goals

1. Eradicate extreme poverty and hunger

Target for 2015: Halve the proportion of people living on less than a dollar a day and those who suffer from hunger.

2. Achieve universal primary education

Target for 2015: Ensure that all girls and boys complete primary school

3. Promote gender equality and empower women

Target for 2005 and 2015: Eliminate gender disparities in primary and secondary education preferably by 2005, and at all levels by 2015.

4. Reduce child mortality

Target for 2015: Reduce by two-thirds the mortality rate among children under five.

5. Improve maternal health

Target for 2015: Reduce by three-quarters the ratio of women dying in childbirth.

6. Combat HIV/AIDS, malaria and other diseases

Target for 2015: Halt and begin to reverse the spread of HIV/AIDS and the incidence of malaria and other diseases.

7. Ensure environmental sustainability

Targets:

Integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources.

By 2015, reduce by half the proportion of people without access to safe drinking water.

By 2020, achieve significant improvement in the lives of at least 100 million slum dwellers.

8. Develop a global partnership for development

Targets:

Develop further an open trading and financial system that includes a commitment to good governance, development and poverty reduction - nationally and internationally.

Address the least developed countries' special needs, and the special needs of landlocked and small island developing States.

Deal comprehensively with developing countries' debt problems.

Develop decent and productive work for youth.

In co-operation with pharmaceutical companies, provide access to affordable essential drugs in developing countries.

In co-operation with the private sector, make available the benefits of new technologies - especially information and communications technologies.

Millennium Ecosystem Assessment (MA), 2001

This practical and international work programme was launched by the UN Secretary General to collect and provide information for the major biodiversity conventions (CBD, the United Nations Convention to Combat Desertification, the Ramsar Convention on Wetlands, and the Convention on Migratory Species). It focuses on ecosystem services, and how changes in these services affect human well-being. It also predicts how ecosystem changes may affect people in the future, and the appropriate responses to improve ecosystem management and thereby contribute to human well-being and poverty alleviation. Further information is provided at its website <http://www.millenniumassessment.org/>.

Equator Initiative, 2002

This is a partnership of several international conservation agencies and government departments. It was launched in 2002 specifically to champion the importance of reducing poverty through natural resource use in the poorest communities, which are often biodiversity rich. Its work is organised around four themes: The Equator Prize, Equator Dialogues, Equator Knowledge and Equator Ventures. For more information visit <http://www.undp.org/equatorinitiative/>.

Global Strategy for Plant Conservation (GSPC), 2002

This strategy was adopted by the 6th Conference of Parties to the CBD, in 2002, to provide a framework for action for plant conservation. It has 16 global targets to be achieved by 2010, some of which are directly relevant to improving well-being. The reason for a strategy under the CBD is that setting meaningful targets is feasible since scientific understanding of at least higher plants, though incomplete, is better than for most other groups. Visit <http://www.bgci.org/conservation/strategy.html> for more information, and to download the GSPC.

The implementation of the GSPC is supported by the Global Partnership for Plant Conservation (GPPC), for which BGCI provides the secretariat. For more information, visit www.plants2010.org

World Summit on Sustainable Development (WSSD), 2002

The WSSD evaluated progress achieved since UNCED and reiterated the importance of Agenda 21. It adopts the Johannesburg Plan of Implementation (JPOI), which provides for a more focused approach, with concrete steps and quantifiable and time-bound targets and goals. The JPOI confirms and builds upon the CBD and MDGs as tools for achieving poverty reduction linked to

biodiversity conservation. This provides the context of work for the UN's Division for Sustainable Development, whose website provides more information, at <http://www.un.org/esa/dsd.htm/>

Global Strategy for Plant Conservation 2010 Targets

1. A working list of all known plant species
2. A preliminary assessment of the conservation status of all known plant species
3. Models with protocols for plant conservation and sustainable use
4. 10% of each of the world's ecological regions conserved
5. 50% of the most important areas for plant diversity protected
6. 30% of production lands managed consistent with plant diversity conservation
7. 60% of the world's threatened species conserved in situ
8. 60% of threatened plants in ex situ collections and 10% of them in recovery programmes
9. 70% of the genetic diversity of the major socio-economically important plants conserved
10. Management plans in place for at least 100 major alien species that threaten plants
11. No species of wild flora endangered by international trade
12. 30% of plant-based products derived from sustainably managed sources
13. Decline of plant resources, and associated indigenous and local knowledge that support livelihoods, halted
14. Education and awareness about plant diversity promoted
15. Capacity built for the conservation of plant diversity
16. Networks for plant conservation established and strengthened

Annex 2:

Main characteristics of botanic gardens

The list below contains some defining characteristics of Botanic Gardens: however, it is not exclusive or comprehensive. This is based on the lists and discussion contained in botanic garden policy and review papers, to which the reader should refer for more details (Wyse Jackson, 1999, 2000; IUCN-BGS, 1989).

- Adequate labelling of plants
- An underlying scientific basis for the collections
- Communication of information to other gardens, institutions, organisations and the public
- Exchange of seeds or other materials with other botanic gardens, arboreta or research stations (within the guidelines of international conventions, national laws and customs regulations)
- Long term commitment to, and responsibility for, the maintenance of plant collections
- Maintenance of research programmes in plant taxonomy in associated herbaria
- Monitoring of plants in the collection
- Open to the public
- Promoting conservation through extension and environmental education activities
- Proper documentation of the collections, including wild origin
- Undertaking scientific or technical research on plants in the collections

Various types of botanic gardens exist, some of which are 'multi-purpose' and others of which carry out different subsets of activities. The fastest growing type are "community botanic gardens" which are created to serve specific needs of their local communities. Other types of botanic gardens include: ornamental gardens, horticultural gardens, historical gardens, university gardens, conservation gardens, taxonomically-themed gardens, alpine gardens, wild gardens and combined zoological and botanical gardens. Many gardens are state administered or managed by regional or local authorities and receive public funding. About a third belong to universities or other research institutes.

Bibliography

- Adams, W.M., Aveling, R., Brockinton, D., Dickson, B., Elliot, J., Hutton, J., Roe, D., Vira, B., Wolmar, W., 2004. Biodiversity Conservation and the Eradication of Poverty. *Science*, **306**: 1146-1149.
- Alsop, R. (ed.), 2005. *Power, rights, and poverty: concepts and connections*. The World Bank, Washington D.C, USA.
- Amponsah, K., Crentsil, O., Odamtten, G.T., Ofosuene-Djan, W., 2002. *Manual for the Propagation and Cultivation of Medicinal Plants in Ghana*. Aburi Botanic Garden, Ghana.
- Andrade, I.R., 2004. *Project "Education for Caatinga Conservation at the Botanic Garden of FZB-BH"*, Final Report. Fundação Zoo-Botânica de Belo Horizonte, Belo Horizonte, Brazil.
- Bass, S., Reid, H., Satterthwaite, D., Steele, P. (eds.), 2005. *Reducing poverty and sustaining the environment. The politics of local engagement*. Earthscan and IIED, London, UK.
- Benham, S., 2005. Botanic Garden promotes healthy eating in New Zealand, *Cuttings*, **2(2)**: 7.
- BGCI, 2005a. Botanic Gardens lead fight against urban poverty in Colombia, *Cuttings*, **2(4)**: 7.
- BGCI, 2005b. Dalai Lama declares Mexican botanic garden a "peace zone", *Cuttings*, **2(1)**: 7.
- BGCI, 1999. Agenda 21: Programme of Action for Sustainable Development, *BGCNews*, **3(2)**: 48-54.
- Botanic Garden Francisco Xavier Clavijero, 2005. *Grant Application to BGCI*.
- Botanic Garden of Smith College, 2005. *The Taxus Project* <http://www.smith.edu/garden/Academics/acadtaxus.html>, accessed 16 November 2005.
- Colchester, M., 2002. *Salvaging Nature: Indigenous peoples, protected areas and biodiversity conservation*. World Rainforest Movement, Montevideo.
- Coley, R.L., Kuo, F.E., Sullivan, W.C., 1997. Where does community grow? The social context created by nature in urban public housing, *Environment and Behavior*, **29(4)**: 468-494.
- Damanka, L.A., Ofosuene-Djan, W., 2001. *Handbook for the Harvesting, Preparation & Storage of Medicinal Plants*. Aburi Botanic Gardens and BGCI, Ghana.
- de Lange, J.H., 1997. Propagation of honeybush tea, *ARC Bulletin*.
- DFID, 2006. *Poverty and Environment*. DFID, London, UK.
- Earth University, 2001. *Earth University - University Information*. <http://www.earth.ac.cr/ing/info/index.html>, accessed 2 February 2006
- Earth University Foundation, 2001. *EARTH Inaugurates Ethnobotanical Garden*. <http://www.earth-usa.org/news/news2.html>, accessed 26 January 2006.
- Ewane, J.S., 2001. The importance of community involvement in Conservation, *Roots*, **23**: 32-35.
- FAO, 2005. *FAO's role on MDGs - Basic information: FAO's contribution to achievement of the development goals of the United Nations Millennium Declaration*. FAO, Rome, Italy. http://www.fao.org/es/ESS/mdg_kit/contrib.asp, accessed 17 January 2006.
- Frazel, M., 1991. Horticultural Therapy, *Hospital and Community Psychiatry*, **42(11)**: 1192.
- Gaona, J.P., 2002. Processus de coopération très bénéfique entre la Suisse et le Paraguay, *La Feuille Verte: Journal des conservatoire et Jardin Botaniques*, **32**: 4-5.
- Gillett, H.J., 2002. *Conservation and sustainable use of medicinal plants in Ghana 1999-2002*. Cambridge, UNEP-WCMC. <http://www.unep-wcmc.org/species/plants/ghana/>, accessed 17 November 2005.
- Gorbunov, Y.N., 2001. The role of Russian botanic gardens in the study and development of economic plants. *BGCNews*, **3(7)**: 35-38.
- GPC, 2005. *New Communities Ready, Set, Grow!* http://www.garfieldconservatory.org/new_communities.htm, accessed 5 January 2006.
- Gracia, M., Latham, P., 2003. *Conservation Manuals for the Congo, African Botanic Gardens Network Bulletin*, 7.
- Hamilton, A.C., 2004. Medicinal plants, conservation and livelihoods. *Biodiversity and Conservation*, **13**: 1477-1517.
- Heywood, V., 1999. *Use and potential of wild plants in farm households. Agriculture department*. FAO, Rome, Italy.
- Hutton, J.M., Leader-Williams, N., 2003. Sustainable use and incentive-driven conservation: realigning human and conservation interests. *Oryx*, **37(2)**: 215-226.
- Huxley, A., 1984. *Green Inheritance*. William Collins Sons & Co., London, UK.
- ITTO, 2004. *Annual Review and Assessment of the World Timber Trade*. ITTO, Yokohama, Japan.
- IUCN, 2004. *2004 IUCN Redlist of Threatened Species*. www.redlist.org, accessed 1 February 2006.
- IUCN-BGS, WWF, 1989. *The Botanic Gardens Conservation Strategy*. IUCN-BGS (Botanic Gardens Secretariat), WWF and IUCN, Kew, UK & Gland, Switzerland.
- Jahal, S., Umana, A., 2003. The Environment/Poverty Nexus, *Development Policy Journal*, **3**: 53-70.
- Kanbur R., Squire, L., 1999. *The Evolution of Thinking about Poverty: Exploring the Interactions*. The World Bank Group, Washington D.C., USA.

- Keller, T., 1996. *Botanic Gardens Educational Involvement in the Local Community*, in Hobson, C. (ed.), Third International Botanic Gardens Conservation Congress 1992, BGCI, London, pp 187-189.
- Kibungu Kemelo, A.O., 2004. Trials on Conserving Mangosteen fruit in wet sawdust, *African Botanic Gardens Network Bulletin*, 8.
- Koziell, I., McNeill, C.I., 2002. *Building on Hidden Opportunities to Achieve the Millennium Development Goals: Poverty Reduction through Conservation and the Sustainable Use of Biodiversity*. IIED, London.
- Kulshreshtha, K., 2005. From paper to practice - botanic gardens and the Convention on Biological Diversity: article 10 -sustainable use of components of biological diversity - Home garden project, NBRI, Lucknow, *Roots*, **2 (1)**: 13-14.
- Kuo, F.E., Sullivan, W.C., 2001. Environment and crime in the inner city - Does vegetation reduce crime?, *Environment and Behavior*, **33 (3)**: 343-367.
- Latham, P., 1999. Edible caterpillars and their food plants in Bas Congo, Democratic Republic of Congo, *BGC News*, **3(3)**: 40-42.
- Mason, A., Benveniste, P., 2006. Growing Young People from the Ground Up, *Roots*, In Press.
- Millennium Ecosystem Assessment, 2005a. *Ecosystems and Human Well-being: Biodiversity Synthesis*. World Resources Institute, Washington D.C., USA.
- Millennium Ecosystem Assessment 2005b. *Ecosystems and Human Well-Being: Current State and Trends: Findings of the Condition and Trends Working Group*. Island Press, Washington D.C, USA.
- Millennium Ecosystem Assessment, 2005c. *Living Beyond Our Means: Natural Assets and Human Well-being (Statement of the MA Board)*. Island Press, Washington D.C, USA.
- Mombeki, S., 2004. Projet de création d'un jardin botanique dans le site ex-ORSTOM, *African Botanic Gardens Network Bulletin*, 8.
- Nayar, M.P. (ed.), 1987. *Network of botanic gardens: bicentenary volume of Indian Botanic Garden*. Botanical Survey of India, Calcutta, India.
- NBRI, 2005. *Case study -1: Outreach Programmes*, in Kulshreshtha, K., Pushpangadan, P., Kumar, S., Richardson, M. & Willison, J. (eds.), Education Guidelines: Environmental Education in Botanic Gardens, NBRI (The National Botanical Research Institute), Lucknow, India, pp 24-25.
- NBRI, 2003. *The Lucknow Statement on Botanic Gardens of India*. <http://www.ibgn.org/ibgnnetwork3.htm>, accessed 6 January 2006.
- Ndam, N., Sunderland, T., 1997. *The role of the Limbe Botanic Garden in the conservation and development of the Mount Cameroon region*, in Touchell, D.H. & Dixon, K.W. (eds.), The 4th International Botanic Gardens Conservation Congress, 1995, Kings Park and Botanic Garden, West Perth, Australia, pp 277-286.
- NTBG, 2005. *National Tropical Botanical Garden, Kahanu webpage*. <http://www.ntbg.org/gardens/kahanu.html>, accessed 3 March 2006.
- NYBG, 2005. *Serving the People of the Bronx*. New York Botanical Garden, New York, USA.
- NYBG, 1996. *Bronx Green-Up Information Folder*. New York Botanical Garden, New York, USA.
- Oldfield, S.F., Lusty, C., MacKinven, A., 1998. *The World List of Threatened Trees*. World Conservation Press, Cambridge, U.K.
- Oliveira, D.M.Z.A., Queros, E.P., Franco, B.F., Silva, B.A.W.d., 2005. *Preliminary Report: Survey of Native Species Related to the Afro-Brazilian Culture in the Urban Parks and in the Botanical Garden of Salvador*. Botanical Gardens of Salvador, Salvador, Brazil.
- Otsubo, L., 1999. Women and Conservation in Cameroon, *The Canopy*, November/December 1999.
- Park, S.H., Kim, E., Mattson, R.H., 2004. Horticultural therapy as an alternative medicine for pain management: Psychophysiological and psychological impacts of plant visual stimuli on pain tolerance and recovery, *Applied Psychophysiology and Biofeedback*, **29(4)**: 291-292.
- Philips, O., Meilleur, B., 1995. Survey by CPC Reveals "Extraordinary" Contributions of Wild Plants to US Economy, *Diversity*, **11**: (3).
- Pinazzo, J., 2002. Projet Etnobotanique du Paraguay (EPY), *La Feuille Verte: Journal des conservatoire et Jardin Botaniques*, **32**: 5.
- Pushpangadan, P., 1998. Empowering the community: Wealth for All, *Roots*, **17**: 29-31.
- Roe, D., Mulliken, T., Milledge, T., Mosh, S., Mremi, J., Grieg-Gran, M., 2002. *Making a living or making a killing? Wildlife Trade, Trade Controls and Rural Livelihoods*. IIED and Traffic, London and Cambridge, UK.
- Satterthwaite, D. (ed.), 2003. *The Millennium Development Goals and Local Processes. Hitting the target or missing the point?* IIED, London, UK.
- Secretariat of the CBD, 2003. *Global Strategy for Plant Conservation*. Secretariat of the Convention for Biological Diversity, Montreal, Canada.
- Secretariat of the CBD, 2002. *Report of the World Summit on Sustainable Development*. Johannesburg, South Africa, 26 August - 4 September. UN, New York, USA.
- Simson, S., Straus, M.C., 1997. *Horticulture as Therapy: Principles and Practice*. Haworth Press Inc., USA.
- Skeffington, S.M., 2006. Organic fruit and vegetable growing as a national policy: the Cuban story <http://www.energybulletin.net/13067.html>, accessed 23 February 2006.
- Sullivan, W.C., Kuo, F.E., DePooter, S.F., 2004. The fruit of urban nature - Vital neighborhood spaces, *Environment and Behavior*, **36(5)**: 678-700.
- Taylor, A.F., Kuo, F.E., Sullivan, W.C., 2001. Coping with ADD - The surprising connection to green play settings, *Environment and Behavior*, **33(1)**: 54-77.
- The World Bank Group, 2006. *The World Bank -About Us* <http://web.worldbank.org>, accessed 1 February 2006.
- Tkachenko, K.G., Pautova, I.A., Korobova, M.M., 1997. The introduction Nursery for Food, Crop and Medicinal Plants at the Komarov Botanical Institute of the Russian Academy of Sciences: its role in the conservation of biodiversity, *BGCNews*, **2(8)**: 38-40.
- UN, 2005. *The Millennium Development Goals Report*. United Nations Department of Public Information, New York, USA.
- van Wyke, B.E., 2002. A review of ethnobotanical research in South Africa, *South African Journal of Botany*, **68(1)**: 1-13.
- Vovides, A.P., Cortéz, M.E., Iglesias, C.G., Lascurain, M., 1995. The Jardin Botanico Francisco Javier Clavijero in Xalapa, Veracruz, Mexico, *BGCNews*, **2(5)**: 32-38.
- Walter, K.S., Gillett, H.J., 1998. *1997 IUCN Red List of Threatened Plants*. Compiled by the World Conservation Monitoring Centre. IUCN, Cambridge, UK.

WHO, 2003. *Medicinal plants*. Factsheet no 134, WHO, Geneva, Switzerland.

WHO, 2001. *Mental and neurological disorders*. Factsheet no. 144, WHO, Geneva, Switzerland.

WHO, IUCN, WWF, 1993. *Guidelines on the Conservation of Medicinal Plants*. IUCN, Gland, Switzerland,.

Willison, J., 2004. *Education for Sustainable Development: Guidelines for Action in Botanic Gardens*. London, Botanic Gardens Conservation International.

Wilson, E.O., 1992. *The Diversity of Life*. Belknap, Cambridge, MA, USA.

World Commission on Environment and Development, 1987. *Our Common Future*. Oxford University Press, Oxford, UK.

World Commission on Forestry and Sustainable Development, 1999. *Our Forests, Our Future*. Cambridge University Press, Cambridge, UK.

Wyse Jackson, P., 1999. Experimentation on a Large Scale - An Analysis of the Holdings and Resources of Botanic Gardens, *BGCNews*, **3(3)**: 27-30.

Wyse Jackson, P., Sutherland, L.A., 2000. *International Agenda for Botanic Gardens in Conservation*. BGCI, London.

Acronyms

BGCI	Botanic Gardens Conservation International
BGU	Bronx Green-Up
CBD	Convention on Biological Diversity
CCSD	Centre for Conservation and Sustainable Development, MBG
DFID	Department for International Development, UK Government
EPY	Projet Etnobotanica Paraguaya
FAO	Food and Agriculture Organisation of the United Nations
GPPC	Global Partnership for Plant Conservation
GPC	Garfield Park Conservatory, Chicago
GSPC	Global Strategy for Plant Conservation
HIV/AIDS	Human Immunodeficiency Virus/ Acquired Immune Deficiency Syndrome
IABGC	International Agenda for Botanic Gardens in Conservation
IiN	Investing in Nature
ITTO	International Tropical Timber Organization
IPGRI	International Plant Genetic Resources Institute
IUCN	World Conservation Union
JPOI	Johannesburg Plan of Implementation
LBG	Limbe Botanic Garden
MA	Millennium Ecosystem Assessment
MBG	Missouri Botanical Garden
MDG	Millennium Development Goal
NBRI	National Botanical Research Institute, India
NGO	Non-Governmental Organization
NTBG	National Tropical Botanic Garden, Hawaii
NYBG	New York Botanical Garden
SANBI	South African National Biodiversity Institute
TBGRI	Tropical Botanic Garden & Research Institute, India
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WHO	World Health Organisation
WSSD	World Summit on Sustainable Development

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Botanic gardens linking biodiversity with human well-being is one of the six core themes of BGCI's work. BGCI believes that the global network of botanic gardens can play a key role in using plant diversity to improve human well-being. For more information about botanic gardens, biodiversity and human well-being, visit www.bgci.org/wellbeing or email wellbeing@bgci.org

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