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Etnobotanica Paraguaya: an integrated ethnofloristic program

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Abstract. This paper describes the Etnobotanica Paraguaya (EPY) Program in applied ethnobotany, a joint effort of the Conservatoire et Jardin Botaniques (CJB) of Geneva, Switzerland and the Botanical Garden of Asunción, Paraguay, in the context of international cooperation for sustainable development and for Agenda 21. Conservation of bio-cultural diversity through participatory resource management, enhancement of traditional knowledge of medicinal plants and phytomedicine, applied ethnofloristics, and promotion of environmental education are presented, as are also the achievements and challenges of intercultural, interdisciplinary and international cooperation for sustainable development engaging botanical gardens.

Key words: Biodiversity, Botanical gardens, Environmental education, Ethnobotany, Medicinal plants, Sustainable development, Paraguay

INTRODUCTION

This paper analyses the implications and challenges of the Etnobotanica Paraguaya (EPY) Program (ROGUET 2001a, b) that applies botany and taxonomy for sustainable development through environmental education and cooperation in North-South programs in collaboration with botanical gardens, municipalities, civic organizations, traditional medicinal practitioners, humanitarian organizations and academia in Paraguay. The preliminary results of its ethnobotanical inventories, environmental education courses, community-based medicinal plant gardens, and participatory resource management schemes for bio-cultural conservation and the sustainable use of medicinal flora used in traditional medicine are presented. We indicate the challenges for the sustainable harvesting and use of wild medicinal plants for primary health care and for sustainable conservation of biocultural diversity in relation to the Program's activities with medicinal plant harvesters, transporters, transformers, manufacturers, vendors and users.

The environmental education programs made in urban, suburban, and rural arenas, and in buffer zones near protected areas are evaluated for their relevance in the sustainable use and conservation of bio-cultural resources among Paraguay's most impoverished populations. These people are also the custodians of a wealth of traditional knowledge and practices about medicinal plants which are applicable in primary health care programs among populations who have little access to allopathic Western medicine.

In the following pages we first describe the Etnobotanica Paraguaya Program and we then analyse the processes developed with partners in Paraguay to examine the significance of our joint approach. Last of all we indicate the challenges for botanical gardens and international cooperation in applied ethnobotany and ethnofloristics embedded in sustainable development processes.

THE ETNOBOTANICA PARAGUAYA PROJECT: BACKGROUND AND CONTEXT

Under the auspices of Geneva's Botanical Gardens (CJB) and in collaboration with Asuncion's Botanical Gardens, the Etnobotanica Paraguaya (EPY) Program was implemented in

1995 to promote community participatory resource management of medicinal plants and to foment sustainable development. The EPY Program in applied research allows both specialists and lay people to acknowledge the significance and value of medicinal plants which are commercialized in markets in Asunción.

Cooperation for the promotion of sustainable harvesting, management and use of medicinal plants associated to the conservation of bio-cultural diversity have implied: a) generation of environmental education capacity building and community-based medicinal plant gardens that value Paraguay's phytomedical tradition; b) promotion of traditional medical practitioners, herbalists and phytomedical experts and of their traditional knowledge systems for primary health care; c) sensitivization to restore medicinal plant habitats and socio-cultural contexts; and d) training persons for *in situ* and *ex situ* medicinal plant conservation involving rational management of the wild and domesticated flora. Because the medicinal plants are usually managed by female traditional herbalists, practitioners and market vendors, understanding the gender perspective and working with women is pivotal in the project, as is integrated work with households and communities to achieve sustainable livelihoods.

EPY Program is based on the redaction of the Flora del Paraguay Project (SPICHIGER & RAMELLA 1983). It is complementary to the other applied floristic and ethnobotanical research that Geneva's CJB advances in Switzerland and in Europe, such as in the Alpine area in the Swiss Valais region (ROGUET 1991, 1994; ROGUET & SPICHIGER 1994), or in the Geneva region, and also in Poland (OLIVET 2000), as with other programs in the tropics in Madagascar, Senegal, Ivory Coast, Brazil, and Bolivia. The scope of these joint approaches engages botanical gardens and communities in North-South, South-North and South-South cooperation for biodiversity conservation and for sustainable development.

The CJB ethnobotanical program is under the direction of Prof. R. Spichiger and D. Roguet who, in association with Paraguayan partners A. Pin and G. Gónzales, have developed the EPY Program as a joint endeavour among the cities of Geneva and Asunción, municipalities, civic organizations which, along with a network of rural and urban dwellers of countries of the North and South, contribute to the achievement of sustainable development. The joint programs in cooperation for development, humanitarian aid, primary health care, techno-scientific cooperation, and environmental education programs involve the Botanical Gardens, community-based projects and medicinal plant gardens, as the CJB has redefined its functions to contribute to sustainable development goals within Switzerland and in countries such as Paraguay. These programs involve new paradigms in ethnobotany and in applied floristics, as well as equitable and transparent collaboration with communities to advance the sustainable conservation, use and management of biological and cultural diversity (ROGUET 2001a, b).

Through community-run projects for the conservation of traditional medicinal plants in Paraguay, using medicinal plant gardens ("viveros" and "viveritos comunitarios"), we contribute to local self-determination of health care. Our specific collaboration as scientists is the analysis of the taxonomy, quality, safety, efficacy and/or toxicity of plant products, and to provide knowledge to local communities applicable to quality control. These contribute to setting standards for risk reduction and measures on preventive toxicity of medicinal plants, and thus contribute to the security of primary health care. We especially collaborate with communities in the development of sustainable livelihoods through joint projects with the Swiss Red Cross and the Tesaïreka-Paraguay project for rural development, and the promotion of sustainable extractivism, agroecology, and primary health programs based on traditional plant medicine (PIN *et al.* 2001). Other aspects of the project involve local NGOs and civic organizations for the capacitation of participatory resource management and conservation.

These new roles of the Botanical Gardens of Paraguay and Switzerland involve intercultural, interdisciplinary, international and intermunicipal cooperation to enhance sustainable development through the conservation of biocultural diversity and the improvement of primary health care. The EPY Program also contributes to the empowerment of rural, suburban and urban communities in

the recuperation of their knowledge and practices of traditional medicine (preventive and curative). This implies a new interface of applied floristics to advance innovative forms of cooperation based upon community networks, botanical gardens and medicinal plant gardens. These processes engage capacity-building, environmental education training, rehabilitation of endangered plant habitats, knowledge-sharing, transfer of technology, and the empowerment of women and poor populations who are engaged in the conservation and sustained use of medicinal plants. An ethics of transparency among all stakeholders for sustained biocultural conservation and for the promotion of the well-being of the most marginal and impoverished of peoples in Paraguay, characterises this program.

Interinstitutional and Interdisciplinary Cooperation for Sustainable Medicinal Plant Management

As indicated above, the Etnobotanica Paraguaya Program is financed by the City of Geneva's Fund for Development Assistance and it is aimed at interinstitutional, intercultural and interdisciplinary collaboration between Geneva and Asunción. The goals of this applied research are to collaborate to the conservation of the cultural practices and traditional knowledge of the medicinal plants and of traditional medical systems. For this the Botanical Gardens in Geneva and Asunción have developed environmental education dynamics for relevant stakeholders and training courses, workshops, and interactive exhibitions, and created dozens of little community-based medicinal plant gardens (*viveritos*) related to one large *vivero* in the Botanical Gardens of Asunción. This last one holds more than 500 living species of medicinal plants used in Paraguay, together with an herbarium and seed banks, and proposes exhibitions and interactive activities for visitors and general public in collaboration with a Center for Environmental Education (CEAM) inside the Botanical Garden.

The Program has promoted an ethnobotanical and floristic inventory and a register of the medicinal plants sold in Asunción's markets. Taxonomic formalization, which was very poor (Cataldo 1968; Gónzales Torres 1970), was made with the commitment to the ethical restitution of the data in order to contribute to health security through phytochemical and taxonomic validation, submission of data on toxicity gradients for toxicological validation, to provide parameters for quality control for producers and consumers of these health products and to improve sustainable livelihoods.

Because more than 25% of the area in Paraguayan markets is dedicated to the sale of fresh, dried, or packaged medicinal plants (Roguet 2001a, b) we have made the initial inventory based upon market surveys. Of the 550 plant species inventoried as sold in Asuncion's markets, 20% are exotic having reached Paraguay from Europe since Colonial times (Martin & Valverde 1995), while 80% are native, and most are wild species except for cases such as stevia (*Stevia rebaudiana* Bertoni, ka'a he'ê). The ethnobotanical inventory indicates that the Amerindian medicinal plant heritage of the Guarani peoples and the Western medicinal plant heritage have evolved with high indices of biocultural diversity in Paraguay due to centuries of sustained use and management which are now under threat of loss due to the overexploitation of medicinal plants. Several cultural patterns however, maintain the medicinal legacy. For example, the habit of drinking either "mate", a hot infusion of *Ilex paraguariensis* A.St.-Hill, or téréré, which is a cold infusion of the same species, involves the consumption of more than forty different species of medicinal and aromatic plants macerated in the water used for the "mate" or the "téréré". Each person, expresses his or her identity according to specific types of plant mixtures, drinking utensils and seasonal uses These socio-cultural dynamics and their socio-ecological impacts are being analysed.

Over 90% of Paraguayans consume over four liters of maté or of téréré on a daily basis and this cultural system is an important component in the traditional plant use complex which is complementary to their traditional phytomedicine. Paraguay is unique in the world for the high use of medicinal plants that are commercialized in markets, and this biocultural heritage is important for

the well-being and identity of Paraguayans, and also for the harvesters and custodians of plant resources and plant knowledge, which are mainly women of low-income households.

The ethnobotanical inventories were made with community participation, and especially with women who are medicinal plant practitioners, with market vendors of medicinal plants 'yuyeroas' (from the root word *yuyos* referring to medicinals) and also local with healers or 'curanderos-as' as well as with plant harvesters and manufacturers. These ethnobotanical analyses allowed the classification of flora in *emic* or vernacular taxonomies and according to local medicinal classificatory schemes, and also according to local perceptions and understanding of the use and applications of medicinal plants, as well as in *etic* or Western techno-scientific criteria. Surveys of over 60 local laboratories (often clandestine) that transform, manufacture and sell plants in Asunción without sanitary or state control were made. Surveys of other factors implying lack of quality control or safety standards which endanger human life were also analysed . The Program will determine phytochemical and toxicological valuations and recommend phytosanitary standards and quality control measure as important dimensions of applied research for the restitution of knowledge and expertise while promoting phytomedical security.

The uncontrolled exploitation and unsustainable harvesting of wild plants has been documented by the EPY Program and information is disseminated to alert local populations of the negative impacts of the accrued demand for plants that are often supplied by vendors without formation in traditional medicine or sustained management. A parallel educational process is made in countries of the North such as Switzerland, in expositions and interactive events such as that made in the Botanical Gardens in the recent "Cap au Sud" exhibition in September 2002 in Geneva, to encourage Northern consumers, organizations and industries to foment sustainable development. The "Cap au Sud" activities were complementary to the exposition at the Museum of the History of Sciences on Emile Hassler's (1895-1915) collections in Paraguay.

Participatory resource management and project management are fomented at all phases. Local communities participate in determining the priorities of urban, suburban and rural populations in conserving their phytomedical traditions (Cataldo 1968; Gonzales Torres 1970) and to engage in actions for sustainable development. The environmental and socio-cultural impacts of unsustainable harvesting, medicinal plant depletion, and the lack of quality control of medicinal processes that endanger human life, have been analysed in workshops with community leaders who, in turn, train others. Leaders were capacitated in recuperating traditional plant medicine and installing and managing medicinal plant gardens to strengthen the community use and conservation of medicinal plants. Traditional socio-cultural systems to use medicinal plants were reinforced, for example with a special valuation of the transmission of female-based knowledge of phytomedicine (Roguet 2001a, b).

Applied and Integrated Ethnofloristics and Ethnobotany

In the floristic inventory of medicinal plants, 510 species were identified; of these 99% were flowering plants which indicate one of the world's highest indices found in a single market (Roguet 2001a, b). Of the 172 known botanical families for Paraguay (Spichiger & Ramella 1983), 94 were represented in the ethnobotanical survey, involving families such as: Asteraceae (15 %), Fabaceae (10%), Lamiaceae (5%), Euphorbiaceae (4%), Solana-ceae (4%), Verbenaceae (4%), Amaranthaceae (4%), Myrtaceae (4%), Cucurbitaceae (4%), Rubiaceae (3%), Rutaceae (3%), Apiaceae (3%).

Forty of the exotic (or non native) species of medicinal plant are of European origin, such as sage, rosemary, fennel, garlic, among others and they usually have Spanish names (such as salvia, romero, ruda, tilo), while native plants often have Amerindian names in Guarani. The role of the Jesuit missions in introducing exotic plants to Paraguay was significant, and our ethnohistorical research is documenting the impact of these processes as well as the Jesuits' role domesticating and commercializing mate as the "green gold" of

Paraguay.

The EPY Program also described and analysed the methods of preparation of the plants, especially those used with mate and tereré, as well as the modes of preparation of fresh, dried, packaged, transformed and conditioned (soap, oil, ointment, etc) plants, and of plant mixtures of pulverised plants originating from other countries (such as Peru). We also documented the forms of administration and use of plant medicine as well as the seasonality of their availability and use. We characterised the intrinsic properties of each plant in relation to the categories of popular medicine and ethnomedicine that establish diagnosis, prescription, therapeutics, dosage and uses. We also analyzed the toxic or negative effects, which may depend among other things on dosage, plant qualities, interaction with other plants, and interaction with the patient's health.

The ethnobotanical inventory identified 40 species that are toxic, 20 of which are used for abortive purposes, such as *Mirabilis jalapa* L.(alelí), *Asclepias curassavica* L. (bandera española), *Schkuhria abrotonoides* Roth (canchalagua), *Crotalaria incana* L.(mbói aguai), *Melia azedarach* L.(paraíso), *Arecastrum romanzoffianum* (Cham.) Becc. (pindo guasu), *Ruta chalepensis* L. (ruda), and *Jatropha isabelii* Muell. Arg. (yaguarova). Analyses indicated that 15 % of the commercialized plants have high toxicity values, especially those used as abortives. These research results were shared with the local communities, who expressed the urgency to redress the negative impacts of certain dosages and uses, due to erosion of knowledge or misuse. Results have allowed local communities and researchers to indicate the need to establish quality control systems in order to avoid future intoxication and deaths.

The socio-economic survey of the EPY Program was carried out by an interdisciplinary team of Paraguayan and Swiss researchers and community leaders. Documentation was made of the social, cultural and economical contexts of medicinal plant gatherers, harvesters, transporters, manufacturers, vendors and users related to the market system.. With quantitative and qualitative methods for market analyses of medicinal plants to map, assess and monitor market dynamics and characteristics and marketing chains. While comparing these results to other field surveys we initiated a research methodology which has been adapted by local researchers according to case-specific conditions. With methodologies (similar to those indicated in ALEXIADES 1996, CUNNINGHAM 2002, and MARTIN 1995) we used ethnobotanical approaches to analyse the market system as well as the processes of harvesting, transportation, packaging and sale of medicinal plants. We observed, for example, that five families, or 50 persons who are custodians of traditional phytotherapeutic knowledge, can use the areas between gathered plants and the Mercado Cuatro (Mercado Central) in Asunción with sustainable practices, while other individuals and groups do not do so. We analysed these impacts with local communities and ranked the medicinal plants and traditional practices which are under threat of extinction. Through participatory analyses the EPY Program has also been analysing the degree and risks of medicinal plant extinction, studying causes ranging from habitat destruction by imposition of monoculture, to overharvesting and loss of traditional knowledge and practices. The EPY Program is also collaborating with IUCN to establish a list of endangered medicinal plant species for the Red List of the Flora of Paraguay (BERTONI *et al.* 1994), while selecting with the local communities their priorities of endangered species for conservation. Among the most threatened species that undergo unsustainable extractivism that we inventoried and which the EPY Program is looking forward to monitor: *Equisetum giganteum* L.(cola de caballo), *Hypericum connatum* Lam (ka'avo tory), *Dioscorea campestris* Griseb. (mecho akâ), *Dorstenia* sp. (taropé), *Victoria cruziana* Orb. (victoria or yrupê), and *Jatropha isabelii* Muell. Arg. (yaguarova).

IMPLICATIONS, APPLICATIONS AND CHALLENGES OF THE ETNOBOTANICA PARAGUAYA PROGRAM

Because many people, especially women, derive incomes and hold key roles as custodians and vendors of medicinal plants, and traditional practitioners use phytotherapeutics as preventive and curative medicine, the Etnobotanica Paraguaya Program is keen on supporting them to guarantee

primary healthcare and sustainable livelihoods. It has established priorities to work with vulnerable communities (children, suburban population, small farmers) and households to combat poverty and enhance sustainable development. A network of plant gatherers, harvesters, traditional healers and practitioners, and vendors of rural and urban contexts around Asuncion, is engaged in a process of environmental awareness spanning an urban-rural continuum to advance sustainable development in an integral manner for key communities and ecosystems under threat such as those in, or near, the city of Asunción.

The collection of over 500 living medicinal plants in the Asunción "Vivero" or Medicinal Plant Garden are used for training courses and workshops, and to create awareness of the medical importance of these plant resources and their related traditional knowledge. A network of subsidiary medicinal plant gardens has also been established across communities of the Municipality that participate in the EPY Program to cover the habitats and communities involved in the network of medicinal plant use and conservation.

In Paraguay, like many countries of the South, well over 60% of the people have little or no access to Western medicine or maintain their traditional medicinal practices in parallel to Western allopathic medicine. The Program is investigating the applications of traditional and of intercultural medicinal systems for primary health care in programs for sustainable development.

As part of the traditional knowledge, local biodiversity and habitats where medicinal plants grow are threatened by extinction, and the traditional livelihoods and cultural dynamics are also being destroyed, there is an increasing interest from local people to salvage the bio-cultural bases for their traditional phytomedicine. The EPY Program seeks to redress these erosive processes through environmental education and capacity training, community-based recuperation of bio-cultural resource conservation strategies and by implementing community-run programs for sustainable development. This collaboration with the Municipality of Asunción was established through a cultural covenant signed with the City of Geneva's Department of Cultural Affairs of which the CJB is part, and which allows a decentralized but concerted action for North-South cooperation and development.

To collaborate with communities who conserve and use the medicinal plants and traditional health systems, surveys were made with community leaders and other key local resource users. Base-line studies allowed a basic characterisation of the socio-cultural and environmental and ethnofloristic contexts, and data was systematized in digital databases and also disseminated for community use, for example through Manuals (Pin *et al.* 2001) and in courses, workshops, exhibitions as well as in interactive visits to the Medicinal Plant Gardens and exhibitions. The Medicinal Plant Garden in the Botanical Gardens of Asunción and other local medicinal plant gardens were developed with, for and by each community and accompanied by a series of training courses, workshops, collections, exhibitions, and botanical garden visits. These processes have also involved innovative museographical interventions such as that of the Ethnobotany Ethnomedicinal Plant Exhibition in the Museum of Natural History within the Asunción Botanical Garden. Along with these processes, the Botanical Gardens enhance their roles as nodes for environmental education for sustainable development, and as interactive arenas to propel awareness for the respect for traditional medicinal plants.

The partnership among the Botanical Gardens has allowed joint research cooperation and innovative interdisciplinary and intercultural collaboration. For example survey research, formal and informal interviews, participant observation and field surveys were developed and applied with the Paraguayan partners and in collaboration with the local university and with organizations of the municipalities, and notably with active participation of the local populations who use medicinal plants. The surveys were extended to medicinal plant harvesters, sellers, users, traditional healers and preventive medicine practitioners, men and women farmers, municipal health promoters, and with other key civilian members such as teachers, students, Associations of women and of neighbours, Farmers Associations, and local NGO's, allowing a representative participation of key stakeholders. Capacity building and training of colleagues from Paraguay and Switzerland have invol-

ved exchange programs where Paraguayan researchers have collaborated in research and training at the Botanical Gardens of Geneva while Swiss researchers have taught training courses in Environmental Education Methodology as well as Ethnobotany and Applied Floristics at the Asunción Botanical Gardens (ROGUET 2001a,b). Further capacity building and training will evolve as the EPY Program advances, and in specific innovative paradigms for intercultural and interdisciplinary cooperation will be generated with restitution of knowledge and expertise to local communities from research on science and technology and on traditional knowledge systems to contribute to quality control standards of medicinal plant products for primary health care.

Through a joint endeavour the ethnobotanical living reference collection has been established in the Botanical Garden of Asunción. The Program has at present inventoried over 600 different medicinal plant species with taxonomic identification and an herbarium is at present under construction as the specimens are mounted and labelled on herbarium sheets.

The EPY Program has over five years of experience in workshops, courses, and has also created didactic material for schools and local communities and for general dissemination. There are publications, posters, and community-based activities to consolidate the resources and knowledge for the conservation of medicinal plants for different stakeholders. For example, the "Manual de Capacitación" was created to train the promoters of community medicinal plant gardens or 'viveros comunitarios', and its use is complementary to a tool kit of 50 botanical illustrations of key medicinal plants. Further pedagogical material will be created in printed, visual, audio and audiovisual means for different stakeholders, and for literate and non literate users, while the digital databases are to be developed for use by general public through user friendly interfaces, and specialized databases are also to be developed which correlate botanical, floristic, and ethnobotanical data according to internationally accepted parameters and standards. Thematic environmental education courses and workshops at the Botanical Garden of Asunción and its Center of Environmental Education (CEAM) have also engaged decentralized courses and workshops made in the urban neighbourhoods of Asunción as well as in suburban areas and in rural and buffer zones around protected areas such as the Ybiqui Park. These courses are to be extended to critical areas where biocultural diversity related to medicinal plant use is under threat, and the participatory mechanisms for community involvement are to be further developed to equitably engage genders, age groups, and specialists and non specialists.

With the urban and rural populations around Asunción several interactive workshops and courses have been made for targeted publics and stakeholders. Other related projects such as a reforestation scheme with medicinal tree species are being made in cooperation with Paraguayan graduate students who collaborate with the Program, while Swiss graduate students are involved in systematizing ethnobotanical research at the Botanical Gardens of Asunción (VAZ 2002).

Diverse communication strategies for the EPY Program have also have been applied to reach dispersed and marginalized populations in suburban areas and slums. For example in 1997 an itinerant and interactive exhibition in a municipal bus visited different neighbourhoods, which allowed community involvement about their needs and expectations to recuperate their traditional medicinal plant systems. We also had the collaboration of local radio to disseminate information and to debate the EPY Program, while Paraguayan TV programs have broadcasted the EPY Program goals and results, and the EPY Program itself has created a series of documentary videos for dissemination in countries of the North and South. Further developments in communication strategies to debate and advance the EPY goals are needed, in particular to educate both Northern and Southern stakeholders in sustainable development.

In 1998 collaboration with local Paraguayan NGOs such as the Bertoni Foundation implied their pedagogical and communication skills in the Program to further empower local communities of their medicinal plant knowledge and practices. The Bertoni Foundation's pedagogical methods for environmental education are based on ludical and interactive dynamics. These successfully engaged populations with traditional music, popu-

lar feasts, and street theatre, reaching otherwise marginalized sectors and allowing them to debate upon the recuperation of the practices and knowledge systems of their traditional medicinal plants. The challenge of extending interactive and ludical means for application in the debate of issues which involve dimensions in health, recuperation of medicinal plant systems, and dissemination of scientific data on the toxicity of certain plant dosages redefines Botanical Garden activities and interventions within the contexts of cutting-edge museology, communication sciences, and popularization of science, as the Botanical Gardens and related stakeholders create their own material in new arenas of applied ethnobotany and ethnofloristics.

In summary, through the Etnobotanica Paraguaya Program a series of dynamic process has been implemented to date:

- cooperation for sustainable development in urban and rural areas;
- a detailed inventory of the uses of medicinal and useful plants, documentation of linguistic and socio-cultural data, data on sources, uses, harvesting and/or domestication processes;
- verification of aspects related to taxonomy;
- a phytochemical survey on pharmaceutical and toxicity data in the specialized literature;
- restitution of data through environmental education, medicinal plant gardens, and phytomedicine;
- creation of both temporary and permanent expositions and courses, workshops and didactic materials;
- evaluation of traditional knowledge and practices of medicinal plants;
- collaboration with the Tesaïreka-Paraguay of program of the Swiss Red Cross for health care and rural development;
- collaboration with international conservation organizations, i.e. IUCN on endangered medicinal flora (Bertoni *et al.* 1994);
- development of management schemes for long term bio-cultural conservation;
- cooperation in programs for selective reforestation and contribution to projects for the sustainable management of secondary and non-wood forest products;
- cooperation in the conservation of medicinal plants associated with primary health care and sustainable livelihoods by empowering communities, and women and children in particular.

To date, collaborations with 19 farming organisations, the Municipality of Asunción, the Botanical Gardens, NGOs, local Associations and research centers are in place to accomplish these goals. Cooperation with the Centre for Environmental Education in the Botanic Garden is ongoing through courses, workshops, activities with public involvement, interactive experiences, thematic workshops with teachers, students, community leaders, and visitors at the Botanical Gardens (of which there are 5000 each weekend) with subjects such as: medicinal plant toxicity; dosage, knowledge, classification, and usage; identification of plant species threatened by extinction; risks of automedication; family health; sanitary aspects of commercialized plants sold in markets and/or harvested near homes; sustainable harvesting of medicinal plants; multiplication, selection and domestication of certain species, alternative organic cultivation schemes for small farmers, and quality control for medicinal plant products and processes to minimize health risks, plant toxicity and misuse. A challenge regarding these courses and workshops is not only their permanent upgrading, but also their dissemination to other communities and stakeholders. A system of course evaluation is to be harnessed to correlate their impacts on community-based dynamics for the generation of sustainable development in specific areas which will be verifiable with indicators and with long-term biocultural resource conservation.

In rural areas the work in applied floristics and ethnobotany will contribute to the enhancement of sustainable development in local livelihoods among small farmer communities. Projects will involve organic agriculture and soft technology for the cultivation and (solar) drying of medicinal plants, as well as integrated pest control, and agroecological projects will be related to the sustainable extractivism and harvesting of wild plants and to sustainable management of habitats. Also, processes for the valuation of ecological and socio-cultural dynamics for primary health care security of local communities, and regional processes to conserve biological and cultural diversity will be implemented in collaboration with other organizations.

These dynamics will involve the EPY Program and Botanical Gardens in a very challenging context to promote and develop applied projects for sustainable development. Promotion of community-based wild and domesticated medicinal plant management on short, medium and long term bases will imply innovative intercultural and interdisciplinary cooperation in applied ethnofloristics and ethnobotany to be developed by the partners and stakeholders involved.

Because South-South collaboration is also being fomented between Paraguayans involved in the EPY Program and ethnobotanical projects in Bolivia and in Brazil as an important form of South-South collaboration, it encourages the exchange experiences among local communities and with researchers engaged in developing regional models for sustainable development. The South-South collaboration is now challenged to consolidate and expand within Latin America but also with other similar projects in other countries of the South, e.g. Senegal and Mali.

The general guidelines and applied ethnofloristics and ethnobotany of the CJB's Program in Paraguay follow those we use in the Alps (ROGUET 1991, 1994; ROGUET & SPICHIGER 1994): participatory resource management and decision-making of communities in all processes of project; participatory monitoring and evaluation to allow short, mid and long term bases of sustainable development objectives for the conservation of cultural and biological diversity; documentation and recuperation of the cultural and biological heritage for community well-being; compilation, classification and taxonomic systematization of species and resource use according to vernacular and to Western scientific analytical categories; promotion of sustainable conservation and use of biogenetic resources of flora and of medicinal plants in particular; and respect for bio-cultural resources according to ethical codes of conduct for applied research in intercultural, interdisciplinary and interinstitutional collaboration. These parameters will evolve as sustainable development processes advance and hopefully attain a critical mass of sustainability processes worldwide. The correlation of the projects in Switzerland and the rest of Europe with those of countries of the South are being developed on theoretical and methodological grounds; however, so we can compare the implications of traditional resource use and of the traditional knowledge and practices both between and among local communities (and-or indigenous people) when conserving and using medicinal plants for primary health care, and the conservation of biodiversity and of cultural diversity.

As we simultaneously collaborate on an operative implementation of Agenda 21 through a joint commitment of the City of Geneva with programs in Paraguay involving sustainable development as our main goals, while involving primary health care and phytomedicine as key components, the Botanical Gardens are engaged in innovative cooperation to enhance and recover bio-cultural diversity. The CJB's projects in other countries of the South (La Paz in Bolivia, Dakar in Senegal, Bamako in Mali) are also embarked in generating innovative educational processes and community-based projects adapted to each region to contribute to better health care conditions and quality of life, in the context of achieving sustainable development. By extending our experience of North-South and South-South cooperation across civil society organizations, municipalities and other sectors involved in sustainable development, the Botanical Gardens, and the EPY Program presented here, are advancing applied research with the responsibility in promoting community well-being, sustainable livelihoods and the conservation of biocultural diversity.

CONCLUSION

The implementation of the EPY Program between the Botanical Gardens of the cities of Asunción and of Geneva allow an important component of collaboration with countries of the South to advance sustainable development. Through specific cooperation with other cities, municipalities, regions, civil society organizations, academia and North-South and South-South partnerships to promote primary health care and the conservation of traditional plant medicine, the CJB Botanical Gardens of Geneva are engaged in a network of operative projects in environmental education, capacity-building, participatory man-

agement, where applied ethnobotany and ethnofloristics have concrete impacts on the generation of sustainable development. The process involves developing the short, mid and long term bases for the conservation of bio-cultural diversity. As this Third Millennium starts with an increasingly interdependent and globalizing world which faces the alarming extinction of over 60 per cent of the world's linguistic and cultural heritage within this century (Oviedo & Maffi 2000) and the possible extinction of 22-47 per cent of the world's plant species (Pitman & Jorgensen 2002) due mainly to human activities, the role of Switzerland and Botanical Gardens in scientific and humanitarian cooperation is significant in redressing these complex processes.

At present in Switzerland the social and political context is favourable to consolidate collaborative projects in sustainable development with countries of the South and the Etnobotanica Paraguaya Programis an example of a contribution. These programs imply new roles for Botanical Gardens as nodes for international cooperation with community-based environmental education with applied ethnobotany and ethnofloristics. It also involves the implementation of innovative and relevant dynamics for the conservation of plant resources and their habitats, and of plant knowledge and practices which were traditionally held and transmitted across groups or individual specialists in traditional and local communities. Because these resources and knowledge are at risk of being diminished or lost as people lose their traditional customs and practices, an urgent and concerted effort is required through punctual projects such as the ones engaging the City of Geneva and the Municipality of Asunción which focus on the valuation and conservation of medicinal plants for primary health care. Plant genetic erosion, systematic pillage and destruction of habitats and species, unrestrained commercialization and unsustainable harvesting of wild and domesticated species and loss of biocultural diversity, are growing risks as an uncontrolled demand for medicinal plants and their derivatives accrue from industrialized countries and from local users. If this tendency is to be redressed in an effort to achieve sustainable development in the Third Millennium, an unprecedented effort must be made within and beyond Botanical Gardens.

The Etnobotanica Paraguay Program is a modest contribution to collaborate with this endeavour, and to indicate means to manage or solve problems related to the loss of bio-cultural resources related to medicinal plants in specific. To implement practical processes for sustainable use and conservation of these resources, the Program promotes participatory, democratic and inclusive community-based management schemes and medicinal plant gardens for primary health care. These encourage the sustainability of medicinal plant and of the peoples who conserve, manage and use these for preventive and curative medicine, while seeking to enhance sustainable livelihoods, biocultural diversity and life itself.

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