

***Prosopis*: Semiarid Fuelwood and Forage Tree Building Consensus for the Disenfranchised**

A Workshop
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Workshop Rationale and Objectives

The 3.4 billion hectares of the world's drylands constitute 25% of the earth's surface and harbor 500 million people. The people of these drylands belong to some of the world's poorest communities, with problems of food security, inadequate access to drinking water, and inadequate access to sanitation facilities. Examples of poor economic conditions in drylands can be found in major areas of India, sub-Saharan Africa, Haiti, Mexico, Brazil, Argentina, and Peru. In the United States, some areas with the greatest unemployment and greatest health problems are located in semiarid regions of southern Texas.

The diversity of plant communities declines rapidly with increasing aridity. Thus, the availability of plants capable of producing food, firewood, cash flow, and soil fertility without irrigation also decline rapidly with increasing aridity. Multipurpose genera that are very biologically diverse, resulting from multiple interbreeding species, and are widely adapted to the world's semiarid regions are rare *Acacia*, *Casuarina*, *Eucalyptus*, *Tamarisk*, and *Prosopis* are the principal genera with great biological diversity and ecological plasticity that have been used worldwide in arid regions. *Prosopis* has a significant advantage over *Eucalyptus* and *Tamarisk* in being a nitrogen fixer. *Prosopis* has a significant advantage over *Acacia* and *Casuarina* in that only *Prosopis* has great historical precedence for providing food for humans and domestic livestock.

The nitrogen-fixing genus *Prosopis* has more than 40 species native to North and South America, Africa, and Asia that range from 1-m-tall shrubs to 18-m-tall trees. Hundreds of hectares of *Prosopis* occur naturally in Death Valley, California, the hottest location in the Western Hemisphere. Other *Prosopis* species have become naturalized to harsh semiarid areas of Haiti, Sahelian Africa, and India. *Prosopis* pods, which are high in sugar (30%), with moderate levels of protein (12%), have been used for human and animal food by indigenous people for millennia. In Mexico, Argentina, and Brazil *Prosopis* pods are a critically important source of animal feed. In Peru, pods of especially sweet varieties are used for human food. In North America, soils under the canopy of *Prosopis* have 1,000 kg/ha more soil nitrogen and 8,000 kg/ha more soil carbon than soils outside the canopies of the trees. In India, *Prosopis* has been used to reclaim high-pH

(10.4) soils. *Prosopis* strains have been found that will grow in salinities equal to ocean water. In Somalia, *Prosopis* has been used for sand dune control. In many places of Sahelian Africa, it is important for fuelwood and forage. In western India and Haiti, *Prosopis* provides more firewood than any other species. Although the reddish/brown lumber of *Prosopis* is usually less than 2 m in length and 0.4 m in width, it finishes very well, is harder than oak, and is more dimensionally stable (lower volumetric shrinkage) than any lumber measured to date. Thus production of flooring, fine furniture, and artisanal products is a very active growth industry in the United States and Argentina.

It is useful to cite illustrative economic data:

In the Chaco Province of northwestern Argentina, 140,000 tons/year of *Prosopis* logs are harvested for furniture and flooring.

In the state of Texas, 15,000 tons of *Prosopis* chips and chunks are processed yearly for sale in retail stores across the United States. Also, in the United States, a small but fast-growing *Prosopis* lumber, flooring, and furniture market has developed.

In Peru, 180,000 tons of *Prosopis* pods are used annually for livestock feed.

In Mexico in 1970, 40,000 tons of *Prosopis* pods were used annually for livestock feed.

In Gujarat state of India, 300,000 30-kg bags of *Prosopis* charcoal are produced each year for sale in large cities.

In Haiti in 1991, the total value of the charcoal industry (principally resulting from *Prosopis*) was \$50 million, and the charcoal industry supported 150,000 people.

In the Sahel, about 16 million cubic meters of firewood are required per year. Senegal imports 50,000 cubic meters of wood each year from neighboring countries. *Prosopis* is a major provider of firewood for Senegal.

It is most unfortunate that one of the world's finest furniture lumbers, currently being sold in Argentina and the United States for \$800 per cubic meter (about \$900 per ton) is being manufactured into charcoal at \$200 per ton to satisfy basic living requirements.

Using sawmills currently producing lumber for pallets, fine furniture and flooring production from short *Prosopis* logs could be developed into significant industries in arid lands. Small furniture and flooring components could be integrated into fine furniture. However, large increases in the quality of sanding, joinery, and finishing would be required to meet international standards.

Despite the significant economic impact of *Prosopis* in many regions, at this writing, no country had a national development plan for *Prosopis*. Among development agencies, only the Food and Agriculture Organization (FAO) and Overseas Development Authority (United Kingdom) had *Prosopis* programs in their portfolios.

Great progress has been made in the last six years in identifying *Prosopis* that are rapidly growing (2 meters per year), erect, and thornless and produce sweet pods that can be used in human or animal food. As noted in this volume, researchers in coastal areas of Haiti, arid regions of Cape Verde, and interior Rajasthan deserts of India have all found *Prosopis* seed sources from Peru to have grown the tallest and be erect and thornless. With pod utilization techniques reported in this volume for both human and livestock food, and with identification of superior genetic materials for

tropical arid regions, the route is paved for commercial investments into arid lands.

In 10 years, great strides have also been made in reducing the weedy nature of *Prosopis* by thinning and pruning, promoting intraspecific competition, and incorporating *Prosopis* in agroforestry practices.

Despite the widespread importance of *Prosopis* for firewood and forage for very poor people in arid regions of Mexico, Haiti, Sahelian Africa, and India, there has been little international awareness of the problems and potential for *Prosopis* because of very limited communication between these poor people. With recently improved genetic strains, soil management techniques, native stand management techniques, and marketing efforts, great opportunity exists to rapidly improve the lives of very poor people in some of the world's harshest ecosystems.

Given the fact that one third of the earth's land surface is semiarid or arid, when the local experiences with *Prosopis* are aggregated on a worldwide scale, *Prosopis* is a significant worldwide resource.

It was the intent of this workshop to stimulate awareness of the worldwide magnitude of the contribution that *Prosopis* has already made and to outline immediate concrete steps to rapidly improve the lives, economies, and ecosystems of some of the world's poorest people.

Workshop Summary and Recommendations

There was excellent participation in the workshop from nearly all sectors related to arid-land management. Excellent press coverage was provided by Mr. Kurt Kleiner from *New Scientist*, Ms. Elizabeth Pennisi from *Science*, and Mr. Bob Sivak from Voice of America.

In addition to the participants discussed below, Dr. Barbara Dugelby and Dr. Shirley Keel attended from The Nature Conservancy, Mr. Bruce Rich and Mr. Ken Walsh attended from the Environmental Defense Fund, and Mr. Larry Williams attended from the International Section of the Sierra Club. Dr. Greg Ruark from the U.S. Forest Service and Dr. Philip Simms, the USDA National Program Leader for Range, also participated in the conference. We were indeed fortunate to have excellent representation from the World Bank, including Mr. Eduardo Loayza, Dr. Bill Beattie (economist, Latin America), Dr. Norman Jones (forester, India), Dr. Bob Kirmse (forester, Latin America), Dr. Christian Taupiac (forester, East Africa), and Dr. Peter Dewees (forester, Horn of Africa).

The reception at the National Academy of Sciences on Tuesday evening provided an excellent opportunity for participants to become acquainted before the workshop. The 20% *Prosopis* flour cookies brought by Mr. Jose Inacio da Silva from Brazil were served and most appreciated.

Upon registration, each participant was given a 4-inch-square finished mesquite piece with the laser-engraved Los Amigos del Mesquite logo.

The Wednesday program began with an acknowledgment of the workshop sponsors and an informative welcome by Agency for International Development (AID) agroforester Mr. Mike Benge.

A very colorful and appropriate welcome message was provided by Ms. Betty Alberts of the President's office at the National Academy of Sciences. Ms. Alberts related that when she was about 10 years old and living in Hawaii, she earned spending money by collecting *Prosopis* pods that were fed to cattle. She received only \$0.50 per 25-pound bag of pods, but, during World War II, this was important

when they were cut off from the mainland. She also recounted getting a large thorn in her foot from collecting pods one day. Clearly, she was very familiar with the good and bad points of *Prosopis*. When she was visiting India, she saw *Prosopis* in many places, but the foresters accompanying her insisted the trees were *Acacias*. Finally, a specialist from the Central Arid Zone Research Institute confirmed that what she saw was indeed *Prosopis*.

Also on Wednesday, Mr. David Miller, past President of Los Amigos del Mesquite, set up his exhibit of flooring, furniture, and lumber. This exhibit was much appreciated, as it was the first time that many *Prosopis* scientists outside Texas or Argentina had seen fine *Prosopis* furniture and flooring. Several international foresters commented that the wood was similar in color and figure to sissham or Indian Rosewood.

Other U.S. industry participants at the meeting included Mr. Jerry Lawson of W.W. Woods and Mr. Bob Colberts, the new owner of Lazzari Fuels in San Francisco. Lazzari Fuels is the oldest and largest mesquite charcoal importing company in the U.S. Several years ago, Lazzari Fuels began a policy of purchasing only mesquite charcoal made from pruned branches and cull trees. This has opened up the stands to complete clearing of the land at no additional cost.

It was also very significant that Dr. Carlos Rodriguez Franco, the Forestal Vocal Ejectivo of INIFAP (Director of the research branch, Mexican Forest Service), gave a presentation and moderated a session. He was interested in volume tables for mesquite and stand-management techniques.

Drs. Rafiq Ahmad from Pakistan, Gurbachan Singh from India, and Ousman Diagne of Senegal opened the workshop session on land reclamation and soil stabilization with comprehensive reviews of the use of *Prosopis* for sand-dune reclamation in the Arab Gulf States, use of *Prosopis* for reclamation of high-pH (10.4) soils resulting from irrigation mismanagement in India, and nitrogen fixation and utilization of *Prosopis* in Senegal.

Following lunch, Dr. Stephen Bristow of the NGO SOS Sahel presented the results of 10 years using *Prosopis* in controlling sand-dune movements on the upper branch of the Nile in Sudan. *Prosopis* has been the most successful species used to control sand dune movements near the irrigated areas along the Nile, where dunes have drifted to cover entire villages. This effort was supported by Rotary clubs in the United Kingdom. Dr. Zach Lea and Mr. Henri Valles of Haiti then illustrated the fact that *Prosopis* was the number one fuelwood species in Haiti. Mr. Valles reported on his progress in establishing 13 *Prosopis* pod collection/grinding sites in Haiti. The *Prosopis* is being ground for animal feed. Dr. Rebecca Butterfield of CARE surveyed the approximately 15-year project of tree planting in Niger, West Africa. *Prosopis* was usually an important component of these planting efforts. However, she reported that farmers did not like the trees because of the thorns. She felt that *Prosopis* was useful for stream-bank control but would not be useful in farmers' fields unless thornless varieties were available. She also stressed the need for utilization projects for *Prosopis* in Niger.

At the coffee break in the pod utilization session, Mr. Jose Inacio da Silva provided pastries with 20% *Prosopis* flour, coffee made with 50% coffee and 50% roasted *Prosopis* flour, and finely ground *Prosopis* flour for samples. He brought 35 kg of *Prosopis* cookies to be distributed to guests at the workshop.

The session on human and animal uses of *Prosopis* pods was superb. Ms. Michelle Silbert began this session by discussing her research on the *Prosopis*-pod cooperative in central Mexico. In some years this cooperative processed several thousand tons of pods that were purchased from people in the area. An electric hammermill was used to grind the pods into various rations for animal feed. Ms. Silbert reported on her interviews with farmers to determine the extent of utilization and the prices paid for *Prosopis* pods.

Mr. Inacio da Silva then reported on his 3,000-ha *Prosopis* plantation in northeastern Brazil and his system for drying (with wood-fired coffee driers) and grinding the pods. Each year he usually processes about 4,000 tons of pods, which are sold to the people in the surrounding area.

As the current President of the International *Prosopis* Association, an organization that has had several international conferences in South America, he stressed the need for cooperative efforts between any new organization and existing *Prosopis* organizations.

Ing. Nora Grados of the University of Piura in Peru described the historical uses of *Prosopis* pods for human food and reviewed the program at the University of Piura for drying and fractionating pods into products for human use. The frost-sensitive *Prosopis* in Peru are especially sweet, with very little bitter aftertaste. A number of excellent products are already being marketed for human use in Peru.

The mesquite barbecue reception hosted by the Texas A&M Research Foundation on Wednesday evening was most helpful in introducing Texas Congressional aides to both the Texas and the international dimensions of *Prosopis* (mesquite). Texas barbecue manufacturer Jerry Lawson explained the Texas Beef Council/Texas mesquite barbecue-producers initiative. Mr. David Miller, who is the largest mesquite sawmill producer in Texas, explained his perspectives, and Mr. Bob Colbert of Lazzari Fuels discussed U.S./Mexican mesquite-charcoal sustainable-harvest initiatives. The extensive international dimension of the workshop participants helped portray the international dimension of the problems and opportunities of *Prosopis* to the Texas Congressional delegation.

The presentations on Thursday morning provided an excellent overview of the genetics and management opportunities for *Prosopis*. Dr. Phil Harris of the Henry Doubleday Research Association in Great Britain reported on the use of *Prosopis* in their trials in India and Cape Verde. The trials in Cape Verde examined over 100 seed sources of *Prosopis* from all the world's major regions. The Peruvian *Prosopis* were the tallest, straightest, and fastest growing in these trials. The Indian *Prosopis cineraria* was one of the slowest growing of all the species. *Prosopis africana*, native to West Africa, was very poorly adapted and did not survive the nursery.

Dr. Harsh from the Central Arid Zone Research Institute in Jodhpur, India, reported on their replicated trial of over 110 *Prosopis* families from Argentina and Peru. While some of the multistemmed *Prosopis alba* had the highest biomass, the Peruvian *Prosopis* were the tallest

and straightest, and some had no thorns. Elite selections from this trial have been grafted and distributed to other research stations in India.

Dr. Peter Felker and Ms. Nancy Patch reported on results of 10-year-old field trials designed to alleviate weedy aspects of mesquite by managing it in a savannah ecosystem. This work included research on pruning, thinning, and techniques designed to eliminate poor genetic stock and graft superior materials onto the rootstock. They also reported on Haitian progeny trials in which the Peruvian *Prosopis* of the same lineage as in Cape Verde and India were, once again, the tallest and straightest, with no thorns.

Ing. Mariano Cony of Argentina reported on progeny trials for two of the major arboreal *Prosopis* in Argentina. He examined about 70 families of *Prosopis* from about eight regions in Argentina. He reported that no geographic region was superior as a seed source. The geographic region with the greatest mean biomass contained some of the best- and worst-performing individual families (mother trees). This clearly pointed to the need for cloning superior individual trees and establishing clonal seed orchards of superior trees.

The high-value-added utilization sessions featured former Los Amigos del Mesquite President David Miller and Mr. Jerry Lawson, President of one of the largest mesquite barbeque-wood manufacturers in Texas. Mr. Miller stressed the need for all segments of the mesquite industry to work closely together. The exhibit of mesquite veneer, flooring, furniture, and kitchen cabinets in the entrance was the clearest demonstration of the high-value-added potential of mesquite. This was perhaps the first time that people outside United States or Argentina had observed the superb quality of mesquite's capabilities. Indeed, a notable National Academy of Sciences personality purchased the mesquite writing stand for her husband.

Mr. Jerry Lawson described the marketing approaches that allowed him to be successful in developing a mesquite barbeque-wood business. The fact that his retail packages are sold in about 8,000 retail outlets throughout the United States was a very powerful tribute to the potential market demand for mesquite products. Many of the multilateral foreign-aid agencies were impressed with the commercialization potential presented by Mr.

Lawson and Mr. Miller. Their concrete examples of successful *Prosopis*-based businesses in semiarid regions were indeed refreshing.

Dr. Peter Wood, Past Chairman of the Commonwealth Forestry Association, gave a presentation on the role of value-added products in developing countries. He stated that colored woods, both red and dark, were highly valued, were in very short supply because they were obtained from tropical rain forests, and were available only in short, narrow pieces. Accordingly, the reddish color of *Prosopis* would appear to be very appropriate for this high-value international market.

Ing. Judith Ochoa of Argentina followed with a historical review of *Prosopis* in her country. Before Europeans arrived, extensive *Prosopis* forests provided pods for human food. After the immigration of Europeans began, *Prosopis* pods were used extensively for livestock forage. Privately owned British railroad companies destroyed much of the extensive forests for railway cross ties and fuel for steam locomotives. Currently *Prosopis* is used extensively for furniture. While there are many universities with programs in botanical and ecological studies, there is no current national program to integrate all aspects of *Prosopis* utilization in Argentina.

Dr. Sabine Bruns of the International Foundation for Science in Sweden provided an overview of their grants program for beginning scientists in developing countries. Dr. Bruns particularly encouraged applications from scientists from arid regions.

Dr. Carlos Rodriguez Franco, the INIFAP Vocal Ejectivo for Forestry from Mexico, reviewed forestry programs in Mexico and stated that about 50% of Mexico is semiarid or arid. No major *Prosopis* programs exist in Mexico, but he hopes to initiate mesquite-management programs in the near future.

For the banquet address, we were most fortunate to have Mr. Kurt Mann, Minority Agriculture Staff for Research Titles of the U.S. House of Representatives. Mr. Mann discussed difficulties in funding arid-land projects and stressed the importance of keeping legislators informed of the progress and results in economic-development activities.

The program on Friday morning began with a shared presentation by Dr. Dah Salihi of FAO and Dr. Ikar of the German foreign-aid project. They discussed their respective sand-dune reforestation programs with *Prosopis* in Mauritania.

Dr. Russell Greenburg of the Smithsonian Institution reported on the importance of *Acacias* for migratory-bird habitats in Mexico. Dr. Greenburg felt that other leguminous trees, such as *Prosopis*, might also be useful to migratory birds in arid regions.

Dr. El Hadje Sene, Chief of Forest Conservation of FAO, surveyed the many excellent FAO programs in arid-zone forestry. He pointed out the very successful FAO reforestation project in Cape Verde and mentioned the difficulties in managing the social consequences of successful arid-zone reforestation projects where land tenure issues were not resolved.

Ms. Lene Poulsen of the United Nations Development Program (UNDP) gave a clear presentation of how The Convention to Combat Desertification emerged from Agenda 21 of the Rio Summit and has since been ratified by many UN countries.

We were most fortunate to have had Dr. Walter Lusigi of the Global Environment Facility (GEF) provide an overview of the GEF structure and potential projects. The GEF fund of about \$1 billion arose from contributions following the Rio Summit. While the four areas of global climate change, international waters, ozone issues, and biodiversity are the only areas that can be funded, Dr. Lusigi suggested that arid-land reclamation was critical to biodiversity and global climate change, thus, proposals to GEF could be supported for arid-land reclamation. Most critical to GEF funding was support of the Finance Minister or Agriculture Minister of the country submitting a proposal. Dr. Lusigi suggested that a network with *Prosopis* as a model species for arid-land reclamation using other species could be an interesting proposal for GEF.

At lunch on Friday, a very interesting announcement was made by Mr. David Miller of Los Amigos del Mesquite and Ms. Betty Alberts of the President's office of the U.S. National Academy of Sciences. Mr. Miller kindly offered to install a mesquite floor in the anteroom of the U.S. National Academy of Sciences as a gesture of thanks for their support

of the workshop. Ms. Alberts stated that she would be pleased to recommend approval of this project to the art board and executive committee. It is hoped that a piece of *Prosopis* from each of the countries where *Prosopis* is grown could be used to make this floor.

The afternoon program was devoted to discussions of how to continue this important initiative. A panel briefly expressed their views for the future of an international collaborative effort. This panel included Dr. Sabine Bruns of the IFS; Dr. Gurbachan Singh of India; Mr. Michael Bengé of U.S. AID; Mr. Larry Williams, International Director of the Sierra Club; Dr. Rebecca Butterfield of CARE; Dr. El Hadje Sene of FAO; Dr. Carlos Rodriguez Franco of INIFAP/Mexico; Ms. Lene Poulsen of UNDP; and Dr. Peter Wood of the Commonwealth Forestry Association.

After considerable discussion, several courses of action were developed:

The first need seen was to advocate the importance of arid-zone environmental and economic-development issues. It was recommended that individual countries should prepare materials about these issues for use in schools and that countries should share these materials. Use of the e-mail network for this purpose was highly encouraged.

Second, it was considered critically important to maintain the excellent dialogue that occurred as a result of this meeting. Initially this dialogue would continue through the *Prosopis* e-mail network. Several participants suggested that a similar workshop should be convened in several years. Representatives from each country should begin to seek travel funds to participate in such a workshop.

Third, it was decided to submit a proposal to GEF for an international *Prosopis* network. Dr. Peter Felker was designated the coordinator to compile requests from individual countries. These requests would, in turn, be submitted to Lene Poulsen of the UNDP for her review, editing, and submission to GEF. The following volunteered to coordinate individual country requests: Dr. Ousman Diagne (Senegal), Dr. Dah Sahili (Mauritania), Dr. Zach Lea

(Haiti), Dr. Singh and Harsh (India), Ing. Ochoa and Cony (Argentina), Ing. Rodriguez (Mexico), Ing. Grados (Peru), Dr. Rafiq Ahmad (Pakistan), and Ing. Jose Inacio da Silva (Brazil).

Subsequent discussions with Dr. Lusigi confirmed his interest in developing a proposal for submission to GEF. Letters of approval from each country desiring to participate need to be obtained from their respective Ministers of Finance or Agriculture.

After discussion with numerous individuals, it was decided to publish the proceedings by inexpensive desktop publishing so that all NGOs would have the resources to purchase

them. In addition the proceedings will also be placed in their entirety on the World Wide Web, providing access to everyone. We hope this will be agreeable to all participants.

At the conclusion of the workshop on Friday, the participants felt confident that, as a minimum, this fine exchange of information would continue at the level of the e-mail network. The many excellent contacts made at the workshop will doubtless produce many exciting results over the coming years. We are all very hopeful that with hard work we will succeed in establishing a *Prosopis* network with significant resources to serve the people of arid lands.

