CONCEPT NOTE
Research Proposal for SLP Funding – Seed Grants 2004

Project Title Identification of forage type pigeonpea germplasm for a wide range of environments.

Lead Centre(s)

- International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India.
- The International Livestock Research Institute (ILRI), P.O. Box 30709, Nairobi, Kenya.
- International Institute of Tropical Agriculture (IITA), PMB 5320, Ibadan, Nigeria.
- Centro Internacional de Agricultura Tropical (CIAT), A.A. 6713,Cali,Colombia.

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Total Cost of Project (SLP Funds)

US $ 40,000

Anticipated Start Date and Duration of Project

June 2004 to May 2005 (one year)

Locations of Project (Countries)

ICRISAT, Patancheru, India; West African Savanna, Nigeria; Cali, Columbia; CAAS, Beijing, China; Hyderabad, India.

Background (Max.300 words)

A rapid increase in demand for livestock products in developing countries is projected for the next decades (Delgado *et al*., 1999). This offers scope for increasing income and employment through livestock rearing activities to the rural poor families. According to Thornton *et al*. (2000), over 150,000,000 marginal crop-livestock farmers can benefit from the increasing demand for livestock products in India alone. However, lack of fodder in post-rainy season, presents a major constraint to livestock production. To overcome this bottleneck, a crop, which can produce fresh fodder under harsh environments, would prove a boon. Pigeonpea (*Cajuns cajan* (L.) Millsp.) is one such legume that is drought tolerant, thrives well on nutritionally eroded soils, and has little demand for agricultural inputs, can produce both grain and fodder, and contribute to soil improvement. Its high adaptability to diverse environments and multi-usage has resulted in demand for enhanced pigeonpea germplasm in Asia, Africa, and the Americas.

Pigeonpea can supply protein-rich fodder without additional demand on arable land and water, and has considerable potential positive impact on livestock productivity and livelihoods of resource-poor farmers in developing countries.

To utilize its potential, a coordinated and comprehensive evaluation of germplasm for dual-purpose or forage usage alone is required. Recent investigations of limited pigeonpea genotypes have shown their great variability in protein content and *in vitro* digestibility (Blümmel *et al*., 2004). Opportunities for multidimensional crop improvement programs therefore exist to breed pigeonpea genotypes with high food, feed, and forage value. However, besides protein and *in vitro* digestibility of forage, some additional nutritional traits such as anti-nutritive factors including tannins need to be investigated in the global pigeonpea germplasm. Furthermore, these quality traits also require validation by animal performance and livestock productivity measurements in pigeonpea-fed animals for the development of best-bet options.

Project purpose (Max. 200 words)

The purpose of the proposed work is the enhancement of benefits from livestock rearing by alleviating fodder constraints through utilizing the excellent agronomic characteristics of pigeonpea, its wide genetic diversity, adaptation to varied agro-ecological zones, and its low demand for agricultural inputs. In this globally coordinated and multidimensional/multidisciplinary crop improvement activity appropriate pigeonpea germplasm will be selected for further breeding with high forage and food-feed value, while maintaining other desirable traits such as drought tolerance. This project will also help in identifying specific forage production and utilization problems in different target environments.

Contribution to CGIAR goals in germplasm enhancement, natural resource management, policy analysis, and NARS development.

This project will contribute in the following way:

a) Germplasm enhancement

Germplasm enhancement is one of the key activities and we propose to initiate it by selecting parental lines which will have (i) one or more quality traits with high heritability, (ii) high fodder and seed (dual types) yields under limited moisture regimes, and (iii) least influence of genotype x environment interactions. Such parental lines will be used to develop enhanced germplasm in the follow-up mega project.

b) Natural resource management

Pigeonpea is known for its soil amelioration qualities due to its ability to fix nitrogen (@40 kg ha^{-1} $year^{-1}$), add carbon and other nutrients, release soil-bound phosphorus and increase water infiltration capacity. The integration of forage pigeonpea production in the existing cropping systems across agro-ecological situations will help in improving/conserving natural resources and assist in long-term sustainability.

c) Policy analysis

- None -

d) NARS institutional development

The choice of available legume forage in dry areas is limited and consequently pigeonpea is likely to provide a viable option for improving feed resources in livestock systems in tropical regions. The NARS institutions will be provided with seed and other technologies for successful production and utilization of pigeonpea as sole or mixed fodder to livestock to reap the benefits of this technology. The scientists, technicians, and farmers will also be trained in various aspects of the technology.

Outputs (Max. 300 words)

- Pigeonpea core collection available in the global genebank at ICRISAT, Patancheru, evaluated for forage and food-feed quality, and promising germplasm identified.
- Effect of genotype x environment interaction on the quantity and quality of pigeonpea fodder studied and its influence on animal productivity defined.
- Nutritional laboratory quality indices that predict livestock productivity developed and validated.
- Baseline data for implementing a comprehensive pigeonpea improvement program generated.
- Relationship between various agronomic traits and fodder quality parameters determined.

Potential Impact of Outputs: (Max. 200 Words)

- Provides opportunity to select a new source of fodder supply that could be grown in dry environments and when other traditional forages are not available.

- The availability of high protein and high digestible organic matter fodder will enhance animal growth and productivity.

- Nutritionally eroded dry and marginal lands, where pigeonpea can be grown successfully, will be improved through addition of organic matter, nitrogen, and other valuable micronutrients. This will rejuvenate the lands to cultivate other food crops successfully.

- The income of resource-poor farmers will be increased by raising animals on pigeonpea fodder either by grazing or stall-feeding.

- The information generated using this limited seed money of the project will help in developing a mega project to extend further multi-dimentional research and development activities.

- Concerted research and development efforts will result in technologies (varieties and management) that will help in expanding area under forage pigeonpea.

Research Activities in Relation to Outputs (Max. 300 words)

- A pigeonpea core germplasm collection (approximately 150 – 200 line) will be evaluated in at least one location each in India, Ethiopia, Columbia, Nigeria and China for measuring laboratory fodder quality traits using a combination of conventional laboratory and NIRS analysis indices and other important traits

- In India livestock productivity will be estimated on at least 10 different and diverse genotypes of pigeon pea using sheep and measuring intake, digestibility, changes in live weight and nitrogen balance

- Nutritional quality indices of pigeonpea will be determined based on livestock productivity trials and laboratory analysis using stepwise multiple regression procedures.

- Relationships between various quality indices and other desirable traits will be defined and sub-core collections of food-feed-crop and forage types developed.

- Comprehensive and validated baseline data for from a broad range of environments used for cross regional analysis and modeling to support further decision tools.

Impact and Beneficiaries: (Max. 150 words)

- The information generated from this project will be useful in making quality fodder available during periods of feed shortage in different agro-ecological environments. The farmers who adopt this technology will also benefit indirectly by reclaiming their degraded lands. Impact would be evident on the productivity of the follow-up cereal crops. The farmers will diversify their income-generating sources through raising ruminant as well as non-ruminant animals. This will also reduce the crop failure risks, and enhance the profitability of small-size farming families.

- Training of NARS technical, scientific staff, and farmers will be done in production and utilization of pigeonpea as a forage crop. This will help in the execution of the follow-up mega project.

- The scientific information generated from this seed money project will add to the critical database of the world germplasm collection.

Dissemination and Uptake Pathways (Max. 150 words)**:**

Over the past three decades the ICRISAT pigeonpea improvement program has developed a range of varieties/hybrids and these have made significant impact in farmer fields in different countries through down-stream collaborative channels involving NARS, NGOs, and seed companies. These existing channels will be used in this project also. The forage technology will spread from farmer-to-farmer in references sites and outside references sites through active participation of NARS, NGOs and other village level organizations by conducting demonstrations/field days. It is also proposed to have participation of farmers in selecting lines and to get feed back on the technology. For wider dissemination of information the project highlights will be posted on websites and results published in international journals. ICRISAT will take the responsibility of producing and distributing seeds.

Risks and Assumptions Associated with Output Achievement (Max. 200 words):

1. Laboratory quality measurements are closely related to actual livestock productivity.
2. Availability of quality (genetically pure) seed of pigeonpea is necessary, particularly in view of natural out-crossing in the species.
3. Pigeonpea is a very hardy crop and the probability of crop failure is low. However, sometimes early season drought or delayed planting will restrict the biomass production. Insects could cause severe damage in the seed multiplication blocks if recommended insect management practices are not followed.

Financial Summary (Funds Requested from SLP)

Employment (Tech/ Field Asstt.)	9250
Consumables	15500
Workshops and travel	7500
Training	*
Overheads (24%)	7750

Total (US $)	**40,000**
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* Use other sources as and when necessary.

Funding Strategy

The World Bank is targeted for funds for a 3-5 year mega-project involving the five institutions participating in this proposal with other partners from USDA (Srinivas C Rao, Agronomist) and Embrapa, Brazil (Rodolfo Goday). The scientists have already discussed this project with the World Bank authorities. This project addresses the issues related to human health, financial security, and sustainability (through pigeonpea cultivation) and resource-poor smallholder farmers will be benefited enormously.

Specific Capabilities of Consortia Members and Key Staff (Max.300 words)

Generally, the team proposing this work comprises internationally well respected experts in the field of pigeonpea breeding and germplasm evaluation, forage improvement and ruminant nutrition with a proven record in interdisciplinary and multidimensional crop improvement exactly of the kind proposed here. The work proposed now to SLP has been discussed between the principle investigators for a considerable time and all participants are convinced of the need for this work. In addition, some preliminary work on multidimensional pigeonpea improvement has already been initiated by the team members.

K B Saxena, (Ph.D, Plant Breeding) Principal Scientist, with 30 years experience in Pigeonpea Breeding, in Australia, Sri Lanka and ICRISAT. Coordinating various international collaborative projects on pigeonpea research and development.

Michael Blümmel**,** (MSc, Dr. Sc agr., Habil). Food-Feed-Crop and Forage Project Leader of ILRI, ruminant nutritionist, 15 years experience in research, teaching and extension in Europe, US, Africa and Asia. Close collaboration with national and international crop improvement institutions on food-feed-crop work in barley, sorghum, pearl millet, groundnut, pigeonpea and rice.

Jean Hanson (PhD) Senior scientist and Project Leader, Forage Diversity at ILRI with over 25 years experience in genetic resources conservation and management of a range of crops in developing countries. Managing the ILRI forage germplasm collection and working in forage development for over 15 years.

Linus Franke, Agronomist, IITA

Carlos Lascano (PhD)., Ruminant Nutritionist, CIAT Leader of the Tropical Forages Program in CIAT with over 25 years of experience in research in the area of forage quality. The pigeonpea program will fit in an ongoing project funded by BMZ, Germany in Central America that is developing forage alternatives for the dry season.

References

Blümmel M. Hanson J. and Saxena K. B. (2004). Fodder quality in young and old leaves of twenty genotypes of pigeon pea (*Cajanus cajan*). (for submission to International Chickpea and Pigeon Pea Newsletter)

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., and Courbois, C. (1999). Livestock to 2020: The next food revolution. International Food Policy Research Institute, Food and Agriculture Organization of the United Nations, and International Livestock Research Institute. IFPRI Food, Agriculture and the Environment Discussion paper 28, Washington, D. C., 72 pp.

Thornton, P. K., Kruska, R. L., Henninger, N., Kristjianson, P. M., Reid, R. S., Atieno, F., Odera, A. and Ndega, T. 2001. Poverty and Livestock Mapping: Final report to the UK Department for International Development. International Livestock Research Institute, Nairobi, Kenya. August 2001.

List of Private Sector Consortium Members

As of 4 Mar 2004

		Sorghum		Pearl millet		Pigeonpea	
S.No.	Name of company	Prim.	Prom.	Prim.	Prom.	Prim.	Prom.
1	Ajeet Seeds Ltd	x		x			
2	Ankur Seeds Pvt Ltd		x		x	x	
3	Basant Agro Tech (India) Ltd		x				
4	Bioseed Research India Pvt Ltd	x		x			
5	EG Technologies & Services Ltd	x		x			
6	Ganga Kaveri Seeds Pvt Ltd	x		x			
7	Godavari Hybrid Beej Pvt Ltd		x		x		
8	Green Gold Seeds Ltd	x		x		x	
9	J K Agri Genetics Ltd	x		x		x	
10	Kaveri Seed Co Pvt Ltd	x			x		
11	Krishidhan Seeds Ltd		x				
12	Mahodaya Hybrid Seeds Pvt Ltd	x			x		
13	Mahyco					x	
14	Metahelix Life Sciences			x			
15	Misr Hytech Seed Int., SAE, Egypt	x					
16	Nature Great Seed Intl. Pvt Ltd				x		
17	Navbharat Seeds Pvt Ltd			x			
18	P.T. Benihinti Suburintani (BISI),	x					
19	Nuziveedu Seeds Ltd	x		x			
20	Proagro Seed Co Pvt Ltd	x		x			
21	Rasi Seeds Pvt Ltd			x			
22	Sona Genetics Pvt Ltd				x		
23	S M Sehgal Foundation			X			x
24	Tualsi Seeds Pvt Ltd		x		x		
25	Vikki's Agrotech Ltd		x				
26	Zuari Seeds Ltd			x		x	

Crop	Category	No. of Companies
Sorghum	Primary Promotional	12 6
Pearl Millet	Primary Promotional	13 7
Pigeonpea	Primary Promotional	5 1
	Total	**44**