



Raise Plus Small Business Set Aside IQC

DESIGN OF A COMPETITIVE GRANTS SYSTEM FOR AGRICULTURAL RESEARCH FOR MOZAMBIQUE

Draft Final Report

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By
Arvin Bunker
Kenneth Buhr
Peter Gregory
Jose Fafetine

The Weidemann Consortium
933 N. Kenmore St., Ste. 405
Arlington, Virginia 22201 USA
Tel. 703 522 3075, Fax. 703 525 6169
www.weidemann.org



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List of Abbreviations and Acronyms

ACDI/VOCA	Agricultural Cooperative Development International /
CEFRIA	Centre for Artificial Insemination
CEF	Centre for Forestry Experimentation and Wildlife Management
CGIAR	Consultative Group for International Agricultural Research
CGS	Competitive Grants System
CIMMYT	Centro Internacional para Mejoramiento de Maize y Trigo
CIP	Centro Internacional de Papa
CLUSA	Cooperative League of the USA
IIAM (2006)	Agricultural Research Institute of Mozambique
IIAM (1960s)	Mozambican Institute for Agronomic Research
IIVM (1960s)	Mozambican Institute for Veterinary Research
INIA	National Institute for Agronomic Research
INIVE	National Institute for Veterinary Research
ITTA	International Institute for Tropical Agriculture
MADER	Ministry of Agriculture and Rural Development
MCT	Ministry of Science and Technology
MSU	Michigan State University
NGO	Non Governmental Organization
QPM	Quality Protein Maize
RFA	Request for Application

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Executive Summary

Mozambique has made a dramatic recovery since the end of civil war in 1992. However, it is still one of the poorest countries in the world with a per capita income of \$240. Despite significant agricultural resources, the country remains food insecure, with very low average yields of major crops. The application of improved science and technology to agricultural production, processing and marketing activities is critical to transforming a low input - low output subsistence agriculture to a market led system, and to reducing hunger and raising producer incomes.

To improve research coordination and results, the national agricultural research system was recently restructured into the Instituto de Investigacao Agronomica de Mozambique (IIAM). IIAM is implementing management systems to improve accountability and prioritize research activities. The Competitive Grants System (CGS) developed in this report is designed to support IIAM and other research and extension institutions in Mozambique, to expand the amount of research done, and to assure that the research results are delivered to users, and especially to smallholders.

The design team consulted with a wide range of institutions and persons, including the USAID SO Team, other international development institutions, the Ministry of Agricultural and Rural Development (MADER), the Ministry of Science and Technology (MCT), IIAM and other research institutions, the agricultural extension directorate, international research institutions, IIAM zonal centers and agricultural stations, laboratories, universities and agricultural technical schools, non-governmental organizations (NGO), private companies in agricultural processing and marketing, provincial agricultural agencies, smallholders, and others.

There is considerable agreement among the MADER, MCT and IIAM on the goals for agricultural research, which are:

1. Improved food security;
2. Reduced poverty, especially among smallholders; and
3. Achievement of immediate results.

USAID/Mozambique shares these goals in Strategic Objective 6, namely, “rapid rural income growth sustained in target areas.” The Competitive Grants System (CGS), as described below, can help in the achievement of these goals.

The CGS will be implemented with an initial funding of US\$3.3 million over three years. Technical assistance, training and administrative costs are expected to be about \$1.3 million, leaving about \$2 million for grant awards. The project documents will be prepared with the assumption that additional funds will become available from USAID and from other donors for as much as \$10 million, and that the project will be extended to five years.

Research grants will be in the range of \$100,000 to \$300,000 for up to three years. Grants will be available to government institutions, international research institutions, private sector companies and NGOs. Grant funding may be used to provide incentives for the research team based on performance, necessary equipment, limited in-country training, limited national and international travel for collaboration and conferences, and modest contribution to overhead of the grantee. Grant funding will not purchase vehicles or other major equipment, or support long-term training.

USAID/Mozambique will engage a US based development partner (hereafter called contractor), to implement the CGS program. The contractor will finalize the design of the CGS, draft and gain approval for the Request for Applications (RFA), train potential applicants on how to apply, organize the proposal evaluation and get approval of the review committee, brief and guide the review committee, and select the proposals to be recommended to the Advisory Committee for approval.

Through all these processes, the contractor will work alongside personnel from the Program Monitoring and Evaluation staff of IIAM, to build capacity for IIAM to eventually administer the CGS.

After approval of applicants, the contractor will work with the principal investigator to initiate each research project properly, a critical activity. The contractor will monitor projects and provide periodic feedback to grantees, as needed, to keep the research projects on track, and to maintain communications with USAID and with the project Advisory Committee.

IIAM in the initial stages of the CGS will take on a support role. As the program continues, IIAM personnel will take on more tasks and will increasingly provide leadership of the CGS. During year three of the project, the contractor will organize a review of IIAM's capacity to assume control of the CGS.

Criteria for success of the CGS include:

1. Functioning research facilities;
2. Educated, experienced and motivated personnel; and
3. Potential for adoption of improved technologies.

Research Facilities: Adequate research facilities exist in Mozambique for the type of adaptive research needed. Because resources and equipment at many locations are limited, grant applicants will be encouraged to collaborate with other institutions to share resources. Acquisition of minor equipment not available, can be funded within the grant. IIAM has committed to provide needed equipment and resources, not otherwise in place, to the successful grantees. The grant program will permit a modest contribution to overhead for the grantee, which could be used to acquire needed equipment.

Educated, Experienced and Motivated Personnel: IIAM has trained researchers, though they may be few and with limited skills or experience in some areas of investigation. Collaboration among institutions will help to resolve deficiencies in personnel. Within the grant will be allowed short-term training or the ability to bring in specialists from outside Mozambique for short periods to provide the needed skills and experience.

The Ministry of Science and Technology (MCT) is proposing an increase of 40 percent in salaries for scientists. If enacted, this provision will provide greater incentives for researchers to dedicate all their efforts to their research projects. In addition the MCT proposal allows researchers to receive incentives for innovations, discoveries and contracts. Through this provision, the MCT anticipates that the CGS will be able to offer performance incentives to the research team through the grant agreements.

Potential for Adoption of

Young, talented professionals are just getting started in their crop breeding careers in Mozambique. Here, a sorghum breeder explains the advantages of early maturity in sorghum as well as the problems with damage by birds.



Improved Technologies: No single institution in Mozambique, working alone, can achieve the desired level of results within the three years contemplated for this project. Multiple institutions will need to combine their strengths to conduct the research and to deliver the results to users. There are some effective incentive systems now used by private companies and NGOs to motivate delivery of technology and production inputs to producers. These models could be incorporated into the research proposed to the CGS.

All grantees will be required to share their research results with the project. IIAM is building a system to assemble and make available scientific knowledge for their researchers. Lessons learned from the CGS will be contributed to the information center and made available to other researchers and users.

Beginning during the second year of the project, the design team suggests an annual conference for researchers to present their results to peers, with an added benefit that small rewards will be provided to those research teams that best achieve the results in their research plan.

A New Research Paradigm

A new research paradigm is needed to provide the vision and incentives that generate expanded impact. The CGS provides that vision and much of the incentives to the research teams, along with the administrative and operational support needed to jumpstart the CGS. In addition, the CGS provides a framework for building the research and extension capacity of IIAM and other Mozambique institutions, and will soon administer a dynamic competitive grants system for agricultural research.

Capacity building for conducting research and extension for IIAM and other participating research teams will be accomplished through the successful implementation of the funded research, plus the technical assistance and training provided by USAID's implementing contractor.

The CGS will assist IIAM in establishing and updating, as needed, priorities for research, in consultation with all stakeholders and especially with smallholders. We cannot overemphasize the importance of getting right the research priorities. Feedback from the extension service suggests that often the technology given to agents to deliver to farmers does not coincide with the questions farmers are asking.

Current publicly funded agricultural research in Mozambique focuses on the most important food crops, maize, cassava, rice, chick peas, and others. We believe that focus will likely continue, though IIAM's priority setting process ultimately will determine the research priorities.

The level of funding that is contemplated in the first round of grants can be absorbed by IIAM with the existing staff. If another \$2 million were available in the second year, IIAM would still be able to absorb the additional work load. Funding beyond that level may require capacity increases in IIAM's resources, or greater reliance on other research institutions in Mozambique, such as universities, private companies, NGOs, international research centers.

Transparency and accountability in the early stages of the CGS is primarily assured by the implementing contractor. The contractor will build the capacity of IIAM personnel to assure transparency and accountability. Gradually responsibility for these critical functions will pass to IIAM.

Background and Objective of Task Order

Mozambique has made a dramatic recovery since the end of civil war in 1992. Nevertheless, it is still one of the poorest countries in the world with a per capita income of \$240. While the poverty rate has declined from 69% in 1996/97 to 54% in 2002/03, the malnutrition rate has increased over the same period of time, and the country remains food insecure. The majority of Mozambican farmers rely on

Imported rice at this store is from China, Thailand, Vietnam, USA and Taiwan. Mozambique is still working to become food secure.



rain fed, subsistence agricultural production for their livelihoods. Productivity has been stagnant, and nearly all gains in production have been due to area expansion.

Mozambique has received considerable donor assistance to develop the capacity of the Federal Ministry of Agriculture and to develop the sector, including support through the Pro-Agri program. The country is revising its poverty reduction strategy in which agriculture is a key pillar for economic growth. USAID has supported Pro-Agri as

well as implemented programs to increase rural incomes through increased agricultural production, rural enterprise development and roads construction. However, the impact of over \$200 million in investment in Pro-Agri I is hard to measure, and much of USAID's successes to date have been limited to the community level. USAID's implementing partners have attempted to identify and disseminate improved agricultural technologies, but their efforts have been ad-hoc, do not always reflect best practices, and have been limited in scope.

Many studies have demonstrated the strong linkage and multiplier effect of agriculture research on economic growth. While the key to improving the performance of African agriculture requires an integrated approach involving market linkages, a supportive policy environment and other factors -- it is clear that application of science and technology are a key to the dynamic transformation of low input - low output subsistence agriculture practices.

A number of African countries have developed strong research partnerships with extension NGOs, farmers and private sector partners, to promote the adoption of productive technologies. International agriculture research institutes, such as the International Institute of Tropical Agriculture, can also be pivotal in bolstering African agriculture research capacity.

Mozambique's national agriculture research system was recently restructured into the Instituto de Investigacao Agronomica de Mozambique (IIAM). IIAM's leadership is struggling with instituting management systems to improve accountability and to prioritize research activities. USAID, through a cooperative agreement with Michigan State University, has provided training in socio-economic capacity to improve the identification and dissemination of improved crop and livestock technologies by IIAM, including a focus on selected zonal research centers. USAID was recently requested by the Mozambique Ministry of Agriculture to further develop the capacity of IIAM scientists to conduct applied research through a competitive research grant process. Other donors, including DANIDA and the World Bank are also interested in supporting IIAM in this way. In addition, the U.S. Millennium Challenge Corporation has expressed interest in providing support to a competitive grants fund, if a suitable mechanism were established.

The objective of this Task Order is to design a competitive agriculture research grants program to strengthen the capacity of the Mozambique national agriculture research system to implement research that leads to the adoption of improved agricultural technologies. The program will support USAID/Mozambique Strategic Objective 6: Rapid Rural Income Growth Sustained in Target Areas,

including intermediate results 6.1.2A (Number of economically viable technologies adapted at zonal research centers), and results 6.1.2B (Adoption rates of new technologies by smallholders). This project will also support the U.S. Presidential Initiative to End Hunger in Africa.

Summary of Team Activities

The design team included Dr. Arvin Bunker, Agricultural Economist of Weidemann Associates, Inc., as the Chief of Party, Dr. Alsácia Atanásio, Parasitologist and Veterinary Surgeon of IIAM, Dr. Kenneth Buhr, Professor Emeritus Faculty of the University of Florida and specialist in agronomy and plant science, José Fafetine, DMV of the Veterinarian Faculty of the University Eduardo Mondlane, and Dr. Peter Gregory of Cornell University and specialist in bio technology. The team represented a wide range of skills and experience in agricultural development, crop and animal research, extension services, and grants programs in Mozambique, in Africa and worldwide.

The design team reviewed published and unpublished materials relating to the agricultural situation in Mozambique, prior and current agricultural research activities in country, and lessons learned by USAID in designing and administering competitive grants programs. Contacts made by team members incorporated the interests and needs of all key stakeholders in the agricultural research arena, including senior policy makers, researchers and their administrators and support teams, the users of the research and the funding agencies. Specifically the contacts included the following groups:

- USAID/Washington personnel,
- USAID/Mozambique SO6 Team,
- Leadership and researchers of IIAM,
- Research facilities and teams in IIAM central offices, Zonal Centers in Nampula and Sussundenga and Agricultural Stations at Umbelúzi and Namialo,
- The Minister of Agriculture and the Minister of Science and Technology,
- The National Directorate for Rural Extension,
- Provincial Agriculture Directors and staff,
- International research centers including IITA, ICRISAT and ICRAF,
- Universities and educational Institutions,
- NGOs, private companies, small producers,
- Development funding institutions.

Annex F identifies the specific contacts made by the team.

Description of Agricultural Research in Mozambique

Agriculture plays a vital role in the poverty reduction strategy implemented by the Mozambican government. Agriculture research is crucial, since it helps in the design of more effective strategies for accelerating rural economic growth and towards reducing rural poverty in the country.

Average yields of the principal crops are extremely low in Mozambique, even by African standards. Average maize yields, for example, were estimated by Howard et.al. to range from 0.14 to 1.3 tons per hectare, or about 14 percent of the estimated potential yield of 5.0 to 6.5 tons per hectare (see Table 1). Actual yields of other crops were higher, for example, rice yield was 27 percent of potential, sorghum 32 percent of potential, and beans 30 percent. Cassava was further along, with actual yields reaching 60 percent of its potential. There exists the potential for rather large gains in yields in most of the principal food crops with the adaptation of basic agricultural production technologies by the Mozambique smallholders.

Table 1. Actual yields compared with potential yields for selected crops.

		From	To	Midpoint
Maize	Actual yields, Kg/hect	0.14	1.30	0.72
	Potential yields, Kg/hect	5.00	6.50	5.75
	Actual as percent of potential	3%	20%	13%
Sorghum	Actual yields, Kg/hect	0.30	0.60	0.45
	Potential yields, Kg/hect	0.80	2.00	1.40
	Actual as percent of potential	38%	30%	32%
Rice	Actual yields, Kg/hect	0.50	1.80	1.15
	Potential yields, Kg/hect	2.50	6.00	4.25
	Actual as percent of potential	20%	30%	27%
Beans	Actual yields, Kg/hect	0.30	0.60	0.45
	Potential yields, Kg/hect	0.50	2.50	1.50
	Actual as percent of potential	60%	24%	30%
Cassava	Actual yields, Kg/hect	4.00	5.00	4.50
	Potential yields, Kg/hect	5.00	10.00	7.50
	Actual as percent of potential	80%	50%	60%

Source: Bias and Donovan, 2003, p.27 reporting earlier work by Howard et.al. 1998.

In most areas of Mozambique land is abundant, and the crop area could be expanded, if labor saving technologies were available, if inputs were more accessible and less costly, and if markets and delivery systems were available to consume the increased production.

In Mozambique, formal agricultural research began in the 1940's with surveys on natural resources, botany, veterinary studies and commercial farming. In the 60's two autonomous institutions, namely, the Mozambican Institute for Agronomic Research (IIAM) and the Mozambican Institute for Veterinary Research (IIVM), were formally institutionalized. During this period, the agricultural research agenda was mainly based on the needs of commercial farmers who had financial resources to buy inputs to improve agriculture and to establish specific crops oriented to the markets for cotton, cashew nut, sugar, rice, tobacco, tea, maize, groundnut, coconut, sunflower and livestock.

After the independence of the country in 1975, the IIAM and the IIVM were integrated as departments under the Ministry of Agriculture and were renamed the National Institute for Agronomic Research (INIA) and National Institute for Veterinary Research (INIVE) respectively. In 1981 the Centre for Artificial Insemination (CEFRIA) became an independent body from INIVE, and was later transformed to the Institute for Animal Production (IPA). In the same way, in 1985, the mandate for forestry research was removed from INIA and attached to the Centre for Forestry Experimentation and Wildlife Management (CEF). During this stage, the four research institutes, namely, INIA, INIVE, IPA and CEF were the core network of the agricultural research system in Mozambique.

Although there were many local successes, the conduct of research in isolation has not significantly addressed important aspects in the agricultural sector such as farm productivity, profitability, integrated agricultural systems, sustainability, food security and poverty reduction. Therefore, recently, the national agricultural research system in the country was restructured with the creation of the Agricultural Research Institute of Mozambique (IIAM), comprising the former four research institutes (INIA, INIVE, IPA and CEF).

Institutions involved in agricultural research

The principal institutions conducting agricultural research include IIAM, other public scientific and technological research institutes, universities, international research institutions, NGOs, and private

companies. The Ministry of Science and Technology (MCT) is charged with establishing an enabling framework to support the development of science, technology and innovation to reduce poverty, increase economic growth and improve the social well being of Mozambique’s citizens. Through a national Research Fund that the MCT is promoting, there may also be funded agricultural research.

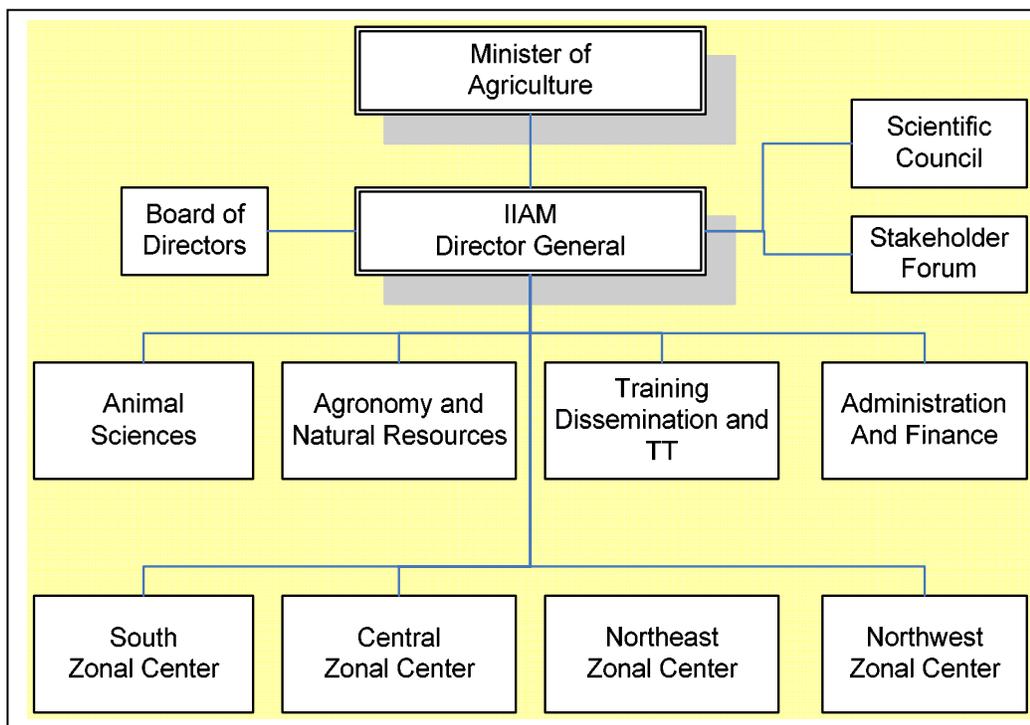
IIAM (Agricultural Research Institute of Mozambique)

The IIAM aims at developing, testing and disseminating technologies that contribute to the increase in agricultural production and productivity of crops and livestock, and to improved food security with the sustainable use of natural resources.

Currently he IIAM’s leadership is designing a research agenda based upon identified demands in priority areas, which will be implemented through national or local programs or projects. The projects/programs will be developed on a competitive basis towards specificities of agro-ecological zones, farming systems, market potential or food security. Capacity building, competitive funds for research and appropriate institutional linkages, as well as fund raising mechanisms, are key issues towards ensuring the success of the programs.

Although the priorities are still under debate amongst different stakeholders in the agricultural sector, seven programs have already been identified, namely (1) natural resources management; (2) development of agricultural production systems; (3) forestry development; (4) livestock development; (5) environment and public health; (6) technology dissemination and transfer; (7) institutional development.

Figure 1. IIAM Organizational Chart



Within these programs, some of the topics that have been identified include the inventory, characterization and evaluation of natural resources (vegetation, climate, including pastures, wildlife, livestock, soil and water); natural resource management and planning (water, soil, climate, pastures & forages, flora and wildlife); management of natural forests; crop production (cereals, legumes, roots and tubers, horticulture and fruits, and commercial crops); integrated pest and disease management;

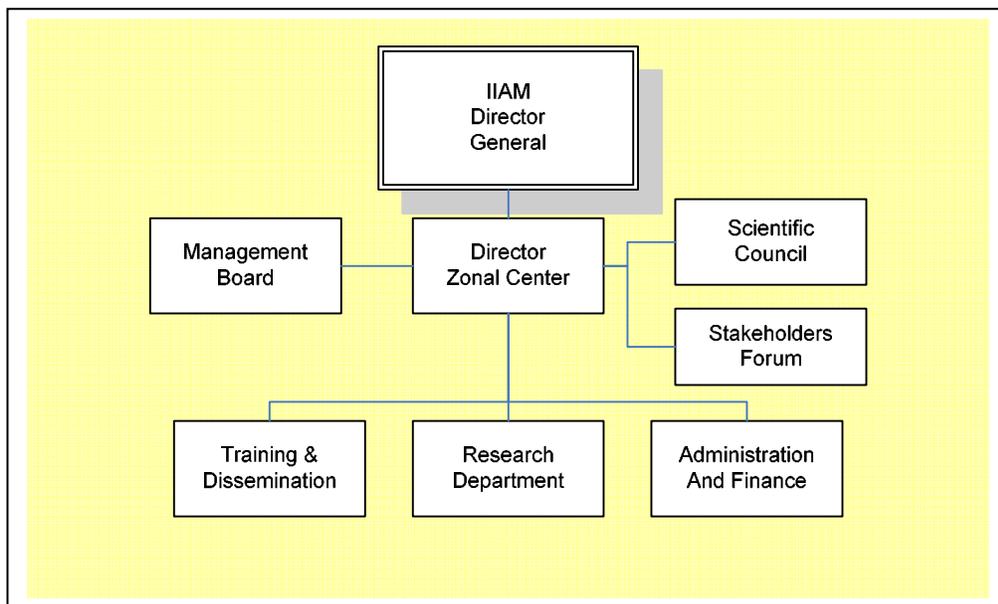
post-harvest (conservation, processing and utilization); conservation, seed breeding multiplication and/plants; characterization and animal breed genetic improvement, animal disease control and vaccine development; veterinary public health and animal traction.

The Institute is organized in four Directorates; animal science; agronomy and natural resources; training dissemination and technology transfer; and administration and finance. There are four Zonal Centers in the South, in the Center at Sussundenga, in the Northeast at Nampula and in the Northwest at Lichinga (see Figure 1 previous page). Research Stations also exist at Umbelúzi and Niamlo. The Central offices of IIAM are in Maputo.

The four Zonal Centers are located in different geographical areas, and among others, tasks have the mandate to coordinate, promote and carry out the agricultural research in the area where they are located; to ensure the involvement of the stakeholders in the definition of research priorities; to make an efficient use of human and financial resources within each project.

The Zonal Center Director responds directly to the IIAM’s Director General (see Figure 2), but the Zonal Centers have their own administrative and technical and scientific staff to carry out the research and other activities. Note that the organizational charts for IIAM, both at the national level and for the zonal centers, contain Stakeholder Forums to encourage input from users in the research decision. These forums are not yet fully functioning.

Figure 2. Zonal Centers Organizational Chart



The design team considers that only persons with advanced degrees, that is, with MSc or PhD level training, can effectively lead the research teams. Those with BSc level training can be important contributors to the research team, but could generally not be the team leader. Table 2 (next page) shows that nine persons or 20 percent of IIAM’s potential research team leaders are located in the Zonal Centers. While IIAM has the policy to push more research to be done in the zonal centers closer to the users, there are currently few qualified staff located there. From the legacy of the civil war, much of IIAM’s personnel capable of leading research moved to Maputo, and is now concentrated in the central office. The ten IIAM employees currently on long-term training are expected to return to the offices from which they left; which means that half of the employees will return to the zonal centers and half to the central office.

Table 2. Location of IIAM personnel by highest level of education

	PhD,MSc	BSc	Total
Zonal Centers	9	43	52
Central	37	33	70
Total	46	76	122
% in ZC	20%	57%	43%

Note: The above number of employees does not include 10 IIAM employees that are presently in long-term training for MSc degrees.

Higher Education Institutions

A number of institutions of higher education exist in the country. Among those, the Eduardo Mondlane University (UEM) is actively involved in agricultural teaching and research through the Faculty of Agronomy and Forestry, Faculty of Veterinary Medicine and the Department of Biology in the Faculty of Science. A memorandum of understanding exists between the Ministry of Agriculture and UEM.

The faculty of agronomy in Cuamba (Niassa province) of the Catholic University is also involved in agricultural research. It has the advantage of being located in the rural area, which can result in the promotion of a strong linkage with rural communities.

New private Universities such as the Universidade Muça Al Bique, the Instituto Superior Politécnico de Manica and the Instituto Superior Politécnico in Gaza are involved in agricultural teaching and are potential agricultural research institutes.

International Agricultural Research Centres

International Agricultural Research Centers (IARC) under the CGIAR system are involved in the improvement, multiplication, distribution and processing of several crops in the country.

The International Institute of Tropical Agriculture (IITA) is engaged in the multiplication, distribution and processing of cassava and sweetpotato through the project Southern Africa Root Crops Research Network (SARRNET). In conjunction with the International Potato Centre, the same institute has a project to improve sweetpotato.

The International Centre for Research in Agro forestry (ICRAF) is carrying out projects in soil improvement using the trees using *Caleandra* and *Tephrosia*. The Centre is also working with TECHNOSERVE in the production of bio diesel in the costal regions using coconut. Fodder production for livestock and seed production are other areas of activity within the Centre.

Non Governmental Organizations

Several Non Governmental Organizations (NGOs) are actively involved in agricultural development programs in Mozambique, including CARE International, World Vision, Save the Children, Africare, CLUSA, TECHNOSERVE, Food for the Hungry International (FHI), Adventist Development and Relief Agency International (ADRA), and ACDI/VOCA.

Many of these NGOs carry on research activities such as the establishment of participatory adaptive trials, market research, seed multiplication and demonstration plots, most often working with basic food crops, such as maize, sorghum, rice, horticultural crops and grain legumes. Some of the NGOs are also involved in the promotion of cash crops with emphasis on cashew nut, sesame, sunflower, paprika, groundnut and pigeonpea. For instance, Word Vision, CARE International and Africare are among the most active NGOs in the promotion of other cash crops, through the provision of improved seed obtained at the IARCs.

The NGOs also have an important role in technology transfer and dissemination, promotion of community self-help activities, with the final goal of creating production and income opportunities through local impact projects.

Private Companies

Some private companies are actively engaged in agricultural research and many more provide product information to producers. For example, the company Dunavant (Mocambique), Ltd. in the Morrumbala District, Zambézia Province, has a cotton concession from the Government of Mozambique. Because the concession requires the company to support the growers, and because it is in the best interests of the company to increase production, Dunavant conducts research in cotton production, and in its concession region, it has established a network of extension agents to support growers and to assist with collecting the cotton from farmers. The company now cooperates with IIAM in maize research. With a little effort, the company could use their extension network to support other crops that are produced by their cotton growers, who also produce crops such as cowpea, groundnuts and maize.

It is probable that other companies with cotton concessions provide some level of support to research and growers. There are reports that tobacco companies also provide support for research for their growers.

Other examples of companies supporting research and extension are Miranda Agrícola Ltd, in Nampula Province and Qualita in Manica Province. Miranda is a processor and exporter of cashew nuts and is involved in the propagation of seed and conducts research in the production of cash crops such as cashew nut, macadamia and castor bean. The Qualita company is involved in the propagation of seed maize and processing maize and horticultural crops.

It is worth mentioning that the linkages between the private companies and NGOs with the government research and extension agencies are limited. There is no widespread coordination of activities. Cooperation does occasionally occur as a result of local initiatives.

Extension Services

Personnel from the Directorate of Extension, while not researchers, will be key players in the delivery to the users of new technology generated by the research. The agricultural extension services operate in all the provinces, covering around 52 districts out of the total of 128 districts in the country.

The organization of the public extension services has the provincial extension service as the principal coordinating unit. In the province, the team is led by the provincial head of extension that functions as

Carotene-rich (orange-flesh) sweetpotato has been a success story. Along with the crop development came an orange tee shirt publicity campaign, to explain to mothers the nutritional benefits. International research center personnel are eager to assist national crop improvement programs.



provincial supervisor of the extension network. In the districts, there are district team supervisors who work with the extension technicians. The extension technicians serve as facilitators and points of contact with the farmers. Each extension technician works with 10 to 12 groups of farmers (each group is composed by 15 to 20 members).

Each extension technician receives a pre-admission training on extension methodology and on specific production regimes. Annually they also attend a refreshment training course.

Some of the problems related to the

agricultural extension services are the inadequate human resource base in terms of quality and quantity. Currently around 600 extension worker are available for 52 districts. The extension technicians face also inadequate technological options that can serve the requirements of the producers.

Frontline extension workers also have difficulties in reaching remote districts, since the bicycle is the common means of transport. Problems with the disbursement of funds occur also frequently in the field. Last but not least, the low salaries are considered to be one of the important causes of the low motivation among the extension service staff.

Issues to be Resolved

Several key issues need to be resolved to help assure the success of the CGS, which are:

- Is there a process in place to accurately identify research priorities?
- Does the capacity exist to conduct research and the corresponding technology transfer to users?
- Is there transparency and accountability in the grants selection and administration?
- What are the adjustments required within IIAM to make the CGS function properly?

Research Priorities

One of the key elements that is needed to underpin a viable CGS for agricultural research and development in Mozambique, is a set of clear priorities that can be addressed by the potential grantees and built into project selection, monitoring and evaluation. As described below, priority setting is underway, and much progress has been achieved.

The macro-level priorities for research and development at IIAM have been proposed and are currently under debate.¹ A priority setting exercise at the micro-level, that is, determining which commodity/constraint combinations will be addressed, is to be conducted by IIAM in collaboration with Michigan State University (MSU) from May 16-18, 2006. The team has been informed by the Director General of IIAM that the entire priority setting process is likely to be completed by the end of 2006, before the launch of the CGS. Meanwhile, the team learned from the Minister of Agriculture that national priority setting is also underway at the agriculture sector level; the latter exercise reaches well beyond research and development.

An IIAM/MSU 2003 report² on gaps and opportunities in Mozambique's agricultural sector, written with support from the Rockefeller Foundation, provides a valuable resource for the entire priority setting process, particularly in emphasizing the need to simultaneously address productivity and nutritional enhancements along with market potential issues.

Need for Inclusiveness

The team suggests that IIAM should emphasize involvement of a broad range of public and private sector stakeholders in the remaining phases of its priority setting process. This will result in: (i) benefits from the broader collective experience and expertise; (ii) maximum efficiency in research through inter-organizational collaboration; (iii) the entire spectrum of issues and activities in the research to delivery continuum being addressed; (iv) an atmosphere of potential inter-organizational collaboration on the agreed upon priorities.

The team also suggests that IIAM place high emphasis on communicating with a wide range of its staff, and especially researchers, about the process and the results of its priority setting initiative. The

¹ Ministry of Agriculture Agricultural Research Institute of Mozambique Directorate Plan: Summary

² Bias, C. and C. Donovan, 2003.

aim is to create a working environment in which each researcher and extension specialist becomes part of a team effort to achieve common goals. This can be reinforced by the incentive scheme proposed by the Ministry of Science and Technology and described in the section “Adjustments for IIAM” in this report. Meanwhile, included in the design of the CGS will be RFAs that clearly detail IIAM’s research priorities and that inform the potential grantee about the need to propose research that addresses IIAM’s agreed upon priorities.

Finally, researchers receiving grants should be required to go the field and talk with growers, male and female. As the extension specialists indicated, “too many of the solutions poured into the funnel are inappropriate. The persons doing the pouring need to check to see if there is a bucket beneath the funnel.” At the same time, we need to recognize that, while the farmer may have a good idea of what the problems are, they usually do not have the breadth of view to comprehend all the possible solutions. That is where the experienced agricultural development person enters - to dialogue, pose potential solutions and get reactions from the farmers.

Macro-Level Priorities

The initial focus of the CGS will be on the short to medium term and is therefore being designed to help translate, whenever possible, IIAM’s current list of priorities for that timeframe into action. These macro-level priorities are as follows:

1. Strengthen and develop the agricultural zonal research centers, taking into account the different agro-ecological zones;
2. Develop research programs and projects based on their agro-ecological potential;
3. Establish technology dissemination and transfer mechanisms;
4. Establish mechanisms for socio-economic evaluation of disseminated technologies;
5. Strengthen the research-extension-producers linkages (public, private and NGO’s);
6. Establish public–private partnerships, in order to attain advantageous results for both parties and resource rationalization;
7. Strengthen human resources, capacity building and development, and research infrastructures;
8. Establish Technical-Scientific Councils at agricultural research and teaching institutions; and
9. Establish monitoring and evaluation (M&E) systems.

As described elsewhere in this report in the section “Competitive Grant System Design,” the CGS is being designed to address all of these priorities except priority #8, which calls for the establishment of technical-scientific councils at agricultural research and teaching institutions, and is beyond the scope of the CGS.

Micro-Level Priorities

Regarding systematic priority setting at the micro-level, the team was informed by the Minister of Agriculture that the priorities will be driven by urgent food security issues and that research and development is needed that can be rapidly translated into farm level impact. He cited the need to focus on such major crops as corn, sorghum, potato, sweetpotato, cassava, and rice. High priority will also be given to work on livestock, including goats, sheep, cattle, and poultry. In addition, agro-forestry and forest management constraints are important areas of concern.

Until the priority setting process is complete, the precise commodity by constraint combinations and other micro-level topics (such as interventions needed in forest management or detection and control of livestock diseases) that will be given highest importance, remains a matter for conjecture. But, for illustrative purposes, the consulting team encourages IIAM to consider the following areas of potentially high payoff, short- to medium-term research and development activities:

1. Utilization of organic nutrients;
2. Production of appropriate, quality seed, including tissue culture and in vitro propagation;
3. On-farm seed storage;
4. Epidemiology of livestock diseases and access to vaccines;
5. Animal traction;
6. Rapid and efficient diagnoses of crop diseases and pest problems;
7. Post harvest handling and marketing/processing; and
8. Economic returns to producers for selected crops, crop rotations or production practices.

Smallholders, which constitute about 90% of Mozambique's food production continue to intercrop, a risk reduction strategy in an area of the world which experiences periodic droughts. There are at least four crops here.



The team has provided a brief descriptions of some specific examples of research and development in several of these areas to be discussed below.

Promoting Short- to Medium-Term High Impact Research

The team observed that most of the research they encountered in Mozambique is focused on development of improved planting material through variety development and seed technology. The team did not observe adequate research in topics that are likely to yield high impact results at relatively low cost in the short- to medium-term.

The team suggests that IIAM leadership, in its continuing priority setting process, create a prioritized list of such topics and that it take steps to promote researchers' interests in them. We suggest that the RFAs contain examples of such research topics to emphasize the short to medium term nature of the CGP. We also suggest that IIAM consider whether it would be worthwhile to invest more resources into such areas as those listed above.

Some aspects of research are better addressed by CGIAR than by Mozambican national organizations. This particularly applies to research that requires long term investment and that is regional in nature. These include brown-streak in cassava, coconut yellowing, maize insect pests such as stalk borer, downy mildew, grey spot, and other crops and problems. Agricultural research on these issues can be best addressed by collaboration with these institutions, which bring resources and knowledge from outside of Mozambique. Thus, fostering research collaboration between IIAM and international organizations is suggested as a goal of the CGP.

Communication of National Priorities to Researchers

Connecting national priorities to the actual research that will be conducted in the laboratories, greenhouses and fields will be a key factor in achieving impact in farmers' fields. The team saw little evidence that the good progress already being made in priority setting by top administrators at the macro-level is being communicated to researchers. The latter seemed unaware that IIAM has already produced a draft document that sets guidelines and research program priorities at least at the macro

level, and that refinements by IIAM and MSU will soon follow. The team did gain the impression that the priorities of researchers can be individualistic in nature, being strongly influenced by their skills, their past educational linkages, and by general knowledge of the needs of the sector. The team suggests that progress to date and, ultimately, the final results of the priority setting process be clearly communicated to the researchers, as well to all other stakeholders.

Capacity to Conduct Research and Technology Transfer

A key factor for a successful competitive grants program for agricultural research is the capacity to conduct research in Mozambique. To assess that capacity, the design team considered three essential elements:

1. The existing infrastructure for agricultural research,
2. The human capacity to conduct research, including the incentives to the research teams, and
3. The ability to deliver research results to the users, defined for the purposes of this program to be focused first on smallholder producers.

All three elements, infrastructure, human capacity, and delivery of results to users exist in Mozambique, in the opinion of the design team. Nevertheless, each of the three elements needs improvements. For the type of research contemplated in the CGS, most of the needed improvements can be accomplished within the grant funding. Leadership within the Ministry of Agriculture and IIAM will still be needed to remove or to ameliorate the remaining limiting factors.

This section will discuss by key crops the ongoing research including infrastructure, human capacity and incentives, and delivery of results, with occasional suggestions for improvements. The following section will review the adjustments needed for success.

The Most Important Crops

From the background documents and discussions with personnel in the various entities, maize and cassava emerged as the primary staples, with a secondary level of important crops being rice, cowpea, and sweetpotato. Several cash crops are important; cotton, coconuts, ground nuts, sesame, cashews, several horticultural crops, and field beans. Some other crops of regional importance are pigeonpea, sorghum and pearl millet. An increasingly important livestock sector consists of chickens, goats, cattle and hogs. Livestock production is in a recovery process following years of armed insurgencies when it was difficult, even risky to be in possession of livestock.

Many crops can be members of more than one group, for example, maize can be a staple, cash, or feed crop. Ground nuts are a food as well as cash crop, and are a good rotation crop provided that effective symbiotic fixation of atmospheric nitrogen occurs. Cassava is known as a “famine” crop for its tolerance to drought stress and because it can be harvested over a period of weeks, even months as needed. Sorghum is a crop with a variety of uses; to make beverages and a feed crop for the increasingly important poultry industry. It is also a drought-tolerant food crop in those not-infrequent years when drought stalks the region. There has been a research and dissemination effort with orange flesh sweetpotato as a source of carotene to combat vitamin A deficiencies – impressive in the public relations effort (orange clothing) and apparent acceptance of the nutritional value of the tuber.

Maize

The maize program at the IIAM Central Zonal Center at Sussundenga near Chimoio shows considerable promise. The maize program personnel know what the growers want; that is white flint varieties of short season, tolerant to drought stress, and disease and insect resistant. One highly commendable effort of the IIAM maize group is their work to provide appropriate, quality seed to

smallholders through the private sector by providing “foundation” seed to the private seed industry to for seed multiplication and subsequent sales to growers at acceptable prices that were slightly more than one dollar US per kilogram.³ This is an important outreach in a country whose agricultural extension system is trying to mature into an effective means of communication between the needs of the growers and the researchers.

The maize program team interacts with the CGIAR center, CIMMYT representatives⁴, and the Eastern Africa Rockefeller Foundation Representative, an individual who is intimately aware of the Mozambican culture and its agricultural situation and needs. The maize project personnel and the documents they made available to the consulting team indicate that the project personnel recognize and are addressing growers’ needs and have open lines of communication for information and the flow of genetic materials (germplasm) to the international and regional agricultural research centers to help the national program achieve success. The human resources are in place to make contributions to improve delivery of improved varieties to the smallholder sector.

However, there are issues that need addressing, including: incentives to improve productivity of the research team, transport from and to Chimoio where most of the professional staff live, sharing of available resources such as vehicles, field equipment,⁵ and a reliable irrigation system. Some issues that require attention are the costs/benefits of travel away from station, the lack of activity reports and annual evaluations, and the assignment of vehicles to individuals and programs. Several conversations concerned the use of vehicles; that possession of a station vehicle should not be for the life of the vehicle but for some shorter period at which time assignment of vehicles are reassigned. Alternatively, a motor pool may be a partial solution.

The design team was told that the maize researchers are aware of and seeking resistant materials for several disease problems: downy mildew (*Pernosclerospora sorghi*⁶), maize streak virus, grey leaf spot (*Cercospora* spp.) and ear rots (*Diplodia* and *Fusarium*). Stalk borers (*Chillo partellus*) and a second species (*Sesami calanist we believe*) are maize disease problems needing research. The maize program personnel explained that they are aware of morphological resistance to the grain weevil, through the use of maize with husks that cover the tips of the maize ear – which is conventional wisdom. The design team did not see all of the above, but does not doubt that these diseases and insect pests are problems.

What the design team did see was widespread nutrient deficiencies – especially nitrogen deficiency in the maize and to a lesser extent, phosphorus deficiency. The nitrogen deficiency is a serious yield-limiting factor, however the cost and availability, and probably the application know how of chemical fertilizers is not well understood. Another common problem observed in growers’ fields and in the research plots was the presence of witchweed (*Striga asiatica*). This problem seems to be endemic and is an issue that can and should be addressed through extension. Research personnel should be emphasizing to the field laborers that the weed must be removed before seed set or the problem will escalate, confounding yield trial data, unless of course the research objective is resistance or tolerance to striga or nutsedge. All of the research stations had a problem with purple nutsedge and its associated plant allelopathy.

The maize program has incorporated the traits for high lysine and tryptophan, referred to as Quality Protein Maize (QPM). They have a picture of two pigs, one fed and marked with QPM and the other

³ As indicated by the reports of sizeable seed supplies of improved varieties being exhausted within hours when offered for sale.

⁴ Centro Internacional para Mejoramiento de Maize y Trigo

⁵ We understand there are two aging tractors in need of parts or replacement.

⁶ Scientific names should be confirmed with specialists.

fed with normal maize and marked with MN (normal maize) that is striking and effective. They report that the growers recognize the superiority of the QPM and seek seed of that variety. This is a case of effective plant breeding and effective promotion of the technology, the science and its delivery, similar to the research and delivery of information for orange flesh (high carotene content) sweetpotato.

The maize personnel talked about the introduction of hybrid maize varieties, a concept that merits further discussion. Hybrids can be expected to have higher yields, respond to chemical fertilizers more than the traditional open-pollinated varieties and will insure the participation of private seed companies, all positive factors. Of concern is the potential of the hybrids to tolerate moisture stress during pollination, i.e., will the hybrids flower over a shorter period of time than the open-pollinated varieties and if so, will that make the hybrids more susceptible to moisture stress at flowering? The maize breeders can address that issue positively if they make it a priority during the breeding process.

With their extension personnel distributed throughout specific provinces, NGOs are well positioned to put new varieties in demonstration plots, educate the growers and participate in the delivery of new maize varieties to growers. Researchers may have to work through a variety of NGOs to reach growers throughout Mozambique. Barring catastrophic events, free seed and tools programs may be counterproductive. Smallholder maize producers are ready for the cash economy.

The personnel and science components, as well as the two-way extension components, often with the help of NGO personnel, of the maize program is very encouraging and bodes well for future agricultural development and expansion.

For maize nutrition there are research and extension projects that could have quick and sustainable impact. Nitrogen is limiting production now and may be even more limiting in the future as demand for land decreases the duration of the fallow period in the slash and burn system common in the smallholder sector. Relying on chemical nutrients probably is at best a partial solution, especially as global prices for chemical fertilizer increase with increased petroleum prices. Of more importance will be organic sources of nitrogen from crop rotations which incorporate nitrogen-fixing legumes, application of livestock manures, and foliage of nitrogen-fixing “alley crops” such as *Leucaena*, *Gliricidia*, *Tephrosia* and others. These alternatives need to be researched for the level of nitrogen delivery and proper utilization methods, tested, perfected and delivered to smallholders.

It is unlikely that any single technology will provide the needed nitrogen throughout Mozambique. Certainly poultry manure will be a good source of nutrients when and where available. There may be organic compounds from cotton, castor bean, cashew, and others that should be utilized. Organic fertilizer often helps build up the desirable microbe populations while suppressing the undesirable organisms, increasing the desirable organic matter and hence, the important cation exchange capacity of the soil.

Sorghum

The design team visited the sorghum improvement program at Niamolo near Nampula. The team was addressed by a young researcher well versed in breeding methodology. He knew from growers that the sorghum varieties should be short-season (90 days maturity versus 180 days for traditional varieties), and have an open panicle to minimize the problems with panicle insects and diseases. Educated at a major university in the sorghum belt of the US Great Plains, he no doubt has access to germplasm and can communicate with sorghum researchers in the US. He recognized that he needs more grower input into what is acceptable or not acceptable to the growers. He is getting input from his field laborers, some of whom are also sorghum producers. He knows there is a serious problem with bird damage. He was aware of a bird tolerance mechanism that seems to be effective in the traditional tall varieties with the slender stem and smaller panicle. That is, when the bird lands on the head to eat the grain, the

slender stock bends and sags into the canopy with the weight of the bird and the bird is uncomfortable and moves on.

The sorghum program has several promising short-season cultivars, with one variety that shows promise as a high-yielding, early variety with good grain quality. However, the question of acceptability in those areas where birds are a problem remains.

Sorghum top leaves with nitrogen and probably magnesium deficiencies.



The design team picked up conflicting information about the use of bird resistant sorghums based on tannin content. US studies show high tannin content reduces losses in the field due to bird consumption, but also reduces weight gain of monogastrics (chickens). A large-scale poultry entrepreneur at Chimoio believes that tannin content of sorghum does not affect weight gains in his chickens. Similarly, he believes that birds are not a problem in Manica Province, where Chimoio is situated. Others, including the design team believe bird populations could increase quickly if an additional food source becomes available. The agronomists at Dunavant, a private cotton improvement and production firm, pointed out that the only way the short-season, stiff-stalked early sorghum varieties would be successful is if

there would be a large number of plots and acreage planted so that the bird damage would be spread over a larger area and damage would be mitigated in individual plots and fields because of the overwhelming presence.

Sorghum is especially vulnerable to the prevalent species of endemic witchweed (*Striga asiatica*). Until some resistance is available in the germplasm, with no negative consequences, control will depend on manual removing of the parasitic plants.

The sorghum program has good scientific talent in one, possibly two young individuals, which will benefit from experience. If they can solve the bird problem sorghum should become an excellent feed source for a poultry industry. Breeding and selecting for an open panicle will help in the control of diseases and insects, as well as contributing to drier grain at harvest.

The sorghum program is doing good research. Project personnel expressed their desire to interact more with the producers, actions that will be important to their success. Progress is limited by lack of a reliable irrigation system, good equipment, more funding for labor, and a current salary policy that may not be able to keep the young talent they have in the program from leaving.

Cassava and Sweetpotato

At the Umbeluzi research station the design team observed variety trials and a policross crossing block of sweetpotatos, as well as variety trials of cassava. The program has strong linkages to international research centers IITA and CIP, with one of the international center scientists stationed in Mozambique at the moment. There has been introduction of improved varieties and notable success has been achieved with the orange-flesh sweetpotato variety high in carotene content. The research and public relations appear to have been very successful in the promotion of the orange-flesh, high carotene content sweetpotato adoption. There are areas for research, including tolerance to low precipitation, sweetpotato weevil control (no apparent resistance – but cultural practices, such as timing of harvest can reduce the problem to acceptable levels), and the interaction between dry conditions and the sweetpotato weevil.

Needed cassava research would include resistance to brown streak virus, mealy bug, and green spider mites (*Mononychellus tanajoa*). Selection is practiced for high dry matter content and sweetness. A high-yielding variety is available but it is a “bitter” variety, high in HCN content.

Brown streak virus has become a factor in Mozambique and has just been confirmed to be vectored by white fly, a pest observed on an alternate host weed of the euphorbiacea family throughout all the sites visited by the consulting team. The virus results in brown streaks in the root and on the lower stem, reducing the edible portion of the root.

IIAM has a tissue culture lab in Maputo, addressing the production of virus-free clones. However, it is not clear that tissue culture will provide large quantities of planting material, especially if the virus, the alternate host for the white fly and the vector already exist in the target plant multiplication areas.

It may be difficult to find short term research projects in cassava for quick, significant impact for smallholders.

The ties to obtaining germplasm from external sources are present and there are capable people working with the roots and tubers program. Obstacles are similar to the above mentioned obstacles for maize program, such as appropriate incentives for the research team, training for workers, tillage and other field research equipment, functioning irrigation systems, renovation of infrastructure such as laboratories, and improved financial administration so funds are available when needed in the agricultural research cycle.

Cotton

There is a Ph.D. plant breeder at the cotton company Dunavant, who is very capable of conducting grant-funded research. Because cotton research for smallholders is provided through Mozambique government concessions to private companies, which then are responsible for conducting research and delivering the results to the growers, the design considered that cotton research would not be a priority for the CGS. The Dunavant company, however, does have a successful model for the delivery of information and production inputs to the growers, that could be utilized to deliver extension services about other crops.

Annual National Agricultural Research Conference

One way to provide incentives for productive research is to hold an annual National Agricultural Research Conference. This conference would invite researchers to showcase their work and present their findings to peers. It would be an excellent opportunity for sharing information and receiving constructive criticism. Interest and preparation for the event can be enhanced by offering rewards (even cash prizes) for the top presentations, or perhaps for the top research implementations for the year. Total prize costs might be in the range of \$25,000 to \$30,000, and a similar amount for travel expenses. The competition established could have a significant impact on the development of agricultural science in Mozambique.

Details of the prize concept should be discussed and worked out. This prize availability would provide a clear incentive, hone research and presentation skills and reduce the problem of a letdown of end of grant cutbacks. Extreme care must be exercised in the choice of the prize selection committee, with at least one international, one regional and probably two Mozambican agricultural scientists not directly connected to any of the grants or grantees. The first annual conference could be as early as two years following the selection of grant proposals. The conference should have a catchy, inclusive name, including crops, soils, and livestock sections. There are precedents that could be studied for “lessons learned,” including the Soils and Crops Society of Florida annual conference – we don’t have to totally reinvent the wheel.

Recommendations on Capacity to Conduct Research

Sufficient technical talent for research is present to launch a competitive grants program in agricultural research and extension in Mozambique. The research infrastructure would be a limiting factor in certain types of research. However with the emphasis on quick impact to smallholder growers, there are many applied research projects needing attention for which the infrastructure is adequate or within reach through targeted grant funding.

Of concern is the need to provide the incentives to attract, maintain and engage competent research teams and to guide those teams to conduct the research that will affect the well-being of the millions of producers and consumers in Mozambique. Providing incentives within a grant can be resolved and has been implemented within prior research supported by donor funding. Continuing incentives beyond the grant is not yet resolved, although the Ministry of Science and Technology has proposed at least a partial solution.

Some of the interviewees supported a subsidy system related to travel support that with careful management resulted in a small cash incentive for those authorized to travel. Others were concerned about possible undesirable side effects and suggested instead that incentives other than cash salary subsidies be used. Other incentives suggested included use of a vehicle, state of the science equipment for research/extension, professional short courses, subsidized housing and professional training.

The need for improved accountability and periodic monitoring through periodic progress reports were expressed by many of the interviewees. Instituting this change in procedures will require rigorous discipline to carefully evaluate the various funded projects and set up a periodic progress report schedule with feedback and corrective action where obstacles and difficulties are encountered. Guidelines will need to be clearly delineated in the request for applications documentation and as funds are made available on a scheduled basis to grant recipients. Care must be taken for rapid disbursement of funds as the progress reports are submitted, reviewed and feedback provided.

The development of the agricultural science community in Mozambique has reached a point where an annual national agricultural conference could and should be held. This would be an opportunity for young and experienced agricultural scientists alike to make presentations, sharing information and receiving constructive criticism. It would stimulate interest in problem solving and encourage researchers to share their results.

Suggested Areas for High Priority Research

In the opinion of the design team several areas for research and extension offer promise of short term impact for a broad cross-section of agriculturalists in Mozambique.

1. Improvements in the dissemination and extension of improved, quality seed, coupled with appropriate agronomic management packages for a variety of field and horticultural crops. This is especially true for the smallholder farmers who appear to have lost the tradition of saving their own seed. The need for a new “agronomic package” is due to the fact that there have been many new varieties of existing crops that are substantially different than varieties of those crops grown previously. Many of the newer varieties are shorter season varieties that farmers prefer to reduce the “hunger months” and to what appears to be a trend to shorter rainy seasons and more erratic rainfall. This need can be addressed in two distinct manners: First, developing and/or adapting on-farm seed storage technologies that are practical and inexpensive, such as a seed saver’s kit.⁷ Second, insuring the survival and health of the private sector seed

⁷ Because planted areas are small, producers could save next season's seeds in relatively small containers, such as sealable clay pots, metal, glass or plastic containers with lids. Dropping a buring cotton ball soaked in alcohol into the container and

producers/marketers through facilitation of financing, credit and tax structures. This second activity is not addressed through the CGS.

2. If there is a “national food” of Mozambique it is maize (*Zea mays*). The consulting team was told that smallholders will sell horticultural crops to purchase maize when their own maize supply is exhausted. Maize is also a cash crop. There are a variety of constraints in maize production, including: inadequate moisture during part or all of the growing season, nutrient deficiencies, especially nitrogen and often phosphorus, diseases such as downy mildew (*Pernosclerospora sorghi*), maize streak virus, grey leaf spot (*Cercospora* spp.), and leaf blight (*Helminthosporium turcicum*). Insect pests include stock borers (*Chillo partelus* and *Sesamia calamist*). There are several key nutrient deficiencies, including:
 - Low soil pH values (in Manica Province, for example, soils are reported to be below 5.0)
 - Hardpans
 - Smallholders use slash and burn technology, cropping a given piece of land for four or five years before abandoning to fallow
 - Manganese toxicity was mentioned as a possible yield-limiting factor
 - Observations of interveinal chlorosis suggested a possible magnesium deficiency
 - Witchweed (*Striga* spp.) is present on much of the corn, sorghum and millet.

There is a “quality protein maize” (QPM) variety (Sussuma) that has improved lysine and tryptophan contents and has gained recognition and acceptance in the population

Mention must be made of the relatively high cost and inaccessibility of chemical fertilizer. A 50 kg bag of urea fertilizer costs about US\$50 and is not readily available in many parts of Mozambique. Attention could and should be given to sources of organic nutrients.

3. There is little evidence of effective symbiotic nitrogen fixation in several legumes, in spite of low soil nitrate levels. Legume crop yields are disappointingly low, for example ground nuts were reported to yield 400-600 kg/ha. Ground nut plants were observed to be a very light green in color, indicating low levels of nitrogen in the foliage. Root systems were examined for nodules with few, if any, being observed, and those that were observed often did not exhibit the characteristic pink color of an effective nodule with *Rhizobium* spp bacteria. Root systems of pigeonpea (*Cajanus cajan*), soybeans (*Glycine max*), mung beans (*Phaseolus mungo*), field beans (*Phaseolus vulgaris*) and even cowpeas (*Vigna unguiculata*) contained little evidence of effective symbiotic nitrogen fixation. NGO representatives reported that their inoculation experiments gave no yield response so there may be an issue of bacterial viability. Legume crops are valued for home consumption as well

Ground nuts here with no apparent nitrogen-fixing bacteria nodules.



quickly sealing the container will burn away the oxygen and help preserve the seed. Keep the seed in a location with less temperature variation.

as a valuable cash crop, especially ground nuts. Increasing legume crop yields will not only contribute to nutrition and cash flow, there should also be a nitrogen contribution to the succeeding non-legume crop. Ground nuts, pigeonpea and cowpea share the same cross-inoculation group. The design team did not observe any weedy legumes that may be a host for the same group of nitrogen fixing bacteria. Given the near total absence of nodules on first-year peanuts after fallow, there may not be any alternate hosts.)

4. Livestock are gaining in importance following the cessation of insurgency hostilities. Many smallholders have chickens that are a source of food and a store of value. But there may be periodic die-offs from Newcastle disease. Obtaining small and economic quantities of vaccine continues to be a problem. Currently the smallest vaccine ampules contain 250 doses.

Also very important for increased smallholder income is animal traction. Currently, hoe culture limits farmers to about 2 hectares of cultivated crops. Land does not seem to be a significant constraint so the use of animals offers a relative simple way to increase production. Sleeping sickness (*Trypanosomas* spp.) is a factor in the bovine population. Tsetse fly and ticks are factors needing attention.

5. There are a number of issues concerning sorghum (*Sorghum bicolor*). Sorghum is much more tolerant of drought stress, and will be an increasingly important asset. The sorghum being grown is a tall (2-3 meters), late (~180 days), white-seeded with small, open panicles. New varieties are short, dense-panicle and early maturing. Farmers like the early maturity but the short varieties are susceptible to intense bird damage where birds are present. The tall varieties do not support the weight of the birds and as a consequence, are somewhat bird resistant. There are early, short-stature varieties that have tannin, offering some bird resistance. Sorghum is used for alcoholic beverages when the maize crop is sufficient and eaten when maize is not adequate for home consumption. Of great importance is the potential for sorghum in livestock rations, especially chickens. There is a dynamic sorghum breeding program in IIAM (Nampula) with a well-trained young plant breeder. It is a crop with great potential and probably some serious obstacles whose solution would benefit from research apart from but in cooperation with the plant breeding work.
6. Tissue culture is at the border line between modern and conventional biotechnologies. With specific reference to plants, the main applications of relevance to Mozambique are:
 - *In vitro* production and mass propagation of plants. Pathogen-free plants can be produced in this way and multiplied rapidly. Seeds of some food crops can be produced through this technique. Mass propagation of low disease load *in vitro* planting material has been developed for perennial crops (oil palm), root and tuber crops (cassava, Irish potato, sweetpotato), banana, and some agro-forestry resources;
 - *Haploid production in plant breeding*. Homozygous lines can be produced in a very short period, and the time needed to develop a new variety is reduced.
 - *In vitro* conservation. This facilitates long term maintenance of genetic resources.
 - Application of anther culture and embryonic techniques to overcome reproduction barriers;
 - Conservation of genetic resources of root and tuber crops;
 - Production of secondary metabolites with agricultural and medicinal interests; and
 - Fundamental research (mastering the conditions for genetic transformation and regeneration of recalcitrant plants, conservation of embryos, anther culture etc.).
7. Diagnostic tools and recombinant vaccines hold enormous potential for Mozambique agriculture. Diagnostics, as applied to crops, involves the improved characterization of local pathogens and the extension of these studies to unknown pathogens, in order to produce more

specific tools (monoclonal antibodies, molecular probes and primers). Such an approach is often used in combination with in vitro culture techniques referred to above.

Disease is a major factor threatening the livestock assets of the poor in low input systems and also limits productivity of, and contribution to income by, these assets. Improved disease control strategies for livestock, through use of improved diagnostics and vaccines, will help secure livestock assets and increase productivity, while also reducing chemical and drug usage, hence improving environmental health. The activities focus on the identification of immunogenic components in pathogen genomes of local strains, which will lead to the production of more efficient vaccines.

Some specific areas of interest include:

- Identification of major diseases affecting priority crops and animals on a national basis
- Application of molecular diagnostic tools to detect pathogens
- Development of diagnostic procedure for diseases of unknown etiology
- Vaccines developed for major diseases of poultry and livestock.

Many of the benefits of utilization of enhanced diagnostic tools and recombinant vaccines will appear beyond the three year delivery period contemplated in the CGS. Nevertheless, because the benefits to producers can be very significant, the design team suggests that the CGS administration consider that a small portion of research funds be directed toward establishing these technologies in Mozambique. This would be consistent with the Minister of Agriculture's suggestion of identification of research leaders and of providing resources to engage in more advanced research.

To achieve the greater longer-term results, it is necessary to put in place the scientific, human and material capacities before proceeding with the more applied research activities. Much of these actions can be promoted and undertaken by the private sector, which can lead to the development of improved seeds and disease or pest control technologies and the subsequent commercialization of these biotechnology products. The sustainability of this sector will depend on the degree of involvement of private companies in the implementation of such activities.

Adjustments for IIAM

The CGS will introduce significant changes in how IIAM administers agricultural research, beginning with the process of determining research priorities, to the selection of projects to fund, to the administration of the research teams, to the dissemination of technology to users. Challenges exist, though the design team believes that the implementation of the designed program will overcome these challenges. Key criteria for success of the program are:

1. Improvements in research facilities,
2. Educated, experienced and motivated personnel,
3. Potential for adoption of improved technologies, and
4. Commitment of the Ministry of Agriculture and of IIAM leadership

Improved Research Facilities

The research facilities exist with land, fields, irrigation infrastructure, roads, buildings and limited amounts of equipment. Additional needs such as laboratory equipment, fencing for research plots, field research equipment and other small items can be provided within the research grant. Costly equipment such as tractors will not be funded, though in most cases that equipment exists.

Operating tractors were observed at some facilities, as were tractor and field equipment repair stations. Field personnel reported occasional delay in field preparations for the research plots because of non-availability of equipment. IIAM leadership has indicated they will provide the tractors and other equipment they are pledged to support. We suggest that the RFA instructions and associated training for applicants clarify that the applicant will need to identify what resources will be provided by the collaborating institutions and how they can assure that those resources will be provided in a timely manner.

Much of the laboratory equipment the design team observed is old and may not function properly, has been poorly maintained, and in some cases it has not been calibrated in a long time. Researchers often reported that laboratory results were not always reliable. While the research grants will provide some of the needed new equipment, maintenance and calibration, IIAM and other collaborating will need to also provide additional support, maintenance and in some cases acquisition. The grant application should describe clearly by whom and by what means reliable laboratory results will be available to the research teams.

Grant applicants will be encouraged to share resources among collaborating institutions, to reduce capital outlays. Also within the grant will be permitted a small contribution to overhead for the participating institutions, funding to help support the contribution IIAM and other participating institutions will need to provide.

Educated, Experienced and Motivated Personnel

Low wages for public sector employees makes attracting high quality staff difficult. The Minister of Science is proposing to increase base wages of scientists by 40 percent, hopefully to be effective by the start of 2007. This is a significant boost to motivate IIAM and other public sector researchers.

In addition the Minister is proposing to permit incentive awards to researchers who generate innovations, make discoveries or inventions, or who bring contracts to the institution. It appears from the current proposal that the CGS will be able to structure research grants to include incentive systems that reward individuals and institutions for outstanding performance. Some private companies and NGOs already have successful incentive systems that reward improved performance.

Limited training is contemplated within the grants, to improve immediately needed researcher skills, to resolve unanticipated problems that arise, and to more efficiently and rapidly complete the research tasks. Where one institution lacks skills, the grant program will encourage collaboration among institutions to draw upon the strengths of each.

Adoption of Improved Technologies

Research results not adopted have little value. IIAM has already embarked upon a process to set realistic research priorities by incorporating all of the stakeholders in the priority setting process. This process should be completed by the second semester of 2006, in time to guide the grant solicitation and selection processes.

Key to selection of applications will be the ability of the application to demonstrate how research results will be delivered to users for their adoption, and how the results offer a practical benefit to the users. No one institution in Mozambique does both research and delivery of results to users well. Grant applicants should collaborate to bring the respective strengths of each institution to both conduct the research and deliver the results to users. There exist in Mozambique successful models for research and for delivery of results. This design requests institutions to do both tasks well.

Grantees will be required to report research results and lessons learned to a central knowledge unit within IIAM. The project will assist IIAM to organize and administer the knowledge gained from the funded research.

Seasoned research leaders in IIAM and in the contractor will need to remind the young and newly trained researchers who are eager to help their country to solve immediate and practical problems first. An opportunity to utilize their profound new skills will come with time. If a buyer cannot see the result of your work in the price of food in the street, you are not doing the right research.

Mozambican farmers, male and female, are anxious to increase their agricultural productivity and are very receptive to new technologies and are willing to share information and ideas.



Support Needed from IIAM

Successful implementation will require support from IIAM for the following activities:

1. Close monitoring and evaluation of grants,
2. Establish an incentive policy for personnel,
3. Make infrastructure improvements for zonal centers,
4. Provide leadership for competitive grant selection and administration processes, and
5. Facilitate collaboration with extension and other partners for delivery of research results.

The implementation partner will support, train, provide examples and otherwise provide technical and administrative support to IIAM for the implementation of the above support items. Initially the contractor may take the lead in one or all of these items. As the project progresses it is anticipated that IIAM personnel will take greater and greater responsibility for implementing support for the CGS.

Transparency and Accountability

The concept of competing for grant funds is widely understood and accepted in Mozambique by researchers, extension service leaders, NGO leaders and staff, business leaders and senior staff, and by the policy makers the team consulted. In particular IIAM leadership was enthusiastic about the potential to increase the amount of resources available for research and, equally important, the potential to improve the transparency and accountability by the research teams receiving grants.

IIAM now has in place some of the policies and processes that are required to assure transparency and accountability in a Competitive Grants System (CGS) administration. Other policies and processes are in the process of being implemented, as identified in IIAMs institutional development priorities.

Additional policies and processes will need to be developed by IIAM with support by the implementing partner.

As an example of policies and processes already in place, IIAM zonal centers receive funds from donors, deposit those funds in separate bank accounts, allocate and control the use of funds for approved expenditures, prepare end of month reports on expenditures and reconcile these reports with

balances in the bank statements, and then report to IIAM central offices. As funds are consumed replenishment is requested. Periodically reallocation of funds by line items may be prepared by the zonal centers and requested to funding agencies.

Several IIAM employees have experience implementing competitive grants, most at the level of preparing budgets, receiving funds, setting up bank accounts, managing purchases and reporting to the funding institution on the use of the funds. There is little experience within IIAM on setting up performance targets, comparing actual results with performance targets, and implementing project corrections or workouts when results are below expectations.

A key task of the implementing partner for USAID will be to assist IIAM administration complete their vision of how a competitive grants program can work in Mozambique and chart the course to realize their vision. Setting an example of transparency and accountability in grants administration is an important first lesson. Other key tasks for the implementing partner are to build IIAM's capacity to effectively prioritize research to meet the critical needs, transparently select winning research proposals, effectively and efficiently manage funds disbursements and reporting, evaluate results and fairly compare them with targets or otherwise anticipated performance, strengthen the capacity for grants administrators to adjust resource utilization, and to assist in the communicating the results of the CGS to policy makers, funding agencies and the public.

This combination of vision setting, examples of transparency and accountability, capacity building, and technical assistance in all phases of grants administration should quickly enable IIAM to assume a more active role in the administration of the CGS. Within the first phase of the project the implementing partner will make an assessment of the capacity of IIAM to assume administration of parts or all of the competitive grants system and prepare and implement a plan for the handoff of the selected activities to IIAM.⁸

IIAM personnel will also gain experience as a grantee and implementing partner for the research funded by the CGS. IIAM employees operating as grantees with defined targets for the research output, and outside assessments of performance will be a valuable experience to draw upon if and when IIAM is charged with the complete CGS administration.

Achieving transparency and accountability require the correct execution of many activities (see Annex A). Many activities can be implemented simply by building the capacity of IIAM personnel and by verifying the application of the capacity building. For example the first two processes listed under grant administration in Annex A are 1, published grant administration policies and procedures, and 2, grantees are trained on the periodic reporting system. Because IIAM personnel have done these tasks with other donors, hopefully only a quick review of the processes to be used in the CGS will be needed.

On the other hand the tasks of setting performance targets, assessing performance, disbursing performance incentive awards, and reallocating resources from poorly performing projects are activities seldom done previously by IIAM. The team believes that IIAM personnel are capable of being trained and implementing these activities, with capacity building and technical assistance from the implementing contractor.

Other activities of a well run competitive grants system such as reporting on performance variables and development of incentive systems to reward achievements of targets is not currently practiced in IIAM and is difficult to implement within the current policy framework for IIAM. The team received reports of indirect incentives reaching selected researchers through travel per diems, purchased assets

⁸ Annex A identifies key activities the institution responsible for CGS administration institution will need to implement for USAID or other donors be assured that funds are allocated and utilized according to the grant agreements.

exclusively utilized, and by selection for long-term training. These incentives are not always bad, but when put in widespread practice give the impression of a lack of transparency and accountability.

To improve incentives directly to researchers and allow direct payment of performance incentives the Minister of Science and Technology is proposing a new incentive plan. This plan would raise base salaries for researchers within government agencies by 40 percent, and will allow researchers to accept additional compensation for innovation, discoveries and inventions and incentives for contracts. It appears that incentives for contracts will include performance incentives contemplated within the CGS.

Along with capacity building in incentive systems will be needed examples of how such systems can be established and operate, and the observation by IIAM employees of increased number and quality of research results. Other benefits are higher team moral and greater commitment of IIAM employees; results that will be apparent to most only after a few years of implementation.

Innovations are needed in the framework of how IIAM can collaborate with other public and private institutions that have strengths in transferring research generated technology to users, and in incorporating users' feedback into the processes for setting research priorities. Successful systems of delivering research results to users including setting performance targets with incentives for the extension workers do exist within private sector companies and NGOs. Implementing similar incentive systems within IIAM or within the Extension Directorate of the Ministry of Agriculture will have its own set of challenges.

The implementing partner will need to build the capacity for IIAM administrators and research project leaders to form effective research teams that will be motivated to set and achieve performance targets. Incentive payments for exceptional performance, realization that users are implementing research results and timely disbursement of grant funds are all items that can help motivate team members to higher performance.

Project Monitoring

Even though the number of grants is relatively small, accurate and timely reporting for the CGS will not be simple, especially if performance incentives are incorporated into the grant. Performance incentives work everywhere, including cases the team observed in operation with private companies in Mozambique. Setting the right incentives and determining how to measure them is critical. And just as critical is the reliability of the reports that present the data showing the levels of performance.

An effective monitoring plan is the first step. Financial reports will be submitted monthly with supporting documentation and will be carefully reviewed by the implementing partner and IIAM.

Feedback to the grantee on report anomalies will be immediate. Periodic field visits will be conducted to review the actual policies and processes implemented on the ground.

Research progress reports could be monthly, quarterly or semi-annually depending on the specific research project. These reports will also be carefully reviewed by the implementing partner and IIAM as appropriate. Thoughtful feed back will be provided to the research reports. Increased scrutiny will be given to those grantees that are not achieving some or all of their targets, and to those grantees with prior or currently anticipated problems. Finding problems early expands

Flea beetles, a serious constraint in sesame production are just beginning their attack on the this young sesame plant.



the options available to fix them.

It is anticipated that the implementing partner or cooperating personnel of IIAM will visit every research site at least once every year, to keep informed on research progress, to facilitate adjustments in the research plan, and to verify reported data.

Competitive Grants Program Design

The implementation of the Competitive Grants Program will represent a partnership between the implementation partner (called the contractor hereafter) and IIAM.

Performance Requirements

The contractor will implement the following activities:

1. Establish an office at IIAM;
2. Propose two budget scenarios: 3 years/USD 3.3 million and 5 yrs/USD 10.0 million;
3. Create, and continually update, a website for the CGS;
4. Draft, gain approval for, and issue an RFP calling for concept notes;
5. Establish a review panel to evaluate and prioritize concept notes;
6. Conduct a nationwide competition for concept notes involving all relevant public and private sector stakeholders;
7. Draft and gain approval for an RFP calling for full proposals;
8. Organize a proposal writing workshop for successful applicants;
9. Establish a review panel to evaluate and prioritize full proposals;
10. Conduct a competition for full proposals;
11. Negotiate with successful applicants on programmatic and budgetary issues;
12. Work closely with principal investigators to launch each project;
13. Monitor progress in, and provide feedback to, each team on programmatic and budgetary issues through frequent interactions, including on-site visits and written reports;
14. Establish clear and frequent communication on progress and other issues with USAID and the Advisory Committee including timely face-to-face meetings;
15. Provide technical assistance to troubled projects;
16. Organize and facilitate a review of the CGS approximately 3 months before completion of the first 3 year phase;
17. Identify and address CGS-related capacity building needs at IIAM, in research, extension and administration;
18. Perform an assessment and develop a plan for management of grant funds by a independent entity after year 2;
19. Work closely with IIAM to facilitate transition of CGS leadership exclusively to IIAM; and
20. Seek the support of additional donors to sustain and expand the CGS

Performance Standards

The activity will achieve the following targets with a \$3.3 million funding level:

1. Plan for transition to the management of grant funds by an independent entity;
2. Award at least of 50% of grant funds by the end of year 1 and 100% by the end of year 2; and
3. Build capacity of IIAM to conduct transparent and accountable processes for proposal review, selection, and award and management of a CGS.
4. Monitor and evaluate grantee performance no less than semiannually, suggest corrective actions as appropriate to the advisory committee and implement approved actions;

5. Provide periodic summary and detail reports to the advisory committee on the progress of the CGS;
6. Provide summary reports to stakeholders on progress of the CGS.

SO6 Results Framework

The overall result will be the increased capacity of the Mozambique national agriculture research system to implement research that leads to the development and adoption of improved practical agricultural technologies. The program will thus support USAID/Mozambique Strategic Objective 6: Increase in Rural Incomes Sustained, and the U.S. Presidential Initiative to End Hunger in Africa.

Key results must include: (i) broader and deeper involvement of a broad range of public and private sector stakeholders in planning and conducting high priority research; and (ii) translating experimental results into impact at the farm level. This will ensure that: (i) a broader set of experience and expertise is brought into play; (ii) maximum efficiency-and the least redundancy-in research is attained through inter-organizational division of labor; (iii) the full complement of issues and activities associated with the research to delivery continuum are addressed; and (iv) a new culture of inter-organizational collaboration on upon priorities is created.

Another key result will be a sustainable CGS with the potential to achieve impact well beyond the initial portfolio of projects and to positively impact all aspects of Mozambique’s research and development. This will be achieved by capacity building activities in the areas of research and delivery and project management as well as competitive grants administration.

Indicators will be:

1. Stronger capacity of the Mozambique national agricultural research system to
 - a. Manage a competitive grants system; and
 - b. Conduct high quality research and development focused on practical solutions and rapid and sustainable impact at the farm-level;
2. Adoption of technology; and
3. Breadth and depth of partnerships

SO 6 Illustrative Activities:

1. Form an advisory committee;
2. Obtain approval for both RFA’s (concept notes and full proposals);
3. Build in a broad range of public and private sector stakeholders;
4. Grants review and approval; and
5. Capacity building within IIAM

Indicators will be:

1. IR6.1.2: Provision of public and private sector support services increased
 1. 6.1.2.A: Number of economically viable technologies adapted at zonal research centers
 2. 6.1.2.B: Adoption rates of new technologies by smallholders

Design Parameters

The following design parameters must be addressed in the project proposal and budget:

1. The project will have two components, namely a CGS fund and administrative/ training.
2. There will be a two stage application process. First, concept notes will be solicited and evaluated. Second, applicants whose concept notes were successful will be invited to submit full proposals.

3. Potential recipients of grants may include: Mozambique Government agencies, international agriculture research institutions, universities, private companies and NGOs. The grantee must have active operations in Mozambique.
4. The grants will include delivery of results to users, or specify a detailed plan of how research results will be delivered to users, especially smallholders.
5. Technical assistance and training will be provided to IIAM in competitive grant design and administration.
6. Limited technical assistance may be made available through the contractor to grantees who suffer serious unanticipated research complications and who demonstrate the potential to recover quickly their research program with timely assistance.

Criteria for the selection of grantees shall include:

1. Potential to build research capacity of IIAM;
2. Research that addresses Mozambique agriculture priorities;
3. Public-private partnerships developed for research and delivery;
4. Capability of grantee to implement the proposed activities;
5. Demonstrated ability to manage funds;
6. Potential for adoption of research results at farm/enterprise level; and
7. Potential impact on reducing poverty and increasing food security.

Funding levels per grant are expected to range from \$100,000 to \$300,000 for up to 3 years.

Examples of what the CGS will fund are:

- Incentives for scientists/institutions based on performance and effective grants management
- Essential equipment and supplies to conduct research
- Limited in-country training
- Limited national and international travel for collaboration and conferences
- Irrigation capacity for research plots

Examples of what the CGS will not fund are:

- Vehicles
- Long-term training abroad

The role of IIAM will include:

1. The Advisory Committee will be chaired by the Director-General of IIAM, which will approve all CGS grants.
2. Monitor and evaluate CGS projects through M&E Unit;
3. Recipient and partner for implementation of CGS activities;
4. Identify potential synergies with other USAID/Mozambique SOs, for example democracy and governance, social sector, and HIV/AIDS, in the Mission's portfolio;
5. Address Mission cross-cutting issues, including gender, food security, environment, transparency and accountability, HIV/AIDS and conflict mitigation in both their technical and management approach. With the contractor IIAM must make every attempt to promote gender balance and ethnic diversity in project staffing as well as proposing strategies to ensure the participation of women as full beneficiaries;
6. Integrate public-private partnerships, including Global Development Alliances, (GDAs) to enhance development impact;
7. Develop Performance Standards for the \$10 million funding level.

8. Explore and develop linkages for training of scientists through the USAID/Mozambique capacity development activities.

Evaluation Criteria for Task Order Proposals

A. Technical Approach (35 points)

1. The Technical soundness of the proposal (feasibility/workability of the proposed technical approach for accomplishment of SO 6 and IR level results (20 points).
2. Methodology for achieving and measuring results that will contribute to SO 6 and IR level results (clear, convincing criteria to be used for achieving expected results and to aid in performance monitoring. Demonstration of sustainability of project activities without continued USAID funding (15 points).

B. Personnel (25 points)

Qualifications of proposed personnel shall be scored based on the following sub-criteria:

1. Demonstrated capability, experience, educations and qualifications of the offeror's proposed Chief of Party (14 points);
2. Demonstrated maximum use of local staff reflecting the ethnic and regional diversity of Mozambique and the states in which USAID works (6 points);
3. Appropriateness of the skills and experience of the proposed staff, staffing plan, and organizational structure relative to project objectives and outputs (5 points)

C. Past Performance (25 points)

The Technical Evaluation Panel (TEP) will evaluate past performance of the Offeror based on reference checks and relevant past performance information submitted and may consider other past performance information.

1. Assessment of past performance will focus on the offeror's demonstrated success in past contracts: demonstrated success in providing similar design and implementation services on past contracts, including satisfaction of clients with offeror's services/products; effectiveness of key personnel, including effectiveness and appropriateness of personnel for the job, and prompt and satisfactory changes in personnel when a need to replace personnel was identified; evidence of ability to operate within budget, adaptability (evidence of ability to adapt to changes in development environments and government or client priorities).(20 points)
2. Use of small business concerns on current and past contract(s) and in the CGS project (offers from small business concerns will not be evaluated against this factor). (5 points)

D. Institutional Capability (15 points)

1. Demonstrated effective home office support to assure quality managerial and technical backstopping for a program of this complexity, including successful management of/integration with other partners (positive experience working with and providing direction to other development partners) (10 points).
2. Evidence that proposed domestic and international development partners have relevant experience in the research to delivery continuum.(5 points).

Conclusions and Recommendations

The Ministry of Agricultural and Rural development, the Ministry of Science and Technology and the Agricultural Research Institute of Mozambique all expressed similar goals for agricultural research. Those are:

1. Improved food security;
2. Reduced poverty, especially among the smallholder sector; and
3. Achievement of immediate results.

USAID/Mozambique shares these goals in Strategic Objective 6, Rapid rural income growth sustained in target areas.

The Competitive Grants System as described in this paper can achieve those goals.

No single institution in Mozambique working alone can achieve the desired level of results within the three years contemplated for this project. Multiple institutions will need to combine their strengths to conduct the research and to deliver the results to users. And even though institutions combine their strengths, a new research paradigm is needed to provide the incentives that make the system work. The CGS provides those incentives and the administrative and operational support. In addition, the CGS provides a framework for building the capacity of IIAM and other Mozambique institutions to stand alone in administering competitive grants for agricultural research.

The design team recommends that USAID/Mozambique implement the CGS, if possible to begin in time for at least some of the research projects to take advantage of the next rainy season.

Specific actions that are needed for a successful CGS are:

1. Link research with extension. Successful research exists in Mozambique. Successful extension models also exist. There is an urgent need to link research with extension. Every grant awarded should demonstrate how the grantee will deliver results to users, especially smallholders. If results delivery is beyond the project end, the proposal should describe in detail how the results will be delivered.
2. Capacity exists in IIAM and in other institutions to conduct the type of adaptive research most needed in Mozambique. In particular there exist:
 - a. Capable personnel who know how to do research. In some areas the length of experience may be limited, the breadth of skills may be narrow, and the incentive systems to motivate superior performance may be lacking. All of these limitations can be overcome within the grants.
 - b. Functioning research infrastructure of land, access roads, communications, research plots and fields, buildings, irrigation systems installed machinery, functioning field equipment, laboratories, weather stations, record keeping capabilities and other components.

True, much of the equipment is old, irrigation systems are short key components, tractors and field equipment are waiting parts and repairs, laboratory equipment is old and may not be calibrated accurately, and any number of other limitations. Many of these limitations can be resolved within the grants. IIAM is committed to providing the resources to make operational other infrastructure items that the CGS will not fund, for example providing tractors to do the field work on a timely basis.

- c. IIAM has an administrative structure in place to care for the infrastructure, pay the research teams, to allocate funding and report use of funds, implement research projects and to make research results available for delivery to users. The Agricultural Directorate for Extension, NGOs and private companies have agents in place to deliver results to users, including smallholders.

The system works for the current research environment. A key goal of the CGS is to change the environment, introducing performance incentives into the allocation of research monies, and to include the delivery of results to farmers within those incentives. The CGS provides resources to

A disappointing yield of bambarra groundnut. There were no nitrogen fixing nodules on the roots.



expand the amount of research conducted and to change the paradigm of research administration in Mozambique.

Successful grants applicants will leverage CGS resources by using existing resources from wherever they exist to jumpstart research in demand and deliver results to users. Short-term training for researchers can be accommodated within a grant, as can bringing in experts from outside Mozambique for short periods. Long-term training is not supported.

Capacity building for IIAM, for other participating agencies and research teams, is accomplished through successful implementation of the funded research, plus the technical assistance and training provided by USAID's implementing contractor.

3. A key technology transfer for the contractor will be how to design and administer a competitive grants system. While the concept of competitive grants is known in Mozambique, experience with CGS implementation is rare. The contractor will work alongside and build the capacity of IIAM personnel to administer performance based

research programs. Fluid communications with the agricultural research stakeholders is essential. Why was a grant application rejected? What research deficiencies are highlighted in the periodic report? How can a wayward research project be turned around? Or should it be terminated? The contractor will work closely with IIAM personnel to communicate to all stakeholders how the performance based competitive grants systems are working, until the stakeholders begin to observe on their own the positive results.

4. Assist IIAM to establish and to update, as needed, priorities for research, in consultation with all stakeholders and especially with smallholders. Current publicly funded agricultural research in Mozambique focuses on the most important food crops, maize, cassava, rice, chick peas, and others. That focus should continue. Cotton and tobacco research are done by private companies which benefit from government granted concessions and are encouraged or required to do crop development and support growers. The animal sector is a small component now of the food supply, but it will be demanding more research as the industry grows. While we anticipate that the first grants will focus more on crops and animal production, improved processing and marketing systems will very soon enter the mix for research support.

We cannot overemphasize the importance of getting right the research priorities. Feedback from the public extension service suggests that often the technology given to agents for delivery to farmers does not coincide with the questions farmers are asking. Anticipating today what farmers' questions will be in several years, can be difficult. Still the best technology for project smallholders' needs is based on consulting them in the field when determining research priorities.

5. The Ministry of Science and Technology has prepared a proposal that would result in increasing researchers' pay levels by 40 percent. That is an important change for the stability of the public

research institutions. The CGS can function even if that proposal is not successful; only increased funding will be needed to be allocated to provide incentives for research team members.

6. Level of funding that is contemplated in the first round can be absorbed by IIAM with the existing staff. If another \$2 million were available in the second year, IIAM would still be able to absorb the additional work load. Funding beyond that level may require capacity increases in IIAM's resources, or greater reliance on other research institutions in Mozambique, such as universities, private companies, NGOs, international research centers.
7. The USAID implementing contractor primarily assures transparency and accountability in the early stages of the CGS. The contractor will build the capacity of IIAM personnel to assure transparency and accountability. Gradually responsibility for these critical functions will pass to IIAM. In the third year of the project, an assessment will be made of IIAM's capacity to assume management of the CTS.
8. IIAM is building the capacity to gather scientific data from within and from outside of Mozambique. The CGS will support that effort, requiring all grantees to submit timely technical reports on their research results, for sharing with others. The design team recommends an annual conference for presentation of results to peers, with prizes for the best research. The implementing contractor will work with IIAM and USAID to define criteria and to select the recipients of the prizes.

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ANNEXES

Annex A: Transparency and Accountability Activities

Below are listed key activities that promote transparency and accountability. Not all activities will be used for every grant cycle, nor are all possible activities included in the list.

- I. Processes to request applications for grants and evaluation of the applications
 - Prepare the request for grants consistent with research priorities and with easy to follow instructions on how to submit the request.
 - Clear instructions for grant applicants (When practical to administer training for applicants will improve the quality of proposals.)
 - Orientation of the review team to assure consistent application of evaluation factors
 - Disclosed evaluation factors applied consistently by the review team
 - Prompt notification of results to grantees with feedback on reasons for approval or rejection
 - Disclosed processes for grant award and funding, to facilitate planning for project startup
 - Complete and timely reports available on all stages of the grant application and evaluation processes

- II. Processes of grant administration
 - Published grant administration policies and procedures
 - Grantees trained on the periodic reporting system
 - Prompt feedback to grantees on periodic reports
 - Follow up on non reporting
 - Periodic visits by grants administrator(s) to sites of research activities and interaction with members of the research team
 - Immediate follow up and quick resolution of departures from planned activities
 - Short term technical assistance to the grantee as appropriate to overcome unforeseen events that might stop or significantly reduce results from the research.
 - When appropriate develop with the grantee workout plans for under or non performing projects
 - Reallocation of resources from non-performing projects to performing projects
 - Provide summary and detailed periodic reports to funding institutions on the implementation status of the grants.

- III. Performance evaluations
 - Invite or require applicants to propose performance targets in their applications.
 - During the process of negotiating the grant award review and adjust as needed any performance incentive system the applicant has proposed.
 - Review performance as described by the grantee in periodic reports and compare with targets set in the grant agreement. Provide feedback to the grantee on achievements or lack thereof.
 - As appropriate negotiate with the grantee adjustments in the performance targets and recommend adjustments of targets. This step is especially important and sensitive if performance incentives are involved.
 - Conduct technical reviews of research progress or lack of progress as appropriate.
 - Maintain detailed records of the progress by each project in meeting planned targets.

- Provide summary and detailed periodic reports to the funding institutions on the performance of the grantees.

IV. Performance incentives

- Set incentives for reaching performance targets when the accomplishments or output can be reasonably projected and easily measured.
- Invite and train applicants on how to propose reasonable processes and targets that are to be used for awarding performance incentives.
- Assure that incentives for performance are known and applied consistently for all members of the research team.
- Conduct an annual review of performance incentives earned for each grant and for the overall grant program. Prepare reports for the funding agency and summary reports for the grantees.
- Review with each grantee the targets set for the coming year and adjust targets as appropriate.
- Disburse performance incentives promptly.

V. Grant continuation for next period

- Initial grant funding awarded for up to six quarters.
- Immediate review of annual report by grantee, and written confirmation of additional four quarters of funding, or until project is to end.
- Unusual results may require negotiations between grantee and grant manager. Adjustments to the grant agreement or significant adjustments of activities or targets may require approval by a member of the advisory council.

Annex B. Short Answers to Issues to Address in the Report

1. Who are the IIAM scientists and administrators who have experience in developing and monitoring competitive agriculture proposals for research?

Answer

While the term competitive grants is well understood, the implementation experience is limited, especially the monitoring and evaluation components. No evidence surfaced that performance incentives have ever been part of research projects. IIAM's director has expressed his and his team's willingness to learn and adapt the process, recognizing that competitive grants will be the future of agricultural research.

There are two or three persons that have some experience with administering what was called competitive grants program funded by other donors. In addition, funds handling processes such as opening separate bank accounts and reconciling expenditure reports with bank statements is known in IIAM central offices, in Zonal Centers and in Agricultural Stations.

2. What is the capacity of IIAM at headquarters and key zonal centers to implement a competitive grants agriculture research program?

Answer

There is a small, but growing group of young, well-trained scientists with strong, useful linkages to research programs outside Mozambique who are gaining experience in addressing needs in Mozambican agriculture. These young scientists, returning from education and training abroad, need to be encouraged (required) to interact directly with farmers and extension personnel to gain knowledge of the problems, constraints and potentials which need to be addressed in the Mozambican context.

Implementation will benefit greatly from guidance and assistance – which the IIAM director has stated. The willingness and spirit of cooperation is there and with timely and appropriate funding, near-continuous guidance in the early stages, close monitoring, frequent progress reports (monthly financial and probably quarterly progress highlights), the competitive grants program in agriculture should be do-able.

There are key issues that need to be addressed for a competitive grants program to achieve objectives, for example the issue of adequate incentives for researchers. Institutional compensation is low, to the point that skilled individuals are tempted to seek/accept opportunities to increase income, quite possibly compromising time and attention given to the grant. Individuals with valuable research and delivery (extension) skills are in short supply and opportunities will exist for alternative work and compensation. On the other hand, if compensation is extraordinary, it distorts the system and the institutions will have difficulty retaining those individuals who received additional compensation during the course of the grant, potentially resulting in a “brain drain” from the institution and possibly from the country.

It needs to be said and repeated that two-way extension needs to be an important component. Research, by itself, will not deliver the results expected of this effort.

3. How can cross-cutting considerations be incorporated in a competitive agriculture research program, including the involvement of women as participants and beneficiaries of agriculture research activities?

Answer

The cross-cutting considerations need to be spelled out in documents, including RFP, and the proposal selection team will need to evaluate proposals with a check-list of those considerations.

It is highly unlikely, at least from the Mozambican point of view, that women will be overlooked. The participation of women was emphasized at independence and has been a theme since, unlike the colonial period, and will be welcomed by the Mozambicans. When talking to smallholders to get their input, research and extension workers will need to be sure to talk to women. Their questions can be quite different from men.

Transparency and accountability is a cross-cutting issue that will be front and center in the implementation of the Competitive Grants System. In year three there will be an assessment of IIAM's capacity to administer the CGS, of which a significant component of that assessment is the transparency and accountability standards in place.

HIV/AIDS often removes the most important source of labor from rural families. When determining research priorities researchers and extensionists need to be sure to visit with families affected by HIV/AIDS to understand the questions they are asking about agricultural production and marketing.

4. What is the appropriate role of the private sector in supporting a competitive agriculture research program?

Answer

Governmental entities and non-governmental aid entities should be encouraged to incorporate potentially important components in the private sector in joint proposals. Cooperation will achieve positive results unlikely to be achieved, or sustained, by governmental and non-governmental organization (NGO) agencies alone.

These aspects – cooperation and sustainability – need to be emphasized in the competitive grants program documents, including the request for applications (RFA). Cooperation has not been as widespread as would be hoped. “Sustainability” has had a difficult time showing itself given the relatively recent independence, followed by the 16 years of armed insurgency-induced chaos and infrastructure destruction, and slightly more than a decade of recovery, punctuated by drought and flood disasters.

Including the private sector will help assure sustainability, if the technology is appropriate. Private sector companies are less likely to fund research, but they often are willing to fund distribution and farmer education in the use of improved technology. If the investment is large to distribute a new technology and educate the users, private sector companies may ask for limited exclusive rights to reduce the risks of recovering their investment. IIAM may want to develop policies to respond to these requests.

5. What are the critical investments needed in training, infrastructure and grants funding to result in significant adoption of agriculture technologies that increase agricultural productivity and increase rural income?

Answer

The first critical task is to do select research topics that respond to the questions users are asking, or will ask. This requires that researchers and administrators are thoroughly aware of the problems and constraints facing the rural sector.

Careful preparation of the RFA is required to focus the applications on providing answers to the most important questions. Selection and orientation of the application selection committee is also important to be sure the research priorities are known and applied in the selection process.

Once the research is underway supervision is needed to be sure the progress is satisfactory and that answers to the questions are coming.

When the answers are available, the extension specialists, public or private, need to be trained and provided with the necessary materials and equipment to deliver the information to producers.

Most of the infrastructure for research exists, as do trained personnel. Most of the limitations can be overcome with the contemplated grants. Other limitations may be overcome by investments by IIAM or other institutions or companies. If the grant applicant cannot demonstrate how the limitations will be overcome the research should not be funded.

It is clear that a key failure in the current system is an effective transfer of information from the producers to the researcher and from the researcher to the producer. For that reason the CGS requires the extension activities to be part of the research application.

6. What is the potential for leveraging additional funds from donors and other sources?

Answer

There is donor interest in joining the CGS but no promises of funding. It may require a successful first phase of the CGS to solidify interest of other funding institutions. When that interest arises the Advisory Committee will need to be expanded to incorporate representatives from other institutions. The ability of IIAM personnel to assume transparent and accountable administration of the CGS will be a key factor in attracting other funding institutions.

7. How should the program allocate its investments among headquarters and zonal centers?

Answer

In general research at the zonal centers will better reflect the questions asked by users in those zones. Therefore pushing more research funds to the zonal centers will result in more effective use of research resources.

On the other hand only 20 percent of IIAM personnel with MSc and PhD degrees are assigned to the zonal centers. Likewise equipment, laboratories, access to scientific information and other specialists is more limited in the zonal centers. The allocation of research resources will have to balance the desire to work closer to the users with the reality of available resources by location. Moving additional resources to zonal centers will take time.

One additional important item to consider is that coordination and monitoring of the research projects and training of the group that will administer the CGS are especially important activities in the early stages. Those activities will almost certainly be located in the central office.

8. At what stage will IIAM scientists and administrators be able to fully implement a competitive agriculture research grants program?

Answer

The CGS design calls for an assessment of IIAM's capabilities to assume operations of the CGS in the third year of the project. The design team believes IIAM will not be able to fully implement the CGS before that time.

9. How can priorities for research be developed for rapid technology adoption within a 3-year funded program?

Answer

Fortunately, IIAM has anticipated the issue and is well into the process of setting research priorities for the first round of applications. Priority setting should not delay the timetable for implementation of the CGS. IIAM will need to continue updating the priorities, taking special care to incorporate all stakeholders in the.

During the team's field visits several persons claimed that on-shelf technologies not yet implemented exist. If true, we anticipate that one or more grant applicants will identify what are those technologies and propose to distribute them to farmers as part of the grant. Even if on-shelf technologies do not exist, the nature of adaptive research means that limited distribution of the new technologies will be possible in the third year of the project. Also, some applicants will surely propose that the CGS fund research that is already underway, but that need additional resources to complete and distribute to users.

10. How can the competitive grants agriculture research program be effectively linked with the USAID/MSU policy program and other USAID funded activities, initiatives and partners?

Answer

The USAID/MSU program is already affecting the CGS, because the background documentation and the knowledge of Mozambique agriculture by the MSU team members provided much greater clarity of the problems to be resolved within the research grants.

Adoption of some technologies will only occur, or adoption will occur faster if proper policies are in place. For example, a private sector seed company would like to reproduce seed developed by IIAM. To help to recover their costs for multiplying the seed, the company requested for a short period an exclusive license to sell that variety, and after that period anyone could multiply and sell that seed. IIAM did not approve the request, probably delaying introduction to the market of an improved variety. The design team did not follow-up on this issue, but if IIAM or the MADER does not have a policy in place for these situations they may want to define a policy. The issue will come up again within the CGS, as we are encouraging collaboration between private and public institutions.

The economics work MSU is carrying out will provide important data to guide research priority setting. For example, animal traction did not increase in utilization between the two surveys the MSU program supported. Why there was no increase in utilization is not revealed in the survey. But that data may motivate a researcher to propose to the CGS a hypothesis to test that could increase agricultural productivity by expanding animal traction.

Annex C. Draft Statement of Work for Concept Notes

COMPETITIVE GRANTS SYSTEM FOR AGRICULTURAL RESEARCH AND DEVELOPMENT IN MOZAMBIQUE

REQUEST FOR CONCEPT NOTES

A. Context and Purpose of the Competitive Grants System

This request for concept notes is the first step in launching a competitive agricultural research and development system (CGS) for Mozambique. Initial funding for the CGS is provided by United States Agency for International Development (USAID) and supports USAID/Mozambique Strategic Objective 6: Rapid Rural Income Growth Sustained in Target Areas, and the U.S. Presidential Initiative to End Hunger in Africa. The CGS was designed through cooperation between USAID and the Instituto de Investigacao Agronomica de Mozambique (IIAM) with valuable inputs from several national and international public and private sector organizations operating in Mozambique.

The primary goal of the CGS is to foster collaboration between the public and private sectors that will have short to medium term impact at the farm level. The CGS has also been designed to strengthen the country's capacity to implement impact-driven research and development. Applicants should demonstrate: (i) relevance to Mozambique's agricultural research and development priorities; (ii) high quality science and a feasible approach to overcoming an agricultural constraint; (iii) potential impact at the farm level; (iv) strong partnerships with organizations possessing complementary research and development capacities.

Successful applicants will be requested to submit full proposals to the CGS, project support for which will range up to three years. Continuation of the projects will depend on performance and availability of funds from USAID or from donors who may decide to join the initiative.

B. Eligible Applicants

Eligible applicants are any public or private sector institutions engaged in agricultural research, development, and/or extension in Mozambique. A wide range of development partners are eligible to apply including national research institutions, universities, NGOs, international agricultural research centers, private companies, and contractors.

C. Concept Note Format

The concept note should be no more than 3 pages (either single or double spaced), excluding title page and should be in the following format.

1. Title Page containing the following:

- 1.1 Title of the Research Proposal
- 1.2 Submitting (lead) institution
- 1.3 Investigators: Name, title, address, contact information (including email and fax), signatures of lead investigator(s)
- 1.4 Institutional Administrative Officials (if different from investigator): Name, title, full mailing address, signatures

- 1.5 Budget: Total requested funding
- 1.6 Collaborating organizations
2. *Aim and Specific Objectives*
3. *Background and Rationale*
4. *Experimental Design*
5. *Expected outcomes and impact*
6. *Role of each institution in collaboration*
7. *Facilities and Resources*
8. *Proposed budget summary, including line items for salaries and fringe benefits, other direct costs, overhead and total costs.*
9. *Major References*

D. Evaluation of Concept Notes

A review panel will be appointed by the Advisory Committee of the CGS. The panel will comprise no more than five experts drawn from Mozambique and abroad. Collectively, members of the panel will represent a wide array of skills and experience in agricultural product development and delivery. The panel will be constituted to guarantee the integrity and consistency of an open and transparent concept note review process. Their detailed evaluations will be used by the Advisory Committee to select the concept notes that will be developed as full proposals.

Concept notes will be evaluated and ranked according to the four criteria listed below. The total achievable points are 100. The maximum points for each criterion are shown in parentheses.

1. ***Degree to which the concept note addresses Mozambique's priorities for agricultural research and development.*** Focus areas of national importance have been defined by IIAM. These are shown in Annex ____, along with some specific examples of research and development activities that might be conducted in each area. (20 POINTS)
2. ***Quality of science and feasibility of approach.*** The proposed approach and the underlying research design must be of high quality. There should also be appropriate assessment of the effort required to complete the research, including realistic timelines, milestones and a budget. Applicants must show that they and their partners have the experience and qualifications to engage in the type of research and development activities proposed. They must also indicate access to the necessary staff, facilities and other resources needed to accomplish the work envisioned or indicate any additional resources that may be necessary. Limited funding from the CGS may be used to fill gaps in equipment, staffing, or other resources needed to conduct the proposed work. (25 POINTS).
3. ***Potential impact at the farm level.*** Proposals must be focused on delivering impact at the farm level in the short- to medium-term. Examples of such work include, but are not restricted to:
 - Utilization of organic nutrients;
 - Production of appropriate, quality seed, including tissue culture and in vitro propagation;
 - On-farm seed storage;
 - Epidemiology of livestock diseases and access to vaccines;
 - Animal traction;
 - Rapid and efficient diagnoses of crop diseases and pest problems;
 - Post harvest handling and marketing/processing; and
 - Economic returns to producers for selected crops, crop rotations or production practices.

Concept notes should address each link in the product development and delivery chain. Even if it is not feasible to achieve actual delivery within the project timeframe, there must be a clearly articulated vision of how this could be accomplished within an extended period. Prospective grantees must show they are aware of the market and socioeconomic conditions related to the final

utilization of the proposed technology. They must anticipate potential barriers and address them within the context of the research project, e.g., farmer participation in evaluating crop trials, ex ante analysis of beneficiaries. (35 POINTS).

4. ***Breadth and quality of partnerships.*** Few individual organizations can address the full spectrum of agricultural research and development activities needed to achieve impact at the farm level. Therefore, to complement their own areas of expertise, applicants are encouraged to partner with organizations within Mozambique, in other African countries, and around the world. Applicants should demonstrate that each partner has a specific and complementary role(s) in the proposed project. A justifiable distribution of the grant resources as well as effective mechanisms for cooperation should also be shown. (20 POINTS).

Applicants will receive notification of the results of this competition by_____.

E. Submission of Concept Notes

Concept notes (___ copies) should be submitted to.....by2006

Annex D. Draft Statement of Work for Full Proposal

COMPETITIVE GRANTS SYSTEM FOR AGRICULTURAL RESEARCH AND DEVELOPMENT IN MOZAMBIQUE

REQUEST FOR FULL PROPOSALS

A. Context and Purpose of the Competitive Grants System

This request for full proposals is the second step in launching a competitive agricultural research and development system (CGS) for Mozambique. Initial funding for the CGS is provided by United States Agency for International Development (USAID) and supports USAID/Mozambique Strategic Objective 6: Rapid Rural Income Growth Sustained in Target Areas, and the U.S. Presidential Initiative to End Hunger in Africa. The CGS was designed through cooperation between USAID and the Instituto de Investigacao Agronomica de Mozambique (IIAM) with valuable inputs from several national and international public and private sector organizations operating in Mozambique.

The primary goal of the CGS is to foster collaboration between the public and private sectors that will have short to medium term impact at the farm level. The CGS has also been designed to strengthen the country's capacity to implement impact-driven research and development. Applicants should demonstrate: (i) relevance to Mozambique's agricultural research and development priorities; (ii) high quality science and a feasible approach to overcoming an agricultural constraint; (iii) potential impact at the farm level; (iv) strong partnerships with organizations possessing complementary research and development capacities.

B. Operational Status of the Competitive Agricultural Research and Development System (CGS) for Mozambique

In _____, 2006 the competitive agricultural research and development system (CGS) for Mozambique distributed a call for concept notes throughout the country. The deadline for receipt of the notes was _____, 2006. Notes were evaluated by reviewers in the region and abroad. In _____, a review panel selected the notes for development into full proposals. The winning principal investigators have been invited to the CGS workshop on proposal writing to be conducted on ___ at ___. Detailed outlines of full proposals will be drafted by competing teams at the workshop. Within approximately 3 weeks after the workshop (precise date to be determined) full proposals will be prepared and submitted to the CGS.

C. Review Panel

A review panel will be appointed by the Advisory Committee of the CGS. The panel will comprise no more than five Mozambican and foreign experts who will guarantee the integrity and consistency of an open and transparent proposal review process. The review panel will comprise some of the individuals who reviewed the concept notes as well as several others. Collectively, members of the panel will represent a wide array of skills and experience in agricultural research, development and delivery. Their detailed evaluations will be used by the core committee to select the winning proposals contingent on availability of funds. Subsequently, the Advisory Committee of the CGS will review the proposals and the corresponding evaluations and will endorse the winning proposals as appropriate.

D. Eligible Applicants

Eligible applicants are any teams from public or private sector institutions engaged in agricultural research, development, and/or extension in Mozambique and who were successful in the concept note phase of the competition. A wide range of development partners are eligible to apply including national research institutions, universities, NGOs, international agricultural research centers, private companies, and contractors.

E. Requirements for Full Proposals

Full proposals must address, at a minimum, the following:

1. ***Degree to which the concept note addresses Mozambique's priorities for agricultural research and development.*** Focus areas of national importance have been defined by IIAM. These are shown in Annex___, along with some specific examples of research and development activities that might be conducted in each area.
2. ***Quality of science and feasibility of approach.*** The proposed approach and the underlying research design must be of high quality. There should also be appropriate assessment of the effort required to complete the research, including realistic timelines, milestones and a budget. Applicants must show that they and their partners have the experience and qualifications to engage in the type of research and development activities proposed. They must also indicate access to the necessary staff, facilities and other resources needed to accomplish the work envisioned or indicate any additional resources that may be necessary. Limited funding from the CGS may be used to fill gaps in equipment, staffing, or other resources needed to conduct the proposed work.
3. ***Potential impact at the farm level.*** Proposals must be focused on delivering impact at the farm level. Hence, concept notes should address each link in the product development and delivery chain. Even if it is not feasible to achieve actual delivery within the project timeframe, there must be a clearly articulated vision of how this could be accomplished within an extended period. Prospective grantees must show they are aware of the market and socioeconomic conditions related to the final utilization of the proposed technology. They must anticipate potential barriers and address them within the context of the research project, e.g., farmer participation in evaluating crop trials, *ex ante* analysis of beneficiaries.
4. ***Breadth and quality of partnerships.*** Few individual organizations can address the full spectrum of agricultural research and development activities needed to achieve impact at the farm level. Therefore, to complement their own areas of expertise, applicants are encouraged to partner with organizations within Mozambique, in other African countries, and around the world. Applicants should demonstrate that each partner has a specific and complementary role(s) in the proposed project. A justifiable distribution of the grant resources as well as effective mechanisms for cooperation should also be shown.

F. Full Proposal Format

The full proposal should be no more than 30 pages (either single or double spaced), excluding the title page, and should be in the following format.

1, Cover Page with signatures containing the following:

- 1.1 Title of the Research Proposal
- 1.2 Submitting (lead) institution
- 1.3 Investigators: Name, title, address, contact information (including email and fax), signatures of lead investigator(s)
- 1.4 Institutional Administrative Officials (if different from investigator): Name, title, full mailing address, signatures

- 1.5 Budget: Total requested funding
- 1.6 Collaborating countries: All countries involved in the project

2. Project Summary (maximum of one page)

3. Project Description

- 3.1 Introduction.
- 3.2 Objectives and hypothesis
- 3.3 Rationale and Significance
- 3.4 Research update
- 3.5 Experimental plan
- 3.6 Materials and methods
- 3.7 Expected outcomes and impact
- 3.8 Role of each collaborating institution
- 3.9 Timetable
- 3.10 Facilities and equipment
- 3.11 Literature review

4. Budget

5. Budget explanation

6. Current and pending support

7. Curriculum vitae (for each principal investigator)

8. Appendices

G. Evaluation Criteria

Full proposals will be evaluated and ranked according to the following criteria:

1. SCIENTIFIC EXCELLENCE AND TECHNOLOGY TRANSFER CAPACITY (23 POINTS)
 - 1.1. Quality of the proposed research approach and the underlying research design
 - 1.2. Quality of the technology transfer strategy
 - 1.3. Quality of the capacity building strategy
 - 1.4. Demonstrated experience, skills and track record of researchers and other collaborators in the project
2. NATIONAL AND INTERNATIONAL COLLABORATION (21 POINTS)
 - 2.1. Degree to which effective collaboration between research institutions within Mozambique is developed to address the research to development to delivery continuum
 - 2.2. Degree to which the expertise of international partners will be effectively utilized
3. ADHERENCE TO MOZAMBICAN PRIORITIES (20 POINTS)
 - 3.1. Degree to which the proposed research addresses a national priority determined by IIAM

3.2. Degree to which Mozambique can benefit from application of research results within a reasonable timeframe

4. CAPACITY BUILDING (15 POINTS)

4.1. Degree to which resources and opportunities for capacity building are targeted effectively and shared equitably among collaborators

5. TECHNICAL FEASIBILITY AND LIKELIHOOD OF ACHIEVING IMPACT (21 POINTS)

5.1. Likelihood of research success

5.2. Likelihood of generating a product(s)

5.3. Probability of product delivery to end-users

5.4. Availability of resources for the planned research and technology transfer activities

5.5. Appropriate assessment of effort required to complete the research and technology transfer, including realistic timelines and budget

Annex E. Notes From Site Visits

Trip Notes

(Jose Fafetine, Kenneth L. Buhr, Arvin Bunker, Peter Gregory)

Meeting with Technical Director IIAM: Calisto Bias and staff

Date: 30/03/2006

Place: IIAM

- Introduction to the Agricultural Research Institute of Mozambique (IIAM) - current development challenges; vision; mission; objectives; research priorities; institutional priorities at short and medium terms; existing human resources; IIAM structure – by IIAM Director General Calisto Bias.
- IIAM is now being asked to demonstrate impact from its research. The core grant system currently used is not generating sufficient impact. Researchers need to understand the how their research is to be applied, and its impact on users. Within IIAM there is the need to harmonize the priorities of the Ministry of Agriculture, the priorities of IIAM administration and personnel in the central office, and priorities of the zonal centers. An improved dialog is needed.
- Brief explanation of the Consultant Group work was presented.

Meeting with Dr. Tom Walker (Michigan State University), Food Security III Project Country Director and Cynthia Donovan (MSU)

Date: 30 and 31/03/2006

Place: IIAM

- Discussed findings in two Ministry of Agriculture and Rural Development Research Reports:
 - No. 54E, “Gaps and Opportunities for Agricultural Sector Development in Mozambique” by Calisto Bias and Cynthia Donovan, April 2003, 129 pp.
 - No. 57E, “Determinants of Rural Income, Poverty, and Perceived Well-being, In Mozambique, in 2001-2002” by T. Walker, D. Tschirley, J. Low, M. Pequenino Tanque, D. Boughton, E. Payongayong, and M. Weber, May 2004, 69 pp.
- Aspects to take into account for the establishment of Agricultural Research Grant include the limited ability of national institutions to manage research grants, the variety of issues to resolve in the different production zones of Mozambique, limitations on extension services to farmers from compensation levels of extension workers and others. There are about 30 crops with a production value of \$500,000 or greater. There is a lack of resources to conduct research and extension for all.
- Characterization of Mozambican agriculture
 - Nutritional trends for several crops, problems in markets, and in production.
 - Food safety problems
- Agricultural research problems (e.g., compensation levels and consequent divided time commitments of researchers).
- Relation between research and extension is often distant.

Visit to IIAM’s tissue culture lab

- A new, well managed, tissue culture lab has been set up and is conducting excellent preliminary work on *in vitro* production and mass propagation of crops. Pathogen-free plants can be produced in this way and multiplied rapidly. Mass propagation of low disease load *in vitro* planting material will be developed for several commodities including root and tuber crops (cassava, Irish potato, sweetpotato), banana, and some agro-forestry resources;
- Routine virus detection methods will be needed to test the disease status of the cleaned up materials.
- In the longer term, the lab could engage in:

- *Haploid production in plant breeding*. Homozygous lines can be produced in a very short period, and the time needed to develop a new variety is reduced.
- *In vitro* conservation. This facilitates long term maintenance of genetic resources.
- Application of anther culture and embryonic techniques to overcome reproduction barriers;
- Conservation of genetic resources of root and tuber crops;
- Production of secondary metabolites with agricultural and medicinal interests; and
- Fundamental research (mastering the conditions for genetic transformation and regeneration of recalcitrant plants, conservation of embryos, anther culture etc.).

Meeting with Dr. Carlos E. Dominguez O., International Crops Research Institute for the Semi-Arid Tropics – Country representative

Date: 31/03/2006

Place: IIAM

- IIAM should define the programs/priorities;
- Combine research and development/dissemination activities [the challenge if the objective is to reach the ‘family sector’ farmers]
- Research focus in Mozambique should be more on good agricultural practices and less on variety trials;
- ICRISAT’s approach of working with the full spectrum of improved ag practices to markets could be very beneficial to IIAM but there are currently no IIAM counterparts collaborating with ICRISAT – the CGS could catalyze IIAM-ICRISAT collaboration particularly at the zonal stations;

Meeting with Dr. Boaventura Nuvunga, Director Agrarian Services

Date: 31/03/2006

Place: Ministry of Agriculture

- There are research needs in the following areas:
 - Food security is still an issue, drought tolerant varieties are needed, increase of animal protein for human consumption is needed.
 - Plants/crops: pest and diseases; need for more export crops; post-harvest loss problems are large; there are wild plants that have potential for commercialization; there is a growing interest in bio-diesel.
 - Livestock: diseases need greater attention.
 - Continuing needs are better water use, distribution of inputs, establishment of fito-sanitary standards to permit exports.
- How to meet the needs?
 - IIAM, plus consultancies (local and expatriates).
- The problem of incentives (the issue of low compensation)
 - Salary subsidies probably not solution, a better approach would be indirect by providing equipment (motorbikes, bicycles, computers, etc.) and short training.

Meeting with CGIAR Centers representatives (Maria I. Andrade – IITA/CIP, Carlos Dominguez - ICRISAT)

Date: 31/03/2006

Place: IIAM

- Need to set priorities in agricultural research.
- Not too much emphasis on “short term impact” research.
- There is the possibility of having both “short term impact” and “long term impact” research.
- Growing capacity to perform agricultural research but lack of knowledge in certain areas; very limited laboratory capabilities, there is a low motivation for some researchers, there needs to be greater skills in setting research priorities, and improved administrative capacity.
- There exists the possibility of creating a “bonus payment for performance.” There needs to be training on how to select the best research proposals.

Meeting with former students in USA, Eng. Ricardo Maria and Eng. Feliciano Mazuze

Date: 31/03/2006

Place: IIAM

- Current task is to establish a linkage between what was learned in graduate programs in USA and current duties in IIAM.
- Returned students were happy with education/training but gave no suggestions for possible improvements. They were not yet fully and productively engaged. They appear to be good candidates to participate in the competitive grant program.
- Restraints limiting their work after returning include limited laboratory capabilities, lack of basic data on the agricultural situation, low salaries.

Visit the Umbelúzi Research Station (Cecilia Ruth Bila and staff)

Date: 01/04/2006

Place: Umbelúzi Research Station

- Total area: 700 ha; 100 ha with crops research and increase; 600 ha with pasture; only 5 ha irrigated (irrigation equipment is old)
- Facility is not fenced and theft affects up to 80 percent of research plots.
- Labor shortages were cited
- Staff: 1 MSc; 4 BSc; 11 technicians; 8 lower level technicians
- Research on cassava, maize, sweetpotato, groundnut, cowpea, couve, tomato onion and cabbage in crop improvement, pest control and management practices.
 - Policross plots of sweetpotato were observed – objective is to incorporate the high carotene (orange flesh) trait into high-yielding cultivars. Local varieties yield 5 tons/ha in 180 days and one orange-fleshed selection has yield potential of 10 tons in 150 days. One local clone has desired traits, except yield and orange color. They have eight well-adapted clones, but some are not tolerant to low precipitation (i.e., 300 mm). Sweetpotato weevil continues to be serious – no known resistance. Some control can be achieved with proper timing of harvest. Drought increases weevil problem.
 - A breeding nursery of cassava was visited. Serious problem is brown streak virus, affecting the quality of the roots, and reducing the usable portion of the roots. No known resistance, but some tolerance has been noted. In addition to the brown streak virus, mealy bugs, spider mites, high dry matter content, sweetness are selection objectives. They have identified one “bitter” clone with good yield and some tolerance to brown streak virus.
 - Maize research focuses on earliness (short season), flint grain type, downey mildew, lysine and tryptophan content (2x normal for those two amino acids). A popular variety of 10 years has been Matuba, a 95-day open-pollinated variety. They mentioned an interesting phenomenon – the life cycle of Matuba is getting longer, which they attribute to farmers selecting the larger ears for seed and the larger ears are produced on later-maturing plants in the open-pollinated population. (They did not mention, but there probably is another factor contributing to the population maturing later and later, especially in the family sector plots – the early-maturing ears probably get eaten or sold for uses other than seed – resulting in the loss of the genes for earliness.) They have a QPM (quality protein maize) variety, Sassuma, high in lysine and tryptophan, maturing in 110 days.
 - There is increasing demand for hybrid varieties to replace the open-pollinated varieties, especially from the private seed industry. [Although a good idea to encourage seed company involvement, care must be taken to make sure that the hybrid variety tolerates drought stress during pollination as well or better than the open-pollinated varieties. This

can be done, especially if the three-way or double-crosses are used to insure a longer period (via variability for time to flowering) when pollen will be available. If single-crosses are used, greater yield potential is likely, but there is potential for greater risk if flowering is more uniform and occurs over shorter period of time.]

- Source of funds: are IIAM and the Zonal Research Center
- Management of funds: according to government rules (money in the bank; three quotations for purchase; check emission and copy of the check as well of the receipt; bank statement at the end of each month; reconciliation between expenses and bank statement).
- Staff can monitor results, measure results and prepare reports about the results.
- Problems cited: infrastructure; aging and inadequate irrigation system; no fences; theft of crops; communication (no internet access).

Meeting with Jim (Jake) Walter (TECHNOSERVE) and Tim Russell (CARE)

Date: 03/04/2006

Place: Nampula

- Staff
 - CARE: 40 extensionists
 - TECHNOSERVE: 1 agronomist; 3 technicians; 1 cashew expert.
- Two types of crops: for subsistence and for cash income.
- Maize: the biggest crop – used for subsistence and for cash.
- Cash crops: tobacco, cashew, peanut, sesame.
- Problems with the extension services in the province to disseminate technologies [– and to serve as two-way link between the grower and the researcher].
- Good research topic: cashew, however longer term investment in plant breeding research as it takes longer for each generation [five years to fruit]
- Researching Tephrosia [a legume used for soil improvement, see photo elsewhere – may want to attach].
- Working with the neem tree and castor bean as insect repellent [both good candidates for on-farm seed storage, an area needing research].

Meeting with Nampula NGOs (CARE, CLUSA, TECHNOSERVE, Save the Children)

Date: 03/04/2006

Place: Nampula

- Martin Mason of CLUSA gave a PowerPoint presentation, showing a “conservation tillage” technology they are promoting with the associations of farmers they are working with. The “conservation tillage” technology consists of digging a hole several inches deep and incorporating organic materials such as plant residues and covering with soil and planting on top.
- Sesame is becoming more popular: but there is problem of excessive over planting of seed – seed is so small that hand planting results in excessively high plant populations. Producers do not know how or when to thin plants. Flea beetle is a serious pest, resulting in damage to leaves, approaching near-total defoliation in severe cases. Sesame performs well in dry weather, dry zones. Also, the way the current sesame plant matures makes it very difficult to mechanize – making it an appropriate crop for manual labor farmers.
- Japan is a good market for sesame.
- Cashew trees: trees are now getting very old and there has been little incentive to replace old trees with new plantings. Fire is a hazard to cashew tree, as well as diseases. There has been little, if any recent research on cashew trees.

- Peanuts: selected by hand; common problems with aflatoxin. Lab testing for aflatoxin is expensive, only done in labs far removed from production site.
- Suggested topics for peanut research: seed selection and production; proper post-harvest handling.
- Castor bean: potential use for bio-diesel [grows easily, pests and diseases are very rare – note: castor bean leaves are toxic, a factor which could be used in seed storage technologies]
- Soybean: potential for cash crop [later field observation revealed very few nitrogen-fixing nodules on roots, a factor needing further exploration of available information and research – IITA had a soybean breeder and published info on the “promiscuous” bacteria – other than the usual *Rhizobium japonicum*].
- Cassava: coastal areas with more problems [esp. brown streak virus and spider mites – growers do not have as many crop options for the lowland coastal areas].
- Macadamia nut production has generated interest, but there is a longer lag from planting to production – “ten years” was mentioned.
- Priorities in research: sesame, peanut, cassava and sorghum.
- Research can be done in collaboration with IIAM: NGOs could collect data and IIAM process and analyze them.
- The connection between NGOs and IIAM should be improved - after trials data go to IIAM, results are not returned.
- It is important to improve communication between farmers and IIAM – two-way extension is needed.
- NGOs have extensionists but may need more personnel for monitoring and evaluation of impact at the farmer level.
- Inputs needed: laboratories better equipped (the available laboratory is not doing analyses and sending to distant labs and cost is high); results from local laboratories not trusted; better salaries and transport for the government extension services
- Poultry production is important for farmers. USAID is funding a research on feed formulation for poultry with local feeds such as cassava, an excellent carbohydrate source. What is needed is additional sources of economical protein supplements. There are two companies making poultry feed in Nampula. One also slaughters chickens.
- Some farmers are using animal traction for tillage. Custom tillage costs vary from 25 USD/ha for previously tilled land to 100 USD/ha (if plowing a new area).
- Question was raised – can research stations be operated like commercial farm, that is sell the production to generate funds to maintain the station and the workers?

Meeting with Provincial Director of Agriculture (represented by Eng. Agostinho Zacarias)

Date: 03/04/2006

Place: Nampula

- Possible areas of research: (1) pests and diseases, e.g. in cassava and coconuts; (2) agricultural practices to enhance yields (3) community based management of natural resources; (4) animal traction.
- Staff for extension: 118 extensionists (2 with BSc others with diploma and certificate); bicycle used for transport; motorbike only for the supervisor.
- IIAM and DPA should meet more often.
- Problems: transport to maintain the extension network; incentives for the workers.

Meeting with MIRANDA AGRÍCOLA

Date: 03/04/2006

Place: Nampula

- The company is primarily a cashew processor and exporter. It is also involved in seed propagation and research.
- Crops: cashew nut, macadamia (starting), castor bean (on research stage).
- Did research on groundnut (Namitil and JL 24): identification of the seed; size, color, resistance and production. Tests for aflatoxins done in South Africa. Mostly ground nut work was done to provide incentives to growers to intercrop while the cashew trees were coming into production. Seed research has slowed down.
- Castor bean: There is a need to identify the best type of seed, seed management and transformation to obtain oil for exportation.
- Cashew nut: imported new varieties from INCAJÚ but they had diseases.
- Other important crops are maize and beans.

Meeting with ALEXIM LIMITADA (MOÇAMBIQUE)

Date: 03/04/2006

Place: Nampula

- Company is involved in cashew nut commercialization: buy cashew nut from the farmers and sells.
- Plans to strengthen the cashew nut production: plant new trees; if can't process, export as raw.

Meeting with INCAJÚ

Date: 03/04/2006

Place: Nampula

- Nampula produces 70% of the national production of cashew: 64 thousand smalls producers and 50 big producers.
- Supports promotion and commercialization of cashew.
- Promotion: control pest and diseases in small-holder plantings, in the private sector and in farm associations.
- Research: identification of improved clones; selection and multiplication. Finding new pesticides.
- Pest and disease control: supply chemicals to control Oeideum. Pesticides are not sold; only the application is charged.
- Commercialization: monitoring the quantity commercialized and control the amount sold locally or exported.
- Loan system to small industries (established with USAID): TECHNOSERVE identify the equipment needed and INCAJÚ provide the money to the farmers.
- Staff: 96 extensionists in Nampula, of this 30 are involved in the distribution of chemicals.

Visit to a farmers' association with Martin Mason and two EMPRENDIA/CLUSA extension agents

Date :03/04/2006

Location: 50 kms from Nampula

- Greeted by two EMPRENDIA/CLUSA extension agents – a male and female. It was immediately apparent that they were well accepted by the farmers' association group made up of women and men. Although the concept is "cooperative" the term "cooperative" is not used,

even abhorred because that was the term (“cooperativa”) used by the Portuguese to conscript labor during the colonial period.

- The groundnut (peanut) field we entered (first year cropping, following clearing and tillage) showed signs of nitrogen deficiency, which is unusual for a legume crop which typically is well nodulated. Permission was granted to unearth two peanut plants and suspicions were confirmed, there were no nitrogen-fixing nodules on the plants. Questions were asked of the farmers about relative yields and a very revealing statement was made – “second year peanuts, planted in same field used for peanuts the previous year, yielded ‘much more.’” An apparent explanation is the nitrogen-fixing bacteria multiply the first year and are more prevalent the second year, compared to land which had not been cropped to the legume in recent years, and, the high probability that the soil pH is acid, contributing to short survival period of the nitrogen-fixing bacteria.
- Maize plants were examined for nutrient deficiencies and nitrogen deficiency symptoms were observed (foliage was not dark green and bottom leaves – nitrogen is one of the nutrients mobilized out of old tissue into new tissue – displayed the midrib and tip yellowing associated with nitrogen deficiency). Phosphorus deficiencies (purpling along the edges of leaves, usually on leaves of mid-stalk) were observed as well, however not to the extent of the nitrogen deficiencies.
- Cowpeas, by contrast, appeared reasonably healthy, though very few nodules were observed on the root systems and those few that were found did not display the characteristic pink color associated with the presence of leghemoglobin found in healthy, nitrogen-fixing nodules.
- We were shown traditional sorghum, some plants of a new variety of sorghum – “Macia”, and a small parcel of what appeared to be finger millet.
- Witchweed (*Striga asiatica*) was observed on the roots of maize and sorghum. [This is a problem for extension to address in the short term – while the little striga plants are pretty, with their flashy red flowers, growers should be admonished to remove them before they produce seed. Striga seed is small, like kitchen pepper and each plant must produce thousands of seed which will lie dormant in the soil until exudates of desirable hosts stimulate germination.]
- Farmers were asked about certain horticultural crops, especially papaya (which takes little effort or resources to grow), watermelon (which they recognized as having a strong market) and tomato, and the response was “nao temos sementes” (we don’t have seed).
- At the end of the tour and discussions, the visitors were invited to sit at a table in the shade and some thirty to forty folks sang, followed by speeches thanking the visitors for the visit, and the visitors were given two bags of assorted fresh vegetables. This is from a group who were reported to be “cutting up and boiling leather” only a few months ago.

Visit Zonal Research Centre (Centro de investigação e multiplicação de sementes de algodão de Namialo)

Date: 04/04/2006

Place: Nampula - Namialo

- Activities involve crop improvement, protection, agronomy and production systems.
- Some of the on-going trials for crop improvement: sorghum (6 varieties – DLT, GWT, ADIN, UHSN, MLT, HROB); cotton; cowpea (9 varieties); sesame; soybean; peanut, feijão boer (pigeonpea), feijão holoco (bambarra groundnut), and mungbean.
- A young sorghum breeder, recently returned from graduate studies in the US explained the sorghum work. Traditional sorghum varieties are two meters tall and take about 180 days to mature. Improved varieties of dwarf grain sorghum mature in about 90 days, and for that reason

has excited the sorghum team and the workers who come from the farming community. The huge drawback is that the dwarf, early sorghum is extremely susceptible to bird damage. It was explained that the birds can land on the stiff-stalked early grain sorghum and have lunch. The traditional sorghum, on the other hand, is tall and the stem bends under the weight of the bird and the sorghum head and bird sag and the bird does not or cannot remain sitting on the sorghum head – a practical form of morphological resistance. We were told that from the variety trial phase until seed can be made available for farmers can take three years for sorghum. If more resources (primarily irrigation facilities) could be allocated the time could be reduced to 2 years.

- Earliness was cited as desirable – as the hungriest time for the farmer is during the growing season. Any time a crop matures a day earlier, the hunger period is cut shorter by another day.
- The talented young sorghum breeder mentioned that he would like closer contact with growers but for the time-being, for lack of time and resources he was relying upon feedback from his field hands who come from the farming community.
- The question was asked of the sorghum team what the soil pH was and the young breeder said, “the lab reports 6.8, but I don’t believe it.” [Research and extension workers should have access to a portable, durable pH meter that may only offer precision to one or two tenths of a pH, rather than having to rely upon questionable lab pH meters that can give pH readings to the hundredth of a point, when properly calibrated.]
- Examples of agronomy and production systems: planting density trials for peanut and soybean varieties.
- Cowpea and soybean crops were being evaluated for pest incidence.
- Root systems of cowpeas, peanuts, bambarra groundnuts, and mungbeans were examined for nodules. Only cowpeas exhibited some nodules and they were not pink inside, as one would expect for positive signs of nitrogen-fixation.
- Sunnhemp (*Crotalaria spp.*) was observed growing on edges of fields. Sunnhemp has gained recognition for being a candidate for green manure. No further information was gathered.
- Staff: 2 BSc, 1 MSc, 1 MSc student, 2 medium level technicians, 1 basic level technician.

Visit Zonal Research Centre (Centro de investigação de cajú)

Date: 04/04/2006

Place: Nampula

- Cashew multiplication and commercialization. [It should be noted that a weedy alternate host (leafy spurge, a member of the Euphorbiaceae family – the latex plants) for white fly (*Bemisia spp.*) was observed in the transplant bags of young cashew plants. A check of the host confirmed the presence of white fly, suggesting that cashew nurseries may want to fumigate young cashew plants before distribution, and certainly to eliminate the weedy alternate host. Everywhere we went in Mozambique, from the property of IIAM to the zonal centers, white flies were observed on this alternate host, though in low concentrations, fortunately. However, if there is a vector-transmitted virus problem, additional care must be taken to eliminate the alternate host.]
- Cashew improvement; breeding; clone selection; protection; fungicide selection work being done. It is necessary to graft desirable clonal material on to resistant root stock.

Visit Zonal Research Centre (Posto Agronómico de Nampula)

Date: 04/04/2006

Place: Nampula

- Maize: variety trials; seed multiplication (Matuba - the early season variety, Sussuma - the QPM, slightly later variety, Tsangano and Chinaca – the mid-season varieties, all open pollinated) and rice (Nericas).
- Roots and tuber: improvement, breeding clone selection, variety trials, multiplication of cassava and sweetpotato.
- Management and soil fertility: laboratory soil analysis; soil monitoring and management – the laboratory appeared to be becoming useable after a period of disuse.
- Soil laboratory: able to perform pH, P, K, organic matter, Al and H.
- Fitopathology laboratory: isolation of fungi and aflatoxin detection (will start soon).
- Entomology laboratory: identification of pests and parasites; tests for sensitivity to chemicals
- The meteorological station was visited. A very interesting solar intensity instrument was viewed – one that concentrates the solar rays onto a piece of paper, burning a path for those hours when the sunlight is intense..

Visit Provincial Veterinary Laboratory

Date: 04/04/2006

Place: Nampula

- Diagnosis of gastrointestinal parasites; Giemsa stained smears for detection of *Trypanosoma* and some tick born diseases.
- Will be transformed into a regional laboratory.
- Staff: 1 BSc; 2 laboratory technicians.

Visit Dunavant

Date: 05/04/2006

Place: Morrumbala – Zambézia

- Main crop: cotton.
- Other crops: cowpea, peanut, sunflower and maize, which the Dunavant folks know are important to their farmers..
- Involved in research, extension and commercialization activities.
- Research activities on cotton in order to find better varieties (looking to some aspects like maturity and uniformity).
- Use a concession (area given by the government) for research and extension activities.
- The company get the seeds, distribute to the farmers and those have to sell the cotton only to Dunavant.
- The company started in 1996 working with 822 farmers; currently work with 30 thousands farmers.
- The seed is given free to the farmers; usually the farmers get 40 to 50 Kg of seed.
- Pesticide is sold in a credit basis at the price of 450 thousands (one kit contains 3 pesticides and can be used for 5 applications, the recommended number for cotton).
- The input to the farmers is 0.5 million Meticaís per year; the company expects to get at least 85% of recovery.
- Around 28 thousand hectares are cultivated annually.
- Using inputs the yield can be 500 to 600 Kg/ha up to 1000 Kg/ha. If the area is up to 2 ha there is no need for extra labour.
- Animal traction is not used, yet.
- The minimum price of cotton is set by the government; this season the price is 5 thousands Meticaís and the company will buy at the price of 5.5 thousands Meticaís.

- Constraints: to get new varieties to be tested; no research on cultivation practices; Cotton Institute has not been importing new varieties of cotton for last 10-15 years.
- There is research going on to find new varieties. Important characteristics: good yield (at least 1500 kg/ha), drought tolerance, and staple length.
- The company has got good relation with other institutions like IIAM and the Eduardo Mondlane University (UEM): now a researcher from IIAM is doing an internship at Dunavant; several students from UEM do their thesis work at the company.
- Extension: done in 5 surrounding regions each with a BSc; within each region of influence they work with a chief extension officer (21 in total); the chief officer has got assistants (total 5), 70 facilitators and 750 farmers. [The extension program and its pyramid structure of DUNAVANT appears to be a very successful model. Anyone wanting to improve agricultural extension in Mozambique should get a firsthand, close-up look at the DUNAVANT model.]
- The facilitators (leader farmers) are not paid but get a commission of 50 Meticaís/Kg sold.
- Training is offered pre planting; pre treatment; pre harvesting and pre marketing.
- Other crops: demonstration plots with maize and cowpea. Maize (variety Sussuma) cultivated with cowpea (7 ha).
- They have a small pigeonpea breeding effort started.
- Breeding of sunflower (at the faculty of agronomy, UEM) and production of seed in the company.
- Research needed: applied (adapted) research; proper density and spacing.

Visit Associação dos Heróis Moçambicanos with Tom Gardiner

Date: 05/04/2006

Place: Manica

- The Association of farmers has got 80 ha; a dam and a building a water storage tank.
- Each of the 15 farmers has got individual plot.
- Crops: tomato, sweet pepper, onion, cucumber, eggplant.
- They have established a contract with SHOPRITE and seven fixed buyers from Beira.
- The clients contact them by cell phone. The selling price is determined by the market price.
- Cucumber is sold with higher prices compared to others.
- This year has been a good rain year.
- When good yield is achieved the savings are used to buy animals (cattle, goats and chicken) and some times to put the money in the bank.
- There is no water pump; only 3 ha are irrigated and the farmers have to carry the water by hand.
- There are diseases e.g. in tomato. ACIDI/VOCA helps them in solving some of the problems.

Visit: Instituto Superior Politécnico de Manica

Date: 06/04/2006

Place: Manica

- This is a new technical school for agriculture business. They have about 60 students, 8 teachers and 4 administrators. They expect to have 250 students in five years. It will have three degrees: certificate (after 2 years); “bacharelato” (after 3 years) and “licenciatura” (after 4 years).
- With their training they also have a business incubator to help students learn agro-business. Only one course is underway, that is Agribusiness. Thirty percent of a student’s time is in practical applications of what they learn.

- Research topics to be addressed: adaptive research on vegetables; food processing (tomato and fruits).

Visit: Instituto Agrário de Chimoio (IAC)

Date: 06/04/2006

Place: Manica

- IAC offers three, three-year courses: forestry, wildlife management and agriculture and animal husbandry to approximately 300 students.
- Staff: around 30 teachers.
- The institute has demonstration plots with tobacco, maize, and sunflower without irrigation and vegetables, with irrigation.
- There is no research activity.
- Possible research topics: crop protection; improved varieties; use of modern techniques.
- Research needs are crop protection, improved varieties, land management and crop rotation, improved varieties of seeds, and how to improve extension to smallholders.

Visit ACDI/VOCA and AFRICARE with Tom Gardiner and the Africare Rep.

Date: 06/04/2006

Place: Manica

AFRICARE

- Financed by USAID. Works only in Manica in 4 districts (Gondola, Sussundenga, Manica and Bárue).
- Africare does extension work and some research. They have demonstration plots and promote orange flesh sweetpotato. They do seed selection trials for maize. They provide seeds to farmers for soybeans, sesame and sunflower (seed available from earlier project). Sunflower: the idea is to produce and process for vegetable oil.
- Africare has a machine to process soy milk, which they believe delays onset of HIV/AIDS. One machine was imported from Canada to produce milk. Not sufficient soybeans to fully occupy the machine.
- Africare is helping to obtain a loan from Opportunity Bank. Not yet successful.
- Africare works in four districts, serving 12,000 farmers. They work with associations of farmers, each with about 20 farmers. They have 9 extension agents that each supervise 12 leaders that each work with about 8 groups of farmers with about 20 farmers per group. This structure works but is relatively costly and probably not sustainable.
- They are looking at banana production.
- Research activities: maize variety trials with 12 entries. Pest resistance, taste and yield are factors evaluated on farm.
- There are few sorghum producers in the region.

ACDI/VOCA

- Financed by USAID. Works in Manica in the same districts as AFRICARE except Bárue. Now starting in Nhamatanda (Sofala province).
- Crops worked with in Manica include soybean, sesame.
- ACDI/VOCA works with groups of farmers to increase their income, and to assist with marketing of their crops.
- Soybeans: They are supporting about 364 growers. Yields are very low, about 0.3 MT per hectare, could reach 0.7 MT per hectare (about 10 bushels per acre, compared to US yields of

50 bushels per acre). Need new varieties. Spraying is not feasible. There is a manufacturer of feed for chickens in Dondo. Cultivated 600 ha in Nhamatanda. TECHNOSERVE has started a poultry initiative using soybean.

- Sesame is a good crop this year, with good prices. They are supporting about 700 growers with a total of about 600 acres. Yields for a good producer average about 700 Kg per hectare, for less skilled producers about 350 Kg per hectare. They are working on best cultural practices for growing sesame.
- Horticulture crops: They keep weekly price data on seven markets including Beira, Chimoio and Manica. They now can do some price trends. Research is needed on diseases.
- They are experimenting with banana, which is sold in Beira and some markets of Tete and Maputo..
- Financing is a problem. The banks do not want to finance growers individually, but the grower association is not legally constituted yet, so the bank will not lend.
- Problems with livestock production: farmers do not want to pay for vaccines and medications. Use of deep dip tanks would reduce the drug costs. Animal traction should be introduced. Promote training for the veterinary assistants in the treatment of internal and external parasites.
- Chimio is a good area for fruit trees. They need grafted tree stocks.
- Research topics to be addressed: agricultural practices (what is the best cultivation method sole-cropping or intercropping); pest and disease control.
- ACDI/VOCA uses a layered extension system similar to Africare.
- ACDI/VOCA has done little work with IIAM, more with ICRISAT.

Visit ADIPSA (Apoio ao desenvolvimento de iniciativas privadas do sector agrário)

Date: 06/04/2006

Place: Manica

- ADIPSA is supported by DANIDA, the Danish aid agency. DANIDA supports agriculture in three areas: rural network; direct support to PROAGRI and ADIPSA.
- ADIPSA works with agri-business, with small and intermediate clients. The ADIPSA's first phase ended in 2005. Phase 3 areas of activity include: (1) support the organization of small and medium farmers; capacity building; (2) agri-business; (3) rural finance in credit scheme (through the GAPI). Areas which were not covered included infrastructure development; research development and trade fair support.
- ADIPSA is involved in feasibility studies - helping farmers to get information on crops and markets. There is very little information about the private sector agro-businesses.
- ADIPSA does not get involved in agricultural production research.
- ADIPSA works with some large companies, e.g. the paprika company.
- The demand for support from ADIPSA usually comes from the beneficiaries.
- Constraints: need to increase production of maize. Low productivity is due to a variety of factors: inappropriate varieties; low soil fertility; lack of inputs – esp. fertilizer and pesticides; shortage of equipment; inefficient agricultural practices; only one maize processing facility in Manica and only one company commercializing maize in the province; there is 1 poultry producer.
- Research topics: maize and cash crops such as jatropha, whose common name is “physic nut” (*Jatropha curcas* L.⁹), macadamia and vanilla. Also, need to intensify beef production.

⁹ The jatropha crop apparently has a couple of important insect pests: *Pachycoris klugii*, Burmeister, and *Leptoglossus zonatus*, pests which damage the fruit of this euphorbiacea plant. The consultants did not see this plant or the pests to verify.

- There needs to be a central repository of information on crop production and on markets.

Visit with Bernard and Brenda Van Dyk

Date:06/04/2006

Place: Chimoio, Qualita Seed

Involved in seed sales, especially maize and vegetable seeds. Works with the maize program team at Sussundenga to get quality seed of appropriate varieties of maize, and buys vegetable seed in bulk from South Africa and packages and markets to growers.

- Believes that farmers have money to purchase seed, citing several instances when farmers purchased all of the seed he had for sale in a fraction of a day. Believes the market is there.
- Wants to market vaccines and small packages of fertilizer.
- Frustrated by lack of credit to expand their operation, lack of seed-cleaning equipment that another entity in Chimoio has been given but does not use. Sufficiently frustrated by inability to get credit that is considering pulling out of Mozambique and moving to Uganda where credit is easier to obtain.
- Believes that there are excessively high levels of manganese in soil, cites soil lab analyses indicating Mn levels ten times “normal.”
- Reports soil pHs in region to be in range of 4.7, which is more than 100 times more acid than a neutral soil with pH of 7.0.
- Appears to be a relatively successful example of what is needed to help the family sector – an aggressive entrepreneur.

Meeting with His Excellence Minister of Science and Technology

Date: 10/04/2006

Place: Maputo

- Ministry of Science and Technology (MCT) is a managing and policy making unit not a research unit. The different research institutes are under the various ministries to which they belong, but MCT coordinates the research.
- Need to think on the added value of the cooperation (money/support/projects) in Mozambique. The research environment is still weak. It is difficult to perform research with impact, but that is what is needed.
- Strategic areas of research: (1) agriculture – increase production of food and livestock; agro processing – machinery to process products and places to conserve products; (2) water management; (3) natural resources e.g. use of medicinal plants; (4) energy, e.g. use of Jatropha; (5) biotechnology. Mozambique needs meat processors (don't have now), more commercial grain storage silos.
- In research institutes of the country there are around 460 researchers: 30 PhD; 156 MSc and 274 BSc.
- Needs for capacity building: development of human resources; massive program of education.
- Needs to promote innovation: special program for innovation.
- The government will create “incubator” programs.
- Need to improve the linkage with the private sector.
- Establish frontier research: contacts with reference laboratories to do high-end research.
- The research is fragmented: no contact between scientists.
- Better coordination with donor supporting research is needed. Which research to do should be determined in the following order: determine the broad research lines, and under the research lines determine the programs, and then define the specific research projects. An annual

conference will be held in late April for improving research coordination. Conference should be repeated annually.

- Needed better coordination among donor agencies and between the donor agencies and the government.
- Financing: creation of the National research Fund – for this year 500 thousand US\$ already exists other 500 thousand US\$ from Denmark. The national research Fund will finance: (1) competitive grants (2) areas of innovation (3) for specific studies done by certain centers of excellence. The money will be allocated to each of these categories with the competitive grants receiving major part of the funds.
- There is an on-going process to create Regional Centre of Science and Technology with the objective of stimulating development of research. They will be located in south (Gaza), centre (Tete) and north (Nampula).
- Documents/rules/regulations: policy for science and technology; statute of the researcher (to be submitted to the Council of Ministries for approval).
- No problems if the agricultural research grant be managed by IIAM. Ways of coordination have to be established between IIAM and MCT.
- Incentives: MCT has proposed increasing salaries of researchers by 40%. This would make their salaries closer to those of University Professors. The proposal to be presented to the Council of Ministers very soon, and hopes to be approved this year to begin application on 1 January 2007. Also researchers can receive incentives for innovations, for discoveries and inventions, and for bringing research contracts. According to the Minister the latter, bringing contracts, would appear to be applicable to the CGS concept of paying performance incentives within the research grants. These extra incentives should go part to the institution and part to the research team.
- Paying incentives can create problems with the staff, need to carefully manage. Research needs teamwork, and careful management of funds.

Meeting with PROAGRI coordinator

Date: 10/04/2006

Place: Maputo

- PROAGRI started in 1999 with the general goal of managing the use of funds.
- Research: reformulation of research – creation of IIAM as result of fusion of 4 institutes (INIA, INIVE, IPA, CEF).
- One component of PROAGRI was funding research through competitive grants first funded by IFAD and DANIDA. The grant had two goals: capacity building and research. Trying to do both at same time did not work well.
- Two sets of the project: (1) in 1998 only IFAD: 2 MSc and 1 PhD. Difficult to measure the impact at farm level; (2) co-funded by DANIDA with duration of 1.5 year: funding research through PROAGRI.
- Capacity building: training of the staff, e.g. 10 MSc in Denmark.
- Research: evaluation of the grant program by DANIDA and IFAD concluded that the weakest point was monitoring the funds and evaluation. It is difficult to establish farm level impacts of the funded research.
- IFAD has helped in establishing a tool for monitoring and evaluation.
- Research should be more linked to the farmers.
- Improve the linkage between extension and research.

- What are the priorities in future projects: involve more the research institutions in the local level; appropriate involvement of the beneficiaries; research based on priorities (at the end of April the priorities for the MADER will be established, which will guide actions at PROAGRI); financial resources for research have to be on time; disbursement of funds must be quick. Lack of government funding early in the fiscal year prevented timely disbursement of funds to researchers.

Meeting with His Excellence Minister of Agriculture

Date: 10/04/2006

Place: Maputo

- The Competitive Research Grant for Agriculture will play an important role in finding technical solutions with impact in agriculture.
- The country defies the researchers to do projects with short term impact and applied research to reduce poverty.
- Agriculture has to be seen as a whole: crops and livestock.
- Look to improve the research link to extension, including feedback from farmers.
- Efforts of the researchers must have immediate application.
- Staff development to go beyond applied research, with some highly skilled people doing more basic research.
- Need to strengthen Zonal Centers, capacity building there by bringing scientists to Mozambique to work with local scientists, and to provide more training programs.
- Research priorities are:
 - Food security, including maize, sorghum, potatoes, sweetpotatoes, cassava, rice.
 - Need to improve animal production, especially small animals as goats, sheep, poultry (especially with bird flu on the horizon).
 - Need to develop agroforestry.
- Role of the ministry: influence the setting of priorities and IIAM take the priorities and work with them. Setting research priorities: first draft will be ready before June. (Later it was explained to the team that the priority setting by MADER is agriculture sector activities, not specifically for research.
- Extension and research: needed better linkage between the Zonal Centers and farmers; researchers have to go to the demonstration plots and work with the extensionists. The new Directors of the Zonal centers have the mandate to improve the linkage between extension and research.
- Extension must be coordinated between all the institutions: government, NGOs and private sector. Extensionists can be assigned to work on research projects. Incentives to the extensionists for outstanding performance could be included. Mixing public and private moneys into an extensionists wages would not be acceptable. The private companies can help the extensionists to solve some of the problems of the nation in providing means for extension.

Meeting with PROAGRI Working Group

Date: 10/04/2006

Place: Maputo

- Selection of Zonal Center Directors
- Explanation on the activities of the selection jury
- World Bank has given 1 million USD for the rehabilitation of the Zonal Centers. Sweden will probably also give 750 thousand USD.

- Collaboration with ISNAR (International Service for Natural Agricultural Research): training in leadership; modules for training of trainers in research participatory and dissemination of technologies; identification of success cases; develop the strategic plan.
- Report of the visit held by ILRI's Director General.
- Brief description of the agricultural research grant.

Meeting with NGOs (TECHNOSERVE, CARE, World Vision)

Date: 10/04/2006

Place: Maputo

- Brief description of the competitive grant proposal.
- IIAM has potential to do research.
- World Vision works with IIAM as extension agency: IIAM does the research and World Vision does the extension.
- CARE: works in testing different varieties of maize and "on farm research".
- CARE has 60 extension agents. That level is not sustainable with available funds. CARE is looking to use groups of farmers to complement extension work, and reduce the number of extension agents. An alternative is to strengthen the public sector extension service.
- Livestock is seen has having bigger risk. Animal traction is useful to increase crop production.
- Limited link between farmers and researchers: usually the farmers do not influence research topics. Currently, the participatory methods being implemented now help to improve the link between farmers and researchers, especially 2-way communication.
- Training for extension agents is limited. There is an initial training, but ongoing training is limited or does not occur.

Visit Directorate of Animal Science

Date: 11/04/2006

Place: Maputo

- Current activities of the Directorate of Animal Sciences (DAS): research on animal diseases including zoonoses; research on animal production; quality control and food hygiene; production of biologicals; quality control of biological and pharmaceuticals; training of basic and medium level laboratory technicians.
- Challenges: implementation of quality assurance; improvement of diagnostic tests; recruitment of qualified staff; staff training; training on laboratory data base management system and staff training on maintenance and repair of equipment. Laboratory equipment comes often by donation from various countries, France, Italy, US, South Africa. When the time comes for calibration or repair it is very expensive. Some equipment is not calibrated for several years and may give erroneous results. A truck from S. Africa can come with calibration equipment, but costs \$US500 per day, to expensive.
- Lack of competent qualified staff in the field and in the laboratories.
- Users contact the laboratories to send samples: private sector, farmers, enterprises.
- Work with farmers e.g. for artificial insemination.
- Extension services responsible to make the link with the farmers.
- Examples of interventions in the field: 2 MSc students worked in Manica in poultry management; vaccine I2 for Newcastle tested in 4 provinces.
- Distribution of the biological products mainly by governmental agencies and private entities who go to the DAS to buy the products.
- Private entities not involved in commercialization because there is no market.

- ILRI will assist IIAM to re-introduce animal traction.
- Other important issues: zoonoses; improve food conservation for animals; characterization of local breeds; professional training; maintenance and repair of equipment; communication between institutes.

Visit Agronomy Faculty Eduardo Mondlane University

Date: 11/04/2006

Place: Maputo

- Explanation of the competitive grant proposal.
- Need for a sustainable use of the forestry was discussed.
- Small linkage between extension and research; problems with technology dissemination.
- With the use of participatory methods things are changing.
- The faculty trains BSc as well as MSc.
- Knowledge of different plant diseases in tomato, coconut, maize. Need to introduce resistant varieties.
- Incentives are important for the implementation of research activities.

Meeting with IIAM Director General

Date: 11/04/2006

Place: Maputo

- Discussion on how the competitive grant proposal will work. Aspects covered: administration of the funds, management of the fund; review committee; advisory body; executive committee; selection criteria.

Meeting with the Extension Services Ministry of Agriculture

Date: 11/04/2006

Place: Maputo

- Mozambique has 128 districts; the extension services covers only 52 districts.
- There are about 600 extensionists in the country. The extension network is composed by the following levels: provincial head of extension services; district team supervision; extensionists. Each extensionist works with 10 to 12 groups of farmers (each composed by 15 to 20 farmers).
- Training for extensionists: pre-admission training in extension methodology and on specific methodologies.
- Annually the extensionists have in-service training.
- The supervisor has a motorbike and the extensionists use bicycles.
- Financial resources are inadequate to cover the whole country.
- Problems with the disbursement of funds; funds are not there when needed.
- Communication problems may also occur if the extensionist does not talk the local language – it is not clear how many languages/dialects are spoken in Mozambique, probably more than two dozen. It may be difficult for some Mozambicans to speak to others. Often, translations are needed for communications between different groups. If the extensionist learns the local language his/her acceptance into the community is improved and the effectiveness of training enhanced.
- Technologies given to the extensionists to be transmitted to the farmers sometimes often do not answer the questions farmers are asking. Also the technologies are often not sufficiently detailed, or do not consider many common problems of producers.

- Transfer of technologies from other countries which are not adapted or appropriate to our country, e.g. FFS (farm feeding school) imported from Asia.
- Problems with the distribution of inputs and commercialization.
- Poor pay leads to low motivation of the staff. Incentives are needed to motivate the staff.
- Need for applied research to help the farmers. Need to include post-harvest processing and commercialization. Growers are increasingly asking questions about cash crops such as cotton, paprika, tobacco, sunflower, fruits. These crops have ready cash markets for the farmers production.
- Animal traction can improve the land plowing.
- The competitive research grant proposal would help to cover new geographical areas; would also allow extensionists to work in areas important for the communities but which are not priority for the government.
- Maize production could increase to 2-3 MT per hectare with the proper technology applied.

End of Trip Notes.

Annex F. Contacts by the Research Team

List of Persons Contacted

In USAID/Washington

NAME	INSTITUTION/POSITION	CONTACT
David A. O'Brian, PhD Manager	Manager Research Programs, USAID/EGAT	dobrien@usaid.gov 202 216 0465
Adam Reinhart	AAAS Diplomacy Fellow, MERC & CDR Programs, USAID	areinhart@usaid.gov 202 712 5365
Caroline Gerwe	AAAS Diplomacy Fellow, MERC & CDR Programs, USAID	cgenwe@usaid.gov 202 712 1581
Robert Bertram	Team Leader Int'l. Research & Biotechnology, USAID/EGAT/ESP/IRB	rbertram@usaid.gov 202 712 5064
Larry R. Beach	Biotechnology Advisor, Africa USAID/EGAT/ESP/IRB	lbeach@usaid.gov 202 712 4049
Eric P. Witte, Food Security Advisor	Int'l Research and Biotechnology Team, Office of Environment and Science Policy	ewitte@usaid.gov 202 712 1906
Felipe P. Manteiga	Senior Director of Agricultural Programs, Millennium Challenge Corporation	manteigaFP@mcc.gov 202 521 3673
Tim Grosser	Agricultural Development Specialist	grossert@mcc.gov 202 521 3698
Stephanie Roueche	Program Officer, Agricultural Programs, Millennium Challenge Corporation	rouecheS@mcc.gov 202 521 3697

In Mozambique

Date: 30/3/2006 10.30 h - IIAM

NAME	INSTITUTION/POSITION	CONTACT
Calisto Bias	IIAM Director General	Calisto_bvias@hotmail.com +258 823281800
Sancho Cumbe	IIAM Technical Director- Agronomy and natural Resources	+258 829800720
Rosa Costa	IIAM Technical Director- Animal Science	+258 823069420
Alsácia Atanásio	IIAM Technical and Cooperation Adviser	Alsacio63@yahoo.com +258 825117712
Paula Pimentel	IIAM technical Director- Training and Technology Transfer	+258 823087520
Irene de Souza	USAID, Agricultural Activities Manager	+258 21352059 isouza@usaid.gov

Date: 31/3/2006 9.00 h - IIAM

NAME	INSTITUTION/POSITION	CONTACT
Tom Walker	Food Security III project Country Director	walkerts@teledata.mz +258 823173450
Cynthia Donovan	Asst. Professor International Development,	donovan@msu.edu

	Michigan State University	517 432 5181
--	---------------------------	--------------

Date: 31/3/2006 10.00 h - IIAM

NAME	INSTITUTION/POSITION	CONTACT
Carlos E. Dominguez O.	International Crops Research Institute for the Semi-Arid Tropics – Country representative	c.dominguez@cgiar.org icrisatmoz@panintra.com

Date: 31/3/2006 12.00 h – Ministry of Agriculture

NAME	INSTITUTION/POSITION	CONTACT
Boaventura Nuvunga	Director of Agrarian Services	bnuvunga@map.gov.mz +258 21460195

Date: 31/3/2006 14.15 h - IIAM

NAME	INSTITUTION/POSITION	CONTACT
Carlos E. Dominguez O.	International Crops Research Institute for the Semi-Arid Tropics	c.dominguez@cgiar.org icrisatmoz@panintra.com
Maria Isabel Andrade	IITA/CIP	mandrade@cgiar.org
John Casey	ICRAF Country Representative	j.casey@cgiar.org j.casey@intra.co.mz +258 21461775 +258 823000496
Francisco Jr. Matuca	World Vision	francisco_matuca@wvi.org

Date: 31/3/2006 15.20 h - IIAM

NAME	INSTITUTION/POSITION	CONTACT
Feliciano M. Mazuze	IIAM Socio-economics Units Head	mazuzeefe@msu.edu +258 823253420
Ricardo Maria	IIAM Soil fertility	rmaria@hawaii.edu

Date: 01/04/2006 8.30 h - Umbelúzi

NAME	INSTITUTION/POSITION	CONTACT
Cecília Ruth	IIAM – Estação Agrária do Umbeluzi (EAU)	+258 820799660
Sancho Cumbe	IIAM Technical Director- Agronomy and natural Resources	+258 829800720
Maria Isabel Andrade	IITA/CIP	mandrade@cgiar.org
Abdul Naico	IITA/CIP/IIAM	a.naico@intra.co.mz
José Ricardo	IITA/CIP/IIAM	j.ricardo@intra.co.mz
Mário Ferrão	IIAM – EAU	+258 82 3807499
Fernando G. J. Bié	IIAM – EAU	+258 820160380
Amâncio Mutemba	IIAM – EAU	+258 829529890
Emília Huô	IIAM – EAU	+258 827788520
Timóteo Pechisso	IIAM – EAU	+258 822197270
Constantino Tomás Senete	IIAM – EAU	Senetec2003@yahoo.com.br

Date: 03/04/2006 7.15 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Jake Walter	Technoserve	jake.walter@tvcabo.co.mz
Tim Russel	CARE	tim@carenl.org.mz
Fernando Chitio	IIAM	fernando_chitio@hotmail.com

Date: 03/04/2006 9.00 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Martin Mason	Emprenda/Clusa	memhort@aol.com +258 825178017
Stephen Gudz	Consultant	stephen@teledata.mz
Richard Dixon	Save the Children	rdixon@teledata.mz
Sérgio Ussaca	Clusa	sussaca@hotmail.com
Abdul Haje António	Care	age@carenl.org.mz
Shakti Pal	Technoserve	muskaandal@bytessystem-mz.com
Fernando Chitio	IIAM	fernando_chitio@hotmail.com

Date: 03/04/2006 14.00 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Agostinho Zacarias	Direcção Provincial de Pecuária	azacarias@teledata.mz
Fernando Chitio	IIAM	fernando_chitio@hotmail.com

Date: 03/04/2006 15.30 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Fernando Carvalheira	Miranda Agrícola, Lda	+258 2 6 218 217 miagril@teledata.mz
António Miranda	Miranda Agrícola	+258 8 2 60 94 660 mirandacaju@teledata.mz

Date: 03/04/2006 16.00 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Ali Cherif Deroua	Alexim Limitada (Moçambique)	alexim@mail.com +258 826012620

Date: 03/04/2006 16.30 h – Nampula

NAME	INSTITUTION/POSITION	CONTACT
Eugénio Amós	Incajú	+258 826673720 +258 26214462
Eng. Filomena Maiopue	Delegada Regional Norte, Incaju	incajuno@teledata.mz +258 2 6 216 338

Date: 04/4/2006 9.00 h – Namialo - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Joaquim Mutaliano	IIAM – Northeast Zonal Research Centre, Namialo	jmutualino@hotmail.com +258 824005333
Domingos Jocene	IIAM – Northeast Zonal	jocene_domingos@yahoo.com

	Research Centre, Namialo	br
Pedro V. Rodrigues	IIAM – Northeast Zonal Research Centre	+258 827995570

Date: 04/04/2006 11.00 h – Nassuruma- Nampula

NAME	INSTITUTION/POSITION	CONTACT
Pedro Victor Rodrigues	IIAM – Northeast Zonal Research Centre, Nassuruma	+258 82799557
Monassis Carlos	IIAM – Northeast Zonal Research Centre, Nassuruma	

Date: 04/04/2006 13.30 h- Nampula

NAME	INSTITUTION/POSITION	CONTACT
Idalina Celestino Napita	IIAM Zonal Research Centre Posto Agronómico de Nampula	+258 820251350
Orlando Atija Táxi	IIAM Zonal Research Centre Posto Agronómico de Nampula	+258 26240070
Jaime Baltazar Ali	IIAM Zonal Research Centre Posto Agronómico de Nampula	
Uatemua Anly Cássimo	IIAM Zonal Research Centre Posto Agronómico de Nampula	+258 842473180
Adelino Afonso Manuel	IIAM Zonal Research Centre Posto Agronómico de Nampula	
Faruk Ragú	IIAM Zonal Research Centre Posto Agronómico de Nampula	
Venâncio Alexandre Salegua	IIAM Zonal Research Centre Posto Agronómico de Nampula	+258 823634110

Date: 04/04/2006 16.30 h - Nampula

NAME	INSTITUTION/POSITION	CONTACT
Aurora Bernardete Paulo	DPA- Veterinary Laboratory	+258 826844570 +258 26213891
Terezinha Atanásio	DPA –Veterinary Laboratory	+258 2621381
Eugénia B. Tapalapa	DPA- Veterinary Laboratory	+258 2621381

Date: 05/04/2006 9.30 h – Morrumbala, Zambézia

NAME	INSTITUTION/POSITION	CONTACT
Marcos Freire	Dunavant- Delegate Morrumbala	Marcosfreire60@gmail.com +258 82 3038800
Luis Pereira	Dunavant – Managing Director	lpereira@dunavant.co.mz dunavantmoz@dunavant.co.mz +258 82 5094920

Date: 05/04/2006 16.15 h - Manica

NAME	INSTITUTION/POSITION	CONTACT
15 farmers	Associação dos Heróis Moçambicanos	

Rodrigues João Mambonhe	Zonal Centre Coodenator	+258 824844990
Tom Gardiner	ACDI/VOCA	+258 825558010
Ofélio Chuva	ACDI/VOCA	+258 822514330

Date: 06/04/2006 9.00 h - Manica

NAME	INSTITUTION/POSITION	CONTACT
Henrique Bettencourt	ADIPSA – Apoio ao Desenvolvimento de Iniciativas Privadas do Sector Agrário	hbettencourt@adipsamanica.org

Date: 06/04/2006 9.00 h – Manica, Sussundenga

NAME	INSTITUTION/POSITION	CONTACT
Flemming Nielsen	IIAM Zonal Research Centre	fnielsen@pobox.com +258 827153160
José Manuel Saúte	IIAM Zonal Research Centre	+258 824079400
Manuel Armindo Temo	IIAM Zonal research Centre	+258 825179965
Pedro Silvestre Chauque	IIAM Zonal Research Centre	+258 827267680
David Mariote	IIAM Zonal research Centre	+258 821327270
Rodrigues Mambonhe	IIAM Zonal Research Centre	+258 824844990
Abílio Antunes	Poultry farmer	
Elizabeth	Veterinary Laboratory	
Carlos Quembo	Veterinary Laboratory	
Bernhard & Brenda Van ...	QUALITA	

Date: 06/04/2006 10.50 h - Manica

NAME	INSTITUTION/POSITION	CONTACT
Antonius J.H. Rulkens	Instituto Superior Politécnico de Manica	ajhrulkens@yahoo.com ispmanica@yahoo.com
João Luis Ferrão	Instituto Superior Politécnico de Manica	pecuaria@teledata.mz ispmanica@yahoo.com
Dário H. T. Jane	Instituto Superior Politécnico de Manica	ispmanica@yahoo.com

Date: 06/04/2006 14.00 h - Manica

NAME	INSTITUTION/POSITION	CONTACT
José Tuia	Director – Instituto Agrário de Chimoio	+258 823885130
Manuel Etiete	Director of academic affair – Instituto Agrário de Chimoio	+258 825631400

Date: 06/04/2006 16.00 h - Manica

NAME	INSTITUTION/POSITION	CONTACT
Tom Gardiner	ACDI/VOCA	+258 825558010
Ofélio Chuva	ACDI/VOCA	ofchuva@yahoo.com.br +258 822514330

Adelino Jorge	Africare	+258 825883680
---------------	----------	----------------

Date: 10/04/2006 8.00h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Venâncio Massinga	Minister of Science and Technology	Venancio.massingue@mct.gov.mz +(+258-21) 352 843/00

Date: 10/04/2006 10.45h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Fernando Songane	Proagri Coodenator	fsongane@map.gov.mz +258 21460026 +258 823053880

Date: 10/04/2006 11.00 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Tomás Mandlate	Minister of Agriculture	mandlate@tvcabo.co.mz (+258-1)46 00 55
Christine de Voest	USAID - Rural Incomes Team Leader	cvoest@usaid.gov +258 21352050 +258 823174800

Date: 10/04/2006 13.00 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
John Casey	ICRAFT Country Representative	j.casey@cgiar.org j.casey@intra.co.mz +258 21461775 +258 823000496

Date: 10/04/2006 14.00 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Calisto Bias	IIAM Director General	+258 823281800
Sancho Cumbe	IIAM Technical Director- Agronomy and natural Resources	+258 829800720
Rosa Costa	IIAM Technical Director- Animal Science	+258 823069420
Alsácia Atanásio	IIAM Technical and Cooperation Adviser	+258 825117712
Paula Pimentel	IIAM technical Director- Training and Technology Transfer	+258 823087520
Irene de Souza	USAID	+258 21352059 isouza@usaid.gov
Custódio Mucavel	IFAD	c.mucavel@ifad.org
Imelda Sousa	EU	Imelda.sousa@cec.eu
Paulino D'Úmba	DANIDA Programme Officer	paudua@um.dk +258 21480000

Date: 10/04/2006 16.00 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Irene de Souza	USAID	+258 21352059 isouza@usaid.gov
Jake Walter	Technoserve	jake.walter@tv cabo.co.mz
Marcelino Botão	World Vision	marcelino_botao@wvi.org
Francisco Jr Matuca	World Vision	francisco_matuca@wvi.org
Michelle Carter	CARE	mcarter@care.org.mz

Date: 11/04/2006 9.30 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Paula Dias	Animal Science Directorate (ASD)- Vaccine Unit	
Antonieta Nhamusso	ASD – Diagnostic and Research Department	
Helena Matusse	ASD – Food Quality Control Department	
Venâncio Quiba	ASD – Diagnostic and Research Department	
Cristiano Conceição	ASD- Department of Animal Production	
Felicidade Macome	ASD – Department of Animal Production	
Ilharco Mondlane	ASD - Nutrition and food Department	
Zacarias Massango	ASD – Animal Production Department	
Leonildo Munguambe	Food Quality Control Department	
Sónia Maciel	ASD- Centre for Animal Genetic Resources and Assisted Reproductive Technologies	
Damião Nguluve	ASD – Forage Agronomy and Animal Nutrition	
Carlos Matos	ASD – Diagnostic and Research Department	
Manuel Reis	Quality Manager and virologist	

Date: 11/04/2006 11.15 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Andrade F. Egas	Dean of the Faculty	aegas@uem.mz
Mário Paulo Falcão	Deputy Dean	mariopaulofalcao@yahoo.com
Armindo Cambule	Deputy Dean for Administration	cambule@zebra.uem.mz
Ana Maria Mondjana	Deputy Dean for research	amondjana@uem.mz
Gabriel Albano	Head of Department	agabriel@uem.mz
Domingos Cugala	Lecturer	dcugala@zebra.uem.mz

Date: 11/04/2006 13.15 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Calisto Bias	IIAM Director General	Calisto_bias@hotmail.com +258-21 46 22 40

Date: 11/04/2006 14.30 h - Maputo

NAME	INSTITUTION/POSITION	CONTACT
Hélder Gemo	National Director of Extension	hgemo@map.gov.mz
Teodósio Jeremias		tnunes@map.gov.mz
Américo Manhiça		americomanhica@yahoo.com.br
Sandra Silva	Head of Department of Planification	ssilva@tvcabo.co.mz
Inácio T. Nhancale		inhancale@map.gov.mz