CASE STUDY 1:

GRIFFITH UNIVERSITY, QUEENSLAND-ASTRAZENECA: THE NATURAL PRODUCT DISCOVERY UNIT (NPD) PARTNERSHIP[1]

Introduction

In 1993, the State of Queensland's Griffith University and Astra Zeneca established the Natural Product Discovery Unit (NPD) within the Eskitis Institute for Cell and Molecular Therapies at Griffith University. Now in its 14th year, the NPD screens extracts of flora and fauna - including plants from Queensland's rainforest and marine invertebrates (including sponges, octocorals, lace corals and sea squirts) of the Great Barrier Reef - to identify bioactive molecules as potential leads for pharmaceutical discovery and development. More than 45,000 samples have been collected to date. Terrestrial collections are made by the Queensland Herbarium, and have included more than 100 plant species new to science; marine collections are made by the Queensland Museum, with several thousands of new species discovered – for example, of the more than 3,000 sponge species collected, around 70% are new to science (Camp and Quinn, 2007; Hooper, 2007). Collections have also been made under sub-contract in Tasmania, China, India, and Papua New Guinea. NPD has discovered over 700 new bioactive compounds from its approximately 45,000 specimens. In addition to collections of marine and terrestrial organisms that identified new species and populations of endangered species, the NPD provided critical information on biodiversity 'hot spots', and was used not only in drafting the Queensland Biodiversity Act 2004, but in environmental planning and management throughout the region.

Astra Zeneca has invested more than $100 million USD in the collaboration, which has created a state of the art natural product discovery unit. The NPD has served, in effect, as an arm of the Astra Zeneca R&D network, and as such had an exclusive partnership with Astra Zeneca. This exclusive relationship concluded in 2007, although collaboration on specific projects will continue. The end of the exclusive partnership with Astra Zeneca will allow Griffith University to use its facilities, know-how, and staff to build collaborations with other research and commercial groups. No commercial products from the partnership have as yet reached the market, but this is not unusual given the long timelines for drug-discovery and development, particularly for natural products, and the low odds of developing commercial products in this sector. The collaborative agreement and consequent investment in Queensland has resulted in significant technology transfer and plays an important role in the development of the state's Brisbane biotechnology hub. It stands as one of the few 'developed to developed country' natural product discovery models for technology transfer.

Legal frameworks

The Griffith University and Astra Zeneca partnership spanned a critical time in the development of policy guiding access to "genetic resources" and sharing of benefits

[1] This case study is excerpted from a longer study published by UNU-IAS, Queensland Biodiscovery Collaboration: A Case Study of the Griffith University Eskitis Institute and Astra Zeneca Partnership for Natural Product Discovery, by SA Laird, C Monagle, and S Johnston (in press).

from their use, beginning in the same year – 1993 - that the Convention on Biological Diversity entered into force (Box 1). The CBD established that States have sovereign rights over their genetic resources. It also confirmed the authority of States to determine access to genetic resources, and sets out that Parties should facilitate access to genetic resources by instituting legislative, administrative or policy measures that also ensure fair and equitable sharing of benefits arising from the commercial use of these resources.

These international access and benefit-sharing obligations were provided for by the Government of Australia in the Environment Protection and Biodiversity Conservation Act (1999) and later detailed in Part 8A of the Environment Protection and Biodiversity Conservation Regulations. In 2002 and consequent to the adoption of the Bonn Guidelines all Australian states and territories agreed to a nationally consistent approach to access to genetic resources and to apply the Guidelines. In Queensland and the Northern Territory this has resulted in specific legislative measures, the Queensland Biodiscovery Act 2004 and the Northern Territory Biological Resources Act 2006 (DEWHA, 2007). In other states and territories no dedicated legislation yet exists, though in some jurisdictions there are limited access and benefit sharing measures implemented pursuant to more general legislative and policy instruments. All states remain committed to the implementation of the Bonn Guidelines, with most having already initiated legislative development processes. For example, in Tasmania a comprehensive access and benefit sharing approach is currently being developed in a process led by the Tasmanian Department of Primary Industries (K.Kent, pers.comm.2007). Western Australia has also indicated in its Biotechnology Industry Development Strategy that dedicated legislation will be developed in that jurisdiction by the end of 2008 (http://www.doir.wa.gov.au/documents/businessandindustry/WABiotechnologyDevelopmentStrategy.pdf, page 22).

The Partners

Astra Zeneca

Based in the UK, Astra Zeneca is one of the largest pharmaceutical companies in the world, ranked number six in 2006 with global sales of $26.7 billion USD (IMS Health, 2007). Astra Zeneca employs over 12,000 people in R&D, around 4500 of which are part of Global Discovery. There are 6 major Discovery and Development facilities in the UK, US and Sweden, and 4 Discovery sites in the US, Canada and France. In Japan, the company runs a facility for clinical development. R&D investment in 2006 was $3.9 billion USD, and 21 candidate drugs were added to the early development portfolio in 2006 (Astra Zeneca annual report, 2006; Astra Zeneca, 2007). More than 1,700 external R&D collaborations and agreements have been formed to complement in-house capabilities, reflecting an industry-wide trend towards such external partnerships in the industry. In 2006 alone 325 new collaborations were formed (Astra Zeneca, 2007). In Australia, Astra Zeneca employs more than 1,000 people as part of export, sales and marketing to the region, through research collaborations at major teaching hospitals and universities, and as part of its collaboration with Griffith University (Denerley, 2006). The major research areas for Astra Zeneca are respiratory (asthma, COPD), inflammation (osteo-arthritis), CNS (Alzheimer's, depression, anxiety, psychosis), pain (neuropathic, and chronic nociceptive), infection (antibacterials), cancer (anti-invasives, anti-angiogenics), and cardiovascular (thrombosis, metabolism, arrhythmia) (Astra Zeneca, 2007).

Eskitis Institute for Cell and Molecular Therapies, Griffith University

The Eskitis Institute is a research centre of Griffith University, founded in 1975 and located in Brisbane, the capital of Queensland (Griffith University, 2007). The Eskitis Institute undertakes research on the molecular and cellular mechanisms of human diseases, specifically cancer, infection and immunity, neglected diseases, neurological diseases, and stem cell biology. Specific research programs include bioactive molecule synthesis, cancer biology, chemical biology, clinical neurosciences, drug discovery and design, molecular libraries, stem cells, structural chemistry and systems biology (Eskitis, 2007). The Eskitis Institute incorporates five key facilities – the Queensland Compound Library, the National Centre for Adult Stem Cell Research, Cancer Therapeutics CRC, Nature Bank and Eskitis Molecular Screening (Eskitis Institute, 2007).

The Queensland Herbarium

The Queensland Herbarium was established in 1855, and is located on the grounds of the Queensland Botanic Garden in Brisbane. Administratively, the Herbarium falls within the Queensland Environment Protection Authority, an authority of the Queensland Government. The Herbarium undertakes a range of activities including maintaining historical specimens and reference collections, surveys and mapping of Queensland vegetation, and research into plant diversity (Environment Protection Authority Queensland, 2007), The Herbarium in 2003 employed 68 staff, including 33 botanists (Queensland Herbarium, 2003).

The Queensland Museum

The Queensland Museum, established in 1862, is a Statutory Authority of the Queensland Government, situated in Brisbane with regional services delivered through the Museum Resource Centre Network in six regional sites across the State of Queensland (Queensland Museum, 2007). The Museum provides museological services in science, natural environment and cultural heritage, and employs over 215 people and many volunteers (P.Riley, pers.comm 2007). The museum's organisational structure reflects its focus on the themes of knowledge generation, knowledge management and knowledge dissemination. Falling within the Knowledge Generation theme are the substantive divisions of Biodiversity and Geosciences, Cultures and Histories, and Science and Technology in Society (Queensland Museum, 2006). Within the knowledge management theme falls the museum collections maintenance and accession activities. In recent years, these accessions to Museum collections have been from a range of activities including but not limited to the AZ/Griffith collaboration. Other collection programs include a monumental seabed mapping of invertebrate marine life and fish throughout the Great Barrier Reef inter-reed region (GBR Seabed Marine Biodiversity Project), and the Torres Strait Seabed Mapping Project, undertaken by a consortium of agencies including the Museum, Australian Institute of Marine Sciences (AIMS), Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), Marine & Atmospheric Research and Queensland Department of Primary Industries and Fisheries (DPI&F), funded by Commonwealth agencies and industry. The Museum, like most public institutions in Australia, is funded through a combination of government funding, research grants, consultancies, corporate sponsorships for particular activities, and business endeavours, such as retail shops (Queensland Museum, 2006).

The Natural Product Discovery Partnership

The NPD partnership was launched in 1993, renewed in 1998 and again in 2002, and is due to conclude in 2007.As part of the NPD partnership, Astra Zeneca provides funding to Griffith University to participate in their biodiscovery and commercialization efforts. Griffith University in turn partners with domestic and overseas collecting institutions to undertake biota collections (see below), make extracts of samples, and then run these samples through high throughput screens (HTS). Active compounds are then identified and isolated at Griffith University via bioassay guided fractionation, and structures are elucidated (Quinn et al, 2002; Camp and Quinn, 2007; Denerley, 2006; Chart 1.). The role of Griffith University evolved during the course of the partnership – originally, the HTS and lead discovery were to be done at Griffith and the leads sent to collaborators at Astra Zeneca, but over the years Griffith also assumed lead-optimization and medicinal chemistry components because they had the expertise in-house, and the interest in pursuing this research. (Quinn, pers. comm.. 2007).

The high level of involvement of Griffith University researchers in the discovery process is unusual for ABS partnerships, most of which involve collections in high biodiversity regions and higher level discovery within the company. However, NPD was viewed within Astra Zeneca as an extension of the R&D programme, researchers within NPD were in almost daily contact with those at Astra Zeneca, and Griffith University provided expertise on HTS and natural products to Astra Zeneca during the course of the partnership. Griffith University staff sat on the Global Chemistry Forum of Astra Zeneca, headed up the Natural Product Competence Centre, and worked closely with the other research programmes within the company. Integration of Griffith University's work into the company to this extent meant that NPD was not able to work with other parties, whether academic, government or commercial, and Astra Zeneca had exclusive rights to the samples collected during the lifetime of the agreement. Griffith University staff were also required to seek permission prior to publication of any articles reporting on the research, the same as staff of Astra Zeneca. During the lifetime of the project, Griffith University staff published many articles on the NPD research. This high level of collaboration with Astra Zeneca, and the attached conditions, however, also account for the unusually extensive benefits that accrued to the institution and the country (see discussion below). Today, with the exclusive partnership concluding, Griffith University can leverage the fruits of the collaboration – in expertise, capacity, infrastructure, and collections – to strike new partnerships with government research institutions, industry, and academic researchers, and the samples collected are the property of Griffith University and are housed in the Queensland Compound Library.

The activities of NPD are subject to the laws of Queensland and the Commonwealth of Australia. When accessing materials outside Queensland (whether in other states and territories of Australia or internationally) the University is also subject to any applicable laws in the jurisdiction in which collections take place, as well as the Convention on Biological Diversity, which Australia has ratified. To meet its access and benefit sharing obligations under the Queensland Biodiscovery Act 2004, the Astra-Zeneca and Griffith University collaboration has an approved Biodiscovery Plan lodged with the Queensland Department of Tourism, Regional Development and Industry. When collecting on Commonwealth Lands or waters collection is subject to obtaining the appropriate permits under Part 8A of the Environment Protection and Biodiversity Conservation Regulations 2000. When research is for commercial purposes, as it is in the case of the NPD process, a benefit sharing agreement with the access provider must also be lodged with the Department of the Environment, Water, Heritage and the Arts. Permits for access to genetic resources from

Commonwealth controlled lands and waters only came into effect for samples collected after December 2005, however.

Collection of samples

The first step in the discovery process is the collection of samples. Griffith University subcontracted collections to the Queensland Herbarium for terrestrial samples, and The Queensland Museum for marine samples. Most collections were made in Queensland, but others came from Tasmania, China, India and Papua New Guinea. In 2007, the NPD Biota Library, containing collections from the lifetime of the NPD partnership, has in excess of 45,000 biota samples, including vascular plants, algae and macro fungi from Queensland (>20,000), PNG (5,743), and China (6,545). Marine invertebrate samples number more than 9,500 biota from tropical and temperate Australian waters. The Library also includes more than 2,000 soil and aquatic microbial extracts from India and Australia (Camp and Quinn, 2007). The plant collection represents more than 9% of the world's species diversity of higher plants, with representation from 73% of the world's plant families. The marine collection contains more than 10% of global diversity of sponges and ascidians, and 5% of soft corals and gorgonians (Griffith University, 2007; See Table 1). The 2004 Queensland Biodiscovery Act requires samples of all specimens collected to be lodged with the Queensland Museum or Herbarium, something which has been done since the beginning of the partnership in 1993.

The Queensland Museum

The sea is considered by NPD a greater potential source of genetic diversity than the land, having a much larger variety of life forms (phyla). Of the 28 marine phyla less than a third of the total number of species living in Australian waters – which are in turn estimated to comprise about 30% of the world's marine fauna – were known to science at the start of the NPD (Quinn et al, 2002). Over the course of the NPD, the Queensland Museum has collected more than 12,000 specimens of around 5,000 species of marine invertebrates and algae. 8,000 specimens have been extracted and subjected to HTS. Target phyla were predominantly sessile invertebrates - animals fixed to the seabed - including soft corals and gorgonians (cnidarians), lace corals (bryzoans), sea squirts (ascidians) and sponges (Porifera). Of particular interest to NPD are sponges, which show the greatest bioactivity at low "tissue" concentration, highest diversity, and span a greater range of marine habitats (Hooper, 2007). Sponges have extraordinary chemical diversity compared to other phyla, and along with ascidians have yielded the majority of novel compounds and new bioactive natural products. Sponges show such proportionally high chemical bioactivity compared to other marine phyla because: toxins are produced to repel predators, 'free-loaders', and provide a competitive advantage in crowded encrusting communities; many sponges excavate the substratum, breaking down and recycling calcium carbonate back to the reef system; they have a chemical mechanism to facilitate mutualistic associations in the reef; and they form symbiotic relationships with microorganisms (Hooper, 2007).

Examples of sponge species from the Great Barrier Reef demonstrating significant bioactivity include: *Stylissa flabellata*, with a new compound showing significant activity as an anti-inflammatory agent; *Aplysinella rhax*, showing bioactivity against cardiovascular and metabolic assays; *Haliclona ('Adocia') aculeata*, with several new compound analogues showing potential efficacy against osteoporosis; and *Citronia*

astra, a new genus and species of sponge, showing significant bioactivity against anti-thrombosis screens (Hooper, 2007)

For both the Queensland Museum and the Queensland Herbarium, agreements were made with Griffith University that guided the collections and provided up front payments to the institutions to complete the work, including hiring professional staff to manage the project, undertake collections and identify specimens, and to purchase equipment and other materials. A percentage of the royalty received by Griffith University from any commercial product developed was also negotiated, to be shared with the State of Queensland, because both institutions are part of the government.

The Queensland Herbarium

The Queensland Herbarium began a scientific partnership with Griffith University in 1990, and in 1992 entered into a contractual agreement with Griffith to supply plant samples for the Astra Zeneca biodiscovery program. During the first 10 years of the agreement, The Herbarium supplied plant samples for the growing collection, and in the last five years focused only on re-collection of species of interest. The collection of plant samples and herbarium vouchers were initially to include all species occurring in Queensland, but as the collaboration progressed families without intebioactivity were eliminated (eg Poaceae, Cyperaceae and later Eucalypts). Collections for the NPD were undertaken only in Queensland, and by staff of the Herbarium. Collections were comprised of plant material of either flowers, fruits, leaves, stems, and sometimes roots, up to a maximum of 100g dry weight for each taxon (species, subspecies variety), plus a herbarium voucher specimen. During the course of the collections, more than 16,000 plant specimens were added to the Herbarium collection, and at least 100 species new to science were discovered (G. Guymer, pers. comm., 2007).

Unlike the Museum, which provides taxonomic and location details with samples, the Herbarium initially supplied plant samples without these details, and instead provided a bar code to trace specimens within the Herbarium collection. This was done in part to require a return to the Herbarium for re-collection, and also to protect the identity and location of rare and endangered species. In 2001, after many years of collaboration and building of trust between the partners, the Herbarium provided Griffith University with family and genus level taxonomic information on all species in the collection. This assists with literature and database searches on promising leads, and clustering plants for further analysis and de-replication. Griffith University can also obtain species-level detail upon request. Locations for collections remain sensitive, and are not necessary for the NPD on a regular basis in any case, although these too are provided if there is a specific request.

TABLE 1: THE ESKITIS BIOTA COLLECTION, 1993-2007

Regions/countries of collection and type of collection	Number of samples	Number of species (or Operational Taxonomic Units, OTUs)	Number of families	Collecting institution
Queensland	>20,000	>8,000	276	Queensland

vascular plants, algae and macro fungi				Herbarium
Queensland marine invertebrates	>8,000	>3,500		Queensland Museum
Tasmanian marine invertebrates	>1,200	>700		Queensland Museum
China plants (ZiYuan county, Guangxi Province)	6,545	>2,000	183	ZiYuan Medical Company
Papua New Guinea plants	5,743	>1,500	163	Biodiversity Limited

Source: Griffith University, 2007

China

Terrestrial collections in China are made in Zi Yuan county, of Guangxi Province in the southwest of the country. It is a mountainous region with interesting biological niches, and one of the five most biologically-diverse areas of China. Collections are undertaken by the Zi Yuan Medicine Company, which is a major supplier of Traditional Chinese Medicine (TCM). Collections include plants used in TCM, as well as those of taxonomic interest (ie from families showing interesting biological activity). However, traditional knowledge about species use within TCM is not supplied with samples – their use in TCM is used instead as a general screen for activity of any kind (A Carroll, pers.comm., 2007). Voucher specimens for the collection are retained within the company. A taxonomist from the Department of Biology at Guangxi University coordinates collection programs for the Zi Yuan Medicine Company, of which he is a director. Zi Yuan Medicine Company was a state-owned company in the early years of the partnership, which began in 1997, but has since become a privately run company.

Collections of new samples in China concluded in 2003, although re-collection of larger volumes of species already in the collection continues. These recollected samples are now provided in extract form, with Zi Yuan Medicine Company subcontracting extraction to an industrial facility that specializes in TCM extracts (A. Carroll, pers.comm., 2007). It proved difficult to get large quantities of "unknown" bulk plant material into Australia, due to strict quarantine requirements given government concerns about pests and diseases and invasive species, and China has high levels of capacity in extraction that are utilized by botanical medicine and other companies around the world.

The original agreement between Griffith University and Zi Yuan Medical Company was signed in China in 1997, after a few years of discussions between partners, and with a range of government institutions. The Zi Yuan Medicine Company facilitated the dialogue with government, hiring a lawyer from the region to negotiate with the

central government in Beijing for the first agreement, and subsequently, for approval of the second agreement, with the Zi Yuan County Peoples Government of the Zi Yuan Autonomous Region, which granted the collecting permits, and signed off on the collaboration between Zi Yuan Medicine Company and Griffith University. The Trade, Development, and Food and Drug bureaus within the County government reviewed and approved the permits. For the second agreement, the central government said that only county government approval was necessary, and that they, rather than the provincial or central governments, should review and grant such permits. China did not have a central body dealing with ABS, or a national ABS focal point, through which the agreement passed during the negotiation of these agreements (A. Carroll, pers. comm., 2007) (see Box 5).

The agreement between Griffith University and Zi Yuan Medical Company is similar in content to those signed with the Herbarium and Museum, guiding sample quality (eg specifying moisture content, mesh size for grinding), quantity of samples supplied per year, information supplied with samples (eg identified to species level, GPS location of samples), and detailing benefits to be received by the company. The latter include payments for the agreed-upon work plan and samples, provision of a vehicle and the equipment necessary to do this, and royalties (of the same percentage received by the Herbarium and Museum) should a commercial product be developed (A. Carroll, pers.comm., 2007).

Papua New Guinea

Terrestrial collections in Papua New Guinea were undertaken by Biodiversity Limited, a small company run by a natural products researcher who is also based at the Department of Chemistry of the University of Papua New Guinea in Port Moresby. Collections began in 1997. Voucher specimens were lodged with the Papua New Guinea National Herbarium, Lae. As in the case with China, NPD staff felt they had large and representative enough collections for the library and the Astra Zeneca partnership, and so concluded collections in 2003. Collections were made throughout the country, and of the more than 1500 species collected, many were new or previously unknown to science. The collections did not include traditional knowledge, and were random or taxonomically-driven (A. Carroll, pers. comm.., 2007).

Negotiation of an agreement with Papua New Guinea took a few years to conclude. This process included discussions between Biodiversity Ltd and Griffith University, and subsequent approval for collections from the PNG Department of Environment. At the time, the government of PNG did not have an ABS measure in place, nor a national focal point to deal with these issues, so permission was sought through the traditional agency within government for plant collections, the Department of Environment. The elements of the agreement are the same as those described above for China, although in this case royalties go to the government of PNG, as well as the company.

Tasmania

Marine collections in Tasmania were undertaken by Aquenal Pty Ltd., a marine environmental consultancy company. The focus of the collection was temperate marine invertebrates and algae. Around 1600 samples were provided to NPD through this partnership. Aquenal has expertise in collecting and cataloguing samples, and do some in-house taxonomic identifications, particularly for bryozoan, ascidian and

algae, but they also partner with the Tasmania Museum on identifications. The Queensland Museum does all the sponge identifications and is paid separately for this by NPD. Voucher specimens are held at Aquenal, the Tasmanian Museum, and the Queensland Museum. Aquenal use the collection data for their surveying purposes and to assist with recommendations for coastal management in the region (A. Carroll, pers.comm., 2007).

Two, three year agreements have been signed between Aquenal and Griffith University since 2002. Tasmania does not have biodiscovery legislation, so government approval for collections was obtained by Aquenal through collection permits. The agreement between NPD and Aquenal is similar in content to those used for the Queensland Museum and the Queensland Herbarium, in terms of samples received, payments, and royalty sharing.

India

Between 1996 – 2000 a collection of approximately 1800 strains of soil fungi were provided by Biocon Ltd, a private company based in Banglalore India. The agreement between NPD and Biocon is similar in content to those used for the other international collections (A.Carroll, pers.comm, 2007).

The Role of Traditional Knowledge

Traditional knowledge was not collected as part of the Astra Zeneca- Griffith University partnership. This is primarily because for the disease categories of interest to Astra Zeneca – in particular those afflicting older and more affluent populations – traditional knowledge is not considered an important lead for drug discovery efforts (Ron Quinn, pers. comm.., 2007). In some cases, species that show promise in the NPD discovery process have also been used in traditional medicine, but traditional knowledge, given the broad, systematic screening process of the NPD, did not lead researchers to these species. Indirectly, traditional knowledge informed collections in China, in that species, genera, and families used in TCM were requested as part of collections made by the ZiYuan Medical Company, but this was as a way of selecting broadly for activity, and information on how species are used traditionally was not supplied with the samples.

Concerns associated with traditional knowledge and indigenous peoples' rights to control the use of their knowledge and resources have also been raised about collections, especially those made on Aboriginal lands, and the need to develop side agreements with the Aboriginal people whose land and resources are accessed (eg Tooth, 2001). It is clearly critical that the role of indigenous stewardship and ownership over resources found on their lands is recognized and respected, even if traditional knowledge is not used in the research process (eg see Article 8j of the Convention on Biological Diversity). However, the Queensland Herbarium did not collect on Aboriginal lands as part of this partnership, and most collections were made in national parks like the Daintree Forest or otherwise on crown lands (P.Forster, pers.comm 2007; G.Guymer, pers.comm., 2007)

Benefits from the Partnership

Astra Zeneca invested more than $100 million USD over the 14 year lifetime of the NPD, and Australian institutions contributed expertise, infrastructure, and financial

incentives. Queensland, and to a lesser extent China, India, PNG, and Tasmania, provided access to their remarkable biological diversity. Of the Astra Zeneca investment, $45 million USD went to build the research unit at Griffith University, annual costs of running the collaboration came to roughly $9 million/year USD, and $9 million USD went towards collection of samples by partner institutions. Benefits accrued to the range of collaborators in the NPD – Astra Zeneca, Griffith University, The Queensland Herbarium, The Queensland Museum, and companies and institutions in China, India, Papua New Guinea, and Tasmania. At the same time, broader benefits were achieved or may still emerge for the State of Queensland, the Australian research community, the Australian public, and the international community. Benefits that accrue to a cross-section of stakeholders include those that helped build scientific and technological capacity within the State and country, and contributed to the management and conservation of biodiversity.

Benefits included monetary benefits like fees for samples (or to cover the costs of an agreed-upon workplan) and royalties. Non-monetary benefits included the provision of vehicles, equipment, technology, training, building of a state-of-the-art natural product discovery unit, and increased knowledge of biodiversity. Royalties may or may not materialize, since they are dependent upon a drug reaching the market. However, immediate monetary benefits in the form of funds to support the work of collaborators - eg collecting samples, undertaking extractions, HTS, and optimizing leads - and non-monetary benefits like facilities, equipment, training, and capacity-building were shared throughout the partnership. Following is a discussion of the benefits that accrued to various partners and groups during the course of the partnership.

The Eskitis Institute, Griffith University

The Eskitis Institute received the bulk of monetary and non-monetary benefits over the course of the NPD. Monetary benefits include royalties, at a rate standard to the industry but not publicly available (as is standard practice in bioprospecting agreements with pharmaceutical companies). Financial support for agreed workplans, including hiring staff, purchase of equipment and support of infrastructure were also significant, with annual payments to Griffith University averaging $9 million/year.

The most significant benefit for Griffith University is the combination of enhanced expertise, biota collections and compound libraries, scientific and technological capacity and know-how, and infrastructure, in the form of a new state-of-the art facility, acquired during the course of the partnership which – together – have created a leading natural product discovery unit. Now that the exclusive partnership with Astra Zeneca has ceased, Griffith University can leverage these assets into new partnerships with academia, government, and most significantly with other companies.

The NPD was extremely unusual for bioprospecting partnerships, which generally involve little more than the collection of samples sent to companies for screening. The high level of involvement of Griffith University staff in the R&D process, and their close and regular contact with researchers at Astra Zeneca, resulted in enormous benefits for science and technology in the region. It allowed staff to develop skills in working with industry and to their requirements, as well as in the science and technology of HTS, robotics, separation of molecules, and medicinal chemistry, and to become a leader in those areas within the country. Griffith

University is now able to convert a natural product into a normal medicinal chemistry product, which removes much of the complexity and cost traditionally associated with natural products. At a time when in-house natural product discovery programs in the large pharmaceutical companies is in decline (Koehn and Carter, 2005), and natural product discovery is increasingly done by smaller companies, and academic and government research institutes, which then license compounds to large pharmaceutical companies for development, Griffith University is well-situated to play an important role in this field in the coming years.

Specific benefits to the Eskitis Institute that combined to create this state-of-the-art natural product discovery unit over the last 14 years, include:

Building Expertise

Roughly 50 graduate and post graduate staff received training and worked for the NPD at Griffith University over the course of 14 years; many of these have gone on to other institutions and companies (eg MerLion in Singapore, a leader in natural product discovery). Given the shortage of training opportunities in natural product research, this building of expertise is a significant benefit not only for the University, but for the country and the field of natural product research.

Students were not actively involved in the NPD, given their need to publish and constraints placed on publications resulting from the research partnership, but they will be involved in new partnerships growing from the NPD, such as that on neglected diseases (see below). A stream of students were, however, hired over the years as research assistants by the NPD, and after their work with advanced technologies and equipment went on to do PhDs.

Biota collections and compound libraries

Griffith University retains ownership over the samples collected as part of the NPD. The result today is the NatureBank, the Queensland Compound Library, and the Lead-Like Peaks Library. These collections include:

- 45,000 samples reside in the Eskitis Institute natural product collection from biologically diverse terrestrial and marine sites in Queensland, Tasmania, China, India, and Papua New Guinea. These represent "unparalleled taxonomic breadth containing almost 60% of global plant diversity at the family level, including all major plant families containing more than one genus… and 9,5000 biota of marine invertebrates, including 10% of global diversity of the world's sponges and ascidians and 5% of global diversity of soft corals and gorgonians" (Eskitis Institute, 2007).

- 300,000 pre-fractionated natural products are in the Lead-Like Peaks Library, which is part of the wider Queensland Compound Library;

- Advanced systems for chemical isolation and structure identification led to the discovery of more than 1500 bioactive compounds.

Scientific and technological capacity and know-how

The NPD exposed Australian scientists to natural product discovery in an industry setting, and access to the latest scientific and technological advances. HTS was first performed at Griffith University in the early 1990s, some ten years before any other group in the country. The NPD, by incorporating the most advanced and 'cutting

edge' equipment and technologies, also allowed Australian science to stay abreast of new developments in imaging and separation technologies (Camp and Quinn, 2007).

Intellectual Property Rights

Griffith University retains ownership over the biota samples and compound libraries that resulted from the NPD. Intellectual property rights to commercial products developed from the partnership remain with Astra Zeneca..

Publications

Publications are a measure by which individual scientists, scientific institutions and universities are judged. Past publication records are often directly linked to recruitment criteria, and to institutional funding allocations. The ability to publish is also a feature that helps to attract the best students and staff to a project, and ensures research results reach a wider audience with the associated benefits that the free flow of information generate. Despite restrictions placed on their ability to publish scientific articles from the NPD research, staff of Eskitis Institute published many articles and papers over the course of the partnership,[2].

Griffith University

Beyond the Eskitis Institute, Griffith University benefited from the partnership with Astra Zeneca through the contribution of the NPD to its overall funding base and enhanced research reputation, and as a result its being significantly more competitive in university league tables. The University also benefits from the resulting facility and assets of the Eskitis Institute, which are now available to other research scientists within the University, and other Australian and international research institutions, as well as new public/private partnerships.

The Collecting Institutions

The NPD benefit-sharing package for collecting institutions is standard across institutions and includes up front fees per sample that cover costs of collection including staff, equipment (eg compound microscopes, computers, field equipment), and vehicles, as well as identification of species, and royalties should a commercial product be developed. Roughly $9 million was spent on collections over the course of the 14 years of the NPD. Royalties accrue to the State of Queensland for collections made by the Queensland Herbarium and Queensland Museum, to the government for collections in Papua New Guinea, and to companies collecting under contract in China, India, and Tasmania. The royalty received by collecting agencies is a percentage of that received by Griffith University, and is set at 15% .

[2] A selection of these are listed on the Eskitis web page of the director Ron Quinn at http://www.griffith.edu.au/professional-page/professor-ron-quinn/publications, for example, A. R. Carroll et al., Dysinosin a: A novel inhibitor of factor Vila and thrombin from a new genus and species of Australian sponge of the family dysideidae, Journal Of The American Chemical Society 124, 13340 (Nov 13, 2002); Davis, R. A.; Carroll, A. R.; Watters, D.; Quinn, R. J. The absolute stereochemistry and cytotoxicity of the ascidian-derived metabolite, longithorone J. *Natural Product Research* 2006, 20, 1277-1282

Staff and training

The Queensland Herbarium was able to employ a botanist and technical officer for the duration of the program, which required an experienced botanist who knew what to collect, how to collect, and with good field knowledge and good knowledge of the flora (G. Guymer, pers comm., 2007). Graduate students associated with the Queensland Herbarium used collections to discover new compounds, and these were published in the scientific literature with Herbarium staff as joint authors (G. Guymer, pers comm., 2007).

The Queensland Museum supported 4 full-time parataxonomic positions at the Museum each year, some individuals remaining for many years, and receiving more in-depth training in taxonomy, curation, and marine collection skills. A total of 20 individuals received training over the 14 years of the NPD, and 5 of these have gone on to become taxonomists, and a few to also study molecular biology and chemistry, one of whom now heads-up the Sponge Barcoding Project (Hooper, 2007; J Hooper, pers comm., 2007; www.spongebarcoding.org). Taxonomic research on newly acquired collections was also supported through postdoctoral research fellowships partially funded by the NPD collaboration and partially by other traditional sources of funding (Hooper, 2007).

The value of support for staff, and training in collection, curation and taxonomy cannot be overstated. Although the government promotes academic and commercial partnerships based on the country's unique flora and fauna, and there is increasing demand for taxonomic skills to assist with environmental planning, management and conservation, funds for taxonomy remain limited. The Australian Marine Sciences Association reports a steady decline in the number of taxonomists over the last decades, with the latest count showing 23 marine taxonomists in Australia's museums and research agencies. Nine have retired in the past five years and have not been replaced (Leung, 2007). State governments are the main employers of taxonomists through their herbaria and museums, but are unable to maintain the taxonomic work force in the face of competing claims on State budgets. The Federation of Australian Scientific and Technological Sciences has initiated a research project looking into the taxonomy skills shortage in marine, plant, insect and parasite science (Leung, 2007).

"There are potentially millions of species that remain undocumented and yet fewer and fewer people are employed in this area, or have the necessary taxonomic expertise. Commercial partnerships are currently a major source of employment and support for the development of taxonomic capabilities in research institutions in this country, especially long term collaborations such as that with NPD for which a few key staff were employed for over a decade …" said John Hooper of the Queensland Museum, "Some people, particularly those with political and managerial agendas, feel naming things is futile without a direct economic outcome – this is another reason why biodiscovery has been good in Australia. Not only does the partnership have immediate non-monetary benefits (data for management decisions, conservation planning, and so on), and potential downstream monetary outcomes (royalties), but it also has the knock-on effect of making government more interested in supporting these kinds of jobs." (J Hooper, pers comm., 2007).

Biodiversity information

The most common and significant benefit cited by collecting institution staff from the NPD is the support for collections that would otherwise not be possible within

institutions dependent upon limited government support, and the biodiversity information with important scientific and conservation applications that resulted. Marine invertebrate biodiversity, in particular, is poorly known, expensive to collect, and the expertise to document it is grossly inadequate (Hooper, 2007). Taxonomic identification is expensive and time-consuming, and most research institutions have backlogs which cannot be covered with government support; commercial partnerships are seen as an important way to get this work, central to the Herbarium and Museum's mission, done. "Without knowledge about what species exist, their distribution and their interaction, no informed and sensible environmental management decisions can be taken. Without a comprehensive taxonomy governments cannot safely allocate resources and set priorities for conservation and natural resources utilisation" (Geoff Burton, pers. comm., 2007)

The Queensland Herbarium "always viewed the increase in the knowledge about the State's flora as its [the NPD's] major benefit and the funding from the program delivered this outcome" (G. Guymer, pers comm., 2007). The NPD supported collections and research by the Herbarium that resulted in the discovery of more than 100 species new to science, many of conservation concern, together with hundreds of new records for the distribution of species (eg the extension of range), and collections in parts of Queensland that had never before been systematically surveyed (G. Guymer, pers. comm., 2007).

Expansion of collecting institution collections are a significant benefit of the NPD. More than 16,000 plant specimens were added to the herbarium collection (G. Guymer, pes comm., 2007), and the Queensland Museum incorporated 12,000 specimens of roughly 5,000 species of marine invertebrates and algae into its permanent collection (Hooper, 2007).

These marine specimens yielded more than 200 bioactive compounds, most with novel bioactivity, and 23 new structural classes discovered. Sponges (Porifera), in particular, were most productive, both in terms of new chemical compounds and species diversity (Hooper, 2007). In 1994, there were 1385 species of sponges described for the entire Australian fauna (including its external territories), with less than half of these known to live in tropical waters; this knowledge took 200 years to acquire (Quinn et al, 2002). In contrast, over the past 15 years, 3,000 sponge species were discovered, about 70% new to science, providing a three-fold revision of previous estimates of sponge diversity in Australia and worldwide (5,000 and 15,000 respectively). (Hooper, 2007). The conservation benefits linked to the biodiversity information yielded by the NPD is further discussed below.

Benefits for Conservation of Biodiversity

Although "access and benefit-sharing" (ABS) arrangements are linked to the conservation of biodiversity within the Convention on Biological Diversity and national ABS measures, in practice many ABS partnerships manifest few concrete benefits for conservation . When samples are provided but specimens are not lodged with national research institutions engaged in this process, and these institutions are not supported through collections, the benefits for conservation are limited or none. In a very few cases, bioprospecting partnerships include payments to protected areas and support local conservation activities, such as the case of InBio and Merck in Costa Rica. But even in that case, and overall, the most significant benefits for biodiversity conservation resulting from this type of research have generally been found in the

biodiversity information they provide that is critical for setting conservation priorities, conservation planning, and for management.

The NPD is an extraordinary example of this type of benefit for conservation, providing support for collections of marine and terrestrial organisms, particularly in Queensland, that identified new species and populations of endangered species, provided critical information on biodiversity 'hot spots', and was used not only in drafting the Queensland Biodiversity Act 2004, but in environmental planning and management throughout the region.

In addition to collecting and identifying 100 species new to science, and new records on the distribution of species as described above, the Queensland Herbarium also found new populations of threatened species in remote areas, providing genetic resources to propagate the species, and documented weed encroachment in native forests that has helped inform forest management (Camp and Quinn, 2007). Increased knowledge of species distribution has also been used in environmental planning for Queensland.

The Queensland Museum made astounding taxonomic discoveries as a result of their work for the NPD, and has also made some major advances in the knowledge of spatial distribution of marine organisms across northern Australia, which in turn has contributed to marine conservation and planning processes. This has included the delineation of Marine Protected Areas (MPAs) based on faunal characteristics. It also provided data to undertake biodiversity "hot spot" analysis across northern Australia, identifying areas of comparative species richness, high endemism, and phylogenetic relationships amongst these regional faunas (Hooper, 2007). The material collected from the NPD and other projects also allowed the study of population genetics of some species, and an analysis of "beta diversity" trends (spatial patterns where there are major species turnover points across an environmental gradient) at medium and large spatial scales. As a result, it was possible to delineate a number of biogeographic transition zones across northern Australia and compare these data to traditional marine biogeographic models for Australia. These sorts of data were useful to national bioregional planning processes in both State and Commonwealth waters such as the Great Barrier Reef Marine Park Authority and the Representative Areas Program (Hooper, 2007).

Astra Zeneca

Astra Zeneca benefited from the NPD partnership through access to the remarkable marine and terrestrial biological diversity of Queensland, and to a lesser extent Tasmania, China, India and Papua New Guinea. They also benefited from collaboration with an increasingly sophisticated natural products discovery unit that worked closely with Astra Zeneca researchers, from the existing high levels of scientific expertise within Griffith University and the country, and from working in a country with a robust legal system, and an increasingly clear ABS regulatory environment that grants them legal certainty over the material they study. The Commonwealth and Queensland State governments also provided financial incentives to Astra Zeneca in the form of pricing incentives through the Commonwealth's Factor F scheme, and provision of the research building and other support through the Government of Queensland.

Queensland, Australia and the International Community

The State of Queensland and Australia at large benefited from the investment of $100 million by Astra Zeneca in the NPD, the employment and building of expertise it provided, as well as increased scientific and technological capacity, including the first natural product HTS facility in Australia, and the Queensland Compound Library and Molecular Screening Collaboration that resulted in part from the NPD. Opportunities for private/public partnerships and investment in Australia are also enhanced, as is the potential to employ Australian scientists and so alleviate the scientific brain drain which has afflicted the country. Australia will also benefit from innovative business partnerships that build upon the unique biological and cultural diversity of the country.

The range of benefits for biodiversity conservation described above serve the public in Queensland, Australia, and worldwide, as do the contributions to scientific knowledge and the potential development of new medicines. For example, the Eskitis Institute is working with a range of international organisations in the search for new therapies to combat neglected diseases. These include the Seattle Biomedical Research Institute (SBR) on the biology of disease-causing parasites, the Medicines for Malaria Venture (MMV) and the Drugs for Neglected Diseases Initiative (DNDi). These groups are supporting HTS campaigns at Eskitis Institute to identify natural products that show promise against malaria and sleeping sickness (Quinn, pers comm, 2007; Eskitis 2007).

Conclusions

The NPD provides a valuable opportunity to examine the ways bioprospecting partnerships can yield benefits for provider countries, and for biodiversity conservation, over time. Running for 14 years – much longer than most other such ABS partnerships – it offers a window onto the extent of scientific and technological capacity that can be built, the enormous wealth of biodiversity information that might be collected and analysed, and the ways that the many benefits regularly articulated in ABS policy documents can come together over time to add up to more than the sum of the parts.

Monetary and non-monetary benefits in this case fall within the standard package for "best practice", but it is in the accumulated and multi-faceted nature of the benefits that the real gain for the State and country are to be found. These include the collections and compound libraries, the advanced natural product discovery unit, and the enormous gains in taxonomic and ecological understanding that resulted from the collections. This case demonstrates that these benefits can be of equal, or greater, importance to potential monetary benefits from royalties should a product be commercialized.

The pre-conditions that attracted Astra Zeneca are also the very things that make this a difficult model to reproduce in many other countries – eg existing high levels of scientific and technological capacity, unique biodiversity, a legal system that provides legal certainty, and government incentives for investment. However, the NPD is instructive in terms of providing an example of what ABS "best practice' in partnerships generally seeks to achieve. This includes a wide range of benefits in the short, medium and long term, undertaking high levels of research within provider countries, building scientific and technological capacity, and significant benefits for biodiversity conservation. The building of capacity within the NPD collaborators in ABS policy under the CBD, and working with new state and federal ABS regulations, is also a significant benefit of the partnership.

Conclusion of the exclusive Astra Zeneca-Griffith University partnership provides an excellent opportunity to view in the coming years how the significant accumulated benefits of such a "best practice" partnership can be leveraged to form new collaborations with a range of partners, serve a wider range of public needs (e.g. research on neglected diseases, innovative partnerships based on the country's biological and cultural diversity, support for Indigenous peoples' priorities), and generate benefits for science, medicine, and biodiversity conservation over time.

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Case Study 2.

The Kenya Wildlife Service (KWS), The International Centre for Insect Physiology and Ecology (ICIPE), and Novozymes and Diversa (Verenium) Corporation: Agreements in the Industrial Biotech Sector

Key Players

Kenya Wildlife Service

Kenya Wildlife Service (KWS) is an autonomous parastatal body supervised by a Board of Trustees with exclusive authority over national parks and significant influence over other categories of protected areas. The KWS was established under the Wildlife (Conservation and Management) Act of 1977 (and amended in 1989) (Lettington, 2003). KWS is charged with the protection and conservation of the country's biodiversity, and its mission is "to sustainably conserve and manage Kenya's wildlife and its habitat in collaboration with stakeholders for posterity". It is part of the Ministry of Tourism and Wildlife, and to date has been the ABS focal point for collections made in Kenya's 61 national parks and reserves (but not outside these areas), which include a number of Rift Valley soda lakes with microorganisms of interest to the biotech industry. KWS is also responsible for conducting and coordinating research activities in the field of wildlife and conservation management, as well as regulating research in protected areas, including vetting research proposals and issuing permits for research and for the export of any samples (KWS, 2006; Lettington, 2003). As such, they have directly entered into a number of agreements with outside partners, including Novozymes and Diversa. Other commercial partnerships are less public, including one for crop protection and another focused on insect venoms.

The International Centre for Insect Physiology and Ecology (ICIPE)

ICIPE was established in Kenya in 1970 to "help alleviate poverty, ensure food security, and improve overall health of peoples of the tropics by developing and extending management tools and strategies for harmful and useful anthropods, while preserving the natural resource base through research and capacity building." ICIPE has 233 regular staff members, drawn mainly from the developing world, and of these 45 professionals. Most staff are based at the headquarters in Nairobi (www.icipe.org). ICIPE partners with KWS for bioprospecting contracts, and this relationship is detailed in the "Memorandum of Agreement for Partnership in Discovery and Development of Products Identified from Kenyan Arthropods, Microorganisms, and Plants". For academic agreements involving the transfer of material, ICIPE drafted in 2000 an "Agreement for the Transfer of Biological Material and/or Related Information" (www.wipo.int/tk/en/databases/summaries/icipe.html). ICIPE is also involved in commercial partnerships associated with its work on insects, including that with the venture capital company Bridgeworks, based in Switzerland. Bridgeworks Africa involves a partnership with ICIPE to develop botanicals, biopesticides and fertilizers, microbial pest control, and insect attractants, repellents and traps. The agreement affords Bridgeworks a "right of first refusal" on all new

developments coming out of the research partnership, with benefit-sharing including royalties and technology transfer (www.bridgeworks.ch).

Novozymes

Novozymes is a biotech company based in Denmark, primarily owned by Novo A/S, a wholly-owned subsidiary of the Novo Nordisk Foundation. The company focuses on products that improve industrial performance and quality while saving water, energy, raw materials, and waste. Novozymes has around 4,500 employees, 15% of whom work in R&D, and over 700 products used in more than 40 different industries, and sold in 130 countries (www.novozymes.com). Novozymes' annual sales in 2006 were DKK 6,802 million, with an operating profit of DKK 1,340 million, and net profit of DKK 911 million. The company makes a commitment to support the International Chamber of Commerce's Charter for Sustainable Development, the Convention on Biological Diversity, the UN Universal Declaration of Human Rights, and the UN Global Compact (www.novozymes.com).

Novozymes spends 11-13% of sales on R&D focused on microbiology, biotechnology and gene technology. Their "core competencies" are genetic and biochemical diversity (culture collection, strain screening, genome sequencing, expression cloning); protein design; protein chemistry; pathway engineering; strain development and improvement; and large-scale production. They find, develop or refine enzymes and microorganisms into commercial products, and through 'state-of'the'art' biological production, produce them in large quantities for sale. Microorganisms are responsible for much of the building up and breaking down of different kinds of organic material in the environment, and Novozymes makes use of these capabilities for commercial products that clean surfaces and wastewater or improve the growth of plants. Microorganisms such as bacteria and fungi are also efficient and safe producers of enzymes that Novozymes sells for industrial applications (www.novozymes.com).

The company launches 5-8 new products a year, with development cycles for industrial or technical products – such as enzymes for biofuels and detergents – taking no more than 1-2 years from when a lead enzyme is identified, and for feed and feed products taking roughly 2-3 years, given the more involved approval procedures and requirements for toxicology (Ole Kirk, Novozymes, pers comm., 2007).

Novozymes has 2-3 partnerships with overseas research institutions running at any one time, including one previously with BIOTEC, Thailand for the collection of insect pathogenic fungi (Lange, 2004), and currently that with Kenya Wildlife Service and another in Portugal (Ole Kirk, pers comm., 2007).

Diversa (Verenium Corporation)

Verenium Corporation develops biofuels derived from low-cost abundant biomass and specialty enzyme products. Verenium, a publicly-traded company based in the US, was formed in 2007 through the merger of Diversa Corporation, which worked in enzyme technology, and Celunol Corporation, a developer of cellulosic ethanol process technologies and projects. The combination produced a company with "integrated end-to-end capabilities to make cellulosic biofuels a commercial reality" (www.verenium.com). Diversa signed an agreement with KWS and ICIPE in 2001, as

part of collections to feed its research on enzymes that can be used in industrial processing. Examples of products in this area include Luminase PB-100 and Luminase PB-200, enzymes that enhance the process of pulp bleaching in the paper making industry while reducing the use of harsh bleaching chemicals (www.verenium.com). Luminase was developed from a microbe found in a thermal feature in Kamchatka as part of a partnership between Diversa and the Center for Ecological Research and BioResources Development (CERBRD) in Russia. Enzymes are also used in products to convert plant material into cellulosic ethanol for fuel, and in animal care, including to improve the nutritional value of feed (www.verenium.com). Diversa focuses on enzymes found in microorganisms, since they are the world's most genetically diverse organisms, with broader and more varied characteristics than those observed in plants or animals. In 2005, Diversa had 18 partnerships with groups in 10 countries across six continents, and was collecting in all international waters around the world (Mathur et al, 2004; Diversa, 2005). But the 2007 merger of Diversa and Celunol into Verenium followed a restructuring at Diversa in 2006 that was intended to improve its product sales and to "conserve its dwindling cash pile" by reducing basic research, including bioprospecting partnerships (Sheridan, 2006).

The Kenya Wildlife Service – Novozymes Partnership

Background

In May 2007, The Kenya Wildlife Service and Novozymes entered into a five year partnership for the collection, identification, and characterization of microorganisms from Kenya's national parks. The current agreement grew out of pre-CBD collections that Novozymes received, and their subsequent efforts to address the absence of an agreement associated with these collections after they led to the development of a commercial product, Pulpzyme. Pulpzyme reduces the amount of chlorine needed to bleach wood pulp (Odhiambo, 2007). It remains unclear who collected the samples, or where, and they may have been the result of a staff person collecting while on holiday, a practice common in the years prior to the CBD. Within the company's database, however, the country of origin – Kenya - was clear. It was assumed that collections took place in a protected area, and thus under the management of KWS, so the company approached KWS to reach an agreement.

Commercial sales of Pulpzyme have been modest, but Novozymes sought to develop a benefit-sharing agreement for proceeds from this product in order to "make things straight… in the spirit of the CBD" (Ole Kirk, Novozymes, pers comm., 2007). A deal was negotiated to pay an accumulated royalty on past sales (the exact amount is not available), and running royalties on any future sales, as well as to build a new partnership around microorganism collection, identification, and characterization. Novozymes will train Kenyan students in taxonomy, isolation and identification of microorganisms, and will transfer advanced technology to Kenya, including knowledge of how to collect and isolate micro-organisms and how to characterize microbial diversity. The new agreement also grants Novozymes "rights on similar terms to commercially make use of specific strains isolated in Kenya which are already in Novozymes' possession." (Novozymes/KWS press release, 2007).

The partnership between Novozymes and KWS will run for five years as of 2007. Novozymes has found that with similar agreements in other countries, five years is a

reasonable amount of time to allow for training and technology transfer to provider country institutions, and for Novozymes to fully evaluate the potential of the project, and the available biodiversity (Ole Kirk, pers. comm., 2007).

The 2007 Novozymes-KWS agreement did not result from a particular interest in bioprospecting partnerships in the region on the part of Novozymes, and instead resulted from commercialization of much earlier collections, and a desire to negotiate a benefit-sharing agreement. However, the microbial diversity available in Kenya is of interest to the company, which stands to benefits from access to novel genetic resources. It is the case, however, that the company is not as dependent upon collections from nature as it was even 10 years ago. Advances in science and technology, in particular genomic science, have made it possible to access the enormous biodiversity in Denmark alone, and most of their products derive from Danish biodiversity. The company also has access to increasing numbers of genomes placed in the public domain (on average, one new microbial genome is published a week), and they are able to generate 'artificial evolution" and "diversity" in the laboratory (Ole Kirk, pers. comm., 2007).

Prior informed consent

Under the Wildlife and Conservation Management Act of 1972 (amended in 1989), KWS has jurisdiction over the management of Kenya's 61 national parks and reserves, which form the core of the conservation system. KWS is responsible for regulating research in these areas, including vetting research proposals and issuing permits for research and for the export of any samples (KWS, 2006). National parks are central government property, and reserves are the property of communities, but KWS manages research in the latter areas, as well. Additional prior informed consent from local councils or communities for collections undertaken in reserves is not required.

While KWS serves as the national focal point for ABS in national parks and protected areas, these responsibilities, and their relationship to those of the National Environmental Management Authority (NEMA) of the Ministry of Environment and Natural Resources, have been unclear since new ABS regulations were propagated in December 2006. Prior to these new regulations - Legal Notice 160 "The Environmental Management and Coordination (Conservation of Biological Diversity and Resources, Access to Genetic Resources and Benefit-Sharing) Regulations, 2006", under the Environmental Management and Coordination Act (No 8 of 1999) - there was no specific ABS regulatory regime in Kenya, although elements of a potential ABS regulatory structure were in place, and a range of statutory, regulatory and policy provisions affected access and benefit sharing (Lettington, 2003). In the new regulations section 53 directly addresses access to genetic resources. NEMA is identified as the national ABS focal point, but the relationship between this new role for NEMA, and KWS' existing authority, remains unclear. Discussions are ongoing to address confusion about respective mandates and jurisdictions. At the same time, and typical to the establishment of national focal points around the world, NEMA is a new institution within government with a broad mandate and limited resources, so ABS must compete (often unsuccessfully) with other priorities (Lettington, 2003).

In the meantime, KWS continues to operate according to previous arrangements in which it grants access and receives benefits from ABS partnerships undertaken in protected areas. KWS undertakes to ensure that all necessary permits and

authorizations are obtained for partner companies (Lettington, 2003). In the absence of clear ABS measures, procedures, and institutional authorities, many companies are reluctant to engage in ABS partnerships, however the KWS role as broker and facilitator appears to provide the certainty companies need. In the case of the Novozymes partnership, KWS facilitated all permits and signed the agreement with Novozymes. Directly partnering with companies in this way is somewhat unique for park managers, although one that has been widely proposed as a way of funding expensive and critical research and management activities in conserved areas.

Access to resources

KWS will undertake all collections, and these will be in Kenyan national parks and reserves. The collections do not involve traditional knowledge. Biotechnology research programs like these do not incorporate traditional knowledge into their collecting programs due to the emphasis on microorganisms, and because their research approaches and technologies do not lend themselves to incorporation of this type of information (Lange, 2004; Mathur, 2004). The numbers of samples to be collected per year are not specified in the agreement, and the intention is that this will evolve alongside the partnership in the coming years. In the microbial discovery laboratory set up by Novozymes, and staffed by KWS researchers trained by Novozymes, KWS will undertake isolation and characterization of microorganisms. They will supply research results to Novozymes, which will then decide whether to pursue a lead or not.

Benefit-sharing

Monetary benefits
Under the agreement, KWS – as a representative of the government – will receive running royalties on any commercial product developed. The rate is confidential (see discussion below in section on the Diversa partnership). Novozymes also provides KWS with an upfront payment, a 'lump sum' that covers the costs of sample collections and laboratory work. If research results from the microbial discovery laboratory in Kenya show promise, and Novozymes wishes to pursue something further, it will request samples for research within the company's laboratories, and this will trigger a milestone payment to KWS.

Non-monetary benefits – technology transfer and capacity-building
As part of the benefit-sharing arrangement associated with Pulpzyme, Novozymes sought to expand benefits beyond the purely financial, and develop a broader collaborative project. As elaborated in the 2007 agreement, this includes establishment of a microbial discovery laboratory at KWS, with advanced technology to isolate and characterize microorganisms within Kenya. Necessary materials for implementing enzyme screening in Kenya will also be supplied (Novozymes/KWS, 2007). Staff of KWS will travel to Novozymes, with costs born by Novozymes, to be trained in these techniques, and Kenyan students will be trained in taxonomy, isolation, and identification of microorganisms. The laboratory can be used for other partnerships, as well – Novozymes does not have exclusive rights to its use.

Benefits for biodiversity conservation
Financial benefits will accrue to KWS, whose mission is "to sustainably conserve and manage Kenya's wildlife and its habitat". They will support the wide range of conservation programs undertaken by KWS, and as a result – unlike most

bioprospecting agreements – financial benefits will directly support conservation work in the region. The collections will also generate information and understanding about biodiversity critical to management and conservation in the region.

Benefits for scientific and technological capacity
By building a laboratory at KWS to undertake identification and characterization, and training researchers, a higher level of scientific research will take place than those associated with bioprospecting agreements that involve only the supply of samples. The laboratory is also available for other research projects – academic and commercial – allowing KWS to build upon the capacity resulting from this partnership. As KWS Director Julius Kipng'etich reported, in reference to this partnership: "Tourism is low level income generation. We need to graduate to a higher level where biotechnology takes us" (Odhiambo, 2007).

Intellectual property rights

Any intellectual property that comes out of the partnership will be co-owned by both parties. Both KWS and Novozymes will be listed on patents. Novozymes has a very active patenting policy, with an extensive portfolio of more than 4,200 active patents, patent applications, and licensed patents (www.novozymes.com).

Tracking and monitoring of samples

Given the structure of this agreement, with Novozymes not receiving samples, but data instead, and the request for samples for further study in Denmark triggering milestone payments, there are fewer concerns associated with tracking samples within the company program, and monitoring and compliance, than in many cases. However, Novozymes does have a very well-established tracking system in place. In general, however, developments in science and technology, and dramatic changes in the ways genetic resources are studied and used, mean that tracking and monitoring the use of genetic resources has become increasingly difficult. As a result, trust and regular communication associated with solid partnerships are important elements of tracking and monitoring, and compliance with agreements.

Agreements employed

The agreement used as the basis for discussion between Novozymes and KWS, and adopted with fairly minor changes, was one proposed by KWS. A single agreement guides this partnership, with KWS acquiring permits directly from the government on behalf of the partnership.

The Kenya Wildlife Service- The International Centre for Insect Physiology and Ecology (ICIPE) and Diversa (Verenium) Corporation Partnership

Background

In 2001, the Diversa Corporation signed a three-year agreement with the KWS and ICIPE. This was during a time of expansion in Diversa's collecting partnerships around the world, with a total of 18 partnerships by 2005 (Mathur et al, 2004; Laird

and Wynberg, 2005). In 2004, the agreement was renewed, and at that time, small changes were made in the agreement, including an increase in the flat amount payable annually for the supply of samples, and a simplification of the royalty structure in order to make it easier to manage.

KWS and ICIPE work together in this case, under the 2000 "Memorandum of Agreement for Partnership in Discovery and Development of Products Identified from Kenyan Arthropods, Microorganisms and Plants". The agreement signed with Diversa is with both KWS and ICIPE, with ICIPE managing the partnership, undertaking communication with Diversa, and receiving and then distributing to KWS its share of any financial benefits.

Prior Informed Consent

Prior Informed Consent was facilitated by KWS and ICIPE. Because collections are undertaken only in protected areas, KWS serves as the ABS focal point for the research, as described above in the case of Novozymes.

Access to Resources

KWS undertakes all field collections of material on behalf of Diversa, which provides guidance for collections, formalized in their agreement, as follows:
" Collaborators will be responsible for the collection, processing and shipment to Diversa of environmental samples from diverse habitats within the Republic of Kenya and/or DNA samples isolated from such environmental samples using the Technology. Collaborators shall further be responsible for planning and execution of collection trips with and without the participation of Diversa personnel. Collaborators will provide laboratory space for the collaboration activities. Environmental samples shall include, but not be limited to, soils, sediments, mire, earth, microbial mats and filaments, plants, ecto and endo symbiont microbial communities, endophytes, fungi, animal and/or insect endosymbionts, marine and terrestrial invertebrates, air and water. Collaborators will provide Diversa a minimum of 50 and up to 250 environmental samples per year. All such environmental samples shall be considered "Material" under this Agreement" (Appendix A, Materials, Biodiversity Collaboration Agreement).

Benefit-sharing

All KWS-ICIPE agreements with the private sector include annual fees, royalties, and technical cooperation and training, and most also include some form of milestones (Peter Munyi, ICIPE and Robert Lettington, GRPI, pers comm., 2007).

<u>Monetary benefits</u>
An annual payment is made to ICIPE/KWS from Diversa in order to cover personnel, equipment, and other costs associated with the collections. There is also a bonus mechanism built into the partnership, in which the local institutions receive a small bonus, as a percentage of base funding, if seven criteria are met: completion of data sheets; DNA from samples is supplied when requested; DNA is isolated; shipping protocols are followed; specific sample collection or re-collection are fulfilled; maximum coverage of biotypes and habitats is achieved; and the partners respond in a timely and professional manner.

Dependent upon a successful commercial product, milestone payments and royalties will be paid. As with the Novozymes case, and standard to commercial partnerships, the royalty rate for the Diversa case is not publicly available. However, on a general basis, "the range of royalties currently active for KWS-ICIPE partnerships is between 0.5% - 10%, with the lower end tending to involve highly specialized technologies that require significant value adding outside Kenya. The highest tend to involve less direct values, such as know how and other forms of licensing etc to third parties, although this obviously only involves specific technologies and not material or broader rights. The mid range of royalties tends to involve the use of material in applying more established technologies and where more of the science can be done in Kenya before delivering material. Associated with this, some agreements have incentives where there can be bonuses of up to 5% of the base annual access fees for meeting key recipient requirements for the standards of material delivered." (Peter Munyi, ICIPE and Robert Lettington, GRPI, pers comm., 2007).

Of the monetary benefits received as part of these agreements, KWS and ICIPE divide them 50/50; Diversa will pay ICIPE, which will then forward to KWS its share of the amount received. In other cases in which protected area managers are parties to agreements, such as that with Yellowstone National Park in the US or government research institutions, such as the Queensland Museum and Herbarium in their partnership with Griffith University and Astra Zeneca, financial benefits do not accrue directly to the park managers or research institutions, and will often go to state or federal government coffers.

Non-monetary benefits

License to products and inventions
KWS and ICIPE retain the right to a royalty free license to any products or inventions developed from Materials provided under the partnership, in order to allow them to research, develop and otherwise make use of any products or inventions developed from the Material within the jurisdiction of the Republic of Kenya (but not beyond this jurisdiction). This is not understood to "confer any commercial rights, or rights to transfer any products, inventions or commercial rights to third parties" (12., Agreement Terms, Biodiversity Collaboration Agreement).

Training
Under the agreement, KWS and ICIPE will receive training in technology relevant to the partnership, primarily at Diversa, and undertaken at Diversa's cost.

Research results
Under the agreement, KWS and ICIPE have the right to complete information developed by Diversa, and to research results on any novel genes or organisms discovered therefrom.

Publications
Diversa, KWS and ICIPE researchers will jointly publish the results of any research work when there is a substantive contribution by both parties, and after all parties have provided written approval. The submission and subsequent publication, however, will be delayed until any intellectual property or confidential information contained in the proposed publication is adequately protected as mutually agreed by all Parties (8., Agreement Terms, Biodiversity Collaboration Agreement).

Benefits for biodiversity conservation

In addition to the potential financial benefits that will go to KWS, and the increased biodiversity information and understanding resulting from the project, Diversa suggested that "it might consider providing matching funds for biodiversity conservation activities relating to its fields of interest' (Lettington, 2003).

Intellectual Property Rights

Under the agreement, the company retains intellectual property rights over any products that it develops, provided that ICIPE and KWS have the option of a royalty free license for local adaptation in Kenya when, and if, this is feasible (Lettington, 2003).

There were discussions within KWS and ICIPE at the time of the first agreement, and it was decided to not pursue intellectual property rights, which in any case it might be difficult for ICIPE and KWS to utilize effectively, and rather to focus on seeking greater monetary and non-monetary benefits as part of the partnership (Robert Lettington, pers. comm., 2007). The text in the Biodiversity Collaboration Agreement relating to IPRs is as follows: in the Preamble, "Whereas, Collaborators agree that Diversa will own any invention made by Diversa using the Material; and…" and in the Agreement Terms, 11. "Diversa agrees and understands that if Diversa's use of the Material results in identification of new genes, or any invention, improvement, useful composition, structural modification or derivative of the Material (any of which shall be considered a "Diversa Invention"), Diversa shall promptly disclose any such Diversa Invention to Collaborators. Collaborators agree that, subject to the provisions of this Agreement, Diversa shall own all right, title and interest in and to any or all Diversa Inventions."

Tracking and monitoring

In the agreement, Diversa agrees to assign unique identification numbers to Material sent by Collaborators, and to assure that its identification system allows Collaborators and Diversa to identify all Material and research results (Agreement Terms, Biodiversity Collaboration Agreement, 10.).

Conclusion

The partnerships formed between KWS and ICIPE, and the industrial biotech companies Novozymes and Diversa, provide a range of short, medium and long term benefits. They are also based on procedures for prior informed consent that conform to government standards for collections in protected areas, although these procedures may be in flux alongside the ABS legal framework. These partnerships build scientific and technological capacity, as well as providing support for biodiversity conservation. The scale of investment in laboratories, training, and collections is significant, if far smaller in size and scope than those that might result from pharmaceutical industry partnerships (eg see the Griffith University and Astra Zeneca partnership in Queensland).

However, these partnerships are not necessarily indicative of standard practice in the industrial biotech sector, nor of bioprospecting activities within Kenya. The details of these partnerships are uniquely public, and staff of both Novozymes and Diversa

have spent a great deal of time engaging with the CBD policy process and entering into similar partnerships around the world. Both KWS and ICIPE have a number of other commercial partnerships, the terms of which are less well known, and which may or may not live up to current standards of 'best practice' – although given the institutional capacity of KWS and ICIPE in this area, and the model contracts and agreements from which they work, it is likely that they follow these standards.

At the same time, however, a great deal of bioprospecting is underway in the country, both within and outside of protected areas, that appears to be difficult to monitor and control, and that operates without clear PIC, and sharing of benefits. The KWS-Novozymes and KWS/ICIPE-Diversa partnerships grew up at the same time concerns were raised about the use of an enzyme from a saline lake in Kenya by the US company Genencor International (eg Ngare, 2006; Mbaria, 2004; Lacey, 2006; McGowan, 2006). In 2002, the company announced the development of a product that causes a faded look in denim, and might replace the pumice stones usually employed by the industry. Genencor acknowledges that the enzyme was obtained in Kenya, but there is little detail available on the legal basis for their obtaining the enzyme. All of Kenya's saline lakes fall within the boundaries of protected areas, which means collections might have been undertaken with a KWS research permit (Lettington, 2003). Genencor says that it obtained the sample from a Netherlands-based company that took part in an academic research project with Leicester University in the UK, and that all necessary research permits were obtained (Lacey, 2006). This case remains unresolved, but has heightened awareness within the country about the need for effective ABS measures as an important complement to ABS arrangements between parties.

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Case Study 4.

Ball Horticulture and the South African National Biodiversity Institute

Introduction

In 1999 the then National Botanical Institute – NBI (now constituted as the South African National Biodiversity Institute - SANBI) entered into a Research and Licensing Agreement with the Chicago-based company Ball Horticulture. The five-year agreement (which continues to be renewed on a year to year basis), is the first North-South bioprospecting agreement in the horti- and flori-culture sector, and involves SANBI using its expertise to select South African plants of horticultural interest for Ball, both from its living collections and from the wild. SANBI is a public institution that aims to promote the sustainable use, conservation, appreciation and enjoyment of the exceptionally rich biodiversity of South Africa for the benefit of all people, and also to promote the economic use and potential of indigenous plants[1]. This it does through, *inter alia,* managing the various botanical gardens and herbaria in South Africa, conducting environmental education and outreach programmes, developing bioregional programmes, policies and plans, undertaking biosystematic research and biodiversity collections, conducting ecosystem rehabilitation, and maintaining and developing databases about southern African flora. The bulk of operational funding comes from the Department of Environmental Affairs and Tourism (DEAT) operational grant of R95 million, covering all salaries and the basic running costs of the Institute (SANBI, 2007). Ball is one of the world's largest multinational horticultural companies, holding 40% of the US market in bedding plants and pot plants, 25% of the European market, and 10% of the Japanese market. Ball Horticulture operates globally, in North America, South America, Europe, Asia, Africa, and Oceania[2].

Negotiations and Prior Informed Consent

The process of developing and negotiating the agreement was a long and arduous one, initiated in 1996 and finalised in 1999, after 14 iterations. In 1998, the proposed joint venture was tabled at a meeting of the Board of the NBI, who resolved to inform DEAT about the proposed deal and also to go ahead with the agreement subject to it being within the guidelines of government policy (Glazewski *et al* 2001). However, none of the specifics of the contract were developed in the context of an institutional policy, nor through consultation with interest groups or NBI staff. Within the Institute, suspicion and concern about the agreement grew to the point where "people were getting ready to take the story to the newspapers" (Huntley, 1999). In response, two stakeholder workshops were convened in 1999 in Cape Town and Pretoria with NGOs, academics, and various national and provincial government departments. Substantial media attention was also attracted through this process. Key concerns noted at these meetings focused on the benefit-sharing provisions of the proposed deal, which were perceived to be out of line with the CBD with regard to technology transfer and scientific co-operation. The proposed

[1] Forest Act 122 of 1984, and Forest Amendment Act 53 of 1991.
[2] Locations Ball Breeders, Producers and Distributors across the World, Available at: www.ballhort.com, Accessed on: 13 December 2007.

agreement was also considered to badly undervalue South Africa's national heritage, and to neglect national imperatives towards job creation and the reconstruction and development of South Africa (Fakir, 1999). Further concerns were raised about the use of public funds to develop material for commercial purposes, about the patenting of life, and about the weak role of the local horticultural industry in the agreement. A series of letters to DEAT from NBI requesting guidance and Ministerial approval on the Agreement met with no response and in August 1999 the Agreement was signed. Although earlier NBI press releases in June 1999 had announced the possibility of the agreement, final signature of the agreement was not followed by any public announcements.

In April 2001 the deal again captured the attention of the public through its coverage as a lead story in the *Cape Times* newspaper (Gosling, 2001). This in turn led to a series of radio and press reports about the matter. The NBI, it was claimed, had sold off the patent rights to a US company for huge sections of South Africa's floral kingdom, through a deal signed behind closed doors. Critics argued that this had effectively stifled the potential of local companies to develop the floriculture export industry and, moreover, had been done without DEAT approval. In defending its position, the NBI pointed to the stakeholder workshops held before finalisation of the agreement, to the continued rights of other players in the floriculture industry to commercialise South African plants, and to the long-overdue opportunities for South Africa to obtain benefits from the country's diversity of indigenous plants (Huntley, 2001). In May 2001 an internal NBI Board review was commissioned to, *inter alia:* assess the Agreement as well as progress with its implementation; to review the process of governance leading up to the signing of the Agreement; and to review the legal standing of the NBI to enter into such an agreement. The final report, while recognising the agreement to be a positive development in principle, stressed the insignificant financial and non-monetary benefits derived by NBI from the agreement, included a recommendation that the agreement not be renewed unless renegotiated, and highlighted the urgency for national legislation on the matter (Glazewski *et al* 2001).

One of the crucial issues in this case study concerns the way in which prior informed consent was obtained from national and provincial government. Ball delegated this responsibility to SANBI but, as described above, repeated requests for policy guidance to DEAT from SANBI met with neither acknowledgement nor response, in some cases due to "obstructions" from civil servants (Glazewski *et al* 2001) but also because of the newness of the issue and SANBI "feeling its way around". At the provincial level, it would seem that after some consideration, all nine provinces were in agreement to issue collection permits to SANBI, although with reservations. The Western Cape Nature Conservation Board (WCNCB), for example, was reluctant to issue an open permit with no species listing and considered the requested amounts to be collected as excessive (Jangle, 2001). WCNCB was also of the opinion that the province should benefit in some way from the agreement for the privilege to collect in nature reserves, and that a contribution should be made towards covering management costs. While WCNCB issued a permit for collection purposes, it is pertinent to note that this agency instilled a further level of control by also requiring a permit for export beyond the boundaries of the Western Cape. Written consent of private landowners prior to collection is also a requirement.

What does this case tell us about the procedural aspects of bioprospecting and best practice? Importantly, it emphasises the need for transparency, and also underlines

the importance of allocating time and resources to ensure adequate consultation, debate and clarification. More time spent *before* finalisation of the deal would almost certainly have brought in a wider spectrum of stakeholders and greater support, and through more thorough analysis may have enabled a more comprehensive and beneficial agreement to be developed. But, as Maureen Wolfson, Director of Biosystematics Research and Biodiversity Collections at SANBI notes, more effective stakeholder consultation is also linked to awareness of ABS issues, which was very limited at the time the agreement was negotiated (pers. comm., 2007). Even within government, most were fairly ignorant about ABS requirements of the CBD: "…there was a very small group of folk who had a good overall grasp of ABS matters but generally we met with apathy amongst the others that we tried to consult" (M. Wolfson, SANBI, pers. comm., 2007). Despite this, there is little to suggest that a more consultative process would have guaranteed support, nor that such analyses would have received adequate attention by the SANBI or Ball.

Benefit-Sharing, Technology Transfer and Intellectual Property Rights

Monetary Benefits

Considerable criticism also accompanied the benefit-sharing provisions of the Agreement. International trade in ornamental horticultural products is substantial, estimated at some US$14.4 billion for live trees, planst, bulbs, roots, cut flowers,and foliage. South African genetic material is estimated to contribute at least $1-billion to $2-billion to this trade – although virtually none of this profit is realised by South Africa. On the contrary, through import of horticultural material, South Africa likely pays royalties to foreign companies for products derived from its own flora. The SANBI-Ball agreement thus represented a significant effort by South Africa to control the use of indigenous genetic resources in the global horticultural trade.

In terms of the agreement, SANBI was to supply Ball with different categories of "live plant material", including all horticultural groups except for slow-growing woody perennials and succulents unless specifically requested, as well as research expertise and knowledge of the plants and their habitats. For providing this service, SANBI obtained a once-off research service fee of $125 000, to be used to acquire a greenhouse for the propagation of plants before being sent to the US, and a vehicle, for plant collection trips. An annual research service fee with a "minimum value of $50 000" was also provided, to be used for operating expenses and staff costs. Royalties would also be derived by the SANBI in the event of commercialisation, but these would be offset against the accumulated amount of the annual research fee. Thus, as is pointed out in the SANBI Board's Internal Review of the agreement, direct monetary benefits are limited, conditional, and dependent on royalties exceeding accumulated annual research fees (Glazewski *et al* 2001). In the event of profits being derived from the deal, a Biodiversity Trust Fund was intended to be established by the SANBI, for the purpose of capacity-building in the local horticultural industry, and for conservation and community development projects. The Trust has, however, not yet been formally established as the royalties, which were generated three years after the project was initiated, are still only adequate to contribute to recouping and repaying the operating costs (M. Wolfson, pers comm., 2008).

One of the more controversial and poorly understood aspects of the agreement concerns its scope, and the numbers of species to which the agreement applies.

Glazewski *et al* (2001) point out that although the agreement specifies "25 items", this should not be interpreted to be 25 species, but rather 25 items of plant material that the NBI has selected at any one time following an intensive sifting and screening process. Through this process, Ball effectively has access not only to all South African species, but also to the wealth of botanical knowledge built up over the centuries by the SANBI and South African botanists (Glazewski *et al* 2001). This has been confirmed by Ball, who understand the agreement to mean they have "access to as many South African species as they like". Further, they suggest reference to "25 items" to be "meaningless" and initially intended to guide the number of plants to be kept out of public gardens whilst under development, *not* the number of plants to be scrutinised for commercial potential (Brian Corr, Ball Horticulture, pers. comm., 2003).

Intellectual property rights (IPRs) form a major component of the agreement, and caused much consternation among stakeholders who (a) objected in principle to the patenting and privatisation of life; or (b) considered the agreement to have taken IPRs out of South African hands. In terms of the agreement, IPRs will, depending on the different levels of research, development and ownership on the part of each party, either be obtained in the name of SANBI, jointly with Ball, or in Ball's name alone[3]. Ball has the right to obtain a plant patent, utility patent and/or Plant Breeder's Rights certificate in any country, while SANBI retains the right to obtain such rights in South Africa for plants collected using SANBI's existing collections. Royalty rates are similarly structured around the seven categories of plant material stipulated in the agreement. Thus, material collected by SANBI, using SANBI's existing collections, or material collected from wild habitats using fees provided by Ball secures a 10% royalty for SANBI of net product sales; material identified as "genepool plant material", which is pollinated with Ball plant material, generates a 4% royalty for SANBI; whilst material that is "improved" by Ball through genetic engineering or other techniques results in a 2% royalty for SANBI[4]. Ball, moreover, is granted worldwide marketing rights and free use of the SANBI's logo and trademark "Kirstenbosch", a cause for concern for many critics of the agreement, although SANBI sees this as a way of giving the Kirstenbosch name access to international markets. In reflection eight years on, the Ball Chief Executive remarks that the IP components of the agreement were inadequate: "There are three different layers of royalties: one of which is implausible as it involves GMOs and this is unlikely to ever be done with wild plant material. The other two don't make sense – and we could bypass the co-ownership option if we wanted to". The contract was built up from scratch, which could, roleplayers agree, account for its unnecessary complexity. As Maureen Wolfson of SANBI notes: "…the contract was probably unnecessarily complex because there were no existing models of such an agreement to guide the process and I guess, in that case there is always a tendency to try and cover all bases".

The first plant to be successfully commercialised as part of the agreement was a hybrid of two *Plectranthus* species, developed by SANBI and thus securing a 10% royalty for the Institute. "Mono Lavender", the resulting variety, is now commercially available throughout Europe, the US and Japan. At a wholesale price of $0.10 to 15 cents/unit, projected sales of several million units per annum, and a 10% royalty, it is estimated that benefits to SANBI will be upwards of $20 000 per annum. Plant

[3] Clause 10.
[4] Clause 11.1.

Breeder's Rights have been granted worldwide for the variety, and application has also been made in South Africa. As stated in the agreement, such applications have been made by Ball on behalf of SANBI. A concern that has arisen through this process is that the SANBI has not been active enough in terms of local licensing.

Other items commercialised in terms of the agreement include six *Jamesbrittenia* hybrids, ('Breeze Indigo', 'Breeze Lavender', 'Breeze Pink', 'Breeze Upright White', 'Breeze Upright Lavender', and 'Breeze Plum'), and a form of *Arctotis arctoides* called 'Lemon Drop'. The revenue generated from sales remains undisclosed but royalties generated have not yet surpassed the accrued running costs and returns have been disappointing. There were no new releases in 2005-2006 or 2006-2007 although a new *Crassula* variety is anticipated to be released soon. It is important to note that it has taken eight years to develop just a few products, emphasising the lengthy research and development process in this sector.

Technology Transfer and Non-Monetary Benefits

Non-monetary benefits arising from the agreement have been significant, ranging from an enhanced plant database through to extensive field collections, enlarged herbaria and living collections, and the construction of a greenhouse. Technology transfer components of the agreement are, however, 'soft' rather than direct investments technology transfer and product development within South Africa. Although the agreement specifies that South Africa will be given "special consideration" for product development and scaling up, this is not legally binding and is qualified by language to stipulate "where appropriate and feasible". Part of the agreement is for Ball to present one technical seminar on ornamental horticulture a year, and to host interns each year for up to four months[5]. Thus far, a number of local seminars have been held and eight young Kirstenbosch horticulturalists have been trained in Chicago by Ball in plant breeding, marketing and glasshouse management. All but one of these horticulturalists have stayed in the research community in South Africa, and six currently work at SANBI. A significant result of this training is that increasingly, selection and breeding is taking place in-house at SANBI, enabling improved material to be sent to Ball, which commands a higher royalty for SANBI and reduces the time the product will take to reach market (M. Wolfson, SANBI, pers. comm., 2008).

A major criticism of the agreement is that it contains no significant technology transfer requirements, and does not address national development imperatives for job creation and economic empowerment. On this basis the agreement was initially lambasted both by South Africa's development fraternity and by the local horticultural industry when knowledge about it became public in the late 1990s. In the case of the former, SANBI was considered to have "closed down a major economic opportunity for Namaqualanders instead of making them partners in this development opportunity" (Glover, 2001); to have excluded disenfranchised communities producing indigenous flowers in the Western Cape (Ehrhardt, 2001); and to have diminished opportunities for job creation in the country. In the case of the local horticultural industry, SANBI was accused of monopolising South Africa's floral heritage and making it unattainable to those interested in developing products. Whether or not these impacts have in fact materialised is, however, a moot point.

[5] Clause 12.

Staff at SANBI have observed that seven years down the line there have been no recorded negative impacts on the local horticultural and cut-flower industries (M. Wolfson and A. Harrower, SANBI, pers. comm. 2008), although it is also fair to say that there has been no systematic study to analyse such trends.

At the time the acquisition by Ball of Straathof, a major South African seed company, added to these concerns by local industry and was perceived by some to be simply a way to allow Ball to conduct its own distribution in South Africa, on its own terms. In response, SANBI and others noted South Africa's lack of marketing networks and capital infrastructure in the development of new plant cultivars, insufficient local capacity to competitively develop products for international markets, the difficulties of engaging local companies in co-operative breeding programmes, and the continued rights of other players in the industry to commercialise South African plants (NBI, 2001). Remarks Adam Harrower, Ball project manager at SANBI, "…we don't have the expertise in terms of breeding, developing, marketing, mass propagation and distribution that Ball has. So the NBI-Ball agreement was drawn up because they have the ability to turn our "green ore" into "green gold". We unfortunately don't - nowhere/nobody in South Africa can do this - the raw material in South Africa has very little value, even in our own horticultural industry. Quite simply it has to be "mined and processed" before it becomes valuable..... unlike *Hoodia* which is a ready-made product." In contrast to opinions from critics, the 51% acquisition of Straathof by Ball was seen both by Ball and SANBI as a concrete product of the agreement, resulting in foreign investment and the creation of "hundreds of new jobs" in the horticultural industry (Huntley, 2001). In response to these criticisms Ball notes that "…people have unreasonable expectations of what we can do; it doesn't make economic sense to set up a Ball equivalent in South Africa: why would we set up a competitor?" (Brian Corr, Ball, pers comm., 2007).

Compliance

Despite the existence of compliance clauses in the contract , it is acknowledged by Ball that there is little that South Africa could do in the event of contract violations other than "shaming us". Nonetheless, the SANBI-Ball contract is legally binding and could be challenged in a court of law if required. However, this would be a costly process that would severely stretch the financial resources of a public institution such as SANBI (M. Wolfson, SANBI, pers. comm., 2008). Monitoring and tracking are acknowledged by both parties to be especially problematic. Remarks the chief executive of Ball: "Once seed is sent out, the ability to do anything to ensure compliance is basically zero". SANBI similarly note the difficulties of monitoring material that leaves South Africa and comment that "..to some extent we have to trust in the ethical behaviour of our partners in the contract" (M. Wolfson, SANBI, pers. comm., 2008). However, while some countries may abide by the rules and act in good faith, there are many others who won't. This underpins the belief that an answer to transgressions, including a guarantee that biological resources will only be used in accordance with conditions set by the provider, will only be found multilaterally through the International Regime, the WTO, or an alternative internationally applied mechanism.

Environmental Impact and Biodiversity Conservation

A final point concerns the potential environmental impacts of collecting activities and implications of the deal for biodiversity conservation in South Africa. In the absence

of specific detail, environmental impacts are difficult to assess although the WCNCB considered the requested amounts for collection to be "excessive", and limited the number of cuttings to 30 per species, and the amount of seed to be collected to not exceed 10% of seeds per plant, from no more than 10% of the population (Jangle, 2001). A general concern is the lack of attention given in the agreement to bolstering conservation efforts in South Africa through, for example, the inclusion of conservation authorities or specific nature reserves as direct beneficiaries in the contract. As is the situation in the *Hoodia* case, the biological resource base upon which the contract hinges is not accorded any tangible recognition, and thus remains undervalued. While the agreement may eventually lead to the establishment of conservation projects through the proposed Trust, this is not guaranteed.

Conclusions

Several lessons emerge from this case that are instructive. The difficulties that SANBI has faced in switching hats between being a public interest body and a commercial player are especially useful to learn from. These tensions have played themselves out in a number of ways – in the high levels of suspicion and concern amongst the public about the deal; in the weak agreement, which suggests poor negotiating and legal skills on the part of SANBI; and in the seemingly tardy implementation by SANBI of commercial aspects of the agreement, such as the licensing of products. The significance of these issues is reflected in the National Biodiversity Act (10 of 2004) which precludes SANBI from any regulatory or oversight role in bioprospecting.

More positively, there is now increasing recognition of the role that SANBI can play in initiatives to investigate the sustainable use of South Africa's indigenous plants. Especially noteworthy is the ongoing use by other institutions of the knowledge and expertise of SANBI in the identification of plant material, which can be used and developed into saleable products (M. Wolfson, SANBI, pers. comm., 2008).

The expectations of technology transfer are also significant. Clearly there are different interpretations of what is best practice in this regard, with Ball emphasising softer forms of knowledge and information transfer, and critics placing greater emphasis on joint economic ventures and local economic development.

The lack of experience in developing agreements of this nature by either SANBI or Ball also yields important lessons. Legal expertise was, and continues to be, limited in this field, and this significantly affects the effectiveness of negotiating and drawing up fair and equitable benefit-sharing agreements.

The case also demonstrates vividly the need for a structured and multi-stakeholder oversight of bioprospecting, and the importance of setting aside adequate resources and time to ensure effective consultation and dialogue.

Lastly, the partnership that has developed between SANBI and Ball is considered a useful model from which to develop other ABS arrangements in the horticultural sector and is believed by those involved to be a more ethical and sustainable approach than a once-off collection agreement.

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Case Study 5.

Australian Sandalwood: Aveda-Mt Romance-Aboriginal Community Sourcing Partnerships in Western Australia

Sandalwood in Western Australia

Sandalwood is one of the oldest and most popular incense and perfume ingredients in the world. *Santalum album* is found in India, Nepal, and Indonesia, and is considered the highest quality sandalwood species, but it is endangered from over-harvesting. The oil is found in both stem and roots, so trees are uprooted as part of harvesting. Full maturity is reached when the tree is 60-80 years old, but pressure on *S. album* has meant younger trees are harvested, and the species is now endangered. Australian sandalwood, *Santalum spicatum*, is a small tree (up to 4m) that occurs naturally in the southern half of Western Australia (WA). It is considered lower quality than Indian sandalwood, but is still attractive to the perfume and incense industries.

Western Australian sandalwood was first exported in 1845, and soon became Western Australia's biggest export earner. In the 1920s the essential oil was first produced in a higher quality manner that led to its adoption as an antiseptic in the pharmacopoeias of several countries, including Britain, France, Japan and Belgium, until it was replaced by antibiotics (www.mtromance.com.au). Today, WA sandalwood is primarily exported to South-East Asia for the manufacture of incense, with Taiwan and Hong Kong accounting for more than 60% of annual production, and to India for the production of oil. Other major markets include Malaysia, Singapore, China and Thailand. Sandalwood is used within WA for furniture and crafts. The main company consuming sandalwood domestically is Mt Romance Australia (FPC, 2007). The sandalwood industry in WA is roughly $30-35 million AUD today, with every tree accounted for, and tracked from point of harvest through to end use (David Brockelhurst, Mt Romance, pers. comm., 2007).

There are more than 250,000 tonnes of 'green' sandalwood distributed throughout Western Australia, found wild, in plantations, and in reserves including Aboriginal heritage sites. At present, the total area of distribution is approximately 161 million ha, of which almost half is protected from any form of harvesting. The government sets an annual harvest quota, currently of approximately 2,000 tonnes, which normally is half dead, and half green sandalwood. Harvesting contractors are full time and part time operators with contract quotas varying in size from between 10 – 250 tonnes/annum. Pastoralists and Aboriginal communities make up more than 50% of current contractors. Processing and marketing of all Crown land sandalwood is conducted by Wescorp International, a private company awarded the contract through a public process (FPC, 2007).

Sandalwood is a protected species, and the Department of Environment and Conservation issues licenses to harvesters, as well as the Forest Products Commission (FPC) to harvest the wood. The FPC is a government trading enterprise established to develop and market Western Australia's renewable timber resources. It is also responsible for the commercial harvesting, regeneration, marketing, and development of the sandalwood industry, both in plantations and natural resource

areas. The Department of Conservation and Land Management is responsible for the environmental management of the species (FPC, 2007).

Mt Romance-Aveda-Aboriginal Community Sourcing

Founded in 1995 with a mission of social and environmental responsibility, and based in Albany, Western Australia, Mt Romance is a private company, with roughly 50 employees. It operates the single largest sandalwood processing plant in the world, producing 16,000 kgs of sandalwood oil every year, all from Western Australian sandalwood. In addition to producing oil for the perfume industry, the company uses resins and all other by-products from the wood for use as incense, and in shampoos, detergents and other personal care products. The material used today by the company is wild-harvested, but plantations of both Indian sandalwood (3000 ha) and Australian sandalwood (9000 ha) will be coming on line in the next decade. Mt Romance does not own plantations, and instead intends to rely on partnerships with indigenous communities for its raw material. Wild material is higher quality than that from plantations, is organic, and undertaken by indigenous peoples allows them to stay on, and make a decent living from, their land and resources (David Brockelhurst, Mt Romance, pers. comm., 2007; www.mtromance.com).

Founded in 1978, the Aveda Corporation is a wholly owned subsidiary of the Estee Lauder Companies, and is based in the US. It manufactures plant-based hair care, skin care, makeup, and lifestyle products with a commitment to protect the environment, conserve resources, and support indigenous communities. In the late-1990s, Aveda began to investigate alternative sources of sandalwood for its projects after reports of human rights abuses and poor harvesting associated with sandalwood in India. In 2003, they were introduced to Richard Walley of the Nyoongar Aboriginal peoples, and Stephen Birckbeck of Mt Romance. Aveda decided to move its sourcing of sandalwood to Australia, in partnership with Mt Romance and Aboriginal harvesters, since the trade there met the standards of the Department of Conservation and Land Management (CALM). They found, however, that existing sourcing practices in Australia resulted in minimal benefits for Aboriginal harvesters - with Aboriginal harvesters paid on average $1300 AUD/tonne of wood, compared with pastoralists being paid $8,000 – 11,000 AUD/tonne. As a result, Aveda entered into a partnership with Mt Romance and the Aboriginal Kutkububba community of Wiluna to develop an alternative supply chain, and build capacity in Aboriginal communities. A series of on-going consultations with a range of communities has expanded the sourcing partnerships into three other communities in recent years (David Hircock, Aveda Corporation, pers. comm.., 2007).

Aboriginal harvesters may work through the Forest Products Commission, or through their own private licenses. If harvesters work through the FPC, they supply unprocessed wood, and receive less than $2,000 AUD/tonne. Mt Romance provides an "indigenous bonus" to harvesters, paying $3,600/tonne for unprocessed wood. If harvesters work through a private license, they receive $8,600 AUD/tonne, but they must pay all harvesting, transport, and processing costs, with net revenues of $4500-5,000 AUD/tonne. All material purchased by Mt Romance from Aboriginal communities is certified by the Songman Circle of Wisdom (see below); the premium it pays to harvesters under this scheme is passed on to purchasers of the oil, including Aveda and Givaudan (David Brockelhurst, Mt Romance, pers. comm., 2007).

Songman Circle of Wisdom

During development of sourcing partnerships in Western Australia, Aveda and Mt Romance also supported creation of the **Songman Circle of Wisdom**, "a Western Australian based National Aboriginal Corporation owned, operated, managed and controlled by Aboriginal people" (Songman Circle of Wisdom, 2004). The Songman Circle of Wisdom is based on the belief "that by active participation in supporting and facilitating equitable commercial partnerships between the Indigenous and business communities, based on the sustainable use of natural resources and Indigenous cultural knowledge, positive change will occur" (Songman Circle of Wisdom, 2004). It was designed to meet the challenges faced by indigenous communities when seeking to establish sustainable business enterprises that respect the environment and traditional cultural knowledge, and to facilitate opportunities for the business community to work with and learn from indigenous peoples on an equitable basis. As part of partnerships, companies must obtain prior informed consent, in writing, from involved communities or individuals, and, while recognizing the existence and legitimacy of two parallel systems of law, "customary rights and traditional law will have precedence for the purpose of this protocol" (SCW, 2004).

The Songman Circle of Wisdom certifies the sandalwood supplied to Mt Romance, and the oil supplied to Aveda, including tracking it from the field, coding, and processing it separately. Within Mt Romance there are distillation units that process only Aboriginal peoples' wood, and the oil is quarantined and kept separately in the oil cellar, until sold on to the customer.

Benefits for Aboriginal and local communities

The Aboriginal and local communities sourcing sandalwood under the Songman Circle of Wisdom program receive a range of benefits associated with the supply of sandalwood. In addition to a more equitable price paid, an additional "royalty" of $500 is also set aside on each tonne of wood, paid half by Mt Romance, and half by Aveda. For Aveda, this amounts to paying approximately $25/kilo more for Australian sandalwood oil. These funds are placed in a revolving Capital Works Fund, audited by the Songman Circle of Wisdom, and held by Mt Romance. Funds are provided as interest-free loans, and allow communities to invest in local capacity and engage more effectively in the sandalwood trade, as well as address basic community needs. Examples include equipment such as de-barking machines, four wheel drive vehicles, and lifters to pull trees out of the ground with minimal environmental damage.

In the case of Albert and Norma Philips, who hold a lease on unallocated crown land, approximately 300 miles from Perth in the semi-arid Paynes Find region, supply of $9,000 worth of equipment to meet new harvesting and environmental requirements meant that their capacity, and license, was increased to 100 tonnes/year. The Kutkabubba community has secured a private property license on a larger area of land than previously possible, and the Yamatji and Bondini people have built jobs and training for youth into their sourcing, including building cultural awareness and promoting teaching by Elders and collectors. Support for the sandalwood trade within Aboriginal communities is also a way to help people to stay on their land, and make a decent living. Additional enterprise development is also supported by Mt Romance and Aveda. For example, a 500 ha project has been established with the Kutkabubba community in Wiluna to plant out sandalwood and other indigenous medicinal plants in order to develop other forms of local enterprise. Aveda also makes grants for basic

needs in collaborating communities, including recently a mobile solar-powered de-salination plant.

Aveda works on a number of levels to create a wide range of benefits for communities and conservation. More equitable prices paid for raw or processed materials, capacity-building, and supply of equipment and other materials for sourcing or basic community needs, are part of a package of immediate benefits that result from sourcing. In addition, the company seeks to link producers with a wider range of companies/buyers and certifiers, providing them with a rare commodity for communities – market access. For example, in Nepal Aveda worked with the Federation of Community Forestry Users (FECOFUN), Asia Network for Sustainable Agriculture and Bioresources (ANSAB), Himalayan Bio Trade Private Limited (HBTL), Enterprise Works/VITA, and Smartwood/FSC, to facilitate community owned paper making from sustainable sources of Lokta bark, and trade in other certified natural products. (www.fecofun.org; www.enterpriseworks.org; www.asnab.org; www.himalayanbiotrade.com; www.rainforest-alliance.org). As one partner in the initiative comments: "Aveda's willingness to provide industry expertise, guidance in product development and linkages with the herbal products industry is a contribution that goes beyond a traditional seller/buyer relationship" (The Canopy, 2004).

Aveda also works with indigenous peoples and communities on broader land rights, and increasingly provides linkages between communities and groups working on carbon sequestration and ecosystem services. In Brazil, for example, Aveda has worked with the Yawanawa people for 15 years, and recently assisted them in demarcating and monitoring their land, and defending claims on their land by logging companies. They are also brokering links between the community and groups working on carbon conservation (David Hircock, Aveda, pers. comm., 2007).

Use of images

The use of indigenous peoples' images and cultural property in commercial marketing, without their prior informed consent, is a common problem in the personal care and cosmetic, botanicals, and other sectors. To address this problem, and allow for the use of sandalwood harvesting (not cultural) images in its marketing, Aveda worked with the Kutkabubba community in Wiluna to get approval for the use of approximately 10 images that might, at some point, be used in marketing. In Brazil, Aveda has signed a more formal written agreement with the Yawanawa, setting terms for the use of their images in marketing.

Benefits for companies

In addition to fulfilling socially and environmentally responsible missions, and returning benefits to the lands and communities where sandalwood is sourced, Mt Romance and Aveda benefit from their partnerships with communities in a number of concrete, commercial ways: they secure access to biomass, and in the case of sandalwood a raw material in short supply; they provide customers with the certified products they seek; and they benefit from the story associated with community-based sourcing of raw materials, and the way this distinguishes products, and the company, in the marketplace.

Conclusion

Although sandalwood is a widely known and used species, and 'prospecting' did not occur, the web of partnerships that make up this case highlight important aspects of ABS 'best practice' associated with raw material ("biological material") sourcing in this sector. These include significant consultations with a range of communities and groups on the contours of proposed partnerships; provision of a range of monetary (eg more equitable prices, royalties into a fund) and non-monetary (eg equipment, training, access to markets) benefits; attention paid to state and national laws, as well as prominence given to customary law and decision-making practices; and prior informed consent associated with the use of images in marketing.

Community-based partnerships for raw material sourcing remain the exception in all sectors, however, with large-scale commercial agriculture, or purchase of raw material on the open market, with no questions asked, representing cheaper, more reliable (in the short term), and easier alternatives. Even companies trying to "do the right thing" often source a large portion of raw material in this way. It is clear that incentives must be in place to allow companies to invest in these types of partnerships, including the ability to tell their story and position themselves as unique within the market, or to secure raw material in short supply. Critical to implementing best practice in the personal care and cosmetic, and botanicals, sectors (unlike the pharmaceutical, biotech, or seed, for the most part) is demand from educated consumers for sustainable and equitable raw materials in their 'natural' products, and the role of certifiers in ensuring that claims are accurate.

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Case Study 6.

Natura, Brazil: The Use of Traditional Knowledge and Community-Based Sourcing of "Biological Materials" in the Personal Care and Cosmetics Sector

Natura

Natura was founded in 1969 in Sao Paulo Brazil. In 2006, net revenues were R$2,52 billion, the company had roughly 600 products on the market, and 5,100 employees. Investment in research and development in 2006 was roughly 3.2% of net revenue, totaling R$80 million. Natura products are sold throughout Latin America, and more recently in France. They include cosmetics, personal hygiene, and perfume products. In 2004, Natura went public, and was listed on the Sao Paulo stock exchange. This follows a pattern of socially-responsible companies founded in the 1960s and 1970s subsequently taken over by larger companies, or going public, beginning in the mid-1990s[1] (UNEP, 2005).

The EKOS Line

In 2000, Natura founded the EKOS Line, which "draws from the wealth of Brazil's biodiversity and is inspired by traditional uses of plant ingredients." The products include soaps, shampoos, conditioners, moisturizers, and perfumes, and the line is intended to "increase awareness of the richness of our environmental heritage for future generations and stimulate the development and quality of life of the communities that cultivate or extract those ingredients" (www.natura.com).

The EKOS line includes 14 ingredients/raw materials sourced from a range of communities around Brazil. The ingredients sourced from communities include Cumaru, Pariparoba, Copaíba, Mate Verde, Murumuru, Guaraná, Priprioca, Breu Branco, Cupuaçu, Pitanga, Maracujá, Andiroba, Castanha, and Buriti.

Sustainable sourcing of raw materials in partnership with communities

The EKOS line is based on a commitment to use local biodiversity, and sustainably source raw materials from communities. This means that the company has invested in a range of sourcing partnerships to develop sustainable supplies of raw materials. Communities from which materials are sourced, and the number of families involved in the sourcing of raw materials, is found in Table 1. Natura facilitates partnerships between communities and the local FSC-certifier, IMAFLORA, for certification of forest products, and considers certified raw materials an important element of the EKOS line, and a way to inform consumers about the sourcing practices associated with their products. Natura has also expanded collaborations with certifiers to include

[1] Mother Earth founded in 1975, taken over by Cadbury Schweppes in 2001; The Body Shop founded in 1976, and going public in 1984; Ben and Jerry's and Aveda founded in 1978, and taken over respectively by Unilever in 2000, and Estée Lauder in 1997; and Stonyfield Farm founded in 1983, and taken over by Danone in 2003 (UNEP, 2005).

the Sustainable Agriculture Network (SAN) and the Institute of Biodynamics (IBD) for agricultural or plantation sources.

Table 1. Raw Material Sourcing for the EKOS Line

Community-region	Ingredients/ raw materials sourced	Number of families involved in sourcing
Médio Juruá – Amazonas	Andiroba Murumuru	250
Iratapuru – Amapá	Castanha Copaiba Breu Branco	27
Entorno de Belém – Pará	Priprioca	50
RECA – Acre	Cupuaçu	340
Ilhéus – Bahia	Guaraná Cacau	XX
Ervateira Putinguense – Rio Grande do Sul	Mate	Private company
Chamel – Paraná	Camomila	Private company
Fazenda Alpina – Sao Paulo	Pitanga	Private company
Flora do Brasil – Minas Gerais	Maracujá	Private company
Mil Madeireiras – Amazonas	Louro Rosa	Private company

Source: Pommez, 2005

Use of traditional knowledge

Traditional knowledge is used by Natura to inspire the development of new ingredients (or, more commonly, new applications for existing ingredients), and to develop sustainable management and harvesting strategies for species. The company accesses traditional knowledge through collaborations with ethnobotanists or ethnopharmacologists within universities (eg University of Sao Paulo, University of Campinas, and University Federal of Santa Catarina and through academic publications and databases. For example, the company incorporated an extract of the leaf of Pariparoba that grew from work with the University of Sao Paulo, and is now sourced through a community in the Atlantic Forest. The company also directly works with communities to access traditional knowledge (eg Iratapuru for Breu branco), and has collected widely-known traditional knowledge in markets such as Ver-o-Peso in Belem.

National ABS measures

Natura's partnerships with communities for the sustainable supply of raw materials, and its use of traditional knowledge to develop new ingredients or products, pre-dated Brazilian ABS legislation. Prior to any legal framework, the company established a package of benefits and equitable practices that included: 1. paying a more equitable price for raw and processed materials; 2. providing training and capacity-building in agricultural techniques, and equipment and other materials to add value to raw materials, in order to promote greater benefits within the community; 3. supporting and assisting with the development and administration of

community associations; 4. seeking prior informed consent and payment before using any images of people from communities in marketing; and 5. setting up funds in communities through allocation of .5% of net sales; this is seen as an investment Natura makes in particular communities, and has been established in only one community to date, Iratapuru, and another is pending. Intellectual property rights, whenever developed, have been held by Natura, with the exception of joint product development with universities, in which case the IPRs are shared between the parties, or held by the university (eg Pariparoba) (Anita Campos-Jacob, Natura, pers. comm.., 2007). Natura has a policy of not taking patents out on ingredients, and only patents the proprietary process of extraction, or cosmetic formulations (Philippe Pommez, pers. comm., 2007).

Natura's work helped to inform the development of national ABS measures. Once these measures were in place, however, Natura required consent from the administering body, CGEN, for both existing and any new sourcing partnerships, and those that involve accessing traditional knowledge (including Natura's previous arrangement with the Ver-as-Ervas Association; see below). It is now a requirement that companies present proposals for accessing and commercializing biological resources (not just genetic resources), including sourcing partnerships for raw materials, and that a benefit-sharing plan be in place. The ABS legal framework continues to evolve, however. In December 2007, CGEN launched a public consultation to review the effectiveness of the ABS measure, including minimizing the bureaucracy associated with the law.

Today, Natura has more authorized agreements before the CGEN than any other company. The company also enters into agreements that address rights to use images of local groups in their marketing, as required under the Brazilian Federal Constitution, and - for the use of cultural expressions - as governed by UNESCO Conventions (Anita Campos-Jacob, pers. comm., 2007)

The company distinguishes between different types of relationships and benefits that result for local groups: 1. *Access Agreements* for genetic resources and traditional knowledge that include benefit sharing in non-monetary forms, as well as a percentage of net revenue; 2. *Local Development* projects that include investments made by Natura in specific communities to build local institutions and capacity, not tied directly to accessing genetic resources or traditional knowledge; 3. *Supply partnerships*, which do not involve ABS agreements but include support for production and harvesting of raw materials, and facilitation of links between communities and third-party processors, from whom Natura buys processed products such as oils or extracts. In these cases, communities are not required to exclusively sell raw materials to Natura, and the company encourages additional buyers.

The Natura – Ver-as-Ervas Agreement: the Commercial Use of Traditional Knowledge

In 2001, Natura staff collected information in the Ver-o-Peso market in Belem on a range of useful plants. Species incorporated into Natura products from this exchange included Breu branco, a resin produced from insect-damaged trees, used traditionally as incense and in art work and handicrafts, and extracted from the forest in Iratapuru; Breu branco became an ingredient in a fragrance. Priprioca, used traditionally as a perfume, and now grown in certified sustainable farms around Belem, is also used in a fragrance.

At the time, company staff thought widely known and used traditional knowledge of the kind found in markets was not subject to access and benefit-sharing agreements, although the company did give the market association – Ver-as-Ervas – acknowledgement in its materials, and a verbal agreement was reached. As the ABS policy environment evolved in Brazil, however, and awareness grew of the importance of compensating traditional knowledge holders for the use of their knowledge, the women of Ver-as-Ervas started an administrative procedure before the competent authority in order to claim benefits associated with the use of knowledge they supplied. Natura negotiated an agreement to pay royalties, and provide an up front payment. This agreement has been signed by Natura and Ver-as-Ervas, but has not yet been approved by CGEN, given the complexity of the issue and lack of clear legal guidance on access and benefit-sharing associated with traditional knowledge.

Through this process, Natura built its own internal capacity to deal with prior informed consent associated with traditional knowledge, and developed ways to engage with local groups to achieve truly informed consent, including explaining the Brazilian ABS legislation through theatrical performances, and hiring economists and lawyers selected by communities to work on their behalf (Philippe Pommez, pers. comm., 2007; Anita Campos-Jacob, pers. comm., 2007).

The Natura-Iratapuru Agreement: Sustainable Sourcing Partnership

The Iratapuru community is found in Amapá State, and is comprised of 27 families, living in an 800,000 hectare extractive reserve. The community is made up of 26 caboclo (mixed ethnicity) families. Natura began working in Iratapuru in 1999 to source brazil nuts. Natura worked with the community for three years to support the process of acquiring FSC certification, and contacted an international company, Cognis, to purchase nuts from the community, process them into oil, and sell the oil to Natura (at a premium price shared with communities). In 2005, Natura set up a press within the village to add more value there. The community undertakes a first extraction of the oil, which it then sells to Cognis. In addition, Natura provides funds to the Iratapuru community association, set up in 2005, and fed by .5% of net sales of products supplied by Iratapuru, including copaiba, brazil nuts, and breu branco.

Lessons learned by Natura

When it started the EKOS line, Natura used 12 ingredients from local biodiversity, and worked with 12 communities to source these materials. Over time, the company found that it is important to work with communities that are organized, with an association, and to not deal with an individual or small group within a community. They also learned that concentrating on a few communities initially made more sense, as did sourcing a number of different products from a single community, in order to diversify their livelihood sources and reduce their risk. The third key lesson was that the company had to change the way they do business in order to source raw materials from communities. This included changing expectations in terms of deliveries, particularly for products that might be available during a single period a year; and providing payment in advance to allow communities to purchase, for example, gas for the boat engine to get on the river or into the forest. The company also realized that it was not possible to incorporate any new and exciting ingredient without also developing a plan for the sustainable supply of the raw material (Philippe Pommez, pers. comm., 2007).

Conclusion

Like Aveda - and the handful of companies that have committed real resources and energy to developing sustainable and equitable community-based supplies of "biological materials" in the personal care and cosmetic, botanicals, fragrance and flavor, and food and beverage sectors - Natura's commitment to source raw materials for its EKOS line solely through communities required a dramatic shift in business practice. In order to support this shift, the role of certifiers was critical, providing confirmation of Natura's hard-earned claims, and thereby real distinction in the marketplace, in contrast to the often inflated or inaccurate claims of competitors in this sector to have "sustainable" and culturally-appropriate sourcing practices.

In this case, Natura also addressed the use of traditional knowledge as a starting point for new product development, within the framework of an evolving ABS regime. In a short period of time the company – and the private sector at large – experienced a dramatic shift in how traditional (even common and widespread) knowledge was viewed, and the appropriate ways to receive consent and compensate for its use. Most companies in these sectors have yet to catch up to new ethical and legal realities. Natura adjusted its agreement with Ver-as-Ervas in light of these changes, but national ABS measures are still in flux. Regulating the use of TK is a far more complex undertaking - and one with few examples to provide guidance - compared with regulating genetic or biological resources.

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Case Study 7.

The Commercial Development of *Hoodia*[2]

1. Introduction and Background

The complexities of partnerships, and the difficulties of regulating and implementing access and benefit sharing are vividly demonstrated in the case of *Hoodia* species, succulent plants indigenous to southern Africa and long used to stave off hunger and thirst by the indigenous San peoples, the oldest human inhabitants in Africa (White and Sloane, 1937).

This knowledge was published by colonial botanists and led to the inclusion of *Hoodia* in a 1963 project on edible wild plants of the region undertaken by the South African-based Council for Scientific and Industrial Research (CSIR), one of the largest research organisations in Africa[3]. In 1995, after a lengthy period of development, the CSIR patented use of the active constituents of the plant responsible for suppressing appetite, without the consent of the San[4]. CSIR proceeded in 1998 to grant a license for the further development and commercialization of the patent to the U.K.-based company Phytopharm.

Through a programme dubbed "P57" Phytopharm developed the lead to a more advanced stage, leading to a license and royalty agreement with Pfizer, the US-based based pharmaceutical giant. However, the closure of Pfizer's Natureceuticals group led to the later withdrawal of Pfizer from the agreement. In 2004 a joint development agreement was negotiated between Phytopharm and the consumer giant Unilever. Unilever intends to develop extracts from the active ingredients of the plant and incorporate these into a functional weight-loss food for the mass market. Developments are at an advanced stage and have included clinical safety trials, manufacturing and the cultivation of some 300 ha of *Hoodia* in South Africa and Namibia. Recently, Phytopharm announced the initiation of Stage 3 activities, including supply chain expansion and the inclusion of consumer studies. Much is at stake: the global value of functional foods, meaning "any modified food or food ingredient that may provide a health benefit beyond the traditional nutrients it contain" (American Dietetic Association, 1995) or, more popularly, "better for you" applications, is estimated at US$65 billion (Phytopharm, 2007). The market value for the dietary control of obesity is over US$3 billion per annum in the United States alone (Phytopharm, 2003).

A parallel *Hoodia* market, has also emerged in the past 3-4 years, based on trade in raw material. The publicity generated by the CSIR-Phytopharm-Unilever agreements, the marketing opportunities of San use of the plant, and the patent awarded to the CSIR led to a frenzied interest in *Hoodia* amongst plant traders. By 2004 concerns about the threats posed to natural populations through unregulated collection led to

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[2] This case study draws substantially from Wynberg (2004) and Wynberg and Chennells (2008).
[3] See www.csir.co.za
[4] South African Patent No. 983170. This was followed by the granting of international patents in 1998, GB2338235 and WO9846243: Pharmaceutical compositions having an appetite-suppressant activity.

the inclusion of *Hoodia* spp. in Appendix II of the Convention on International Trade in Endangered Species of Wild Flora and Flora (CITES) (CITES, 2004). By 2006 trade had escalated exponentially—in many cases illegally—from just a few tons to more than 600 tons of wet, harvested material per year, sold as ground powder for incorporation into non-patented dietary supplements. In North America in particular, dozens of *Hoodia* products were sold as diet bars, pills, drinks, and juice, traded by a myriad of companies "free-riding" on the publicity and clinical trials of Phytopharm and Unilever. The CSIR patent was focused on the *Hoodia* extract, and nothing prevented other companies from simply selling the raw material for incorporation into herbal supplements. Most products were of dubious authenticity, contained unsubstantiated quantities of Hoodia, made unfounded claims, and in many cases implied association with the San, who received no benefits. Concerns led to closer analysis of products by the Food and Drug Administration (FDA), which revealed many to have little or no *Hoodia*, and to lack adequate evidence of safety (FDA, 2004). The US Federal Trade Commission (FTC) also brought action against spammers sending e-mail messages about *Hoodia* weight-loss products, alleging that the claims made for the products were false and unsubstantiated (FTC, 2007). In South Africa and Namibia, illegal trade and harvesting of *Hoodia* resulted in a number of prosecutions and arrests; the high prices commanded for the dry product of up to US$200 per kilogram had led to the incorporation of the plant into a global underground network of diamonds, drugs and abalone.

Increasingly, however concerns about the quality and safety of material sold as *Hoodia*, joined with over-harvesting concerns and recognition of the need to ensure the sustainability of *Hoodia* supply have led to a more regulated industry based on cultivated material. Greater vigilance on the part of the FDA and FTC as well as the American Herbal Products Association is rapidly reducing the number of illegitimate products on the US market, and regulators in South Africa, Namibia and Botswana have introduced permitting procedures which prohibit wild harvesting of *Hoodia*, require its transparent cultivation, and set in place mechanisms to track trade across borders.

2. The Types of Resources Utilised: Diverse Approaches to Commercialisation

As described above, the commercial development of *Hoodia* is based on two approaches: (1) a patented *Hoodia* extract, under development by Phytopharm and Unilever as a functional food; and (2) commercialisation of *Hoodia* as a raw, ground up material through incorporation into herbal supplements.

The industry sectors that develop and commercialise *Hoodia* material are thus very different, the former representing the food industry, represented by the largest consumer company in the world; and the latter the herbal supplements market, which is characterised by a large number of relatively small players with extremely divergent policies and ethics.

The economics between these sectors are also vastly different. For Unilever, the focus is on safety and efficacy and the company places emphasis on having sufficient active material to achieve effective weight loss. This is estimated by Unilever to be orders of magnitude greater the amounts currently sold in herbal supplements (K. Povey, Unilever, pers. comm., 2007). Thus Unilever requires vast amounts of

material, and has already planted several hundred hectares of *Hoodia* material, with plans to significantly expand these volumes. Far less material is used for the herbal supplement market, and this combined with the fact that it comprises a much larger group of smaller growers and traders, means that the *Hoodia* industry operates using different economies of scale. This could lead to the emergence of two price structures for consumers, as has emerged for plant sterols: (1) a higher price for supplements, based on low volumes; and (2) a lower price for food, based on high volumes (K. Povey, Unilever, pers comm., 2007). For *Hoodia*, much will depend on how much active ingredient is needed for efficacy, and consumer demand for the product.

3. Navigating Prior Informed Consent and the Access and Transfer of Genetic Resources

Obtaining PIC from government

Although access arrangements vary between these two approaches to commercialisation, there are similarities. Both approaches, at least initially, required access to wild *Hoodia* material, and thus the permission of government departments. The first accessions by the CSIR of *Hoodia* material would have taken place in the 1960s, however, long before any CBD requirements and involved a local research institution (the CSIR) partly funded by government. Later acquisitions of wild material would also have been done by the CSIR, collecting directly from private or public lands for research purposes in South Africa and Namibia, requiring collection permits. The involvement of Phytopharm as a license holder occurred only after the lodging of a patent by the CSIR, and thus the CSIR took primary responsibility both for collecting and negotiating consent with landowners and government at the research stage, prior to the development of a licensing agreement. In South Africa this was done initially at provincial level through request to the Northern Cape Directorate of Nature Conservation to collect *Hoodia* species for their intended commercialisation. In this case, a conventional permitting process led to the CSIR being granted permits for the collection of *Hoodia gordonii*, subject to resource assessments being undertaken and various environmental conditions being met (E. Powell, Northern Cape Nature Conservation, pers. comm., 2002).[5]

At the commencement of the contract between CSIR and Phytopharm for the commercial development of *Hoodia* in 1998, requests were made to the Department of Environmental Affairs and Tourism (DEAT) –the South Africa 'national focal point' for bioprospecting – for permission to develop a bioprospecting agreement. According to the CSIR, the response from DEAT was to acknowledge the lack of legislation in place to govern bioprospecting, but to suggest that the intended commercial collaboration be pursued through law of contract, so as to have case

[5] As the Hoodia industry has evolved and matured, a more sophisticated permitting system has developed for the harvesting and cultivation of Hoodia, and in parallel, government departments in provider countries have engaged more actively in ensuring compliance with ABS requirements. Phytopharm, Unilever and Hoodia growers have also taken a more active role in overseeing permits and working directly with the South African, and more recently, Namibian governments.

studies from which to learn for future policy development (M. Horak, CSIR, pers. comm., 2002).

Obtaining PIC from traditional knowledge holders

While certain administrative procedures were followed by the CSIR to obtain the consent of government bodies responsible for regulating bioprospecting and the collection of biological material, the CSIR was clearly remiss in following similar procedures with the San, holders of traditional knowledge about the appetite suppressing properties of Hoodia. In fact, until 2001, agreements for the further development and commercialisation of the *Hoodia* drug had proceeded apace without acknowledgement of the contribution of the San, let alone their prior informed consent. Indeed, a newspaper report quotes Phytopharm having been told by the CSIR that the 100 000-strong San "no longer existed" (Barnett, 2001). In defence of its position, the CSIR linked its initial reluctance in engaging with the San to a concern that "expectations would be raised with promises that could not be met" (Barnett, 2001) and insisted that the organisational policy on bioprospecting was to eventually share benefits of research based on traditional knowledge. How, it was argued by the CSIR and Phytopharm, could the real owners of traditional knowledge be identified, and what if one group had historically stolen the knowledge from another group? The potential complexities and scenarios seemed endless.

While such concerns were undoubtedly valid they were clearly also in flagrant disregard of the International Labour Organisation (ILO) Convention 169 – an international agreement for the protection of indigenous peoples' rights, the letter and spirit of the CBD, the African Union's Model Law on Access and Benefit Sharing (Ekpere, 2001), and the Bonn Guidelines, a voluntary guide to assist governments to develop an access and benefit-sharing strategy, as well as necessary legal, administrative or policy measures (CBD, 2002). Although not overtly stated by the San, who to a large degree remain on the fringes of international indigenous peoples' movements, they also ignored numerous indigenous peoples' declarations and statements which explicitly refer to the importance of obtaining prior informed consent from holders of traditional knowledge before commercialisation of this knowledge; and ensuring that benefits derived from commercialisation are equitably shared with original holders of the knowledge (see Dutfield, 2002 for a review of such statements).

But in 2001, ongoing vigilance by a South Africa-based NGO Biowatch, combined with assistance from the international NGO Action Aid, alerted the foreign media to the potentially exploitative nature of the CSIR/Phytopharm agreement and a leading story was published in a British newspaper. This catalysed a flurry of media interest, which pressurised the CSIR to enter into negotiations with the San, who had remained oblivious to the fact that their knowledge of *Hoodia* had commercial application and that this knowledge had led to research, scientific validation, and the filing of international patents.

On the part of the San, the following three organisations played – and continue to play - significant roles throughout the case:

– the Working Group of Indigenous Minorities in Southern Africa (WIMSA), the San networking and advocacy organisation established in 1996 at the request of San groups in the region to lobby for San rights;

– the South African San Council, a voluntary association established as part of WIMSA by the three San communities of South Africa (the =Khomani, !Xun and Khwe) in November 2001; and

– the Cape Town-based South African San Institute (SASI), a San service NGO facilitating access of San-based organisations to funding and expertise.

As a South African state institution, the CSIR was reluctant to negotiate with parties outside the country, and through WIMSA, the South African San Council was formally mandated to represent the San in Namibia and Botswana as well as South Africa in all benefit-sharing negotiations about *Hoodia*. With this arrangement in place, recognition was given to the fact that knowledge about the plant crossed national borders, and that the details of sharing benefits between San in different countries needed further consideration. WIMSA and SASI instructed their lawyer to negotiate with the CSIR on behalf of the San, and discussions between the two parties began in earnest.

4. Negotiating a benefit-sharing agreement with the CSIR

Negotiating a Memorandum of Understanding

Early on in the negotiations, the San were faced with a difficult choice. Should they oppose or even challenge the patent, based on ethical considerations and lack of novelty, or should they adopt a more practical approach and become active partners in negotiating a share of royalties from the patent? This was a critical moral dilemma. In communities such as the San, the sharing of knowledge is a culture-defining attribute and is basic to their way of life. Traditional knowledge of plants is viewed as a collective and the idea of 'owning' life abhorrent. The patenting of active compounds of *Hoodia* by the CSIR ran counter to this belief, yet brought with it lucrative opportunities for financial benefits. Ultimately, however, the principle of 'no patents on life' was considered 'too expensive' (Chennells, 2003) and the poverty-stricken San opted to obtain a share of royalties. Writing to the CSIR President in 2001, the CSIR was informed by San lawyers that a legal challenge of any nature did 'not form part of our clients' plans', but emphasised that the San looked on their traditional knowledge regarding *Hoodia,* as well as other plant uses, as being collective San intellectual property that should not morally be able to be owned by any individual or entity (Chennells, 2001)[6].

Three months after formal commencement of negotiations, in February 2002, a Memorandum of Understanding (MOU) was reached between the CSIR and the South African San Council. Key aspects of this agreement included:

- an acknowledgement by the CSIR that the San are the 'custodians of an ancient body of traditional knowledge and cultural values, related *inter alia* to

[6] Of interest, is the subsequent appeal against the patent by the European Patent Office, on the basis of it lacking novelty and being based on prior art. The appeal was subsequently overturned, however.

human uses of the *Hoodia* plant', and recognition that such knowledge pre-dated scientific knowledge developed by Western civilization over the past century;

- a commitment by the CSIR to (1) recognise the role of indigenous peoples as custodians of their own knowledge, innovations and practices; and (2) provide for fair and equitable benefit sharing;

- an acknowledgement and acceptance by the San of the explanation of the CSIR, which provided the 'context' in which the CSIR first registered the P57 patent, without having first engaged the San in negotiations with respect to material transfer, information transfer and associated benefit sharing;

- recognition by the CSIR of the San as originators of the body of traditional knowledge associated with human uses of *Hoodia*;

- a specification that any intellectual property arising from the traditional use of Hoodia and related to the CSIR patents for P57 remains vested exclusively with the CSIR. The San Council has no right to claim any co-ownership of the patents or products derived from the patents; and

- a commitment, on the part of both the CSIR and the San, to a process of negotiating with one another in good faith, in order to arrive at a comprehensive benefit-sharing agreement.

It was also agreed that both parties would provide each other with full disclosure of any 'matters of significance' relating to the agreement, and that all relevant disclosable information held by the CSIR relating to the P57 patent and subsequent licensing agreements would be made available to the San.

An additional understanding considered the San and the CSIR to be the primary parties with regard to benefit sharing. This latter point is especially significant because it effectively excluded other groups – genuine or opportunist – from claiming benefits through prior knowledge about *Hoodia.* While this helped to address earlier concerns expressed by the CSIR and Phytopharm of the need to identify genuine holders of traditional knowledge about the plant, it also raised new concerns from some commentators about excluding non-San groups, such as the Nama, Damara, and Topnaar, who had historically occupied, and still occupy, areas where *Hoodia* grows, and had undoubtedly used the plant as a medicinal remedy and as a food and water substitute.

Developing positions and identifying key issues of concern

While the MOU represented an important first step, negotiation of a concrete benefit-sharing agreement was still some way off. At a series of CSIR-funded workshops and meetings, representatives of the San, the CSIR, and in some cases certain government departments and NGOs, were brought together to further articulate concerns and positions (e.g. Spies, 2002). Key issues arising from these discussions focused on three main themes:

1) building trust between the parties;

2) identifying genuine holders of traditional knowledge about *Hoodia* and potential beneficiaries; and
3) ensuring the broader protection and promotion of San cultures and knowledge.

Building trust

The development of trust between the CSIR and the San emerged initially as a major concern (e.g. Spies, 2002), more especially given the CSIR's history as an institution shaped by the *apartheid* regime, and serving the interests of a repressive government for nearly 40 years. While transformation of this state institution is now well underway, its initial inertia in drawing the San into the project created mistrust and negative impressions amongst the San. Questions raised during this process focused on how the San could be assured that they would receive appropriate royalties and other benefits, and how they could trust that they would have access to all the necessary information. At an early stage in the negotiations the South African San Council alluded in writing to the CSIR's alleged collusion with the *apartheid* regime, as a potential problem in their building of trust. This was met with an outraged response from the CSIR Board, but the frank exchanges that ensued enabled the parties to clear the air and thereafter develop a more trusting relationship as they moved towards a final agreement (Private notes, R. Chennells).

Identifying holders of traditional knowledge and beneficiaries

The San immediately commenced a process amongst communities represented by WIMSA to establish the extent to which *Hoodia* was known and used. Responses from far flung communities in South Africa, Namibia and Botswana confirmed published records that *Hoodia*, known as *!Xhoba* to the San, was still well known and used for a number of purposes, and chiefly as a sustaining *veld*[7] food that also reduced hunger and thirst (Private notes, R. Chennells). Some informants cautioned about the danger of feeding the plant to small children for sustained periods, but otherwise it was confirmed to have a safe and ancient history. This bolstered the belief of the San, as the first peoples on the subcontinent, that their traditional knowledge of *Hoodia* had predated that of pastoralists who had subsequently entered and settled in Southern Africa. The San view was that they had shared knowledge with all subsequent migratory groups, and were thus the primary holders of traditional knowledge relating to *Hoodia*.

Despite this opinion, parties were anxious of the potential conflict that could arise between the San and other groups such as the Nama and Damara. Because both the plant and traditional knowledge about its use extend across Namibia, South Africa and Botswana, this matter was potentially especially complex and fraught. How could a system be created that ensured fairness and equity across the three countries, and within the relatively new organisational structures set up by different San groups in different countries? The restricted distribution of *Hoodia* suggested that not all groups of the San had utilised the plant within living memory. But identifying those groups that did have a clear record of historical use was near impossible, given the San's history of resettlement and dislocation over millennia, and also the manner in which the San have historically moved about the landscape, aggregating and dispersing according to season and resource availability (Hitchcock & Biesele, 2001). Moreover, thousands of people in southern Africa currently claim San descent, and are able to claim a recent history of use of *Hoodia.* Knowledge about the appetite-suppressant properties of *Hoodia* is shared among a broad spectrum of communities

[7] An Afrikaans word meaning uncultivated lands or grassland.

in the region, including the Nama, Damara, and other Khoe speaking peoples, who share the same linguistic roots with the San and have during the past centuries suffered a similar history of persecution and marginalisation.

Resolving these uncertainties presented difficult challenges but there was agreement amongst the San that a nit-picking exercise to link benefit sharing to specific communities using *Hoodia* would be futile and potentially divisive. WIMSA had taken a binding decision at an annual general meeting in 2001, after years of discussions, to the effect that heritage is indivisible, and that benefits resulting from shared heritage, such as *Hoodia*, must thus be shared equally amongst all San peoples. This decision led to a shared formula, decided collectively by the San during the negotiation process, for the equal division of financial benefits between the countries that WIMSA represents.

Protecting San culture and knowledge

More generally, the San sought further clarity about how they could more effectively protect their cultural heritage, including their world-renowned rock art, as well as their rich ethnobotanical and environmental knowledge. In the years preceding the benefit-sharing agreement, the San-affiliated non-governmental organisation the South African San Institute (SASI) had begun to assist WIMSA to establish a code of conduct for research and researchers, and to ensure the control and protection of all San intellectual property (WIMSA, 2001; WIMSA, 2003). There was growing sensitisation and awareness amongst the San about the past appropriation of their knowledge over centuries, without acknowledgement or compensation. How, it was asked, had the CSIR obtained local knowledge of *Hoodia* without the San knowing, and how could such knowledge be protected from future exploitation? Although legislation to protect and promote indigenous knowledge systems was under development in South Africa at the time of the negotiations (and had been for at least five years), there had been no consultation with the San about its content and scope. The absence of legislation to protect holders of traditional and/or indigenous knowledge presented a major stumbling block, requiring the San to negotiate in the absence of any legal requirement for benefit-sharing agreements to be developed with owners of knowledge and/or biological resources. This gap in the South African legislature was subsequently filled by the introduction of the Biodiversity Act (10 of 2004) (Republic of South Africa, 2004) for which the supplementary regulations are still awaited. A similar situation pertained in other countries of origin, such as Namibia and Botswana, where no law was yet in place requiring benefit-sharing agreements.

On the part of the CSIR and government, the absence of legislation created uncertainties as to who should be party to the benefit-sharing agreement, and exactly how traditional or indigenous knowledge should be obtained or used. The CSIR stepped gingerly, unsure (and undoubtedly reluctant) about 'shedding their white coats' and entering into protracted negotiations, but politically obliged to do so. A primary concern for the CSIR was to ensure that the San leadership they engaged with was genuine and representative, and that their agreement with the San would not lead to a flurry of claims to the knowledge from third parties.

Represented by Petrus Vaalbooi, chair of the South African San Council, and one of the authors (Roger Chennells), acting as legal representative, a series of meetings ensued between the San and the CSIR. In March 2003, less than two years after commencing discussions, negotiations concluded on the specifics of a mutually

acceptable benefit-sharing agreement. Announcing the deal, Ben Ngubane, then South African Minister of Arts, Culture, Science and Technology, referred to its historical significance in 'symbolising the restoration of the dignity of indigenous societies', and in unleashing benefits by joining together owners of traditional knowledge and local scientists to add value to the biodiversity and indigenous knowledge systems of southern Africa. It was the 'right thing' to do, he said (Ngubane, 2003).

5. Benefit sharing

The CSIR-San benefit-sharing agreement

The parties negotiated at arm's length for eighteen months, the San initially claiming ten percent of the royalties, in response to the CSIR's early offer of three percent. Both parties argued strongly in favour of their positions, each listening to the other's position, reconsidering implications, moving steadily to ensure progress, and finally, reluctantly, settling on an agreed amount. In terms of the agreement[8], the San would receive six percent of all royalties received by the CSIR from Phytopharm as a result of the successful exploitation of products (Figure 1). This would be for the duration of the royalty period or for as long as the CSIR received financial benefits from commercial sales of the products (Provisions 1.5 and 2). The San would also receive eight percent of the milestone income received by the CSIR from Phytopharm when certain performance targets were reached during the product development period. In the event of successful commercialisation, these monies would be payable into a trust set up jointly by the CSIR and the South African San Council to raise the standard of living and well-being of the San peoples of southern Africa[9] (Figure 1). Monies received by the San would be extracted from royalty and milestone payments obtained by the CSIR, whereas profits received by Phytopharm and Pfizer would remain unchanged. Overall, therefore, the San would receive less than 0.03% of net sales of the product (Wynberg, 2004) although if successful this would still translate into millions of dollars.

Clear and transparent accounting procedures were required to be in place on the part of both the CSIR and the San Trust with regard to financial benefits paid by the CSIR and used by the San Trust. The Trust would include representatives of the CSIR, the =Khomani, !Xun and Khwe, other San stakeholders in southern Africa, WIMSA, a South African lawyer nominated by the South African San Council, and the Department of Science and Technology, with strict rules determining the distribution of funds to beneficiaries. Payments would not be made to individuals and would need to be used to attain the aims and objectives of the Trust. No distribution of funds would be made to a beneficiary community or institution unless a request, approved formally by the Trust, set out a detailed budget and coherent plan, identified a bank account opened by elected representatives, with a proper constitution, and indicated the capacity to account fully for the proper expenditure of funds.

[8] Benefit-sharing Agreement between the CSIR and the South African San Council, March 2003.
[9] Deed of Trust of the San *Hoodia* Benefit-Sharing Trust.

It is noteworthy that the CSIR-San benefit-sharing agreement is confined almost exclusively to monetary benefits, which hinge on product sales and successful commercialisation, although there are general provisions relating to non-monetary benefits. These include a commitment by parties to conserve biodiversity and to undertake best-practice procedures for plant collection (Provision 3.6), required the CSIR to grant the San access to existing study bursaries (Provision 3.7), and, significantly, laid the ground for further collaboration in bioprospecting (Provision 3.8).

In addition to spelling out the details with respect to benefit sharing and administrative aspects such as accounting, the agreement also broadly covered intellectual property issues and, importantly, set out comprehensive measures to protect and indemnify the CSIR. 'Knowledge' was defined as 'the traditional knowledge on the uses of the *Hoodia* plant that occurs in Southern Africa, originally in the hands of the San people'. Provision 4 of the Agreement specified that 'any intellectual property that may be developed or created by the CSIR, including any patent, trade mark or plant breeder's right, as a result of any use of the traditional knowledge, shall be and remain vested in the CSIR'. Moreover, the San Council had no right to claim any co-ownership of the patents or products derived from the patents.

Provision 6, Warranties and Indemnity, included an undertaking and warranty by the San that, *inter alia,* it is the legal custodian of traditional indigenous knowledge on the use of *Hoodia;* that it would not assist or enter into an agreement with any third party for the development, research and exploitation of any competing products or patents; that it would not approach Phytopharm or Pfizer to obtain additional financial benefits; and that it would not contest the enforceability or validity of the CSIR's right, title and interest in the P57 patent and related products.

A further provision on Third Party Claims (Provision 9) set out various measures to protect the CSIR against claims by any third party for intellectual property infringement and stipulated that a successful third party claim against the CSIR could lead to a review of the agreement to accommodate claimants in the sharing of financial benefits. It also required the San Council to share financial benefits with a third party if the latter were successful in proving a claim.

In February 2005, the San Trust, formally named the San *Hoodia* Benefit-Sharing Trust, was registered. The content of the Trust document was discussed over several meetings, including a consultative conference at Upington, South Africa, in October 2003, during which San delegates from South Africa, Namibia and Botswana debated issues and agreed upon guiding principles relating to benefit sharing. There was unanimous agreement that 75 percent of all Trust income would be equally distributed to the then constituted San Councils of Namibia, Botswana and South Africa; that 10 percent would be retained by the Trust for internal and administration purposes; that 10 percent would be allocated to WIMSA as an emergency reserve fund; and that 5 percent would be allocated to WIMSA to cover administration of the San networks. Priorities within the region, such as education, leadership empowerment, and land security, were agreed upon as non-binding recommendations to the Councils. Principles for benefit sharing that would bind the Trust were unanimously endorsed by the WIMSA Annual General Meeting in December 2003 (WIMSA, 2004). The Trust began its work in earnest, electing a Chair, Secretary and Treasurer, and started engaging with the practical challenges of

distributing milestone income received from the CSIR, at that time a total of R560,000.

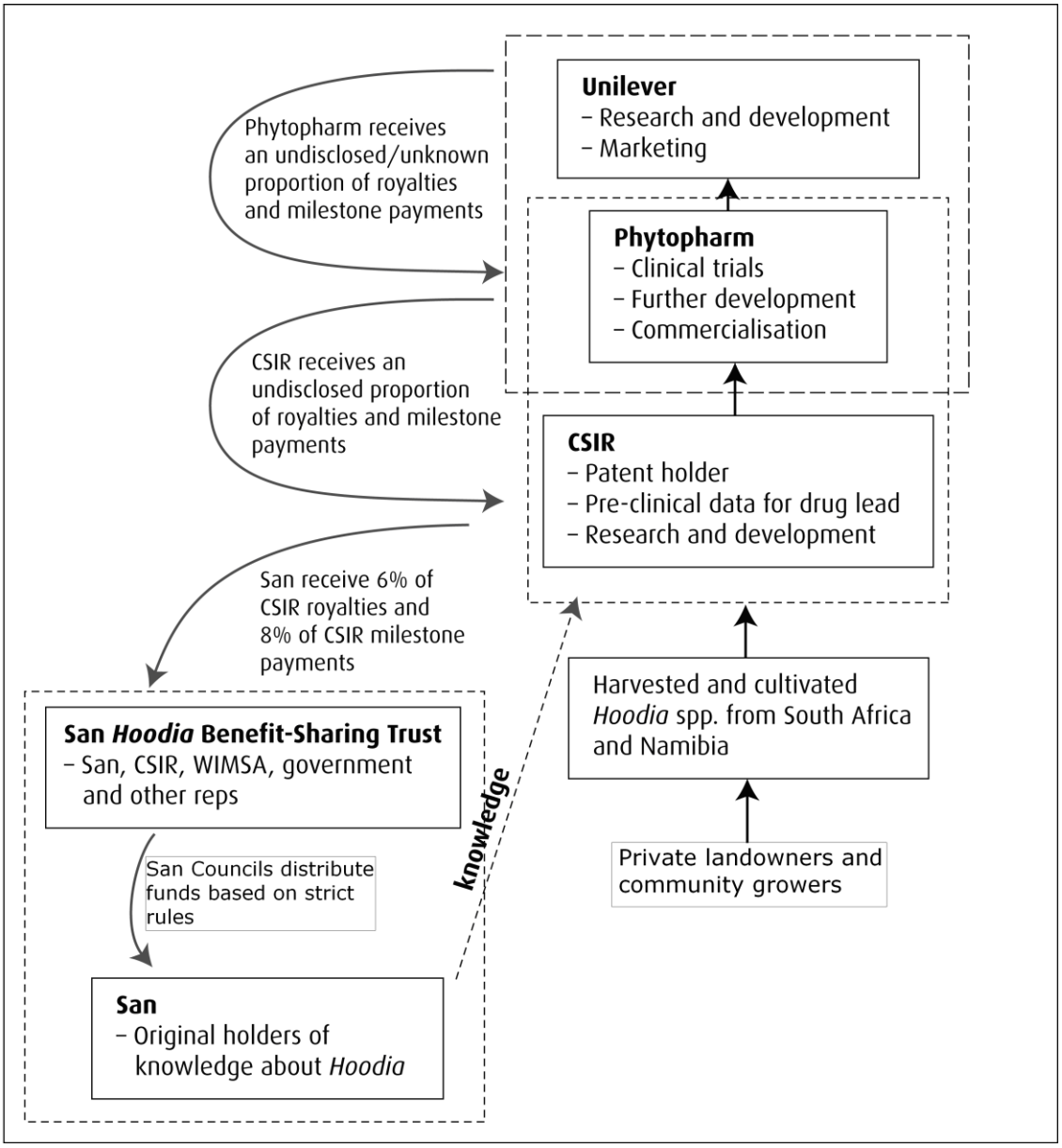

Figure 1. Benefit-sharing and value-adding under the San-CSIR-Phytopharm-Unilever agreements. After Wynberg (2006).

CSIR-Phytopharm-Unilever license agreements

What of the benefits for the CSIR? At the national level, these are purportedly substantial, although difficult to specify or verify owing to the confidentiality of the agreement and reluctance on the part of CSIR and Phytopharm to divulge these details. While CSIR and Phytopharm have been reimbursed for their continuing roles in research and development (R&D), these funds have been allocated largely to cover R&D costs and are not considered by the CSIR as income. Through licensing the technology, the CSIR is likely to earn $10-million in milestone payments, linked to success of the drug during different stages of the clinical trials. The specific

royalty percentage has not been divulged publicly but is considered by the CSIR to "be substantial" compared to international norms (M. Horak, CSIR, pers.comm., April 2002). Typically, royalty percentages for pharmaceuticals range from 0.5% to 5% of total sales (Laird and ten Kate, 1999). If successful, commercialisation of P57 is likely to amount to hundreds of millions of Rand *per annum* for the lifetime of the patent. In this regard many consider South Africa to have reached an important turning point in bioprospecting. Patent rights to the active constituents of *Hoodia* responsible for suppressing appetite have been successfully retained by South Africa through the CSIR (although notably, other *Hoodia*-related patents remain foreign-owned), with foreign drug firms attaining licences for the further development and commercialisation of the drug.

In terms of non-monetary benefits, some of the more significant benefits to emanate from the agreement have been the construction of the Food & Drug Administration (FDA) approvable medicinal plant extraction facility at the CSIR for the manufacture of material for use in clinical trials on P57, as well as the establishment of a Botanical Supplies Unit – both the first of their kind in the world. South Africa is also considered a preferential site for cultivation and the production of material, although Phytopharm does have the right to establish plantations outside of South Africa. Already, up to 300ha of *Hoodia* is cultivated in South Africa and Namibia, generating substantial jobs and investment, and a €30 million extraction facility for *Hoodia* is planned for development in the region.

Benefit Sharing and the Southern African Hoodia Growers Association

Benefit streams have also emerged from those involved in growing *Hoodia* for the herbal and dietary supplement market, with South African growers recently negotiating another benefit-sharing agreement with the San, based on a levy on processed *Hoodia*.[10] This process was initiated in late 2005 when the San were approached by a group of South African *Hoodia* growers who were cognisant of their obligations to share benefits with the San under the 2004 Biodiversity Act and its anticipated access and benefit-sharing regulations. The San realised that the new market for *Hoodia* as a food additive or dietary supplement was likely to grow over the years, and that they had a right to share in benefits. Because these products did not relate directly to the P57 patent and the use of *Hoodia* extracts, the San were legally able to sign an additional benefit-sharing agreement with *Hoodia* growers that was not in breach of their prior agreement with the CSIR. Negotiations commenced between the South African San Council (again acting on behalf of WIMSA), and the South African *Hoodia* Growers Pty Ltd (SAHG), which represented the interests of some commercial growers of *Hoodia* in South Africa who had agreed to comply with certain standards of best practice, safety, fair trade and benefit sharing. In March 2006 a preliminary benefit- sharing agreement was concluded with the SAHG. In terms of the agreement 6% of the gross value of *Hoodia* sold would be allocated to WIMSA – 4% into a Trust for the San, and 2% to WIMSA or the South African San Council. No member was permitted to sell to vendors engaged with the production or marketing of illegal *Hoodia* products.

[10] Benefit sharing agreement and joint venture between the Southern African Hoodia Growers Association and the Working Group of Indigenous Minorities in Southern Africa, March 2007. Unpublished signed legal agreement

Royalties of R176,000 trickled in from this agreement, but it was soon replaced with another more comprehensive initiative that included the majority of South African *Hoodia* growers as well as South African provincial environmental government agencies responsible for ensuring sustainable use of *Hoodia* and administering permits. After a year of negotiations, during which the different realities and negotiating positions of the respective parties emerged in an increasingly mature climate of transparency, a benefit-sharing agreement was concluded in March 2007 between the San and the newly formed Southern African *Hoodia* Growers Association (SAHGA). This had been preceded by the signing of a Memorandum of Understanding in January 2007 between the San (represented by WIMSA), *Hoodia* growers, and the Western Cape and Northern Cape environmental departments[11] which captured the intention of the parties as they entered negotiations.

The benefit-sharing agreement, drafted to be compliant with the provisions of the Biodiversity Act, acknowledged the San to be the primary traditional knowledge holders of *Hoodia*, having a legal right to share benefits arising from its harvesting, growing and marketing. It also recognised the urgent need for regulation to minimise impacts on wild populations and to ensure attainment of standards of legality, safety and fair trade. Stated objectives of the non-profit SAHGA were *inter alia* to regulate the legal production and harvesting of *Hoodia* by its members, in compliance with the CBD; to promote a sustainable *Hoodia* industry in southern Africa; to liaise with all roleplayers; to gather and exchange relevant information relating to permits, quality control, sales and compliance; and to promote research. Two San representatives were elected to be members of the Board of Directors, and an additional two San representatives were designated as observers. WIMSA in turn was to ensure the proper administration of financial benefits, and to further the objectives of SAHGA and help with effective marketing of *Hoodia*. Although the stated intention of the parties was to create an exclusive joint venture and benefit-sharing agreement, WIMSA was entitled, on good cause, to motivate to SAHGA for the signing of another, separate agreement. Parties additionally agreed to promote SAHGA as the only legitimate source of *Hoodia* for the food, food additive, and dietary supplement market, outside of the CSIR/Unilever agreement, and to 'inform the world' that *Hoodia* products outside of the two benefit-sharing agreements were illegal under the CBD. The agreement also, significantly, acknowledged other groups holding traditional knowledge of *Hoodia*, such as the Nama and Damara, and provided an opening for further discussions and possible agreements with such groups.

Financial benefits for the San were formulated based on a ZAR24 levy charged on each kilogram of dry, processed *Hoodia*, paid prior to the issue of CITES export permits and to be revisited on an annual basis. Calculation of the levy was based on a number of factors including the previous SAHG levy of six percent of the sale from the farm, as well as conditions in the world *Hoodia* market - recognising its high levels of fluctuation, the need for the levy to be affordable for growers, and other equity considerations. The agreement also provided for re-evaluation after one year, in recognition of the need for the eventual amount to be fair to both sides. Parties were fully aware that the original figure of six percent had been agreed upon with SAHG without the benefit of adequate knowledge about trade volumes, without extensive calculation of likely implications of percentages for all parties, and without sufficient reliable information to fix an appropriate percentage with surety. Conflict

[11] Signed unpublished legal agreement.

resolution was proposed through mediation or, failing this, through arbitration. The agreement, whilst negotiated in South Africa, was drafted in such a way as to welcome and enable the participation of *Hoodia* growers from neighbouring Namibia and Botswana in due course.

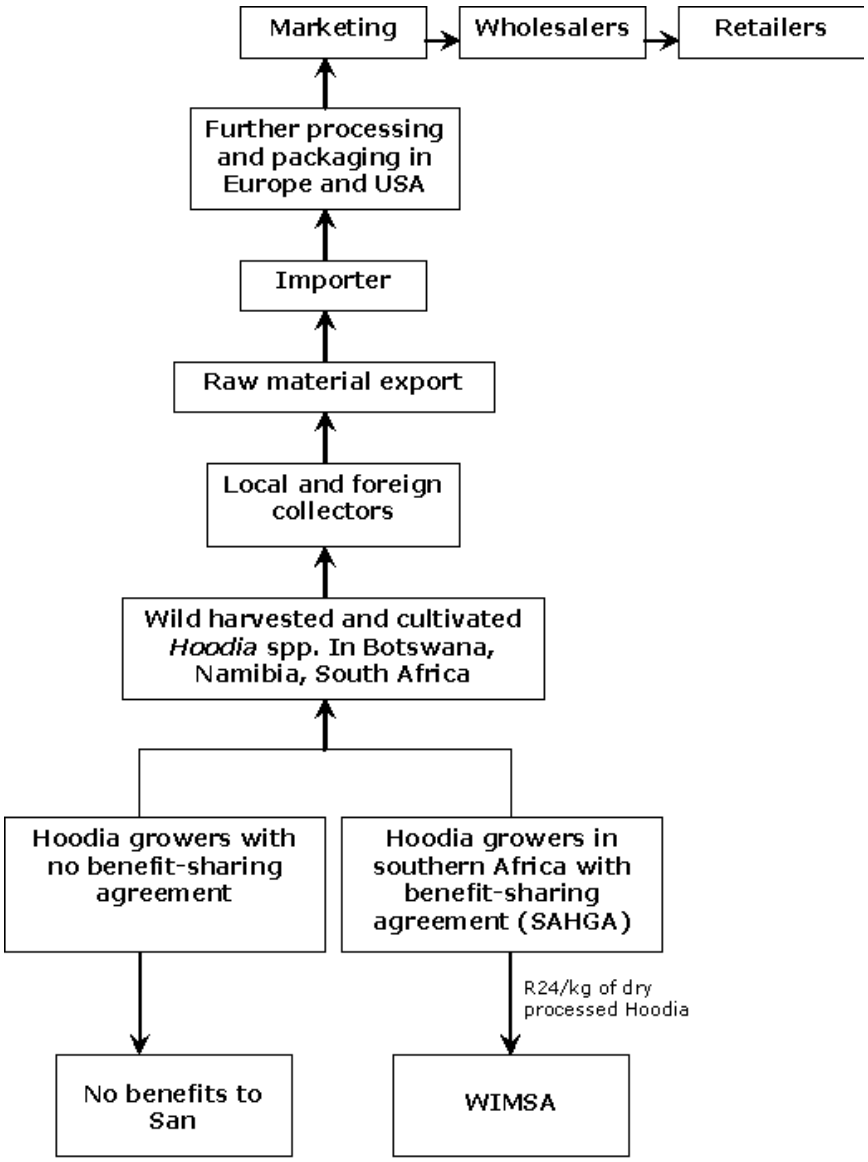

Figure 2. Benefit-sharing through the Southern African *Hoodia* Growers Association, and the *Hoodia* value chain based on trade of raw material

6. Implementation challenges

The conclusion of two benefit-sharing agreements represents a major achievement. Indeed, these agreements characterise some of the most unique examples in the world of where the much-touted benefits from bioprospecting have had practical

realisation. Nonetheless, a number of implementation challenges are now faced by the San, by those involved in the *Hoodia* industry, and by regulators and policy-makers.

Decision-making and the distribution of benefits

One of the key challenges concerns the way in which decisions will now be made about the sharing of benefits. The CSIR/San agreement will pay six percent of royalties into the San *Hoodia* Trust, which as described above, has begun the task of preparing the policies and structures necessary to distribute the significant flows of money anticipated within the next two years. The fair and equitable distribution of large sums of money to beneficiaries in three different countries would be an enormous challenge for any organisation. The fact that these beneficiaries are impoverished indigenous peoples, wrestling with problems of organisational cohesion and under-development, introduces a heightened degree of complexity to this challenge. The SAHGA benefit-sharing agreement also promises to deliver millions of Rands within the next few years, this income flow being channelled directly to the San regional organisation WIMSA. This money does not have any prior allocations that have been earmarked, and its wise distribution will similarly present the relatively inexperienced Board with major challenges.

The burden on San individuals on the San *Hoodia* Trust as well as on the WIMSA Board to meet heightened expectations, and to act wisely and transparently in the eyes of the watching world, will be heavy indeed. NGOs entrusted with providing support will be expected to shoulder part of this responsibility. The objective will be to minimise the negative social and economic impacts, and the intra-community conflicts that may arise following the introduction of large sums of money into San communities. Limited international and local experience exists in the administration and implementation of such agreements, and few, if any, cases address the sharing of benefits within communities. As Barrett and Lybbert (2000) point out, thus far benefit-sharing questions have remained issues of distribution between the community in aggregate and outsiders, whilst at a local and intra-community level there has been little practical experience. Early experiences, however, suggest the potentially divisive impact that natural product trade can have in indigenous communities. In India, for example, the commercialisation of Jeevani *(Trychopus Zeylanicus*) a wild plant with anti-fatigue properties, has led to divisions amongst the tribal community, the Kanis, as to how their knowledge should be used (Tobin, 2002; Gupta, 2004). In Peru, a 1996 agreement of the International Cooperative Biodiversity Group also led to conflict between organisations representing local Aguarana communities, as well as at a national level (Tobin, 2002; Greene, 2004).

In the case of the San, intra-community issues are especially complex. The organisations set up to politically represent the San are relatively new and the introduction of Western values and economies into supposedly traditional communities, already fractured and 'hybridised', presents a suite of difficult social and economic problems. Robins (2002) describes the social complexities of contemporary San identity, knowledge and practice, and charts the intra-community divisions and conflict that emerged between self-designated 'traditionalists' and 'western bushmen' when San land claims were lodged in the Northern Cape Province of South Africa. While these claims resulted in significant benefits for the San, they also had unintended consequences in terms of generating conflict. Robins (2002) points out the contradictions between San 'cultural survival' and the promotion of the

values of 'civil society' and 'liberal individualism', a conclusion that holds particular resonance for the *Hoodia* case, contextualised as it is within the international discourse of indigenous peoples, a vigilant NGO community alert to biopiracy cases, and a new policy framework that requires fair and equitable benefit sharing for use of traditional knowledge.

The possible compensation of other groups that use *Hoodia* and have traditional knowledge of the plant such as the Nama, Damara and Topnaar also represents a major challenge that will demand resolution, especially once Unilever products emerge, other *Hoodia* markets mature, and significant profits begin to flow. Already, Namibia has articulated a position that supports the inclusion of the Nama and other groups in benefit-sharing arrangements, bolstered by the fact that *Hoodia* wild and cultivated populations occur in areas occupied by Nama communities. However, these communities, even more than the San, lack organisational structures and cohesion and will require substantial support to enable them to get to the point at which they can negotiate their rights, and manage and disburse incoming funds. In the interim, structures have emerged through the Hoodia Growers Association of Namibia, to raise and manage funds for the inclusion of the Nama and other indigenous groups in the Hoodia industry with the intention to build organisational and technical capacity within such groups in the medium to long term.

Regional differences in benefit-sharing policies

One of the more interesting aspects of the case lies in its regional implications. *Hoodia* is a biological resource that is shared across national political boundaries, and knowledge of the plant is similarly shared by communities straddling these boundaries. Thus far, however, South Africa has played a leading role - in lodging the patent, developing commercial partnerships with multinational companies, negotiating benefit-sharing arrangements with the San, and facilitating legal trade in the plant. Botswana and Namibia by comparison, although involved in harvesting and cultivating *Hoodia*, have not yet legalised trade in the plant, nor developed commercial partnerships. Moreover, South Africa has adopted ABS legislation, and is supportive of recognising the San as a community with clear rights to benefit from *Hoodia*, but Namibian and Botswanan policies have been more ambivalent. Neither Namibia nor Botswana have ABS legislation in place and in both countries benefits from *Hoodia* are considered to belong to the state, rather than the San or other traditional knowledge holders. Unsurprisingly, these divergent policy approaches have led to concerns.

A central concern relates to the difficulties of controlling trade. Numerous reports exist of illegal material entering South Africa from Namibia, and being exported from South Africa under permit. The areas in which the plant occurs are typically very remote and illegal harvesting is difficult to monitor and enforce. While steps could be taken to address these concerns, their efficacy would be questionable without a regionally coherent position on *Hoodia* use. Strategic approaches to value adding and the use of marketing tools such as Geographical Indications would also be undermined in the absence of strong regional collaboration – needed at government, industry, farmer and community level.

Although the San-*Hoodia* Trust that is set up to disburse benefits already implements benefit-sharing across regional boundaries, based on an acknowledgment of the

shared knowledge of *Hoodia*, there is clearly a need for benefit-sharing strategies to be developed at regional and national levels in cases where genetic resources are shared across boundaries.

Hoodia trade and markets

Without the development of a sustainable and viable industry, no benefits will emerge and a set of complex challenges also confronts those involved in trading and growing *Hoodia.* Like other agricultural commodities, *Hoodia* markets follow the law of supply and demand, which determines the prices, quantities and allocation of resources (Wall, 2001). In line with the classical model described by Homma (1992) *Hoodia* has moved through a rapid expansion phase, followed by a stabilisation phase, where an equilibrium has been reached between the supply and demand of the product, supposedly close to the maximum capacity of extraction. Prices have consequently risen because of the inability to meet a growth in demand, which have lead to the adoption of policies to protect the sector or stimulate sustainable production of the resource. Shrinkage of the resource, restrictive policies on wild harvesting, and incentives to cultivate have stimulated a substantial increase in cultivated *Hoodia* with the challenge now to secure markets for this material. Similarly, although Unilever markets are secure, there remain questions as to whether a product can be developed that is safe and efficacious and desirable to consumers.

Further challenges lie in the monitoring of compliance to the benefit-sharing agreements. While this is relatively straightforward and effective for the CSIR-San benefit-sharing agreement, which has clear milestones, reporting mechanisms and traceability mechanisms, it is less so for the SAHGA benefit-sharing agreement. Because of the nature of *Hoodia* trade by the myriad of companies trading it as a herbal supplement, it is difficult to track the way in which *Hoodia* material is used. Moreover, many *Hoodia* traders wish their trade volumes to remain confidential, yet this information is vital to calculate the agreed levy to the San. The SAHGA agreement depends to a large extent on good faith and the proactive declaration by growers of volumes traded and monies owed. After close to one year of the agreement's existence, and in the absence of the long-awaited regulations which will make benefit-sharing agreements compulsory, many growers have proved reluctant to provide the necessary information. *Hoodia* sales are also currently severely depressed as a result of increased crackdown by compliance institutions on new and unregulated products. Currently the environmental government agencies responsible for issuing permits are not legally required to provide SAHGA with this vital information, however with the promulgation of the regulations and with an amendment of the SAHGA constitution, it is anticipated that the intended benefit sharing payments will flow to the San within the next year.

Some of the greatest threats to benefit-sharing lie outside of the region. Although no conclusive figures exist, it is well known that extensive *Hoodia* populations have been established elsewhere in the world. Some of this genetic material may have been acquired before the entry into force of the Convention on Biological Diversity, and some could just as easily have been smuggled out of the region without the required permission. It is therefore possible that a *Hoodia* industry could thrive outside of southern Africa, without channelling benefits to the original knowledge holders. This concern accounts for a newly-implemented regional decision to prohibit export of live

Hoodia genetic material outside of those countries with wild populations (South Africa, Botswana, and Namibia).

7. Conclusion

The *Hoodia* case study tells a complex story of many strands, and from it a number of important lessons and conclusions can be drawn that are important to integrate into ongoing debates about ways in which benefit sharing for communities can be made more equitable. One of the most crucial lessons to emerge from the case is the need to get it right from the start. Obtaining the prior informed consent of communities holding knowledge about biodiversity from the very outset of a project – and engaging them as active partners – is an absolutely fundamental principle of benefit sharing. The *Hoodia* case study illustrates what can go wrong when this principle is ignored.

The negotiating process between the CSIR and the San has demonstrated the importance of building trust between role players and of having in place a political climate conducive to fair deliberations. It has also reaffirmed the importance of having community-based institutions through which holders of traditional knowledge can be represented in negotiations, and benefits channelled. The process has highlighted the prominent role played by NGOs, legal representatives, and intermediaries in benefit sharing – in this case not only in assisting the San to attain their rights but also in shaping San politics and economic development.

One of the major impacts arising from the commercialisation of *Hoodia* has been the wide-ranging interest it has aroused about the importance of protecting traditional knowledge and ensuring that holders of such knowledge receive fair compensation. Amongst the San, the *Hoodia* case is considered an important empowering tool to enable more informed decisions to be made about their intellectual property and ways to protect it. At government level, the case has led directly to an increased focus and prominence for biodiversity and its potential value, and in South Africa, the inclusion of prior informed consent and benefit sharing within new biodiversity legislation and the requirement of disclosure of origin prior to the granting of patents. At the international level, the case is widely considered to set precedents about the ways in which holders of traditional knowledge should be compensated for their knowledge.

There is clearly an urgent need to introduce new forms of protection for traditional knowledge that not only give communities rights over their knowledge but also enable the wider preservation and promotion of such knowledge systems. The *Hoodia* case demonstrates not only the value of having an integrated system to protect and promote traditional knowledge, but also the importance of so-called 'defensive protection', to prevent the misappropriation of traditional knowledge.

Some of the lessons are still to be learnt and some are only unfolding. If significant monies are eventually received by the San there will be extremely difficult issues to deal with in terms of determining who benefits and how benefits are spread across geographical boundaries and within communities, and of minimising the negative social and economic impacts and conflicts that could arise with the introduction of large sums of money into impoverished communities. The due compensation of other communities such as the Nama, Damara and Topnaar will also require careful

consideration. Overwhelmingly, there will be a need for continued legal, administrative and technical support to enable beneficiaries to claim what is rightfully theirs, and to do so in a manner that consciously and cautiously brings tangible and effective benefits to the original holders of *Hoodia* knowledge.

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