Capitalizing on the Bio-Economic Value of Multi-Purpose Medicinal Plants for the Rehabilitation of Drylands in Sub-Saharan Africa

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Contents

Foreword

Multi-purpose Medicinal Plants (MMPs) remain a crucial element of human and livestock healthcare systems in many developing countries. Industrialized countries also use medicinal plants, as many pharmaceuticals are based on or derived from plant compounds. Over-exploitation of medicinal plants and lack of meaningful legislation to regulate harvesting and trade is having serious repercussions especially for developing countries. The demand for plant-based herbal products has grown exponentially during the last several decades. While this demand might imply a resource sustainability problem it also offers opportunities.

Today, some of Africa's most disadvantaged people live in dryland regions, where in the past they maintained a vibrant culture that was essentially in dynamic equilibrium with their environment. However, with growing populations and borders that limit traditional migratory movement, the pressure on semi-arid lands has reached a critical stage and these lands are now less able to support existing populations. Nevertheless, what looks like a problem actually provides a niche opportunity for countries with drylands to reverse land degradation and advance rural development. The residents of these areas have always relied on the sparse endemic vegetation for their healthcare needs and as a source of food security during famines and droughts. The present review builds upon the recognition that such lands support a unique biota that offers local residents important land rehabilitation and medicinal properties and values not only for their own needs, but for an increasing global demand. These multi-purpose medicinal plants, including trees, shrubs and herbs, would not only fill both a local niche market but also have great potential for a global market.

By combining indigenous knowledge and modern appropriate technology, communities and researchers can identify cultivation practices that offer new sustainable land management practices to halt desertification. Thus, communities can derive a greater share of the increasing global value of medicinal plants and rehabilitate their degraded lands, both of which will improve their quality of life.

Traditionally, drylands have been viewed as having little potential for economic activities because they are prone to drought and land degradation. This paper provides an overview of the situation in drylands in the western Sahel-Sudanian and Kalahari-Highveld regions of Africa, and sets out a process whereby communities, in partnership with researchers and donors, can build on the comparative advantage that such lands offer for cultivating multi-purpose medicinal plants to generate income, support human and livestock healthcare systems, and enhance environmental services. It is hoped that specialists in sustainable land management, agriculture, healthcare, and trade will build on the conclusion that a multi-sector community-driven approach to harnessing MMPs is most advantageous as it follows the holistic thought process of local peoples.

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Executive Summary

The supply of indigenous medicines depends upon native plants, which are generally harvested from wild sources. But globally, wild sources are declining due to land degradation, current harvesting practices, overgrazing, and a lack of enforceable management regulations. This situation is even more pronounced in dryland zones where plant diversity is naturally low. Dryland communities have a niche opportunity to use selected indigenous plant species to halt land degradation, and at the same time provide a sustainable source of affordable healthcare, food, and income.

Although we are in the middle of the Decade for African Traditional Medicine, few efforts have been made in Sub-Saharan Africa (SSA) to formally develop a marketing comparative advantage for indigenous medicinal plants, associated products, and market players. Most health investment is directed at seeking conventional, high-demand health products with little or none directed at improving the quality of traditional phytomedicines, or increasing the benefits that the current market is delivering to millions of people and livestock.

Only about 200 million people (less than 30 percent) of SSA's population has any access to modern health care and pharmaceuticals. The other 480 million people in the region rely on traditional medicines, mainly from multi-purpose medicinal plants (MMPS).

Natural products (herbal medicines) have an estimated global market value of US $65 billion (WHO, 2001). Even a fraction of this market should be economically appealing to Africa. This global market demand should no longer be ignored by communities, governments and donors. As income generators, MMPs compare favorably with coffee, oil palm, cocoa, and cotton and their value should no longer be ignored. Furthermore, MMPs do not appear to be affected by OECD market and trade barriers that affect other commodities from developing countries. This presents a significant niche and trade opportunity that should be captured and optimized by developing countries especially those in sub-Saharan Africa. Rural communities have an opportunity to effectively use their indigenous knowledge to become serious players in the global herbal medicine market.

Land rehabilitation programs based on MMPs can make major contributions to sustainable natural resources management and offer remunerative employment opportunities for women and men, as well as link rural people to urban markets. They can contribute to preventive measures in moderately degraded lands, as well as help in reclaiming severely degraded drylands. In the two regions discussed in this paper thirty-eight endemic MMPs have been identified that are known locally to have important environmental uses, including the capacity to establish and stabilize dunes and increase soil fertility.

Local residents are well aware of the plants' ecological requirements and can play an important role in species selection. Village leadership and institutions (women and farmers) can facilitate the establishment of nurseries to produce seeds and seedlings. Maintenance of established revegetated sites (woodlots, dunes, rangelands, etc.,) would become the responsibility of the communities and herders. This paper has identified a number of good practices that build on the World Health Organization's (WHO) 2003 guidelines on good agricultural and cultivation practices for medicinal plants (WHO 2003).

MMPs have a multitude of medicinal values for human and livestock, as well as nutritional value that contribute to food security especially during

periods of extreme drought. If markets are developed, they can provide an important source of household income. Finally, planting fields of MMPs can both reduce pressure on wild plants and help stabilize and enrich soil in dry and degraded areas, thus promoting sustainable land management (SLM). Intensified production of MMPs offers a multi-sector approach that is consistent with the holistic approach to problem solving followed by African communities for millennia.

However, neither the socio-economic value nor the potential market for MMPs is well understood by decision-makers. This paper attempts to explain these values in hopes that MMP production can be integrated into the mainstream of governments' environment, health, agriculture and trade, and economic planning.

The loss of natural resources is a constant complaint of rural communities. Providing communities with the tools and materials as well as the training to manage these resource investments can help restore their resource base. This is especially true for the sustainable harvesting and cultivation of MMPs which can help rehabilitate degraded land, generate household income, provide local affordable healthcare, and help fill the demands of a rapidly expanding global market for natural health products.

Introduction

Medicinal plants[1] are both the oldest known source of human and livestock healthcare products and an important component of global biodiversity. However, in the context of this paper other non-health values are identified and discussed under the term multi-purpose medicinal plants (MMPs). MMPs have special features that most rural communities recognize and appreciate. Governments and donors need to formally acknowledge and take these features into account when designing a supporting policy framework.

- Medicinal plants are an essential source of affordable healthcare for the rural and urban poor.
- Management of high-demand medicinal plants can yield important environmental benefits land rehabilitation, soil fertility, soil erosion control.
- Medicinal plants is a significant component of biodiversity.
- The collection and sale of medicinal plants are critical to many rural household economies.
- Medicinal plants are primarily collected, traded and used by women.
- Medicinal plants is well suited to local management and offer an alternative source of employment.
- Information regarding source and volumes of supply are generally unknown and incompatible with the demand and effective use of these resources.

At present, the use and trade of medicinal plants in Sub-Saharan Africa (SSA) is unregulated. With the application of scientific technology, new drugs are being identified from plants long used for traditional healthcare. Examples of the bio-economic importance of four medicinal plants commonly

Table 1. Medicinal Plants with Indigenous and Global Use And Trade Values

COMMON NAME	SPECIES	PRODUCT	USE	VALUE
stinkwood, cherry	*Prunus africana*	bark	Benign prostatic hyperplasia Traditional use: genitor-urinary	US $200 million/yr
periwinkle	*Catharanthus roseus*	leaves	Anti-cancer Traditional use: diabetes	US $100 million/yr
horseradish tree	*Moringa oleifera*	powdered seeds	Water purification, multipurpose	Unknown
Mukhombero (Kenya)	*Mondia whytei*	root	Multipurpose: diabetes, appetizer, hypertension, food flavoring, enhancing milk production in lactating mothers.	US $2.00/kg

found in SSA outside of the drylands are identified in Table 1. Two—*Prunus africana and Catharanthus roseus*—now have multi-million dollar values in the global market (as well traditional values) because of their demand for in the treatment of non-communicable diseases. The other two—*Moringa oleifera and Mondia whytei*—retain their traditional multi-purpose values for a significant percentage of the SSA rural and urban poor populations. However, both could acquire a greater global demand in the future.

P. africana, also called Africa stinkwood or African cherry, is probably the best documented African medicinal plant. The documentation tells the story of how high demand and a lucrative price can threaten a plant's existence. *P. aficana's* bark, which is used for stomach, bladder, prostate, and kidney ailments, is a significant source of foreign exchange. However, its unregulated harvesting has had a devastating effect on the wild populations that until recently were the sole source of supply. (See Box 1.) This story is being replicated globally for numerous other species, particularly in the drylands.

Box 1. African cherry (Prunus africana): a medicinal and commercial success

Species: *Prunus africana* (Hook.f.) Kalkman (Rosaceae).
pygeum, Africa stinkwood, African cherry

Geograpical distribution: Afromontane of Africa and Madagascar
Habitat: montane tropical forest

Uses: The bark is traditionally powdered and drunk as a tea for genitor-urinary complaints, allergies, inflammation, kidney disease, malaria, stomach ache and fever, among other uses. Double-blind clinical trials have shown efficacy for many parameters of benign prostatic hypertrophy. Results include significant reduction of symptoms and prostate size and clearance of bladder neck urethra obstruction. The product is sold under the trade name Pygenil in Italy and Tadenan in France. The wood is used locally for construction, furniture and tools.

Sales: Over the counter value of retail sales is estimated at US $220 million annually. About 2,000 kilograms of fresh bark, representing 1,000 kilograms of dried bark are required to make a 5 kilogram extract. International trade in *P. africana* has been regulated under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) since 1995 because to satisfy demand collectors strip the bark off all mature and immature trees. In that year, with an official ban on exports in Cameroon, Kenya, and Madagascar, 5,000 metric tons were exported to Europe. The present return to collectors is approximately 20 cents per dry kilogram.

Domestication is proving difficult as the seed is recalcitrant—seeds must be planted within a few days of collection. Reproduction by cuttings is possible. A Prunus Net Database provides extensive information and extension materials to field workers and researchers. A downloadable monograph in PDF format provides information on species identity, reproductive biology and ecology, distribution, propagation and management, uses, maps, pests, diseases and recommendations.

Sources: Cunningham & Mbenkum, 1993; Schippmann, 2001; ICRAF.

MMPs and the World Bank's Mission

Helping poor people use their traditional knowledge—along with modern agricultural methods and marketing techniques—to raise their incomes is in line with the World Bank's mission of sustainable poverty reduction. Recognizing the important role of MMPs and capitalizing on the knowledge of their uses by rural populations (especially women) and healers in primary healthcare offers the unique opportunity to link Bank poverty-related initiatives and land management perspectives.

It is important to deepen the process of mainstreaming MMPs into the Bank's operations, where appropriate, and to acknowledge that important wild habitats and populations of medicinal plants must be sustainably managed. *Ex-situ* cultivation offers an alternative to wild harvesting for human and ethnoveterinary needs. The rural development dimension identifies cultivation of MMPs using sustainable practices as a means to improve agricultural diversity and productivity and income generation. The Bank's Health, Nutrition and Population Sector, Africa Region has recently given its support to actions that objectively examine the role traditional medicine plays in primary healthcare provision.

Ensuring the sustainability of MMP germplasm and supply are concerns of both the environment and rural development perspectives. The health perspective would seek to ensure that demand is fulfilled with safe, efficacious phytomedicines.

To make the case that identifying and expanding the bio-economic advantages MMPs can bring to community-based land rehabilitation and poverty reduction programs, this paper draws on work done in land management in two drylands regional transition zones in Africa: the western Sahel/Sudanian and Kalahari-Highveld. We consider how the successes of these projects might be expanded by using MMPs. We also consider how MMPs might enhance these projects in areas in which they were less successful. We hope these proposals provide clarity on the multi-sectoral importance of MMPs in poverty reduction that will assist project teams implementing Africa region's development strategy.

Drylands and Desertification

Drylands, which include a range of terrestrial ecosystems in arid, semi-arid, and dry sub-humid zones,[2] cover more than 40 percent of the earth's surface, 43 percent in Africa (see Appendix A). They are characterized by low and erratic rainfall of below 700 millimeters per year, periodic droughts, and particular associations of vegetative cover and soils. Desertification is land degradation in drylands resulting from climatic variations and non-sustainable human activities. Dryland ecosystems are extremely vulnerable to overexploitation and inappropriate land use. Poverty, political instability, deforestation, overgrazing, agricultural encroachment, and inappropriate irrigation practices can all undermine the land's productivity.

Forty percent (270 million) of Africa's 688 million people live in the drylands (UNEP, 1997). More than 250 million people are directly affected by desertification. Another 1.1 billion people in more than 100 countries, many of which are World Bank development partners, are at risk from desertification. These people include many of the world's poorest, most marginalized, and politically weak residents.

WHO declared that desertification represents a serious threat to human health. It can lead to malnutrition, respiratory diseases, burn injuries, and waterborne diseases such a cholera, typhoid, and hepatitis A (Dooley 2002). Desertification also endangers traditional medical plants and practices.

Corvalán (2003) suggests that the disruption of ecosystems may cause the loss of many of nature's chemicals and genes that have already provided humankind with enormous health benefits or that have potential to do so

Natural resource degradation is undermining the livelihoods and opportunities of an increasing percentage of the dryland's poor. This is evident in both agricultural and pastoral systems, the main sources of livelihood for the majority of the rural poor. Data show that areas affected by desertification tend to have the poorest, most marginalized, and politically weakest citizens and are often ignored by decision makers (World Bank 2003a), which poses a major impediment to effective action to prevent desertification or reverse land degradation. Nevertheless, there are actions and investment opportunities in drylands development that make economic sense. The drylands are considered a priority target area for SLM programs.

Land Rehabilitation Actions and MMPs

Recognizing the need for a fresh approach to combating desertification, the United Nations adopted the Convention to Combat Desertification (UNCCD) in 1994. It entered into force in 1996. The UNCCD places a high priority on Africa—the region most affected by land degradation/desertification problems.

UNCCD's premise is that poverty-induced overexploitation of drylands is a major cause for environmental deterioration and loss of livelihoods. An independent evaluation in 2003 of the Global Mechanism (GM) of the UNCCD to combat desertification concluded that in order to make significant progress, UNCCD objectives must be mainstreamed into development and policy frameworks (World Bank, 2003b). This action would engage decision makers and communities in promoting sustainable agriculture and rural development. In addition, opportunities should be more fully exploited for synergies between Food and Agricultural Organization (FAO), International Fund for Agricultural Development (IFAD), United Nations Development Program (UNDP) and the World Bank as well as with other multinational and bilateral donors.

The UNCCD recognizes the critical role of traditional and indigenous knowledge (including knowledge of MMPs) in preventing land degradation and rehabilitating degraded drylands. Article 18 of the UNCCD calls upon the Parties to protect, promote, and use relevant traditional and local technology, knowledge, know-how and practices to undertake to: (a) make inventories of such technology, knowledge, know-how and practices and their potential uses with the participation of local populations, (b) ensure that such technology, knowledge, know-how and practices are adequately protected and that local populations benefit directly from them; (c) encourage and actively support the improvement and dissemination of such technology, knowledge, know-how and practices or of the development of new technology based on them; and (d) as appropriate, facilitate the adaptation of such technology, knowledge, know-how and practices to wide use and integrate them with modern technology.

The UNCCD Fourth Asia-Africa Technical Forum on Combating Desertification, held in Benin in June 2003, which focused on agroforestry and soil conservation, included a session on medicinal and aromatic plant cultivation. The forum recommended greater interregional collaboration and knowledge exchange and called on the Consultative Group on International Agricultural Research (CGIAR) to play a major role. In particular, the forum pointed to the need to identify medicinal plants able to rehabilitate degraded drylands.

Given the scale of the land degradation problem in various parts of the world, the World Bank and other donors support strategic programs on sustainable land management to ensure coordinated and comprehensive actions at local, national, and sub-regional levels. Such programmatic interventions offer opportunities for multiple stakeholders, including those that engage in cultivation and use of MMPs, to contribute towards rehabilitation of degraded lands.

The World Bank and the GEF are presently supporting two biodiversity conservation and management projects in Ethiopia and Ghana that emphasize MMPs conservation and sustainable use. Traditional healers and rural communities are primary beneficiaries. In Ethiopia they are supporting validation studies of six high-demand traditional herbal medicines (three for humans and three for livestock). The WHO guidelines are being followed with the expectation that the process will facilitate the future local production of affordable phytomedicines. In addition, the exchange of

research and development experience with other African countries puts Africa in a strong position to develop its own phytomedicine industry as China and India have done.

The Ghana Northern Savanna Biodiversity Conservation Project is, among other things, supporting a program of medicinal plant propagation, cultivation and conservation of wild sources. In addition, it is assisting the Ghana Ministry of Health's Department of Traditional and Alternative Medicine and rural healers to organize three regional healer associations (Upper West, Upper East and Northern).

Millennium Development Goals

Eliminating poverty and sustaining development are highest priorities under the Millennium Development Goals (MDG) and dryland populations are a main target group. The environment is acknowledged as an essential component of those goals. Central to the environment initiative is the development of strong linkages with the other goals. The MDG recognizes that poor rural households often derive a large share of their incomes from harvesting natural resources. Thus, they are seriously affected by natural resource degradation.

Promoting non-farm sources of income as well as technological improvements in agriculture and pastoralism are key to reducing poverty in dryland rural areas. Until recent times Sub-Saharan pastoralists were nomadic. Now increasing human and livestock populations are forced to remain on the same land because of boundaries imposed by the colonial powers that restrict and inhibit movements. This overuse of the land has led to loss of vegetation, leaving behind depauperate soils and unstable sands that support only the most drought-tolerant of plant species with minimal nutritive value.

Natural Resource Degradation in Drylands

Dryland species have developed unique strategies to cope with intermittent rainfall. Some dryland species are wild relatives of globally important domesticated food crops. Dryland species are resilient and recover quickly from fires, grazing and drought. Species composition varies among ecosystems and many subspecies are found among the many diverse habitats within an ecosystem. The main causes of drylands biodiversity loss are: (a) habitat destruction, fragmentation and/or conversion; (b) grazing pressures; (c) population growth resulting in over-use of resources; (d) change in the abiotic and biotic composition of soils; (e) introduction of invasive species (opportunistic); and (f) possibly changing regional climate.

The vulnerability of dryland biodiversity to environmental change, whether natural or human-caused, is a key dimension of poverty. In general, the poor are most vulnerable to environmental change because they live in ecologically fragile areas. Therefore, they tend to suffer the greatest losses of assets and income when resource mismanagement and environmental degradation increase the frequency of natural disasters (e.g., floods and droughts). Severely degraded natural resources, may not be able to recover. Without an effective framework to support rural communities and pastoral families with technical advice and training, actions to respond to land degradation are difficult.

Drylands Community Successes

A review of actions by the major players suggests that where there is genuine potential for more effective collaboration and coordination in the field more effective SLM programs, especially in drylands, can be expected. The Proceedings of a World Bank Round Table: *Drylands, Poverty and Development* (World Bank, 1999) concluded that a new strategy is needed because dryland economies and the well-being of people living in drylands, have not improved significantly. Actions to reverse the processes of land degradation have often failed particularly in SSA where grinding poverty makes it difficult to adopt innovations.

While most studies of indigenous farming systems have focused on agricultural and cash crop practices, in drylands agroforestry—the deliberate preservation of valued trees and shrubs in crop fields—is an important farming strategy. For example, in West Africa *Acacia albida* sites have sustained continuous cropping for generations.

There are a number of successful examples of using certain plan species to counter land degradation.. In China, a program component has focused on medicinal and other economic plants. In Tanzania, medicinal plants are among the indigenous species used in the reforestation strategy.

Case studies of farmers who have been able to, increase incomes in sustainable ways and in coping with severe natural calamities have helped to demonstrate that drylands development can make economic sense (Steeds & Reij, 2002). There are several good examples in West Africa (Box 2).

In only a few cases have projects helped rural communities in southern Africa to revitalize or upgrade their community-based natural resource management activities. This is surprising considering that the estimated total gross direct use value of "every-day resources" to the South African economy is about US $60 million per year (Mander, 1998). However, two products Rooibus tea (*Aspalathus linearis*) and unwele (*Sutherlandia frutescens*) have increasing commercial value, although Rooibus tea is not strictly a drylands species.

It is clear that successful land rehabilitation and sustainable land management can be achieved when communities are accepted as true partners. It is also recognized that traditional and cultural values and practices cannot be ignored. The World Bank's Knowledge and Learning Group has been a leader in furthering the role of indigenous and community knowledge in identifying and implementing solutions to address local development problems and effect change (World Bank, 2004a). For example, two approaches are critical: (a) indigenous knowledge (IK) and modern technology must have equal acceptance at the community and research level when solving local problems; and (b) society at large must recognize that IK has positive values and contributions to offer and grows when shared, applied, and challenged. The benefits of integrating IK into poverty reduction programs are evidenced by the preparation of a national IK strategy for Uganda. Burkina Faso, Malawi, Kenya, Tanzania and Sri Lanka have held workshops to help launch a similar process. Today more than two dozen projects are under implementation or preparation in which IK plays a significant role. However, a stronger commitment from governments, donors, communities, and other interested players is required to upscale these positive experiences.

Caution is called for regarding proposals for introducing exotic crops to farming communities of dry Africa as a lever to lift the population from the present state of deepening poverty (Pasternak and Schlissel, 2001). It is true that some exotic

plants—including *Jatropha curcas, Prosopis cineraria,* and others—have proved their worth. But recent studies also suggest that invasive exotic species constitute a large and growing threat to biodiversity and ecosystem integrity in many parts of the world (McNeely *et. al.*, 2001). In general, the introduction of exotic plants should not be encouraged without assessing their potential risk.

Box 2. Successful Land Rehabilitation Experiences In Burkina Faso and Niger

In the Central Plateau of Burkina Faso an environmental rehabilitation and agricultural intensification project has resulted in substantial cereal yield increases and increased livestock production. Tens of thousands of hectares of degraded land have been rehabilitated using soil and water conservation techniques. As a result rural poverty declined by almost 50 per cent. An important factor in reaching these remarkable results was the increased organization capacity of the villagers.

Part of a United Nations Environmental Program (UNEP) initiative, this project was aimed at conserving the rich and unique plant life of the drylands and promoting sustainable land management (SLM). The strategy included banning the cutting or harvesting of plants from key sites. It also recommended using thorny plants, tree trunks, and cereal stalks, as well as rock, to reduce soil erosion and planting acacia trees and other plants as wind breaks to cut soil and water erosion. Tests have shown that 2 centimeters of sand can, over several months, become trapped behind the wind breaks, improving soil fertility. In addition, the project included capacity building for residents and training in seedling production and reforestation. (UNEP, 2002).

In the late 1970s, in response to recurrent drought and harvest failures in the Yatenga region of Burkina Faso, Burkinabe farmers adapted a traditional practice called *zaï*—digging pits and filling them with manure for growing cereal crops (Sawadogo et al. 2001; Kaboré and Reij 2003; UNESCO 2003). One farmer discovered numerous tree species germinating in the pits. Experimentation led to the establishment of woodlots. By surrounding the woodlots with cultivated fields the farmer kept livestock from browsing his trees until they were well established. The technique spread widely within the region, and word of it spread even farther. A soil and water conservation project in Niger's Illela District brought r farmers to visit the Yatenga region to see for themselves how *zai* were used to rehabilitate barren, crusted land. The Nigerian farmers then created improved *zai* planting pits in about 9,000 hectares of the Illela District. As a result of this technique, barren land has obtained a market value and is being purchased for rehabilitation. An Integrated Rural Development Project in Niger's Keita Valley has rehabilitated 20,000 hectares of degraded land (9,300 hectares for agriculture, the remainder for sylvo-pastoral production); and planted 17 million trees. The increase in revenues generated by this project exceeded US $6 million per year in addition to other positive results.

In 1989, The Eden Foundation established a program in Niger to combat desertification. This program assisted farmers in cultivating drought-tolerant, edible, perennial crops that would also stabilize the sand. The program identified four tree species that can form a natural green belt north of Tanout (Eden Foundation 2000).

Carucci (2000) recounts another case in Niger in which the Keita district in Tahoua Department, on the edge of the pastoral zone, carried out a successful land rehabilitation program, making use of existing natural tree, shrub, and grass cover.

The Case for Medicinal Plants

Since medicinal plants are an important component of drylands flora, and since the majority of the poor and their livestock depend on medicinal plants for health care needs, the role they might play in halting land degradation and becoming an integral component of community-based land development deserves serious consideration.

Beyond their immediate health values medicinal plants have important ecological, income generation, cultural, social and religious roles. Like certain other species, planted medicinal trees, shrubs, and herbs can help check runoff and erosion, control flooding, purify water, and protect against wind. They can have a positive impact on microclimates and buffer the effects of desertification. Yet the distinctive opportunistic advantages of MMPs to help reduce rural poverty have not yet been sufficiently recognized or exploited in SSA (or globally) by governments or donors. Their uses are poorly defined by resource managers and researchers, and are generally not reflected in official statistics and development policies.

Demand for Medicinal Plants

Medicinal plants are a resource familiar to the inhabitants of the SSA drylands. While market data are scarce, two recent market studies, in Kwazulu-Natal, South Africa and in Burkina Faso have shown that the estimated annual value of medicinal plants products is US $13 million and US $7.5 million respectively (Lambert, 2003). More than 400 species are marketed within Kwazulu-Natal and 150 in Ouagadougou and Bobo-Dioulasso. In the Bank's Ethiopia medicinal plant project it is estimated that 48 million inhabitants (80 percent of the population) use more than 700 medicinal plants with an annual worth of US $74 million. Replacing such products with synthetic imports in the three countries would be expensive and would reduce healthcare accessibility for the poor. While no data are available for the Burkina Faso market study regarding supply, all the vendors and collectors interviewed expressed concern over future sustainability. The monetary value of the plants products sold in the two cities is significant in light of the US $350 per capita income of residents. If the annual per capita expenditure for traditional remedies in SSA is US $3 then for that 70 percent of the population who depend on such herb-based healthcare, the remedies would have a value of at least US $1.4 billion.

SSA annual pharmaceutical sales are estimated to be less than US $3 billion, amounting to slightly more than US $300 per person, if it is assumed that all Africans have access to conventional drugs. The total annual health budget for all the countries of Sub-Saharan Africa is estimated at US $8.2 billion,[3] of which approximately 20–50 percent is set aside for the purchase of conventional drugs. Kenya's Ministry of Health's budget for medicines in 2002 was US $16 million. The National Health Care System provides for the conventional drug needs of only 30 percent of the Kenyan population, meaning they have access to, and can afford conventional drugs. Conversely, the remaining 70 percent (21 million) outside the national system cannot afford to pay for health services and must rely on traditional forms of healthcare. At present, the government has limited information on the role traditional medicine or medicinal plants play in healthcare provision.

The 2004 global market for herbal medicines including herbal products and raw materials is estimated to be US $65 billion (based on a WHO, 2001 estimate of US $45 billion with an annual growth rate of 5–15 percent). If the African drylands were to provide only a small share of this value (*e.g.* 1.0

percent), they could bring in US $650 million, which could have a significant impact on both improving the quality of life and rehabilitating traditionally used degraded lands. Since 80 percent of SSA's population depends on traditional medicine, stimulating the production of medicinal plants in the drylands for national and international markets makes economic sense.

The validation of indigenous African treatments offers income-generating and commercial opportunities for communities and small business enterprises to collaborate in developing locally-based pharmaceutical industries throughout SSA. As for example, in 2002, the International Finance Corporation (IFC) provided an A loan (Bank credit) of US $5million to expand and reorganize Egypt's Atos Phyto-Pharmaceuticals Company (health products and marketing) plus three other subsidiaries.[4]

Supply of Medicinal Plants

China and India are the greatest users of medicinal plants; their traditional plant remedies date back at least 7,000 years (Lambert, Srivastava and Vietmeyer, 1997). In China the total demand in 1994 was 1,6 million metric tons of plants of which only 300,000–400,000 metric tons came from cultivation (Kuipers, 1996).[5] The difference comes from wild harvesting which is increasingly unsustainable. Supplies to sustain the needs of 6 million Kwazulu-Natal consumers and 2.5 million residents of Ouagadougou and Bobo-Dioulasso, Burkina Faso were calculated to be 4,000 metric tons and 2,500 metric tons respectively. While difficult to extrapolate from the above figures for global needs, the annual supply must be quite substantial.

Examples of traditionally important MMPs in the two regions with rapidly growing international demand are identified in the Tables 2 and 3.

Thirty eight regionally important high-value medicinal plants with potentially valuable soil rehabilitation characteristics that could be exploited in SLM programs in drylands areas have been identified. Twenty three species are present in the western Sahel/Sudanian region (Burkina Faso and Niger, Appendix B) and 15 species in the Kalahari-Highveld region (Namibia/Botswana Appendix C).

Table 2. Important High-Demand MMPs of the Western Sahel-Sudanian Region

Common Name	Species	Distribution	Healthcare	Trade Value Major Source
Gum arabic	*Acacia senegal*	widespread tropical Africa, dry savannas and rocky hills	inflammation of throat and stomach Pharmaceutical preparations	Globally US $90 million Sudan
Myrrh	*Commiphora africana*	Sub-Saharan Africa very dry sites	wound sealing, insecticide	US $5.00/kg Somalia

Table 3. Important High-Demand MMPs of the Kalahari-Highveld Region

Common Name	Species	Distribution	Healthcare	Trade Value Major Source
Devil's claw	*Harpagophytum procumbens*	SW Africa arid grasslands	anti-inflammatory, arthritis	US $0.50/gm Namibia, Botswana
Cancer bush	*Sutherlandia frutescens*	Southern Africa sandy plans	anit-cachexia, anti-HIV actions	US $2.50/gm South Africa

This information has been compiled from numerous sources. The most detailed information on medicinal plants in semi-arid regions is found in Kew's SEPASAL database and is incorporated in Appendixes B and C and Tables 4 and 5. Baseline information for each plant includes its scientific and local names, a description of the plant, where it grows and under what conditions, how the plant is used, details of its chemical compounds, and the validation process. Little specific information is given on the role medicinal plants might play in land rehabilitation programs and none on their future sustainability.

In addition to providing detailed information on health care properties of these plants, publications often give information on environmental uses, such as possible roles various species may play in slope stabilization and in controlling soil and water erosion. In addition, information is presently being collected on propagation and cultivation of medicinal plants, as well as related fodder trees and shrubs in range and farming systems, in Bank-funded medicinal plant projects in Ethiopia, Ghana, and Cameroon that may have application in SLM programs.

None of the 38 species are listed in the IUCN Red Data Book (1997) as threatened species of global significance. However, their future supply is of increasing concern because of escalating demand.. Their proposed use in land rehabilitation programs requires the input of traditional healers and medicinal plant collectors. Such actions that enhance these diverse roles will systematically and cooperatively promote mainstreaming of UNCCD and CBD objectives in development and policy frameworks. Furthermore, the actions should generate greater collaboration between communities and the phytopharmaceutical business sector for production, processing, and marketing.

Criteria for Case Area Selection

Research and technical reports of community success in fighting poverty and in rehabilitating degraded lands have demonstrated there is a niche opportunity for medicinal plants. The indigenous knowledge of rural healers and farmers of medicinal plants and their use offer an opportunity to tap into the booming global medicinal market and at the same time rehabilitate degraded lands. A first step is to identify the value(s) in pursuing this opportunity. For example the niche should be evaluated on: (a) profit and revenue return to communities; (b) community commitment to supporting nursery, planting, management and harvesting activities; (c) impact on community's quality of life; and (d) potential to rehabilitate degraded areas.

The identified successes indicate that a number of communities in the Burkina Faso/Niger region have shown an ability to develop, implement, and manage successful SLM projects. While few community examples are available for Namibia or Botswana the proximity of these countries to South Africa gives them ready access to South African projects that describe similar land rehabilitation results. The following information supports the focus on the two regions.

Sahel/Sudanian Region

The Gross National Income (GNI) per capita for Burkina Faso and Niger is approximately US $200 (World Bank, 2004b). The Sahel supports wooded grassland in the south and semi-desert grassland in the north. Rainfall in the Sahel zone is insufficient for permanent agriculture based on rainfed crops. Nevertheless, where water supply permits either permanent or seasonal settlement, rainfed crops are grown. Evidence of such activity is seen in a natural green belt that stretches through the Sahel region along the border with the Sahara desert.

In the past, this green belt was rich in biota. Agricultural production and the annual harvesting of plant and animal resources sustained both sedentary and nomadic populations. Today this biotic richness has been drastically reduced, partly because of erratic rainfall, but mainly because of overgrazing, fuelwood demands, poor agricultural practices, and population increase.

A number of programs have been undertaken to restore the vitality of this green belt by using native plant species, including nitrogen-fixing plants (INCD Secretariat 2003; Ching 2003; UNEP 2002; Reij & Waters-Bayer, 2001; Carucci 2000; Eden Foundation 2000; Reij et. al., 1996; Henning 1996; Nasr al-Amin et al., n.d.)., as well as exotic species (Pasternak and Schlissel 2001). These reports, which cover a range of community-based projects, show the potential for rejuvenation of the entire zone if sustainable programs are implemented on a wider scale.

Table 4 lists 14 species selected from among those in Appendix B as the most promising for initial land rehabilitation trials and also having medicinal and other commercial values. The table is sub-divided into: (a) propagation/cultivation practices identified and products commercialized; (b) practices not identified, but local market available; and (c) less-well-known species with medicinal value. In addition, three important contributions are identified that each plant can make to community efforts to combat desertification and improve living standards. These include the plant's role in reversing land degradation actions; its usefulness as a source of free or affordable health care; and its potential as an income generator, by providing foods, fodder, fibers, and natural products for which there is a local or international market

Table 4. Medicinal Plant Species with Land Rehabilitation Properties: Burkina Faso/Niger				
SPECIES	PHENOLOGY	ENVIRONMENTAL USES	HEALTH CARE USES	INCOME GENERATION USES
1. Propagation/cultivation practices identified and products commercialized				
Acacia senegal	small tree/ shrub	shelter belt, dune stabilizer, N fixer	gum: astringent, angina, inflammations, hemorrhage	**gum arabic,** fibers, tools
Acacia albida	tree	sandy soils, N fixer. rapid growth	bark: circulatory, digestive, genitourinary, nervous system disorders; infections, inflammation, emetic, pain	**medicines,** tools, important fodder tree
Prosopis africana	tree	soil improver, N. fixer	fruits, roots: digestive, respiratory, skin disorders; rheumatism	**medicines, spices,** tools, tannins, famine food
Balanites aegyptiaca	small tree	stabilize drainage pathways	bark, roots, leaves: laxative, anthelmintic, fevers	**molluscicide,** tools, soap, oil, fruit
Commiphora africana	small tree/ shrub	shelter belts, fences	bark: digestive, skin disorders, injuries, poisoning fruits: typhoid fever gum: sealing, disinfecting wounds	**myrrh, medicines,** gums, resins, tools, famine foods
Jatropha curcas	small tree	dune and slope stabilizer	leaves, seed oil: digestive, muscular disorders; pain, fevers, parasites, eczema, neoplasms. roots: muscular disorders	**Curcin, medicines,** cosmetics, dyes, oils, fuel
2. Propagation/cultivation practices not identified, but local market available				
Acacia nilotica	tree	dune stabilizer, N fixer	bark: respiratory disorders; diarrhea, hypotension, roots: toothache seeds: dysentery	**gum,** fibers, tannins, carpentry
Salvadora persica	small tree/ shrub	shelter belt	leaves, bark, roots: injuries, neoplasms, tonic, bacterial plaque	**tooth sticks,** resin, food
Ziziphus mauritiana	small tree/ shrub	dune stabilizer, live fences	seeds: digestive, respiratory disorders, rich in Vitamin C	tools, tannins, dues, food, fodder, **Vit.C**

Table 4. Medicinal Plant Species with Land Rehabilitation Properties: Burkina Faso/Niger				
3. Less well known species with medicinal value				
Acacia tortilis subsp. raddiana	shrub	dune stabilizer, shelter belt, high in P.	anthelmintic, disinfectant	tannins, dyes, fibers, food, fodder
Boscia senegalensis	shrub	dune stabilizer	leaves and bark: circulatory disorders, digestive, genito-urinary, mental and sensory disorders, infections	water clarifier, food
Grewia tenax	shrub	dune stabilizer	wood: respiratory disorders	fibers, tools, food, fodder
Calligonum comosum	shrub	sand stabilizer	anti-inflammatory	survival food, fodder
Leptadenia pyrotechnica	shrub	soil stabilizer, shelter belt	seeds: sensory disorders exudates: infections	thatch, fiber, rugs, tools, food, browse

Note: income generation products in **bold** have known market.

Kalahari-Highveld

The GNI per capita of US $1,780 for Namibia and US $2,900 for Botswana is above the average for SSA (World Bank, 2004b). In Namibia, the most arid African country south of the Sahara, 70 percent of the population depends on subsistence activities (e.g., grazing, herding, farming). With a small but rapidly growing population, increasing at 3.1 percent a year, Namibia is experiencing intense pressure on the country's natural resources. Desertification and land degradation are real threats to sustainable development in the country. The causes include human impacts as well as unpredictable precipitation.

Rainfall in the Kalahari-Highveld regional transition zone ranges from 150 to 500 millimeters per year. Inter-annual variability in rainfall increases from 25 percent in the east to 40 percent in the west. The vegetation pattern is complex. One major area, the Kalahari Acacia-Baikiaea woodlands in the drier south, is characterized by sparse, shrubby acacias. In the wetter north, the vegetation pattern is savanna or woodland dominated by *Baikiaea plurijuga.*

In Botswana and Namibia a major land use problem is encroachment by undesirable species. In Namibia, bush encroachment is the single most important factor hampering sustainable livestock production and improved standards of living in rural areas (de Klerk 2004)[6]. In Botswana, an estimated 8.5 million hectares in the northern areas are affected by encroachment. Actions to reverse land degradation in both countries are bringing together government ministries from many sectors including environment, agriculture, and wildlife and forestry with community leaders and NGOs. The Botswana Community-Based Natural Resources Management Program collects basic environmental data to help communities manage their lands more sustainably.

Table 5 lists 12 species with medicinal and other commercial values selected from Appendix C as most promising for initial land rehabilitation trials. Similar tables could be prepared for all countries or regions with degraded drylands.

Table 5. Medicinal Plant Species with Land Rehabilitation Properties: Botswana/Namibia				
SPECIES	PHENOLOGY	ENVIRONMENTAL USES	HEATH CARE USES	INCOME GENERATION USES
1. Propagation/cultivation practices identified and products commercialized				
Acacia albida	tree	soil improver, animal barrier, N fixer	bark: circulatory, digestive, genitourinary, nervous system disorders; infections, inflammation, pain	**medicines, gum,** tools, important fodder tree
Acacia tortilis	tree	dune control, shelter belt	bark: asthma	browse, fiber, fast grower
Bauhinia rufescens	small tree/shrub	dune stabilizer	root: anti-pyretic, astringent, pods: diarrhoea, dysentry and ophtalmia	**medicines**
Prosopis cineraria	small tree/shrub	soil stabilizer, N fixer	fruits: muscular, respiratory, and skin disorders	tools, tannins, gums, food
Salvadora persica	small tree/shrub	shelter belt	leaves, bark, roots: injuries, neoplasms, tonic, bacterial plaque	**tooth sticks,** resin, food,
Sutherlandia frutescens	shrub	soil improver, N fixer	leaves: stomach, internal cancer, colds, influenza	**medicines**
Harpagophytum procumbens	prostrate perennial	stabilize overgrazed areas	roots: rheumatism, arthritis, general health tonic	growing **medicine** demand
2. Propagation/cultivation practices not identified, but where there is a local market				
Acacia erioloba	tree	sand stabilizer	exudates: infections fruits/leaves: pain roots: respiratory disorders	tools, animal fodder, culturally important
Acanthosicyos horridus	prostrate	colonize shifting dunes	root: many ailments	tubers: **seeds (almond substitute),** food
Citrullus lanatus	prostrate annual	soil stabilizer, rapid growth	fruit: antihyperglycemic	oil, fruit pulp, fruit
3. Less well known species with medicinal value				
Acacia mellifera	tree	soil improver, N fixer, shelter belt	infusion: pain bark: digestive disorders	**medicines,** tools, fiber
Grewia flava	shrub	soil stabilizer	fruit: anemia	fruit

Actions Required

Actions should focus on using agroforestry practices to enhance the rehabilitation values of the MMPs identified in Tables 4 and 5, and on defining a rationale for establishing a marketing comparative advantage for drylands communities. An important source of cultivation practices is the WHO guidelines for medicinal plants (WHO 2003). These guidelines provide a source of information regarding techniques and measures required for appropriate agricultural and collection practices, including post-harvest operations that are intended to contribute to the quality assurance of medical plant materials as sources of herbal medicines. Successful practices developed by communities using MMPs will help strengthen the proposed WHO good agricultural and collection practices (GACP).

Propagation/Cultivation Practices Identified and Products Commercialized [7]

Introducing sustainable propagation, cultivation and harvesting practices offers communities the opportunity to be more fully involved in the policy, decision-making and marketing processes to ensure a sustainable livelihood from MMPs.

In order to expand on the knowledge of documented cultivation practices of species identified in category 1 of Tables 4 and 5, researchers and communities should take into account the pattern of vegetation in relation to environmental factors. For example, factors such as degree of land degradation, compatible species (trees, shrubs, herbs and grasses), and growth rates can affect successful land rehabilitation. Therefore, in developing the production management scheme, testing should be undertaken to identify constraints to up-scaling the project. Project managers should also network with other communities and research institutions on how to overcome the physical and biological barriers to optimize use of water resources. Possibilities include water retention through the use of human-made depressions called called *zai* in Burkina Faso (Ouedraogo & Kaboré, 1996; Taonda, Hien, & Zango, 2001; Ouedraogo & Sawadogo, 2001) and *tassa* in Niger (Hassan, 1996). A technique developed in Israel is the *liman,* a green area in the degraded (desert) landscape, which creates a small oasis (Weekes 1997).

To facilitate the establishment of community-based MMP production systems, the Bank has prepared a toolkit for Task Team Leaders (TTLs) that identifies the best collecting and nursery practices for endemic MMPs used in land rehabilitation programs. (See operational Framework for Using Multi-Purpose Medicinal Plants as Entry-Pints in Land Rehabilitation and Natural Resource Management Projects, Appendices A and B.)

Cultivation Practices Not Identified, But Plants Commercialized

Category 2 in Tables 4 and 5 identifies MMPs that produce well-known and readily accessible commercial products available in rural and urban markets. However, there is no documentary evidence regarding sustainable cultivation practices. This does not mean that local knowledge is absent, but rather that field research is required to document all information that pertains to possible

successful propagation/cultivation of species with known commercial values. When successful cultivation practices are identified for a species, it can be moved to category 1.

Less Well-Known Species

with Medicinal Value

While only a few less-well-known MMPs with medicinal values are identified in category 3 of Tables 4 and 5 many more are known to local people. The toolkit will provide methods to

Table 6. Possible Plant Combinations for Revegetation Trials

TYPE OF LAND	BURKINA FASO/NIGER	BOTSWANA/NAMIBIA
Driest landscapes	*Acacia tortilis subsp. raddiana* *Calligonum comosum* *Cornulaca monacantha*	
Sterile lanas	*Acacia senegal* *Acacia seyel* *Balanites aegyptiaca*	
Fixed dunes	*Acacia senegal* *Leptadenia pyrotechnica* *Cenchorus biflorus*	
Depressions between dunes	*Balanites aegyptiaca* *Boscia senegalensis* *Maerua crassifolia* *Panicum turgidum* *Cenchorus biflorus*	
Depressions	*Acacia tortilis subsp. raddiana* *Balanites aegyptiaca* *Boscia senegalensis* *Calligonum comosum* *Maerua crassifolia* *Panicum turgidum*	
Active soil movement	*Balanities aegyptiaca* *Calligonum comosum* *Commiphora africana* *Panicum turgidum*	
Denuded riverbanks		*Acacia eiorloba* *Acacia albida* *Salvadora persica*
Sandy areas (with trees)		*Acacia tortilis* *Grewia flava* *Schmidtia pappophoroides* *Eragrostis spp.*
Shallow dry soils		*Grewia flava* *et. al*

Note: The literature recognizes that *Acacia senegal* and *Cenchorus biflorus* are common associates in semi-arid disturbed sites in the Sahel/Sudanian zone.

Marketing Skills and Outreach

At present, drylands residents lack a marketing comparative advantage for raw or partially processed medicine plant products. Since most SSA governments have not invested in the development of a traditional medicine market, the industry remains dominated by traditional/artisanal (as opposed to modern industrial) technologies and minimal business skills. For example, while there are no formal controls regarding quality, the specificity of use and mixing of herbal constituents is highly developed by traditional healers. Purchased plant products are usually packaged in old newspapers or recycled plastic bags. Local and regional trade takes place through an extensive network of individuals. While the volume of trade (not formally documented) may be small, large volumes of raw materials are shipped and stored in bulk.

The use of MMPs to rehabilitate degraded lands could offer a new source of supply for consumers and income to those employed in the industry. If the production comparative advantage is to be strengthened and sustained, a market comparative advantage must be promoted that addresses: (a) the policy environment and regulatory mechanisms; (b) sustainability of supplies; (c) the lack of business marketing skills, (d) the need for a market information system to facilitate access to regional and international markets; (e) community and business collaboration for development of a wide range of processed products (simple to sophisticated); (f) improved quality of products currently consumed and traded; and (g) support for rehabilitating land through the production system.

To ensure a market comparative advantage, SSA countries could carry out national market surveys on indigenous MMPs (Mander, 1998; Lambert, 2003). Such surveys would provide quantitative data on demand and supply, volumes collected and sold, values, and contribution to the provision of basic healthcare needs, especially for the 70–80 percent of the population that draws no benefit from public sector healthcare funding. Such surveys were the unanimous recommendation of a World Bank-supported regional workshop held in Ouagadougou in 2003 to provide feedback on the Burkina Faso medicinal plant marketing and supply assessment. Participants came from Benin, Ghana, Guinea, Mali, Niger, Senegal, Togo, and Burkina Faso. Delegations were made up of traditional healers, herbalists, vendors, pharmacists, medical doctors, university researchers and government officials.

The most important next step is to support communities and land users in determining whether medicinal plants can accelerate land rehabilitation. Provision must be made for land users to partner effectively with agronomy and resource management specialists to ensure that traditional and biotechnology considerations are effectively incorporated in SLM programs. At the same time, attention must be paid to establishing market information systems, providing business skills to vendors and promoting an industry that is grossly underdeveloped.

Developing a market advantage will benefit from donor support in doing market research and "branding." Communities will need assistance to ensure that their products:

- have an identity that sets them apart from competitors;
- are better environmentally than competitors;
- provide an environmental claim: i.e. rehabilitating degraded lands; organically grown; produced by women;
- have an indigenous "Green Seal"; and
- are safe, effective, and durable (shelf-life).

Discussion

The link between land degradation/desertification and poverty is complex. Land degradation/desertification is an important cause of the steady decline in rural incomes, resulting in a complex of demographic, economic, and social changes (Mutepfa, 1999). One unpublished World Bank study suggested that the depletion of natural resources in one Sahelian country was equivalent to 20 percent of its annual gross domestic product. At the global level, it is estimated that the annual income foregone in the areas immediately affected by desertification amounts to approximately US $42 billion each year (UNEP, 1997). The losses due to reduced medicinal plant production include both the commercial value and the loss to human productivity from the unavailability of these products.

Strengthening the production comparative advantage of MMPs in land rehabilitation programs can promote a sustainable environment with trees, woody shrubs, herbs (and grasses) that enhances a range of products that can be used for subsistence or sale locally, regionally and internationally. These include: medicines; cosmetics; food; essential oils; spices; and fodder. Plants with these uses are less likely to be used for building materials or fuelwood, thus protecting them from elimination.

A key issue is the need to generate empirical demand-supply and volume-value data to support investments in medicinal plants and traditional medicine in developing countries. More importantly, there is a need to selectively generate data that would make the business case for investing in MMPs in SSA. While some drylands communities have started to play an active role in land rehabilitation programs, only meager data are being accumulated that identify the demand for, and value of, medicinal plants and their increasing importance in the global health market. Meanwhile, the supply of MMPs—especially in the drylands—is far from secure.

The supply of quality medicinal plant products throughout SSA is not only critical for the health of millions of consumers, but also for the welfare of the people who collect, store and transport them to maintain the market supply. Information currently available regarding rural dependence on the harvesting of wild resources is localized.[8] A major market problem is the lack of storage facilities and vending infrastructures resulting in unnecessary spoilage, a decrease in product quality and loss of income. National records are rarely kept of local sales and many sales are illegal. Hence benefits are generally undervalued. As a result, both governments and donors have tended to overlook rural and urban people's dependence on wild resources and such resources are not incorporated into national development and economic policies.

The present medicinal plant market is essentially a "sellers' market" where supply is decreasing while the demand is increasing. However, the monetary returns for the raw materials are not equally divided amongst the "sellers". The collectors receive the least while the middlemen—vendors, traders, and exporters get increasingly more. This is as it has been for centuries. However, the increasing global demand for many medicinal plant products offers the collectors and producers an opportunity to gain "added-value" by partially processing products. Preparation of some medicinal products and extracts and conversion into dosage forms can be carried out at the community level for local, regional and international markets. It is clear that SSA is a source of plant materials that drive the global trade in herbal remedies. A fraction of the present global herbal medicine market of US $65 billion would be a

major boon to Africa's dryland poor, if mechanisms are put in place to ensure that such benefits actually reach them.

More generally, the increasing international demand for natural health products offers a niche opportunity for rural communities that cannot be fulfilled in the industrialized countries even with the latest technologies. Thus, there is a significant market opportunity for communities to increase supplies, thus minimizing unsustainable harvesting of wild sources, while simultaneously alleviating poverty for providers. This is a win-win situation. Land degradation can be reversed by the residents and this activity can be financially rewarding. The risks are low and the rewards are high. However, for these efforts to be successful, governments must ensure that a production comparative advantage is fully supported by appropriate market opportunities locally and internationally.

This paper suggests that by using MMPs as entry points for SLM activities, realistic operational synergies among the Rio conventions on biodiversity (CBD), desertification (UNCCD), and climate change (UNFCCC) can be achieved on the ground. While each of these global agreements has contributed to the understanding of how to combat land degradation/desertification, that knowledge has not been effectively and widely used at the community level. Partnerships must be established with national and international stakeholders supporting community-based land rehabilitation actions. At the same time, such programs must make every effort to link with and benefit from complementary programs such as International Development Research Centre's (IDRC) medicinal plant network, FAO's manuals on market analysis and development, and International Centre for Research in Agroforestry's (ICRAF) medicinal tree domestication program. Success in such partnerships would also make a positive contribution to the 2001–2010 Decade of African Traditional Medicine.

The paper has highlighted the role MMPs can play not only in drylands, but also by inference in all climatic zones where land degradation impacts on the natural resources that sustain the rural poor. The significant global economic value (US $65 billion in trade) and volume (estimated 5 million metric tonnes) of medicinal plants collected, traded, and used annually indicates the need to document and formally recognize their present and future importance to developing countries.

The proposed multi-sector strategy that would link Bank sectors into coordinated interventions underscores the importance of such an approach. The approach would simultaneously support direct investment in sector improvements and indirect interventions aimed at creating capacity for better environment, rural development, and health management. Rather than viewing drylands as potential disaster regions, client governments, communities and donors should start to see them for the advantages they can offer locally and globally. Such an approach builds on the premise that a multi-sector bio-economic approach to drylands rehabilitation will be more rewarding than a more limited individual sector approach. The result is the building and preservation of a comparative advantage tailored to cultures by participatory means.

The World Bank's comparative advantage can be used to: (a) elevate the profile of MMPs in country dialogue processes, especially where evidence suggests that they (MMPs) may play vital roles in natural resource management, healthcare delivery systems, trade and income generation; (b) support training in agro-forestry production and developing management and business skills; (c) promote the growth of efficient MMP agro-business and markets; (d) facilitate collaboration and knowledge sharing; (e) provide a format to share experiences; and (f) support the integration of the needs of the rural poor in national and global MMP agro-business dialogues.

Concluding Remarks

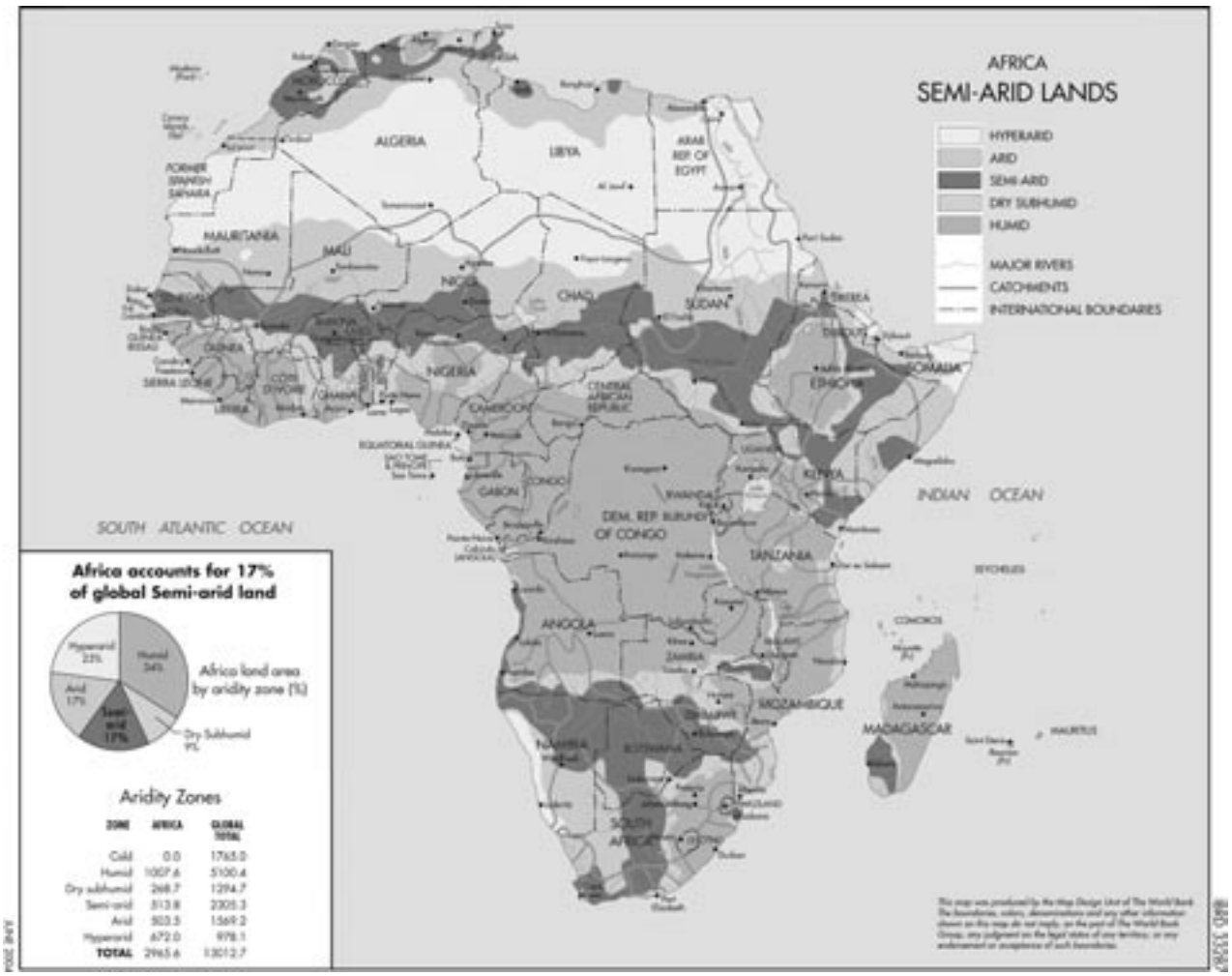
Supplying a global market in which demand for MMPs far outstrips supply offers unrestricted market and trade opportunities to drylands communities and businesses in developing countries. In an era when most SSA countries are struggling with uncompetitive commodities due to trade barriers and agriculture subsidies in OECD countries, this niche should be exploited to the fullest extend possible.

MMPs endemic to these drylands have a built-in production advantage in that they can not be grown economically in any other environmental zone, thus, they offer a unique comparative advantage. Rural communities can exploit this advantage by using the guidelines in the accompanying publication, *Operational Framework For Using Multi-Purpose Medicinal Plants As Entry-Points In Land Rehabilitation And Natural Resources Management Projects.* Assistance will be needed since most SSA governments have not invested in the development of a traditional medicine market that takes advantage of growing regional and global demands for natural products, including medicines, cosmetics, and essential oils.

Since MMPs provide a niche opportunity with multiple benefits (environment, income, health), they present a crucial entry point for land rehabilitation that offers: (a) permanence (sustainability); (b) operational synergies among the Rio conventions on desertification, biodiversity, and climate change; and (c) trade, income and health benefits to poor communities and countries in SSA drylands. This contributes directly to the poverty, health, and environmental goals of the MDGs.

Growing and marketing MMPs is not suitable for all programs everywhere. While it is clear that countries need to be aggressive in supporting development of MMPs, such investments should also be guided by deliberate selectivity. Therefore, efforts aimed at developing MMPs should not be approached as stand-alone initiatives but as part of larger programs in sustainable land management, community development, healthcare, and natural resources management.

Appendix A
Map Highlighting African Arid, Semi-arid and Dry Subhumid Lands, as of June 2004



Appendix B
Drought-Tolerant Medicinal Plant Species in Western Sahel/Sudanian Region (Burkina Faso/Niger) with Potential Role in Land Rehabilitation

SPECIES	DROUGHT TOLERANCE [A]	LIFE FORM	ROOT SYSTEM	PROPAGATION	SOIL
Acacia albida	4	tree	tap root	seed	dry
Acacia ehrenbergiana	5	small tree/shrub	tap root	seed	fine textured soil only (FAO)
Acacia nilotica	4 drought tol-erant, also tolerates soil waterlogg-ing	tree	deep and extensive root system on dry sites; tap root devel-ops first and then laterals, which become compact and massive (CABI.)	seed	dry, also alluvial, heavy clays
Acacia tortilis subsp. Raddiana	4	shrub, small/ medium tree	develops long lateral roots that can be a nuisance in nearby fields	seed	dunes well-drained, favors alkaline
Acacia seyal	2–3	small/ medium tree	relatively shallow, but can develop tap roots to 6–7 m and laterals in upper 50 cm (see also note [b])	seed	lowlands, allu-vial, heavy clays, stony, gravelly alluvial or humic soils
Acacia Senegal	5	tree/shrub to 15 m	tap; lateral roots spreading many meters especially in sands	seed	sandy soils to rocky; slightly acidic to moder-ate alkaline

RAINFALL (MM)	ENVIRONMENTAL USE	MEDICINAL USE	FOOD USE	OTHER USES
100–1,400	soil stabilizer, N fixer	bark: circulatory, digestive, genitourinary, nervous system disorders, infections, inflammation	livestock browse, fruit edible	complementary intercrop
50–400	found along watercourses	anti-inflammatory gum emollient	browse, edible gum	ropes (bark fiber)
125–1,300	dune erosion control, rehabilitation, pioneer species, N fixer	leaves: diarrhea bark: antiamebic, spasmodic, hypotension fruit: anti-diarrhea, fever reducer; roots: chest, stomach problems, toothache gum: anti-diarrhea	livestock foliage and pods fruit, fodder, maybe toxic to goats	tannin gum, strong, durable wood, good fuelwood, inter-cropping. ropes (bark fiber)
50–1,000	pioneer, N fixer, erosion control	anthelmintic, disinfectant (wounds, powdered dry bark)	animal	fuelwood, fast growth
250 – 1,200 (CABI)	fencing, pioneer, N N N fixer	wood: rheumatic fever bark, leaves: gastric ulcers bark: wounds	livestock pods	gum arabic, good firewood, poles (wood), ropes (fibers)
100–800 1100	erosion control, shelter belts, pioneer, N fixer	bark, leaves: astringent for diarrhea, colds gum: diuretic, hemorrhage Gum + bark: angina, inflammation	seeds can be dried and eaten; bees (honey)	fuelwood, gum arabic, "gum gardens" in Sudan, intercropping root bark ropes (fibers)

SPECIES	DROUGHT TOLERANCE [A]	LIFE FORM	ROOT SYSTEM	PROPAGATION	SOIL
Acacia tortilis	5	tree: pioneer species	long tap root to 35 m, numerous lateral roots (x2 width of crown) (CABI)	seed	sand dunes, favors alkaline
Acanthosicyos naudinianus	5	prostrate	tuberous, to 1 m long		sandy, dry
Argania spinosa	4	small tree, will sprout readily from cut stumps and suckers, creating bushy appearance (CABI)	well developed and can extend a long way down if subsoil hard and rocky (CABI)	seed, cuttings	dry, limestones, sandstones, alluvials, will not tolerate deep, moving sands
Balanites aegyptiaca	4	small/medium tree	deep tap root to several meters, also diagonally radiating roots forming hemi-spherical mass; reports of both restricted and wide lateral spread (see also note c)	seed, root cuttings, root suckers	sand, clay, gravel
Boscia senegalensis	4	evergreen shrub		seed	rocky soils, fixed dunes
Calligonum comosum	4	small shrub, understory		seed	desert scrub, sandy, gravelly clay, shifting sands; grows with Stipagrostis pungens (see below)
Commiphora Africana	4	small tree shrub	extensive creeping	cuttings	sand-rocky soils, red clay, sandy clay
Cordia sinensis	5	low shrub			sandy rocky riverine soils
Cornulaca monacantha	5	low bush			dry, sandy, stony
Euphorbia balsamifera	3	shrub			sandy soil

RAINFALL (MM)	ENVIRONMENTAL USE	MEDICINAL USE	FOOD USE	OTHER USES
50–1,000	erosion control N fixer, does not colonize recent dunes	various, disinfectant, powdered bark: wounds [[correct PB=wounds only?]]	fodder; also human food, porridge from pods after extracting seeds (Turkana, Kenya)	afforestation of sand dunes, good fuelwood; inner bark fibers for rope
<500	soil stabilizer	infections	human: edible fruits, fruit pulp, seed cake	edible oil; southern African species
100–500	erosion control	mental disorders	leaves, pods, fruits yield nutritious edible oil; browse	fuelwood
100–800	stabilize drainage pathways	Diabetes, molluscicide insect repellent	human, animal	soap steroids fuelwood
100– 900	erosion control	circulatory, digestive, genitourinary, sensory, mental, skin disorders, infections, injuries	famine food, leaves, seeds/lentil, fruits	fuelwood
70–100	erosion control, sand binding	Anti-inflammatory Anti-ulcer	flowers nutritious browse	
200–800	live fences	fevers, dermatitis, stomach, toothache, gum diseases	human livestock	myrrh easy to propagate with cuttings
	shelter belt	digestive, respiratory	fruit fodder	
<150	revegetation	skin infections, goiter	leaves a green vegetable; browse	
100–600	live fence	many uses, e.g. purgative, laxative, snake bites		wind break, poisonous latex

SPECIES	DROUGHT TOLERANCE [A]	LIFE FORM	ROOT SYSTEM	PROPAGATION	SOIL
Grewia tenax	4–5	small tree shrub	aggressive root system holds fast to soil protecting it from water and wind erosion	seed	very dry sand, rocky
Jatropha curcas	4	small tree shrub	usually 5 roots develop from seedlings: 1 central and 4 peripheral; vegetatively propagated plants do not form tap root	seed cuttings	well drained sand
Leptadenia pyrotechnica	3–4	shrub	root tubers	seed	sandy soils, dunes
Maerua crassifolia	5	shrub		seed	sands
Prosopis africana	4	tree	deep tap root (few lateral roots)	seed	sandy clay, tolerates most soil types
Salvadora persica	5	evergreen shrub/small tree		seed, cuttings	dunes, prefers clays, also found on river and stream banks, seasonally wet sites, saline tolerant
Sclerocarya birrea	3	tree	short tap root, lateral roots (see also note d)	seed, cuttings, trunch-eons, root suckers	sandy, well drained
Zizyphus mauritiana)	5	small tree, shrub	deep and lateral (CABI)	seed	depauperate, sandy loam, gravels, avoids clay

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RAINFALL (MM)	ENVIRONMENTAL USE	MEDICINAL USE	FOOD USE	OTHER USES
100–1,000	superior uses, erosion control, dune fixing	respiratory	human, edible fruit, livestock	traded
>500, but grows best with >1,000	erosion control on dunes and slopes; live fence	digestive, muscular, skin disorders, injuries, infections, neoplasms	spices	oil, fuel traded; introduced from Central and South America
100–450	dune stabilizer	toothbrush, eyes	browse for camels, sheep, goats; edible roots, leaves	wickerwork
100–700	soil stabilizer	stomach disorders	fruit; leaves eaten in couscous	forage
<500 (–1,200)	erosion control, N fixer	respiratory, genitourinary disorders, infections, pain	seeds fodder	intercrop
50–600	shelter belt	fruits, bark, roots, leaves wounds, neoplasms, nutritional disorders, pain, teeth cleaner	human, livestock, bees	wood for saddles
200–1,300	live fence	circulatory, digestive, muscular, skin disorders, inflammation, pain	fruit, browse	traded, multiple uses
100–500	fixing coastal sand dunes, live fence	bark: diarrhea, roots, bark, leaves, seeds, fruits: digestive system disorders	fruit, fodder	wood used for construction, furniture, tool handles

Notes:

a. Drought tolerance classification: 5 – extremely drought tolerant; 4 – drought tolerant; 3 – moderately drought tolerant.

b. *Acacia seyal:* Groof and Soumaré (1995) investigated the roots of five trees in the Sahel. Thin, deep tap root reaches 6 m, laterals in upper 40 cm. Several secondary roots branched vertically downwards from the laterals, sometimes reaching >5 m (so-called "sinker roots") close to main trunk. Maximum length of laterals 25.7 m, 7 times radius of the tree crown. Area exploited by roots estimated to be at least 25 times area covered by crown.

c. *Balanites aegytiaca:* Hall and Walker (1991): also state outward extension of lateral roots to 7 m, 15 cm below soil surface from a tree 12.5 m high and 30 cm dbh.

d. *Sclerocarya birrea:* Groof and Soumaré (1995) investigated the roots of five trees in the Sahel. Thick, relatively short tap root reaches 2.4 m. Lateral roots branched from upper 100 cm of tap root and gradually curved towards soil surface as distance from trunk increased. Lateral roots thick near trunks, but taper sharply within the first 100 cm from trunk. No sinkers from lateral roots. Maximum length of laterals was 50 m, 10.2 times average radius of tree crowns; average length was 5.8 times average crown radius. Area exploited by roots estimated to be at least 34 times crown area.

Appendix C
Drought-Tolerant Medicinal Plant Species in Kalahari Highveld Region (Namibia/Botswana) with Potential Role in Land Rehabilitation

SPECIES	DROUGHT TOLERANCE[A]	TREE/SHRUB/ HERB/GRASS	ROOT SYSTEM	PROPAGATION	SOIL
Acacia erioloba	4	small to large tree to 18 m	tap root to 46 m	seed, cuttings	sand, aggressive colonizer
Acacia mellifera	3–4	shrub/small tree	shallow, extensive	seed	sandy, clay, rocky, dry, prefers loamy soil
Acanthosicyos horridus	3–4	creeping	great depth, woody rootstock	seed	loose sand
Aloe zebrina	4	small succulent			
Arthraerua leubnitziae	4	creeping			
Citrullus lanatus	4–5	prostrate, annual	deep root system	seed	sandy, dry
Bauhinia petersiana subsp. macrantha	4	small tree		seed	sandy, dry
Bauhinia petersiana subsp. petersiana	4	small tree		seed	sandy, dry
Bauhinia rufescens	4	shrub/small tree		seed pretreat/ cuttings	sand gravel
Grewia flava	5	shrub		seed	dry
Harpagophytum procumbens	5	prostrate	tuber; tubers of lateral roots > 25 cm in length and 6 cm diameter; can reach depth of up to 2 m	seed	sandy

RAINFALL (MM)	ENVIRONMENTAL USE	MEDICINAL	FOOD	OTHER
40–800 (250–1,000, ICRAF; 10–900, CABI)	erosion control, N fixer	respiratory disorders, infections, pain	animal feed, edible gum, bees	hard, durable wood for poles, props, utensils
40–800	shelter belt, N fixer	pain, stomachache	edible gum, bees, browse	tools, fiber
<250	dune erosion control	infections	vegetable, fruit, forage	
	soil stabilizer	skin infections, constipation, fever		
	erosion control	general uses		
	soil stabilizer	massage, purgative (fruit pulp)	human, livestock	
350–1,000	soil stabilizer	unspecified	seeds, fruits edible	
350–1,000	disturbed sites	unspecified	seeds, fruit, browse	
200–1,000	barrier, hedges, erosion control, dunes, N fixer	fever, dysentery	browse, edible fruits	light construction, carpentry
300–350		respiratory	human, livestock	wickerwork
100–200		anti-inflammatory, anti-rheumatic		Traded

SPECIES	DROUGHT TOLERANCE[A]	TREE/SHRUB/ HERB/GRASS	ROOT SYSTEM	PROPAGATION	SOIL
Prosopis cineraria	3–4	shrub/small tree	deep root system	seed, suckers cuttings (difficult)	saline, dry, silty, gravels, sandy loam
Salsola (Chenopodium) nollothensis	4	creeping			
Sutherlandia frutescens	4	small shrub		seed (but see note b)	sandy, gravelly
Ximenia caffra	3–4	bushy tree		seeds	sands fertile from flooding

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RAINFALL (MM)	ENVIRONMENTAL USE	MEDICINAL	FOOD	OTHER
75–800	soil improver, shifting sand dunes, N fixer	muscular, respiratory, skin disorders, infections	browse; humans—edible pods and bark ground into flour	construction, posts, tool handles, gum, intercropping with horticultural crops; native to Middle East and W. Asia
	erosion control	infections		
100–150	soil improver, N fixer	stomach problems. fevers, internal cancer, rheumatism, HIV/AIDS		
		unspecified	edible fruit	beverage

Notes

a. Drought tolerance classification: 5 – extremely drought tolerant; 4 – drought tolerant; 3 – moderately drought tolerant

In the absence of other information, the following seed germination details were obtained from the Seed Information Database (Tweddle, Turner, and Dickie 2003); however, the germination protocols relate to controlled laboratory experiments. According to the authors, translating this information to determine how to germinate seeds in the field subsequently requires care.

b. Sutherlandia frutescens: 100% germination; pre-sowing treatments = seed scarified (chipped with scalpel); germination medium = 1 % Agar; germination conditions = 210C, 12 hour photoperiod; (RBG Kew, Wakehurst Place).

Endnotes

[1] Medicinal plants have been defined as those plants that are commonly used in treating and preventing specific ailments and diseases, and that are generally considered to play a beneficial role in healthcare (Lambert, Srivastava and Vietmeyer, 1997). For the purposes of this paper, MMPs are those species that foremost have a range of medicinal values that have been and are being successfully exploited and used by people and their livestock for various ailments. In addition, they contribute directly to food security, income generation and land rehabilitation by enhancing soil stabilization, biodiversity, soil water retention, nitrogen fixation.

[2] The United Nations Convention to Combat Desertification defines arid, semi-arid and dry sub-humid areas as areas (other than polar and sub-polar regions) in which the ratio of annual precipitation to potential evapo-transpiration falls within the range from 0.05 to 0.65.

[3] Estimate calculated using per capita government expenditure data (avg. exchange rate US$) from the World Development Indicators, 2004 and World Health Report, 2004.

[4] This project is IFC's first investment in the phytopharmaceutical sector and was approved March 28, 2002. It is expected that 400 farms will become direct suppliers to Atos. This will result in significant employment creation (especially women), as well as other sectors in the supply chain (e.g. processing, packaging, transportation, storage, etc.).

[5] A total of 10 Traditional Chinese Medicine (TCM) manufacturers in China enjoy annual sales figures of over US$100million. While 200 TCM manufacturers have annual sales values over US$12 million.

[6] It should be noted that there are differences of opinion on this issue. For example, Winer (pers. com.) questions whether the invasion of 'undesirable' plants in the Kalahari is environmentally undesirable. They maybe undesirable for the cattle industry, but may have been an integral component of the biodiversity controlled by fire in the past, whereas today fire is controlled.

[7] Commercialization does not only mean quality packaged, ingredients identified, or with an expiry date, but includes products that are commonly used, in high-demand, and sold in a culturally accepted manner.

[8] Non-timber forest products (other than MMPs) and bush meat are important wild resources. A useful review of these components is provided by Falconer (1997. Non-Timber Forest Products in Southern Ghana. ODA).

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