



# **A plan to apply technology in the improvement of cowpea productivity and utilisation for the benefit of farmers and consumers in Africa**

## **Proceedings of a Small Group Meeting**

**10–12 February 2004**

**Accra, Ghana**



AFRICAN AGRICULTURAL TECHNOLOGY FOUNDATION  
FONDATION AFRICAINE POUR LES TECHNOLOGIES AGRICOLES



# **Cowpea Stakeholders' Workshop**

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## List of abbreviations

AATF	African Agricultural Technology Foundation
ABSP	Agricultural Biotechnology Support Project
ADP	Agricultural Development Project
AFLP	Amplified Fragment Length Polymorphism
ARI	Agricultural Research Institute
ASARECA	Association for Strengthening of Agricultural Research in Eastern and Central Africa
BAC	Bacterial artificial chromosome
BBC	British Broadcasting Cooperation
BCS	Bayer Corp Sciences
BSP	Biosafety Support Program
<i>Bt</i>	<i>Bacillus thuringiensis</i>
CABMV	Cowpea aphid-borne mosaic virus
CAPS	Cleaved amplified polymorphism sequences
CERASS	Centre d'Etude pour l'amélioration de l'Adaptation à la sécheresse
CGIAR	Consultative Group on International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	Centro Internacional de la Papa
CORAF/WECARD	West and Central African Council for Agricultural Research and Development
CRSP	Bean/Cowpea Collaborative Research Support Program
CSIR	Council of Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DANIDA	Danish International Development Agency
DfID	Department for International Development
DW	Deutsche Welle
ECA	Economic Commission for Africa
EST	Expressed sequence tag
FAO	Food and Agriculture Organisation of the United Nations
FARA	Forum for Agricultural Research in Africa
FBO	Farmer based organisations
FFS	Farmer Field Schools
FTO	Freedom to operate
GDA	Global Development Alliance
GEF	Global Environmental Facility
GM	Genetically modified
GMO	Genetically modified organism
GUS	Glucuronidase
ICARDA	International Center for Agricultural Research in the Dry Areas



ICRAF	International Center for Research in Agroforestry
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
ILRI	International Livestock Research Institute
IP	Intellectual property
IPM	Integrated pest Mmanagement
IPM/FFS	Integrated Pest Management/Farmer Field Schools
IPPM	Integrated production and pest management
IPR	Intellectual property rights
IRM	Insect resistance management
IRRI	International Rice Research Institute
ISRA	Institut Senegalais de Recherche Agricole
IWMI	International Water Management Institute
MAS	Marker assisted selection
NAPRI	National Animal Production Research Institute
NARES	National Agricultural Research and Extension Systems
NARS	National Agricultural Research Systems
NCBI	National Center for Biotechnology Information
NEPAD	New Partnership for Africa's Development
NGICA	Network for the Genetic Improvement of Cowpea for Africa
NGO	Non-governmental organisation
NSS	National seed service
OECD	Organisation for Economic Development
PBS	Program for Biosafety Systems
PCR	Polymerase Chain Reaction
PRONAF	Projet de Niébé pour l'Afrique
PEDUNE	Protection Ecologiquement Durable du Niébé
RAPD	Randomly Amplified Polymorphic DNA
RIL	Recombinant inbred lines
RILs	Recombinant inbred lines
ROCAFREMI	Réseau Ouest et Centre Africain de Recherches sur le Mil
SCAR	Sequence characterised amplified region
SLP	Systemwide Livestock Programme
SNPs	Single nucleotide polymorphisms
SRO	Sub-regional organisation
SSR	simple sequence repeat
TSC	Technical Steering Committee
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
VOA	Voice of America
WASNET	West African Seed Network
WVI	World Vision International

## Executive summary

Following the decision of the Technical Steering Committee (TSC) of the AATF/NGICA partnership, formed during the Small Group Meeting in Nairobi, Kenya between 10–11 July 2003, on constraints to cowpea production and utilisation, a Cowpea Stakeholders' Workshop was organised at the M Plaza Hotel in Accra, Ghana from 10–12 February 2004.

The overall objective of the workshop was to develop a process and formulate a plan for cowpea improvement in Sub-Saharan Africa. Project activities will use modern plant improvement technologies in the form of superior-performing cowpea cultivars with novel traits as well as ancillary cowpea production, utilisation and marketing technologies to bring the benefits of modern technologies to African cowpea farmers and consumers.

There were 38 participants at the workshop who included specialists from National Agricultural Research Systems, the CGIAR, Purdue University, University of California, University of Virginia, Michigan State University, Bean/Cowpea CRSP project, University of Ghana, USAID, The Kirkhouse Trust, the private sector such as Biotechnology companies, AATF and NGICA. The Forum for Agricultural Research in Africa (FARA) provided local logistic support for the workshop.

Plenary presentations made by various participants provided the background, updates of Task Force activities since the Nairobi meeting, as well as the technical framework to guide deliberations of the six Task Forces to contribute to preparation of the cowpea product concept note.

The workshop successfully:

- laid the foundation for a cowpea technology transfer project that would be jointly implemented by AATF, NGICA and other development partners
- prepared an outline for a cowpea project that would be implemented to improve cowpea production, utilization and marketing in Sub-Saharan Africa through linkages of modern technologies developed and disseminated in a manner which would bring long term benefits to African cowpea producers and consumers
- formulated a funding plan for the project and identified potential sources of funding for project activities
- established a management structure for implementation of the cowpea project.

The entire project could be funded by a single donor, but different donors may fund component modules that are of particular interest to them. The approved AATF funding formula will be adopted as follows:



- Project formulation – AATF funds 75% while 25% will be jointly sought as matching funds
- Project implementation – AATF funds 25% while 75% will be sought from donors.

The Global Development Alliance Secretariat of the United States Agency for Development (USAID) has expressed interest in the AATF/NGICA partnership cowpea project. Efforts will, therefore, be made to complete the preparation of the project concept note to conform with the GDA guidelines for submission to GDA/USAID.

# Notes of the workshop

## Background

At the small group meeting on 'Constraints to cowpea production and utilisation in Sub-Saharan Africa', held at the African Agricultural Technology Foundation (AATF) in Nairobi, Kenya from 10–11 July 2003, a partnership was formed between the Foundation and the Network for the Genetic Improvement of Cowpea for Africa (NGICA). The Technical Steering Committee of this partnership decided to hold a Cowpea Stakeholders' Workshop in Accra, Ghana to develop a strategy that would deliver the benefits of modern technologies to African cowpea farmers and consumers. This report presents a summary of the organisation and outcome of this stakeholders' workshop.

## Workshop objectives

The overall objective of this workshop was to develop a process and formulate a plan for a project on improvement of cowpea productivity and utilisation in Sub-Saharan Africa. Project activities will use modern plant improvement technologies in the form of superior-performing cowpea cultivars with novel traits, as well as ancillary cowpea production, utilisation and marketing technologies to bring the benefits of these technologies to smallholder farmers in Africa and to improve the diets of rural and urban people of Africa.

Specifically the workshop objectives were to:

- lay the foundation for a project on cowpea productivity and utilisation that would be jointly implemented by AATF, NGICA and other development partners
- prepare a project concept note describing in detail aspects of activities that would improve cowpea production, utilisation and marketing in Sub-Saharan Africa through linkages of modern technologies developed and disseminated in a manner to bring long term benefits to African producers and consumers of this crop
- formulate a funding plan for the project, identify potential sources of funding for project activities and devise a mechanism to assist sub-projects in obtaining the required resources to conduct their respective activities
- discuss and agree on a management structure for implementation of the cowpea project
- create the intellectual and organisational framework for successful implementation of a project on cowpea productivity and utilisation in Africa.

## Pattern of the workshop

A number of key plenary presentations were made at the start of each session to provide background information. Summaries of the presentations are given in the next section of this report. Based on their interests and areas of expertise, the participants were assigned to the six Task Forces (see Annex III) which worked in break-out sessions to discuss particular cowpea production and utilisation constraints, and to identify activities and resources required for the project. Chairs of the task forces synthesised the discussions and later reported to plenary sessions where their recommendations were fully discussed, modified and approved. At a final plenary session, an outline of the cowpea project concept note was formulated.

# Summary of plenary presentations

## Presentation 1

### Technological advances, intellectual property rights, food security and poverty in Africa

*Eugene Terry, Implementing Director, AATF, Nairobi, Kenya*

#### Background

Food insecurity and poverty are major problems which constrain human and socio-economic development in Sub-Saharan Africa, where crop yields fell by about 8% between 1980 and 1995. Farm productivity remain low because of a variety of factors, despite the fact that there are technologies that offer hope for producing crops that can withstand ecological factors such as drought, impoverished soils, pests and diseases. But these technologies must be accessed and delivered to Sub-Saharan Africa in order to enhance agricultural productivity.

#### Creation of AATF

The rationale for creating the African Agricultural Technology Foundation (AATF) was:

- the need for effective mechanisms to negotiate the access and transfer of proprietary and other technologies held by the public and private sectors anywhere in the world
- the need to create appropriate long-term networks to manage the deployment of these technologies at all stages in the value chain.

AATF is a unique initiative without design models to copy; it is an African institution owned and led by Africans, and focusing exclusively on African priorities. It is indeed an innovative private/public partnership designed to harness the best practices, resources and expertise of public/private sectors for the resource-poor smallholder farmers in Sub-Saharan Africa.

#### Mission and core business

AATF links the needs of resource-poor farmers in Sub-Saharan Africa with potential technological solutions through identification and facilitation of royalty-free transfers of proprietary technologies through negotiation, entering into contractual agreements with existing institutions that will manage deployment of the technologies and ensuring that subsequent constraints after access are addressed.

AATF partners and investors include agricultural producers/consumers, regional and national institutions and agencies such as NEPAD, ECA, FARA, SROs and NARS. Others are the International Agricultural Research Centres of the CGIAR, Advanced Research Institutions, local and international NGOs, agricultural technology industry IP holders, African trade and agribusiness organisations, international investors, the Rockefeller Foundation, USAID, UK/DFID and African governments.

## Update

AATF has been incorporated as a private limited liability company in the United Kingdom and in Kenya which is also the host country. A Board of Directors consisting of nine members has been formed and held two meetings, a ten-year Business Plan has been developed and three initial senior management staff have been appointed. Formulation of the AATF project portfolio and the work program for 2004 is in progress. Pilot projects already identified include:

- *Striga* control in cereals
- insect resistant maize for Africa
- pro-vitamin A in maize and rice
- cowpea production and utilisation
- production of bananas and plantains.

A project flow scheme which outlines the specific project activities including technology licensing and regulatory control, FTO assessments, licensing for regional distribution, liability protection, commercialisation and stewardship has been designed and approved.

## Presentation 2

### **The African Agricultural Technology Foundation (AATF) communications and fund development strategy – 2004**

**Nancy Muchiri**, *Communications and Partnerships Manager, AATF, Nairobi, Kenya*

AATF has developed a communications and fund development strategy that revolves around partnership relationships. The overall objective of this relationship is to achieve a high level of commitment which will ensure that there is ownership, mutual responsibility and respect generated in partnerships at the highest levels. AATF originated from collaboration and partnerships, and the fulfillment of its mission depends on successfully linking partners to address the crucial problems of food security and poverty in Africa, especially among resource-poor smallholder farmers in Sub-Saharan Africa.

The level of efficiency of the management of the associations between AATF and its collaborators/partners will determine the nature of the image, role and levels of success. Therefore the strength of AATF will be in maintaining the interest of stakeholders, including donors, and encouraging others to contribute to AATF's programmes and efforts.

The communications/donor/public relations department will continue to expand the Foundation's support base through:

- seeking more investors and partners to provide support in cash and kind
- raising funds and developing relationships in a friendly environment
- appealing to people in order to win confidence for AATF and being involved at all stages of the project development process.

AATF will establish a system of proactive management of information flow to ensure that all those associated with the Foundation are well informed of what is going on at all times.



## Presentation 3

### Introduction: General aims and procedures of the workshop

**Larry Murdock**, *Purdue University, West Lafayette, Indiana, USA*

### Background

Early in its inception, AATF identified eight problem areas for possible technological intervention. One of these problem areas is cowpea, an indigenous crop of Africa. With support from AATF, nine scientists interested in cowpea met in Nairobi, Kenya between 10–11 July 2003. They were:

Ousmane Coulibaly – *an agricultural economist from IITA, Benin*

Idah Sithole-Niang – *NGICA co-chair, Zimbabwe*

Laurie Kitch – *representing FAO*

Ndiaga Cisse – *cowpea breeder, Senegal*

Morag Ferguson – *ICRISAT/IITA*

Eugenia Barros – *CSIR/Bio/Chemtek SA*

Mohammad Ishiyaku – *cowpea breeder, IAR, Nigeria*

Rose Ndegwa – *IP specialist at ILRI, Kenya*

Larry Murdock – *Purdue University and NGICA co-chair*

Eugene Terry – *Implementing Director, AATF, Nairobi.*

They agreed to focus on:

- increasing productivity of cowpea farmers in Sub-Saharan Africa
- fostering greater cowpea utilisation – recognising the nutritional importance of cowpea in feeding the growing population of African cities.

Growing cowpea for the farmers is not enough. It has to be sold if the farmers have to get out of the poverty cycle. Therefore marketing, trade as well as cowpea utilisation are very important aspects. AATF and NGICA agreed to work in a partnership to develop a product concept note as the basis for a future AATF project dealing with increasing cowpea productivity and utilisation.

The process agreed upon is as outlined below:

- plan a small group meeting which took place in July 2003 in Nairobi, Kenya
- create task forces to carry forward the process of selecting project goal
- present preliminary ideas and suggestions to a much larger group of cowpea stakeholders for discussion and deliberation, modification and eventual consensus – the current meeting here in Accra
- develop a draft project concept note by a professional writer, building on the input of the broad cowpea community

- submit the project concept note to a distinguished panel of expert reviewers
- revise the document into a final project concept note to be presented to the AATF Board for approval.

Several additional decisions were reached by the group as outlined below.

- Idah Sithole-Niang, working with AATF staff, would serve as liaison between AATF and NGICA scientists. She would prepare the SGM report.
- Larry Murdock would organise the larger cowpea stakeholders meeting – this meeting – in collaboration with AATF.
- NGICA would help mobilise additional support for the meeting.
- A Technical Standing Committee would consist of participants at the Nairobi meeting plus others added to make the committee more representative. These were: Esther Sakyi-Dawson, a food scientist (University of Ghana-Legon, Accra); Muffy Koch, an expert in biosafety from Golden Genomics, South Africa; George Bruening, who is actively involved in efforts to create a genetic transformation system for cowpea, University of California, Davis.
- The general stakeholders meeting for Accra, Ghana will be in November 2004, but subsequently moved to this date.

## Strategic concepts and values

1. The project will work in three time horizons, in terms of when impact is expected to be felt.
  - Short term: 1–3 years
  - Medium term: 4–7 years
  - Long term: 7–10 years
2. The short-term impacts might involve:
  - increased availability of improved cowpea seeds
  - improved availability of existing storage technologies
  - fostering better input supply or market availability.
3. Medium term impact could involve improved seed produced through the use of DNA markers in selection and breeding (MAS).
4. Long term impacts could include *Bt* cowpea, protective against *Maruca vitrata* or *Callosobruchus maculatus* (cowpea weevils).

This workshop will further discuss these impacts and create a plan for increasing cowpea productivity and utilisation.

## Presentation 4

### Update on the Network for the Genetic Improvement of Cowpea for Africa (NGICA)

**Idah Sithole-Niang**, *University of Zimbabwe, Harare, Zimbabwe*

This presentation gives an update of the Network for the Genetic Improvement of Cowpea for Africa (NGICA) activities, which were agreed at the workshop of cowpea stakeholders held in Dakar, Senegal in January 2001. Participants at this workshop were scientists, representatives from non-governmental organisations (NGOs), donors and administrators. It was agreed that NGICA would use molecular biological tools to address some of the productivity, utilisation and availability constraints that had been identified as limiting cowpea production. By the time of the meeting, NGICA had lobbied donors for funds and continued efforts to promote and support work on the genetic transformation of cowpea. NGICA funded the translation of Maarten Chrispeels pamphlet on genetically modified foods into French. A conference on the Genetic Transformation of Cowpea was organised in Capri, Italy in November 2002.

In 2003, NGICA was involved in preparing background documents for laying the foundation of an effective AATF/NGICA partnership and collaboration, which has culminated in this Accra Cowpea Stakeholders meeting. A consultative meeting was held in Nairobi, Kenya to define the best approach to formulating a cowpea project. This was followed by a Small Group Meeting (SGM) of African scientists who defined the key areas to address productivity and utilisation constraints in cowpea. Four productivity constraint areas were identified and a fifth one was included to address the area of intellectual property rights, IPR. Six taskforce teams and leaders were identified, and formed the basis for assembling a much more encompassing-group of experts for the consultative process planned for the Stakeholders meeting in Accra, Ghana. Professor Murdock obtained funding from the Rockefeller Foundation to organise the meeting, develop a white paper on cowpea, as well as establish a website for cowpea. Although all these activities have been on-going successfully, and a successful partnership has been realised with AATF, NGICA lacks a legal status, which has created some difficulties in acquiring substantial funding.

## Presentation 5

### Socio-economics of cowpea in Sub-Saharan Africa: Production, marketing and trade

**Ousmane Coulibaly**, IITA, Cotonou, Benin

Global challenges in Sub-Saharan Africa include food security and sustainable livelihoods for an increasing population while at the same time protecting the environment. The decreasing per capita food supply and increasing rural poverty require substantial increases in agricultural productivity and improvement in marketing and trade. Scientists, rural development institutions, the private sector and governments are challenged to develop and diffuse technologies, make optimal institutional arrangements and policy reforms and decisions to increase productivity and incomes for sustainable livelihoods. Cowpea can play an important role in efforts to achieve these goals.

Increased cowpea contribution to food security and poverty reduction (incomes) will require:

- promoting production and distribution of certified high quality cowpea seeds
- developing and diffusing cost effective and sustainable integrated pest management technologies
- promoting the development of high nutritious and value-added cowpea products
- empowering public, private, NGO and various cowpea-related organisations
- strengthening collaboration between stakeholders, including the private sector.

The contribution of the Cowpea Marketing and Trade Task Force will be to:

- review past and on-going socio-economic studies on cowpea across Sub-Saharan Africa
- assess key socioeconomic constraints and opportunities for cowpea production, marketing and trade
- recommend new proposals for further cowpea research for development.

The geographical focus will be west, central, east and southern Africa for the main activities which will include: assessment of cowpea marketing performance, consumer preference analysis, surveys on acceptance of *Bt* cowpea, trade analysis, training and capacity building of national research and development systems.

## Presentation 6

### Potential economic and trade impacts of *Bt* cowpea

**Jess Lowenberg-DeBoer**, *Purdue University & Bean/Cowpea CRSP*

Experience with transgenic crops suggests that the economic, marketing and consumer aspects should be considered early in the process of developing a transgenic crop variety. Farmers with access to GM crops may substantially modify farming systems. In some parts of the world, consumers have reacted negatively to products from GM plants, blocking GM grains and oil seeds from certain markets.

This presentation is a summary of recent work on the potential economic and trade effects of *Bt* cowpea. The earliest analysis of the potential impact of *Bt* cowpea was done by Mbene Faye in 1999. She used a standard economic surplus framework for costs and benefits in Senegal. She assumed that the transgenic cowpea would be developed by a public organisation and that it would be made available without cost to ISRA for developing varieties appropriate to Senegal and that the cowpea area would remain constant. Her results showed a 48% internal rate of return, a net present value of 331 million Francs CFA, and robustly positive returns in sensitivity testing under a wide range of conditions.

Potential consumer reaction to *Bt* cowpea is largely unstudied. Kushwaha et al (2004) conducted “person-on-the-street” interviews with some 200 people in Gombe, Jigawa, Adamawa and Kano in Nigeria. The results showed that about 90% of the respondents were familiar with GM terminology. The most common source of information was short-wave radio broadcasts in Hausa by the BBC, VOA and DW. About 70% said that they were “unhappy” with the possibility of consuming GM foods. Preliminary LOGIT analysis suggests that ethical concerns was the variable most closely linked to this negative reaction.

Langyintuo and Lowenberg-DeBoer (2004) analysed the potential effect of *Bt* cowpea on regional trade. In particular, they considered the scenario of *Bt* cowpea being adopted in Nigeria well before other countries in the region. Their results suggest that if *Bt* cowpea roughly doubled yields, Nigeria would become a net exporter of cowpea only when *Bt* cowpea was planted on more than 80% of the cowpea area. Nigeria is currently the largest cowpea importer in the world. If Nigeria became a net exporter this could seriously disrupt the economies of some of its neighbours, particularly Niger. Resistance management requirements may mean that Nigeria remains a net importer. Worldwide refuge requirements on *Bt* cotton and maize range from 50% to 80%.

In industrialised countries, seed companies have usually been responsible for resistance management and biosafety. Many observers have questioned whether the seed

systems in west African countries are prepared to take on this responsibility. Lambert et al (2002) conducted key informant interviews in Senegal, Ghana and Niger to determine the status of the seed system and their interest in *Bt* cowpea. In general, they found that:

- producers were eager for new technology that would boost yields or lower costs, including *Bt* cowpea
- the attitude of politicians and regulators is “wait-and-see” until the GM debate in industrialised countries has been settled
- seed growers and retailers were curious about the concept of a *Bt* cowpea
- in general, there was a lack of reliable information about the costs and benefits of GM crops.

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## Presentation 7

### Establishment of a gene transfer protocol for cowpea (*Vigna unguiculata* L.)

**TJ Higgins**, CSIRO, Australia

The aim of this project is to develop an efficient and robust gene transfer system for cowpea to complement conventional breeding programs. The first criterion for success will be the overall Mendelian segregation of transgenes that have been selected to confer resistance to two insect pests that are difficult to control. The target pests are cowpea pod borer and cowpea weevil.

Over the past 18 years there have been several reports of gene transfer to cowpea. None have resulted in lines that transmit the gene to the next generation in a predictable fashion. This means that it is still necessary to develop an efficient transformation system with characteristics that make it useful in the breeding program, that is Mendelian segregation of the transgenes.

CSIRO have screened five different explant types, 21 divergent genotypes and five culture media to arrive at an efficient regeneration system that yields multiple shoots at a very high frequency. This was a suitable base on which to begin transformation experiments. Using transient expression of the reporter gene for beta-glucuronidase (GUS), it was established that transformation is possible thus confirming several earlier published reports.

The next step was to establish stable transformation. It was found that both the *bar* and *nptII* marker genes worked well under the lab conditions at CSIRO when phosphinothricin (2µg/ml) or geneticin (150µg/ml) was used, respectively. GUS expression has been used to monitor stable expression and while initial experiments showed strong GUS expression, this was restricted to mosaic patterns indicating that only some cells were transformed. A stronger selection regime was imposed by using phosphinothricin at 5µg/ml. Thousands of explants were used and several strongly growing plantlets that appeared to be expressing GUS uniformly throughout the plant were obtained. This indicates that all the cells in the meristem are transformed and therefore it is likely that seeds on these plants will express the transgenes at a ratio of 3:1.

A binary plasmid for gene transfer which contains two sets of right and left borders has been constructed. This will facilitate the removal of the selectable marker gene by selecting progeny plants that have segregated to contain only the gene for insect resistance.

An intellectual property rights audit is being conducted in order to seek licenses for each component technology that is proposed for the project.

Several groups in the NGICA have made progress on genetic transformation of cowpea using different protocols. The Zimbabwe/Michigan State University group is using electroporation for gene transfer. The University of California, Davis group has developed a promising explant source in epicotyls and IITA and Purdue groups have established systems similar to that described above.

## Presentation 8

### Dual-purpose and fodder cowpea: Collaborative research within the CGIAR System-wide Livestock Programme

**Salvador Fernandez-Rivera**, *International Livestock Research Institute, Addis Ababa, Ethiopia*

The Systemwide Livestock Programme (SLP) was established in 1995 to support the Consultative Group on International Agricultural Research (CGIAR) goal of alleviating poverty and protecting natural resources in order to achieve sustainable food security in developing countries. Smallscale farmers in Sub-Saharan Africa have limited assets and opportunities to improve their livelihoods. By integrating crop and livestock production they improve their farm productivity, generate income, improve food security and protect their natural resources. By 2010 it is expected that in the developing world, crop-livestock farmers will produce more than 90% of the milk and 75% of the meat, and their farming enterprises will increasingly depend on dual-purpose (food-feed) crops. The SLP builds and strengthens collaboration between livestock, plant, water, agro-forestry and policy oriented CGIAR centres to develop integrated and coherent strategic and applied research on food-feed crops within the context of sustainable use of land, water and soil nutrients. Its members include CIAT, CIP, CIMMYT, ICARDA, ICRAF, ICRISAT, IFPRI, IITA, ILRI, IRRI and IWMI. The SLP is supported by the World Bank and the governments of Canada, Denmark, Germany, Japan, Switzerland and the United Kingdom.

In west Africa, cowpea is planted on more than 8 million ha. The ruminant livestock population of the region includes approximately 44 million tropical ruminant livestock units (1 unit = 250kg live weight), 38% of which are kept in areas where cowpea is produced. An additional 18% of the livestock units are kept in peri-urban and urban areas, where cowpea hay is commonly marketed and used as livestock feed. Cowpea is therefore an important source of nutrients for both humans and livestock. An *ex ante* assessment of adoption and impact of genetically improved dual-purpose cowpea in the dry savannah of west Africa, conducted within the SLP indicated that the net present value of research and extension on dual-purpose cowpea is 606 million US dollars. This study estimated that investing in research and extension on dual-purpose cowpea over a period of 20 years would have an internal rate of return of 71% and a benefit:cost ratio of 6:3.

IITA, ICRISAT, ILRI and their national partners in west Africa (INERA in Burkina Faso, IER in Mali, INRAN in Niger, and ARI and NAPRI in Nigeria) have investigated options to intensify crop-livestock systems in the dry savannas. These options include the introduction of improved dual-purpose cowpea varieties, pesticides, organic and inorganic fertilisers, and feeding systems for small ruminants based on cereal

and legume residues. A second project implemented in India and Nigeria aims at enhancing the livelihoods of poor livestock keepers through increased use of fodder. Dual-purpose cowpea is the main source of fodder promoted in Nigeria in this project. Experimental results indicated that by including cowpea hay at levels of 30–50% in the diet of fattening sheep, the growth rate increased by 30–40g/d and the carcass yield by 2–5 percentage units. Preliminary germplasm evaluations also point to the existence of considerable genetic variation in fodder yield and quality. An improved variety, with dual-purpose characteristics (IT90K-277-2), yielded as much fodder and more grain, and sustained similar weight gains in sheep than a local variety (Singh et al 2003). On-going work funded by DFID in Nigeria indicates that improved cowpea varieties result in higher household incomes. Developing dual-purpose cowpea varieties can substantially improve the production of food grain and livestock outputs and lead to enhanced livelihoods of poor people.

Improved dual-purpose cowpea can be developed within the AATF/NGICA cowpea initiative. Such an innovation will entail:

- identification of cowpea traits that are related to livestock production
- prediction of these traits with high throughput approaches such as the use of near infrared reflectance spectroscopy and simple laboratory measurements
- identification of sources of genetic variation and molecular markers associated with these traits
- application of these sources in conventional breeding or marker assisted selection programmes to develop superior dual purpose cowpea varieties.

By collaborating with other cowpea improvement programmes involved in the initiative, ILRI, IITA and their partners can contribute to the successful implementation of these activities and the delivery of the superior dual-purpose cowpea.

## References

Singh BB, Ajeigbe HA, Tarawali SA, Fernandez-Rivera S and Abubakar M. 2003. Improving the production and utilization of cowpea as food and fodder. *Field Crops Res* 84: 169-177.

## Presentation 9

### Potential and constraints of improved cowpea varieties in increasing the productivity of cowpea-cereals systems in the dry savannas of west Africa

**BB Singh**, Cowpea Breeder and Head, IITA Station, Kano, Nigeria

Cowpea is the most important source of nutritious food and fodder in west Africa. Of the world's total of about 14 million ha area under cowpea, west Africa alone accounts for about 9 million ha and 3 million tons of production. Of this Nigeria has 5 million ha and Niger 3 million ha. Other countries with significant areas under cowpea are Mali, Burkina Faso, Cameroon, Senegal and Ghana. The International Institute for Tropical Agriculture (IITA), in collaboration with national and regional organisations, has developed high yielding grain type and dual-purpose cowpea varieties combining resistance to major diseases, insect pests and *Striga*. These varieties mature between 60 to 75 days and yield between 2.0 to 2.5t/ha grains and 2 to 3t/ha fodder compared with very low yields of local varieties. These varieties have been cultivated in sole crops as well as in strip crops.

Recent participatory research at the IITA in collaboration with other IARCs and NARS partners (in Kano, Kaduna and Jigawa), Agricultural Development Projects (ADPs) with financial support from USAID, DANIDA, the Gatsby Foundation and DfID has led to the development of an appropriate model which seems to hold great promise for increasing food production in west Africa without affecting the environment and degrading soils. This model involves a holistic combination of improved varieties, improved cropping systems, minimum and selective application of fertilisers and pesticides, feeding crop residues to small ruminants in permanent enclosures on the home compound, and returning of manure to the field.

Based on this model, two “best bet” options are already becoming popular with farmers in northern Nigeria. These are:

- improved strip cropping system involving two rows of densely planted improved sorghum varieties and four rows of densely planted improved medium maturing cowpea in the Sudan savanna where the rainfall is about 600mm
- an improved strip cropping system involving two rows of densely planted improved maize variety and four rows of densely planted double cropping of an improved 60-day cowpea in the northern Guinea savanna where rainfall is about 1000mm.

In both systems, a basal dose of 100kg/ha of NPK (15:15:15) and 1 ton manure/ha is given followed by two sprays of Cypermethrin (a safe insecticide) on cowpea only to control pod borers. The two cereal rows have no competing border rows and therefore

their yield is equivalent to almost three rows. Cowpea does not suffer competition from cereal rows because of its early maturity and the slow initial growth of the cereals. Cowpea fixes atmospheric nitrogen, causes suicidal germination of *Striga hermonthica* and also contributes to improving soil fertility.

These systems have shown up to 300% superiority in productivity and gross income compared to the traditional one row cereal and one row legume inter-cropping. On average, the sorghum-cowpea system gives about 1.5ton/ha sorghum grain, 2ton/ha sorghum fodder, 1.2ton/ha cowpea grain and 1.5ton/ha cowpea fodder. The maize-double crop cowpea system in the higher rainfall zone gives about 1.3ton/ha maize grain and 1.5ton/ha maize fodder along with about 2ton/ha cowpea grain and 1.5ton/ha cowpea fodder. The residue from the first cowpea crop is incorporated in the soil which provides additional fertility to the standing maize crop and the second cowpea crop. Since the improved systems involve 2/3 area under cowpea and 1/3 area under cereals, not only the soil fertility is improved but there is substantial reduction in the incidence of *Striga hermonthica* which is parasitic on sorghum and other cereals. The 1.5t/ha nutritious cowpea haulms and 1.5–2ton/ha cereal fodder supports sedentary feeding of up to 8 sheep or goats producing over 1ton manure/year needed to make the system sustainable. Recent experiments have shown that supplementary feeding of only 200g cowpea haulms per day along with sorghum stover to young rams doubles the weight gain in 70 days compared with feeding them with sorghum stover alone.

### Need for *Bt* cowpea

Although great progress has been made in cowpea improvement, there is a need to protect the cowpea crop with 2–3 sprays of insecticide from *Maruca* pod borer for which no resistance has been found. If the *Bt* gene which confers resistance to the pod borer can be transferred into improved cowpea varieties, the need for insecticide sprays in cowpea will be eliminated and smallholder farmers can substantially increase their yields and greatly enhance their nutritional and economic status. Thus the AATF initiative to catalyse cowpea transformation with *Bt* gene is very timely and a welcome development.



## Presentation 10

### Getting technology into farmers' hands: Increasing farmers' income through improved quantity and quality grain production

**Ouendeba Botorou**, INRAN, Niamey, Niger

Pearl millet and sorghum continue to be the most important staple food crops grown in the Sahel where poor soil fertility and low rainfall are the limiting factors. Production of both crops increased significantly from the 1980s because more marginal lands were brought under cultivation. The Western and Central African Millet Network (ROCAFREMI) involving fourteen countries was established in 1991 to promote pearl millet production and utilisation. Seven research projects in agronomy, breeding, integrated pest management (IPM) and processing were implemented in the ROCAFREMI member countries. Improved technologies developed by the NARS, the Network and agricultural research institutes (ARIs) are available but the level of adoption is limited and the yields of the local and improved cultivars remain low. When the Network was terminated in 2001, the challenge faced by the steering committee was how to develop remunerative markets for millet and sorghum that can provide sufficient incentives for the Sahel farmers to invest in yield increasing technologies. A rapid diagnosis in the region revealed four main findings:

- experience in production and utilisation research exists
- there is an increasing urban population
- the inventory credit system (warrantage) is being experimented by NGOs and farmer associations
- there is an expanding class of small processors, mostly women.

Following this diagnosis, a pilot program was launched in four countries, Burkina Faso, Mali, Nigeria and Cameroon, to increase production of quality grain through the use of improved technologies to link farmers to the market, to provide added value through the production of quality grain and to exchange information. The findings of the one-year program in the four countries revealed that:

- the use of improved technologies (varieties, seed treatments, inorganic fertilisers) increased grain production on the farmers' fields
- farmers were able to market quality grain at a good price through contracts
- the demand for processed products is increasing (local and export markets) thus requiring higher quantities of quality grain and better adapted processing equipment.

Increasing market power of the farmers and helping them to produce premium-quality grain will significantly improve their incomes and therefore their livelihoods.

## Presentation 11

### Kirkhouse Trust fellowships

**Ed Southern**, *Kirkhouse Trust, UK*

The Kirkhouse Trust will fund a number of post-doctoral scientists to work in laboratories in the UK as part of its collaborative project scheme. Fellowships will be for a maximum period of two years in the UK laboratory. The Trust will encourage the visiting fellow to return by providing support for continuation of the project in the home country. Pay and conditions will be in line with national norms and may be influenced by the policies of the host organisation, which will normally act as the employer.

A project funded by the Trust at Bangalore in India has been highly successful and it is hoped that there will be an opportunity, through the AATF/NGICA project, to initiate a similar project in Africa. The Kirkhouse Trust will be favourably disposed to consider proposals from African institutions to implement such a project.

Further information on this project may be obtained from the Kirkhouse Trust website ([www.kirkhousetrust.org](http://www.kirkhousetrust.org)).

# Presentation 12

## Cross-cutting issues

*Phelix Majiwa, AATF, Nairobi, Kenya*

In the design of the AATF/NGICA cowpea productivity and utilisation project, it is essential to clearly define the goals and objectives so that project implementation will deliver a package of integrated products for sustainable dissemination to benefit cowpea growers, consumers and other stakeholders.

The project development process will start by:

- defining the critical path to the product package
- identifying possible constraints/issues along the path
- suggesting options for resolving the constraints/issues identified
- working towards the product.

Strategic cross-cutting issues identified and elaborated upon in this presentation are:

- product concept
- project management concept
- technology development pathway
- geographic deployment strategy
- marketing of inputs and product
- sustainability
- funding.

## Product concept

The major characteristic of the project product is that it should be high quality cowpea seed which is socially acceptable, dual-purpose, with increased productivity and high levels of resistance to biotic and abiotic stresses. The dimensions of the project will be elaborated into a project concept note, following a draft that will emerge from stakeholder consultations and deliberations.

AATF has established a four step project development process according to the following simplified scheme.

Step	Activity	Responsible party
1.	Product concept identification	AATF Management
2.	Project concept note development	AATF Management
3.	Legal/scientific/technical peer review of project concept note	AATF Management
4.	Assessment/feasibility/probability of project success	AATF Management

## Project management concept

The issues to be considered in designing a project management concept are:

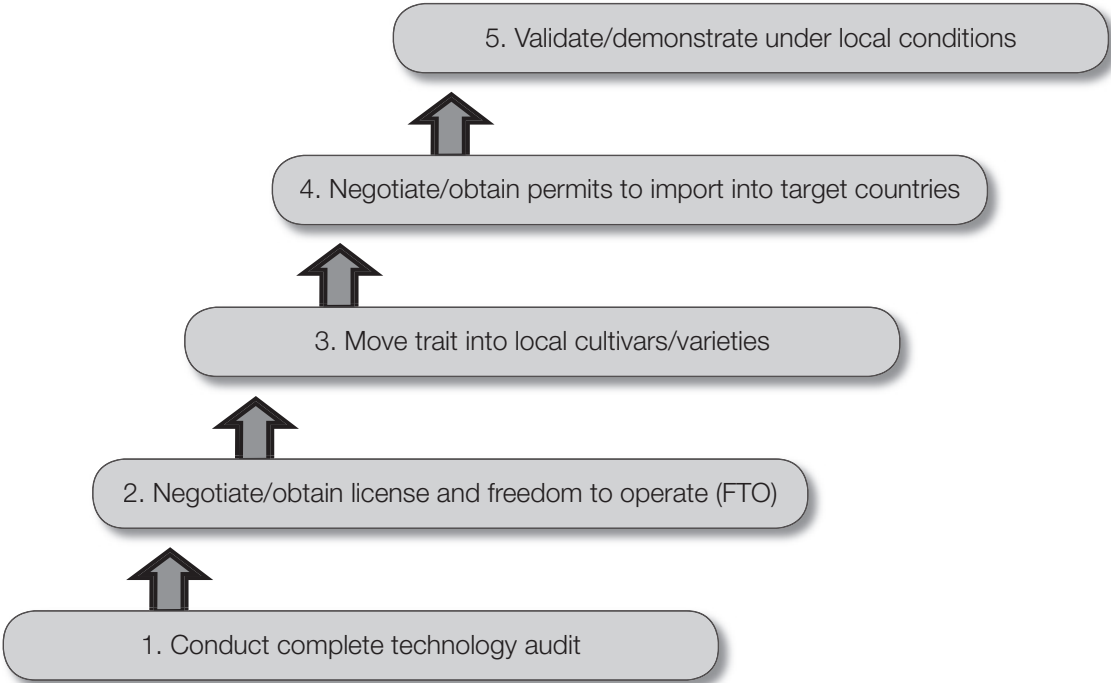
- How can all the individuals and institutions interested in cowpea production and utilisation be coalesced into a focused team of distributed investigators to implement the project plan?
- Who takes leadership and responsibility for the project?
- Who will have ownership of the technology developed by the project?
- Who will have liability?
- How will the technical activities be linked to management activities?

For the cowpea project, the following collaborating partners and their roles are suggested.

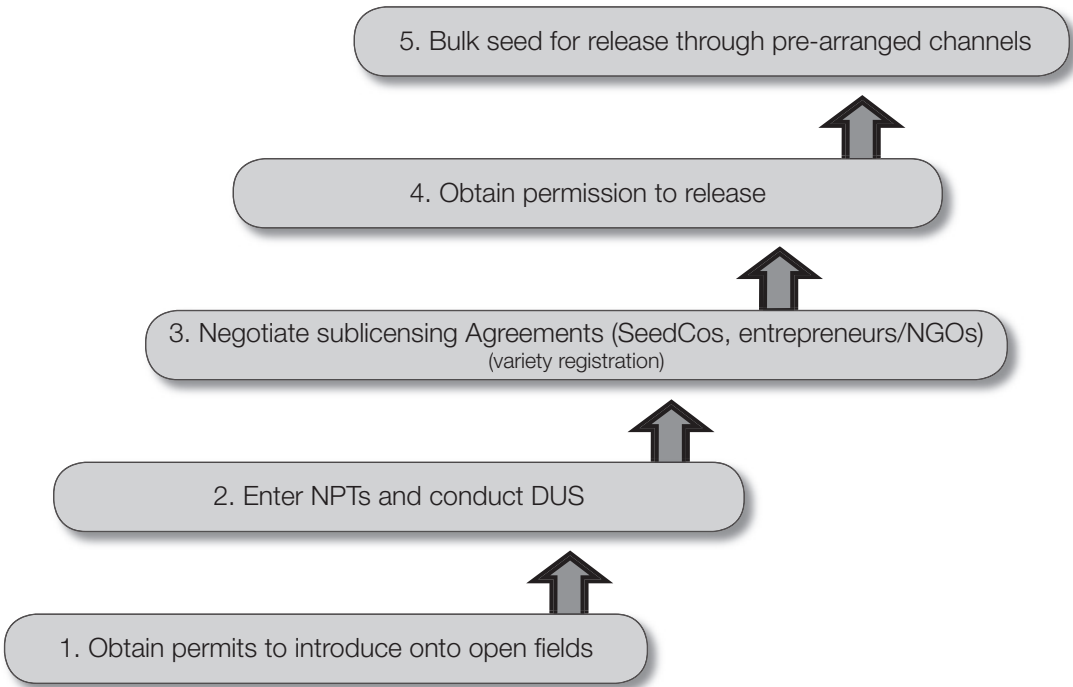
Collaborating entity	Suggested/proposed role
AATF	Technology access, transfer and stewardship Facilitation of IP negotiations and regulatory approvals Elaboration of product/technology opportunities Product sustainability and market development Project oversight and coordination
NGICA	Product conceptualisation, development, validation and demonstration Product adaptation, promotion and adoption
Bean/Cowpea CRSP	Product conceptualisation, development and validation, technology development and elaboration
IITA	Technology development, validation and demonstration, adaptation and refinements
FAO/UN	Popularisation of technologies Product promotion, deployment and dissemination Product/technology advocacy, resource mobilisation Project oversight and coordination
NGOs	Popularisation of technologies Product deployment and dissemination of technologies Advocacy
Private sector	Ensuring availability of the product Promotion and expansion of markets
Public sector	Product/technology improvements and refinement Product back-up innovations and support

### Technology development pathway

When the product development is completed, including validation under contained conditions, the minimum steps to be undertaken before improved seeds reach farmers will include some or all of the following.



Follow up activities will involve the following steps.



## Geographic deployment strategy

The criteria to be taken into account for identifying and evaluating candidate countries for project implementation are:

- cowpea productivity maps to identify cowpea trade linkages and volume of trade
- poverty maps to identify areas where the product will have the highest impact on poverty and human welfare
- be within cowpea productivity zone
- have operational biosafety regulatory instrument
- where the product is likely to have significant impact on livelihoods of small-holders, growers and consumers (from ex ante assessments)
- possess developed channels for seed marketing and distribution with potential for growth
- where the product is socially acceptable.

## Marketing of inputs and product

When the product is finally made available through various forms of marketing and distribution, constraints in product adoption may be experienced in primary and secondary adopters as discussed below.

### Primary adopters

Farmers who may be confronted with:

- predictable availability of farm inputs (fertilisers, pesticides and sprayers)
- affordable stable prices
- credit facilities
- harvest-time need for capital
- information and training
- market information.

### Secondary adopters

Includes traders, processors and consumers.

#### Traders

- product availability, reliability and consistency
- packaging materials
- market information
- distribution channels and transport infrastructure
- product pricing and seasonal price fluctuations (including possible crashes)
- credit facilities
- harvest-time need for capital
- pesticides and post-harvest or storage technologies



## Processors

- packaging materials (plastic sheets and bags)
- pesticides
- appropriate machinery with spare parts and efficient after-sales service

## Consumers

- social acceptability
- palatability and nutritional content
- affordability
- consistency
- training

## Sustainability

Sustainability is important for ensuring that benefits of the technology developed from the project are available over the long term. Sustainability issues include:

- environmental safety
- food safety
- insect pest resistance management
- business viability and profitability
- continuous public education and information dissemination about the product
- private sector involvement
- government interest in and support for the sector.

## Stewardship

Post-deployment issues such as:

- physical containment
- biotic containment
- socio-economic factors that might limit deployment or shorten usefulness.

## Funding

The various components of the project may be funded from a variety of sources, for example:

- traditional funding sources
- non-traditional sources.

# Report of task force deliberations

Task Forces were provided with guidelines to assist them in their deliberations and a standard format to guide the reporting of the outcome of their deliberations. These guidelines are outlined here followed by individual reports from the task forces.

## Guidelines for Task Forces

1. Each Task Force (TF) chair should designate a co-chair to assist in conducting deliberations.
2. For each TF, a rapporteur should be identified who will make a written synopsis of the discussions and recommendations.
3. At the start of the first afternoon session, each TF chair will present a ten-minute (or less) synopsis of the tasks his/her TF will address. This presentation should provide:
  - (a) an overview of the problem(s) and challenges faced by the TF and opportunities available
  - (b) a summary of the ultimate benefits and the categories of beneficiaries of finding solutions to the problem(s)
  - (c) some possible approaches to address the problems including potential partners and networking arrangements.

*For example:* As TF leader for the Field Constraints Task Force, one would say that field productivity of cowpea is substantially less than it could be, giving several examples of constraints such as *Maruca*, *Striga* and diseases. Traditional breeding and screening has been successful in addressing certain field constraints, but not successful in others. New technologies built on the plant molecular revolution of the last 30 years are on the horizon for cowpea, including:

- marker assisted selection to combine useful genes in ways that cannot be done by traditional breeding and screening
- genetic transformation of cowpea to introduce new and useful traits such as *Maruca* resistance or cowpea weevil resistance. If implemented, these technologies could markedly increase cowpea productivity, increase the supply of an excellent indigenous African food, and benefit not only farmers and consumers but traders and food processors as well.

The challenge is first technical which gives rise to organisational challenges.

It was suggested that during the first session, each TF should spend some time defining the problems and tasks before the group. This will serve to ensure that all understand the issues of a particular constraint. The TF may then prioritise the constraints, deciding on what needs to be dealt with first and what can be deferred. In prioritising,

it is well to remember that important problems are sometimes intractable, so priorities may be a combination of importance modified by the feasibility of a solution for the problem. Once priorities are established, the TF can proceed to inventorying existing or ongoing activities that are attempting to address the problem in order to determine if the activities are sufficient, or whether additional activities or resources are needed for more rapid progress. Once the activities have been identified, then the TF should suggest how they can be linked into a project or linked better than they currently are. Possible sources of funding should be considered. Finally, the TF needs to consider how all the project outputs link to other projects such that impact can be achieved. For example if *Bt* cowpea is achieved by plant transformation, how is the new germplasm going to be brought into the national cowpea breeding programs? How would the *Bt* cowpea then move through biosafety and regulatory processes, and how will resistance management issues be dealt with?

## Format for reporting

It is recommended that the deliberations of each Task Force be reported under the following headings.

- Title of Task Force
- List of members of the Task Force
- Summary of recommendations
- Overview of the problem
- Major constraints – prioritised with brief explanations of each
- Challenges posed by constraints
- Opportunities available to address constraints
- Approaches to address the constraints, potential partners and networking arrangements
- Benefits derivable from alleviating the constraints, categories of beneficiaries, namely primary, secondary and tertiary
- Estimated cost of approaches and potential funding sources

# Reports of Task Forces

## Marketing and Trade Task Force

### Members of the Task Force

Ousmane Coulibaly – *Chair*  
Jess Lowenberg-DeBoer – *Rapporteur*  
Ouendeba Botorou  
Sika Gbegbelegbe  
Nancy Muchiri  
Salvador Fernandez-Rivera

### Summary of recommendations: Actions required

The actions required are organised into the three time horizons as recommended by AATF as follows.

#### *Short term (1–3 years)*

- Seed sub-sector study
- Potential consumer acceptance of GM cowpea and willingness to pay premium price

#### *Medium term (4–7 years)*

- Prepare seed sector for radical change
- Consumer reaction to *Bt* cowpea
- Estimate value added by *Bt* cowpea

#### *Long term (8–10 years)*

Build demand for processed cowpea products

#### *Cross cutting issues*

Education and training of researchers, technicians, farmers and consumers.

### Overview of the problem

The impact of the AATF/NGICA cowpea effort will depend on careful attention to economic, trade and consumer issues. These include:

- input supply, particularly seed

- changes in farm/crop management following introduction and adoption of new cowpea technologies
- consumer acceptance of improved and GM cowpea varieties
- acceptance of GM cowpea in regional trade in cowpea.

## Major constraints

Several constraints influence successful cowpea marketing and trade. The major constraints identified are:

- market information – consisting of price information between countries, poor information in some countries, mainly outside the Nigerian grainshed
- consumer acceptance – poorly documented price and visual quality relationships information gaps are evident in the value placed on biochemical characteristics, including protein, sugar, cooking time (b) consumer reaction to GM crops
- barriers to trade – informal taxes and phytosanitary regulations
- seed sector – it is hard to make money on non-hybrid seed anywhere in the world. In west Africa this is affected by high transaction costs, substantial government involvement in seed production and weak seed certification processes
- pesticides – use of synthetic pesticides is costly and is associated with health and environmental risks due to misuse, lack of standard dosage rates for the use of botanical pesticides.
- high labour requirement – especially during cowpea harvest
- fertilisers – particularly phosphates.

## Opportunity to address constraints

A major opportunity to improve and create more impact on cowpea marketing and trade is through building socio-economic concerns into cowpea improvement from the beginning in the following areas:

- farming systems
- seed sector profitability
- consumer preferences and acceptance by trading partners.

## Approaches to be adopted

Specific approaches to achieve this will include the following.

- Helping to build a viable and profitable west African seed sector. *Bt* cowpea may have a large enough benefit to overcome the high transaction costs.
- Using information from consumer preference studies to help develop education programmes on GMOs for west African consumers.

**Product focus**

The product focus would be:

- *Bt* cowpea or other genetic improvement that radically changes cowpea economies, for example the kind of changes such as in hybrid maize that were introduced into maize systems
- All other activities that contribute to developing and deploying *Bt* cowpea for control of *Maruca* including:
  - contributing to cowpea seed systems development
  - responding to consumer concerns about GM cowpea
  - building regional capacities.

**Geographic focus and priorities**

The efforts will be made in a stepwise geographic expansion in the following pattern.

- 1<sup>st</sup> Nigeria cowpea grainshed
- 2<sup>nd</sup> Senegal cowpea grainshed
- 3<sup>rd</sup> eastern and southern Africa

The priorities identified by the Marketing and Trade Task Force are:

- cowpea seed sector studies
- consumer preferences studies
- farming system changes
- development of demand for processed cowpea.

**Milestones to be achieved**

Time line: Short term

**Year 1**

- Initiate seed sector study – build on Lambert et al study; key informant interviews in Nigeria, Cameroon, Mali and Burkina Faso; regional economic study and analysis of cowpea seed sub-sector
- Launch a study on consumer willingness to pay in Benin and Niger
- Collaboration with other scientists on areas such as storage extension, harvest mechanisation and demand for processed cowpea

**Year 2**

- Consultations with seed sector participants in the region on economic analysis; discussions with seed formal sector in west Africa such as Pannar Seed Co
- Consumer education based on concerns identified in willingness to pay study
- Collaboration with other scientists on areas such as storage extension, harvest mechanisation and demand for processed cowpea

**Year 3**

- Seed sub-sector conference
- Consumer education based on concerns identified in willingness to pay study

- Collaboration with other scientists on areas such as storage extension, harvest mechanisation and demand for processed cowpea

Time line: Medium term

**Year 4**

- Collaboration with other scientists on value added by varieties developed with marker assisted breeding, *Bt* cowpea, crop management changes and cowpea processing
- Collaboration with other scientists on economic issues and education related to cowpea technology

**Year 5**

- Incorporating pest geographical information in trade analysis given that there is only little *Maruca* in parts of the Sahel
- Collaboration with other scientists on economic issues and education related to cowpea technology

**Year 6 and 7**

- Initial *Bt* cowpea consumer testing with actual product-experimental economics
- Collaboration with other scientists on economic issues and education related to cowpea technology

Time line: Long term

**Years 8–10**

- Development of market for cowpea processed products
- Collaboration with other scientists on economic issues and education of the public in matters related to cowpea technology

Estimated costs of the different activities

Activity	Estimated cost (US\$)
Willingness to pay	40,000
Consumer education	NA
Seed sub-sector	100,000
Seed sub-sector conference	100,000
<i>Bt</i> cowpea consumer preference study	50,000
Trade analysis incorporating pest GIS	50,000
Capacity building	100,000
<b>Total</b>	<b>440,000</b>



## General discussion

- Participant:** The *Bt* cowpea seed will not be available for another seven years, is the TF timeline therefore not out of frame?
- TF:** *In four years, there will be at least some transformed cowpea plants available and this would be the period when the technology will kick in, to make it feasible to design consumer education. It is necessary to understand consumer perceptions before designing consumer education programmes, therefore obtaining early information on Bt cowpea will be very important.*
- Participant:** What kind of entity will be responsible for producing and disseminating the business/model *Bt* seed and how will market information be managed?
- TF:** *No new market information system will be created, rather the project will link up with existing systems from which data will be obtained for analysis.*
- Participant:** *Bt* is seven years away but the GMO controversy is now with us, is it therefore appropriate to ask questions about *Bt* acceptability at this early stage of development?
- TF:** *The results of studies on the potential benefits of Bt cowpea will provide useful information about how the technology fits into the entire project.*
- Participant:** Cowpea traders are not currently well organised, but they are all cereal traders. If the findings of the market study show that these cowpea traders need support to trade more effectively, how will they be assisted?
- TF:** *Successful models from other African countries can be adapted to deal with this issue.*

## Sub-project proposal: Trade and Marketing

### Enhancing livelihoods in Sub-Saharan Africa through integrated use of emerging cowpea technologies

#### Background

Global challenges for agriculture in Sub-Saharan Africa include food security and sustainable livelihoods for an increasing population while protecting the environment. The decreasing per capita food supply and increasing rural poverty require a substantial increase in agricultural productivity and improvement in marketing, trade and policy. To meet these goals, scientists, rural development institutions, the private sector and governments are challenged to develop and diffuse new technologies, make optimal institutional arrangements and policy decisions to increase agricultural productivity

and incomes for sustainable livelihoods. Cowpea can make a substantial contribution to food security and poverty reduction (incomes). This requires the promotion and diffusion of certified high quality cowpea seeds, the development and diffusion of cost effective and sustainable integrated pest management technologies, the development of trade and marketing of high nutritious and value-added cowpea processed products, and the empowerment through capacity building of public, private, NGO and cowpea-related organisations. Increasing cowpea productivity also requires the strengthening of collaboration and linkages with all key stakeholders in the cowpea sub-sector including the private sector.

## Objectives

1. To increase the contribution of cowpea to food security and enhanced sustainable livelihoods through integrated use of emerging technologies.
2. To provide socio-economic information to all stakeholders on the:
  - (a) constraints and opportunities of efficient input supply particularly high quality seed
  - (b) potential farm/crop management changes with new cowpea technology (*Bt* cowpea)
  - (c) consumer acceptance of improved and GM cowpea varieties
  - (d) potential for marketing and regional trade and the likely impact of GM cowpea on the different cowpea producing and consuming regions.
3. To build the capacity for national agricultural research and extension systems, NGOs and the private sector in developing, diffusing and assessing the impacts of new cowpea technologies.

## Deliverables

- Market plans for cowpea seed production and distribution.
- Information for business opportunities for cowpea grain and processed products.
- Well trained analysts in social sciences for informed decision making in rural development.

## Activities

- Seed sub-sector analysis with a focus on assessing the structure, conduct and performance of on-going and potential high quality seed supply and related capacity building. This information will help to build small seed enterprises and distribution networks.
- Collect and disseminate information and knowledge on consumers acceptance for improved and *Bt* cowpea products.
- Collect and disseminate information for investment options in cowpea marketing, trade and processing.
- Assess the potential impact of changes in farming systems, production and incomes linked to the wide diffusion of *Bt* cowpea and make recommendations to stakeholders and policy makers.

- Capacity building in marketing, policy and economics analysis of national research and extension systems including staff from rural development projects sponsored by USAID, IFAD, African Development Bank (AfDB) and World Bank.

#### Time frame for activities

##### ***Short term – 1–3 years***

- Study of the seed sub-sector
- Potential consumer acceptance of GM cowpea – willingness to pay
- Collect and diffuse information for investment options in cowpea marketing, trade and processing
- Capacity building in marketing, policy and economic analysis of national agricultural research and extension systems and NGOs

##### ***Medium term – 4–7 years***

- Prepare seed sector for radical change
- Consumer reaction to developed *Bt* cowpea
- Estimate value added by *Bt* cowpea
- Assess the potential impact of changes in farming systems, production and incomes linked to the wide diffusion of *Bt* cowpea and make recommendations to stakeholders and policy makers
- Capacity building in marketing, policy and economics analysis of NGOs, national agricultural research and extension systems

##### ***Long term – 8–10 years***

Build demand for processed cowpea products

#### Geographical focus

The project will use a geographical stepwise approach. It will focus first on the Nigeria cowpea grainshed and will be extended later to Senegal cowpea grainshed and then to eastern and southern Africa.

The Nigerian cowpea grainshed is the largest in Africa for cowpea production, trade and consumption. It covers Nigeria, Niger, Burkina Faso, Mali, Ghana, Togo, Benin and Cote d'Ivoire.

## Budget

Rough estimates of the costs of the various activities are shown below.

Activities	Costs (US\$)
A study on consumer willingness to pay	70,000
Consumer information/awareness	60,000
Seed sub-sector analysis	120,000
Seed sub-sector conference (information dissemination)	120,000
<i>Bt</i> cowpea consumer preference study	70,000
Trade analysis incorporating pest GIS	70,000
Capacity building – social scientists	110,000
<b>Total</b>	<b>620,000</b>
<b>Overhead (30%)</b>	<b>186,000</b>
<b>Grand total</b>	<b>806,000</b>

## Partners

The project will be carried out with partners in national agricultural research and extension systems, NGOs, rural development projects, private sector and farmer organisations. Complementary resources will be sought from rural development projects and other partners which can contribute to a large diffusion of improved cowpea technologies. Specific NARES include INRAB (Benin), INERA (Burkina Faso), INRAN (Niger), IAR and University of Bauchi (Nigeria), IER (Mali), ISRA (Senegal), SARI (Ghana), ITRA (Togo) and CNRA (Cote d'Ivoire).

## Methodologies

The seed sub-sector analysis will build on past studies and key informant interviews will be carried out in Nigeria, Benin, Cameroon, Mali and Burkina Faso with a regional economic analysis of the seed sub-sector (structure, conduct and performance analysis). Consumer willingness to pay studies will be the main framework for consumer acceptance assessment. Collaboration with other scientists in NARS will be key in lowering the cost of data collection. GIS will be used to incorporate geographical information on cowpea pests in trade analysis. Training courses will be organised for capacity building for public and private sectors and NGOs.

## Milestones

### Year 1

- Initiate seed sub-sector study – Build on Lambert et al study. Key informant interviews in Nigeria, Benin, Cameroon, Mali and Burkina Faso. Regional economic analysis of seed sub-sector – IITA, Purdue University and NARS

- Launch consumer willingness to pay study in Benin and Niger – IITA, Purdue University and NARS
- Collaboration with other scientists on storage extension, harvest mechanisation and demand for processed cowpea – IITA, Purdue University and NARS

#### **Year 2**

- Seed sub-sector – Consultations with seed sector participants in the region on economic analysis. Discussions with seed formal sector in west Africa, for example Pannar and SeedCo – IITA and Purdue University
- Consumer education based on concerns identified in willingness to pay study – IITA, Purdue University and NARS
- Collaboration with other scientists on storage extension, harvest mechanisation and demand for processed cowpea – IITA, Purdue University and NARS

#### **Year 3**

- Seed sub-sector conference – IITA and Purdue University
- Consumer education based on concerns identified in willingness to pay study – IITA, Purdue University and NARS
- Collaboration with other scientists on storage extension, harvest mechanisation and demand for processed cowpea – IITA, Purdue University and NARS

#### **Year 4**

- Collaboration with other scientists on value added by varieties developed with marker-assisted breeding, *Bt* cowpea, crop management changes and cowpea processing – IITA, Purdue University and NARS
- Collaboration with other scientists on economic issues and education related to cowpea technology – IITA, Purdue University and NARS

#### **Year 5**

- Incorporating pest geographical information in trade analysis – IITA, Purdue University and NARS
- Collaboration with other scientists on economic issues and education related to cowpea technology – IITA, Purdue University and NARS

#### **Year 6 and 7**

- Initial *Bt* cowpea consumer testing with actual product (experimental economics) – Purdue University, IITA and NARS
- Collaboration with other scientists on economic issues and education related to cowpea technology – IITA, Purdue University and NARS

#### **Years 8–10**

- Market development for cowpea processed products – Purdue University, IITA and NARS
- Collaboration with other scientists on economic issues and education related to cowpea technology – IITA, Purdue University and NARS

## Seeds Sector Task Force

### Members of the Task Force

Mohammad Ishiyaku – *Chair*

BB Singh

Jeff Ehlers

Ndiaga Cisse

Issa Drabo

The goal of this TF is to ensure delivery of improved cowpea seeds to smallholder farmers in Sub-Saharan Africa.

### Constraints

Cowpea seed production is constrained by a variety of factors including:

- lack of seed laws and biosafety regulations, even where they are available, enforcement of the laws is weak
- absence of systematic and efficient seed production and delivery systems
- poor access to credit and production inputs by seed producers
- low level of awareness by farmers of the benefits from improved, high quality seeds
- inadequate extension services to facilitate the distribution of cowpea seed
- poor infrastructure and financial conditions of NARS to produce breeder and foundation seed
- lack of sufficiently trained manpower in seed production and certification
- most farmers lack knowledge of improved seed storage technologies
- poor seed market information
- lack of efficient varietal release protocols.

### Challenges

Key challenges posed by these constraints were identified as:

- enactment/enforcement of seed laws and biosafety regulations
- raising awareness of farmers regarding the benefits of improved cowpea seeds
- increasing extension services activities in the distribution of improved cowpea seeds
- improving the training of extension persons
- strengthening NARS breeders in the production of nuclear seeds
- informing farmers of proper storage techniques
- linking farmers to seed markets
- developing efficient seed release protocols.

## Approaches to address the constraints

### Objectives of the programme

In order to address these constraints and the challenges that they pose, a programme consisting of eight main activities is proposed. The objectives of this programme are to:

- facilitate the enactment and/or implementation of seed laws and biosafety regulations
- strengthen the formal and informal seed distribution and marketing systems.

### Activities

#### ***Activity 1: Survey of existing seed laws and biosafety regulations in selected cowpea producing countries***

- Partners: AATF, ABSPII and WASNET
- Milestones: Comprehensive auditing of seed laws and biosafety regulations by February 2005
- Geographical area: Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

#### ***Activity 2: Regional workshop to create awareness among policy makers/private sector on biosafety***

- Partners: AATF and ABSPII
- Milestones: By February 2005, 25 persons will have been sensitised on biosafety
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

#### ***Activity 3: Training of extension staff and private industry in seed production and certification***

- Partners: AATF, NSS, NES and SeedCo
- Milestones: By December 2006, 25 persons will have been trained in seed production and certification in each country
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

#### ***Activity 4: Identify micro-credit schemes and link them with seed producers***

- Partners: Micro-credit schemes and smallholder farmers
- Milestones: By December 2005, at least 2 credit schemes identified and linked to five farmer groups in each country
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon



**Activity 5: On-farm demonstration of promising cowpea**

- Partners: NARS, NES, NGOs and farmer groups
- Milestones: By December 2005 at least 100 on-farm demonstrations of two cowpea varieties mounted
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

**Activity 6: Mass awareness campaign for importance of high quality seed/improved varieties through farmer field days and mass media**

- Partners: Mass media, NGOs, NSS, NES and SeedCo
- Milestones: By December 2005 at least one mass field day held and two radio and TV programmes aired in each of the target countries
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

**Activity 7: Catalysing production of breeder and foundation seed**

- Partners: IITA, CRSP and NSS
- Milestones: By December 2004 one ton of breeder seed of up to four varieties and by December 2005 20 tons of foundation seed produced in each country
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso and Senegal

**Activity 8: Provision of smallscale seed processing equipment**

- Partners: AATF
- Milestones: By December 2005 at least one thresher and one seed cleaning equipment acquired
- Geographical area: Ghana, Nigeria, Niger, Burkina Faso, Senegal, Mozambique and Cameroon

**General discussion**

**Participant:** What is the product focus for this programme?

**TF:** *The product focus is both improved and Bt cowpea seeds. In order to initiate this programme and move forward, it is necessary to use material that is already available through conventional breeding while awaiting the development of other materials such as Bt cowpea.*

*Improved cowpea varieties are produced but farmers are not informed about the availability of these varieties. The programme proposed will ensure access to improved cowpea seeds across Sub-Saharan Africa, production of seeds of improved cowpea varieties will be sustained through involving Farmer-Based Organisations (FBOs) in seed production, creation of markets for seeds and promoting seed enterprises for profitability. Participatory research for breeder and foundation seeds involving NGOs and farmer groups is encouraging and should be promoted.*

- Participant:** Mozambique features prominently in the geographical areas, what is the basis for selection of this country? Is it because of its trade interests in cowpea?
- TF:** *Mozambique expressed considerable interest in developing a cowpea programme although there is no cowpea breeding programme at present. The task force will re-organise the priorities and geographical focus of activities. Farmer education and biodiversity conservation will be emphasised.*

## Sub-project proposal: Seeds Sector

### To ensure delivery of improved high quality cowpea seeds to smallscale farmers in Africa

#### Overview

International centres such as IITA and other partners such as CRSP, in collaboration with NARS, have developed high yielding cowpea varieties with resistance/tolerance to some of the major constraints of production as well as with acceptability by farmers in Sub-Saharan Africa. Recent developments in cowpea transformation research suggest that varieties resistant to the legume pod borer may be developed. However, the already developed varieties and those to be developed are and will continue to be grown by only a handful of farmers who live close to research centres. This is mainly because of poor access by the majority farmers to the seeds of these improved varieties and/or unavailability of the seeds. Inefficient seed supply and marketing outfits with their attendant poor quality control regulation have made seed business, especially cowpea, unattractive for heavy investment. The seed supply sector, where it exists, is often based on non-sustainable structures evolving outside the real needs of the critical stakeholders – farmers. This is why several past efforts aimed at solving the seed problem were rendered ineffective in various countries on the continent. Formal seed marketing structures such as big seed companies, government-owned farmer supply companies, seed multiplying and distributing NGOs etc, do exist in some countries in Africa. However, these structures have not been able to address the seed constraint in most parts of Africa. In Nigeria, for example, formal seed companies provide less than 30% of cowpea seed required by farmers. These companies multiply seeds of one or two varieties popular in the immediate vicinity where the seed company is located. Only few well-to-do farmers patronise such products because the majority resource-poor farmers complain that these companies charge them unreasonably high price for the seed.

#### Objectives of the sub-project

- To facilitate enactment and/or implementation of seed laws and biosafety regulations.

- To strengthen the formal and informal seed dissemination and marketing systems.

## Deliverables

Efficient system for delivery of improved high quality seeds to farmers in Africa.

## Activities leading to deliverables

### *Activity 1: Survey of existing seed laws and systems as well as biosafety regulations for countries of the region*

- **Partners:** WASNET and INSAH
- **Derivable benefits:** Requisite information needed for development of a sustainable seed sector
- **Milestones:** By December 2004 a comprehensive audit of existing seed laws and biosafety regulations will have been compiled and countries where such laws are needed will have been identified and recommendations made to address the deficiencies
- **Budget:** US\$ 55,000

### *Activity 2: Sensitisation workshop for policy makers, seed service officials and private sector*

- **Partners:** NSS, NGOs and seed companies
- **Derivable benefits:** The importance of *Bt* cowpea and other issues understood fully by stakeholders
- **Milestones:** By December 2006 at least 25 officials of NSS, NGOs and seed companies sensitised on *Bt* cowpea and biosafety and resistance management
- **Budget:** US\$ 35,000

### *Activity 3: Training of staff in the enforcement of seed laws, certified seed production and in understanding biosafety regulations and the need to observe them*

- **Partners:** NGOs, private seed companies, informal seed sector and extension services
- **Derivable benefits:** Enhance quality control of seed delivery system
- **Milestones:** By February 2006 at least 25 staff of the seed certification agency, NGOs, private seed companies and members of the informal seed sector will have been trained
- **Budget:** US\$ 35,000

### *Activity 4: Identification of micro credit schemes and input marketers then link with seed producers*

- **Partners:** NGOS, finance institutions and seed growers
- **Derivable benefits:** Seed growers to have access to credit and input supply
- **Milestones:** By February 2005 at least two credit schemes and four input marketers identified and linked with seed growers

- **Budget:** US\$ 8,000

**Activity 5: On-farm demonstration of promising cowpea varieties**

- **Partners:** IITA, farmers, NGOs and ADPs
- **Derivable benefits:** Farmers will know about the potential benefits of improved varieties
- **Milestones:** By February 2004 at least 100 on-farm demonstrations of two varieties mounted
- **Budget:** US\$ 55,000

**Activity 6: Mass awareness creation on the availability, value and benefits of high quality seeds of improved varieties through field days, seed fairs, and television and radio broadcasts**

- **Partners:** NGOs, national extension service, farmers and mass media
- **Derivable benefits:** Importance of high quality seed and benefits of *Bt* cowpea appreciated
- **Milestones:** By December 2005 at least one mass farmers' field day, and two radio and television broadcasts on the importance and benefits of high quality seeds and biosafety issues concerning *Bt* cowpea conducted
- **Budget:** US\$ 12,000

**Activity 7: Catalysing of the production of breeder and foundation seeds of released varieties by NARs**

- **Partners:** IITA and state seed service
- **Derivable benefits:** The basis for certified production
- **Milestones:** By February 2005 up to one ton of breeders of 3–4 varieties produced. By February 2006 up to 20 tons of foundation seeds of up to four varieties produced
- **Budget:** Breeder seed US\$ 60,000 and foundation seed US\$ 110,000

**Activity 8: Provision of smallscale seed handling and processing equipment**

- **Partners:** AATF
- **Derivable benefit:** Processing of breeder and foundation seed will be enhanced
- **Milestones:** By February 2005 at least one thresher and one seed cleaner purchased
- **Budget:** US\$ 90,000
- **Source of funds:** AATF to lead in resource mobilisation

**Geographic strategy**

The seed sector sub-project will be concentrated first within the Nigerian grainshed – Nigeria, Niger, Mali and Burkina Faso then the Senegal grainshed and lastly the eastern Africa grainshed.

Budget summary

Activity	Amount required (US\$)
Survey of existing seed laws, systems, biosafety regulations	55,000
Workshop for policy makers, seed service officials and private sector	35,000
Training in the enforcement of seed laws, certified seed production, understanding of biosafety regulations	35,000
Identification of micro-credit schemes and input marketers	8,000
On-farm demonstration of promising cowpea varieties	55,000
Mass awareness creation	12,000
Production of breeder and foundation seeds	170,000
Smallscale seed handling and processing equipment	90,000
<b>Total</b>	<b>460,000</b>

## Field Constraints Task Force

### Members of the Task Force

Eugenia Barros – *Chair*  
 Jeremy Ouedrago – *Co-chair*  
 Larry Beach – *Rapporteur*  
 TJ Higgins  
 Phil Roberts  
 George Bruening  
 Ivan Ingelbrecht  
 Mike Timko

### Summary of recommendations

- Use the existing inbred lines to develop DNA markers linked to traits for which they have been selected, using conventional marker development technology.
- Use the technology based on the existing recombinant library that was constructed in a laboratory in the USA to develop a genome DNA marker set (breeders with molecular biology background could be trained to do this work by working in the laboratory where the work will be done).
- Transform cowpea with *Bt* gene to be obtained from Monsanto.
- Introgression of *Bt* gene from the transformed lines of cowpea breeding varieties of choice using MAS.
- Capacity building in the use of MAS in breeding programmes throughout cowpea growing areas and capacity building to do transformation of cowpea in one of the national centres.

### Overview of the problem

Big losses of cowpea grain occur in the field

- Parasitic plants cover substantial losses, *Striga gesneroides* and *Eletra*, being the main ones.
- Viral, bacterial and fungal diseases also lead to massive losses.
- Insects are the major cause of losses. Spraying cowpea with a soft insecticide can boost yields markedly.

### Challenges and opportunities

Insecticides are expensive, sprayers are required, few of them have been approved for use in food crops like cowpea, and they often are simply not available to farmers in many areas.

- Plant breeding has helped to ameliorate the cowpea pest problem, but some insect problems like *Maruca*, thrips and pod-sucking bugs have been recalcitrant

to traditional breeding – good resistance genes are scarce or lacking, especially for these insects.

- With the advent of biotechnology, there are new cellular and molecular tools to use in plant improvement, which help breeders address those constraints not easily amenable to conventional breeding approaches.
- Marker-assisted selection (MAS) – the discovery and use of molecular tags linked to specific valuable traits, offers a promising tool. For example it should be possible to identify markers linked to resistance genes to *Striga* and to use these markers in a cowpea breeding program to pyramid into cowpea or simply to introduce a single gene much more easily, avoiding slow and cumbersome bioassays.
- Genetic transformation to introduce novel sources of resistance into cowpea.

*Bt* genes will confer a high degree of resistance and can prevent the major losses *Maruca* causes in cowpea growing areas of Africa.

The field constraints TF will:

- review and prioritise targets for the application of biotech tools
- identify plans for specific activities in the area of MAS
- determine what needs to be done now to get a practical and useful transformation system in hand
- anticipate needs in terms of steps that can be taken to prepare the way for the adoption of *Bt* cowpea or any other GMO cowpea. Issues to consider include:
  - food safety
  - environmental safety
  - preservation of biodiversity.

## Task Force report

Cowpea plants are affected by insect pests, parasitic weeds such as *Striga*, viral, bacterial and fungal diseases, and plant parasitic nematodes. After harvest, cowpea grain may be lost to cowpea weevils and other vermin. Collectively, these biotic pests severely constrain cowpea yields or otherwise reduce the availability of cowpea as food.

Major constraints to cowpea production are:

- *Maruca vitrata*
- weevils (bruchids)
- parasitic weeds *Striga/Electra*
- pod sucking bugs
- thrips
- viruses
- bacterial blight
- fungal diseases: “brown blotch”
- drought/heat tolerance
- efficient nutrient uptake, for example P



- plant architecture
- dual-purpose.

## General technology to be applied

Conventional breeding	Marker-assisted selection	Genetic engineering
<b>Field constraints</b>		
Pod sucking bugs	Pod sucking bugs	<i>Maruca</i>
<i>Striga</i>	Weevil*	Weevil
Nematode*	<i>Striga</i> **	Viruses
Bacterial blight*	Aphids*	Efficient nutrient uptake, for example P
Fungal diseases: "brown blotch"	Thrips	Drought/heat tolerance
Drought/heat tolerance	Drought*/heat tolerance	
	Viruses	
<b>Other constraints</b>		
Dual-purpose	Dual-purpose	
Plant architecture	Plant architecture	
Nutritional quality		

### Key

- \* Indicates recombinant inbred lines (RILs) available for development of DNA markers (for viruses RILs only available for cowpea aphid borne mosaic virus, cowpea mosaic virus and cowpea severe mosaic virus)
- \*\* Closely linked DNA markers have been developed

## Challenges posed by constraints

Cowpea is a crop whose importance in the African context dwarfs the research attention it has received. For example genetic transformation, though advanced to the point at which achievement is within view, has not actually been achieved. A genetic map of cowpea has been developed and a bacterial artificial chromosome (BAC) genomic library is available, but DNA markers of the most valued co-dominant polymerase chain reaction (PCR) type are very few, and no expressed sequence tag (EST) copy DNA library has been prepared for cowpea. Conventional breeding of cowpea must be made more facile by advancing marker-assisted selection (MAS), particularly by providing access to, and the ability to discover, many more co-dominant PCR markers.

For those traits not available in domesticated cowpea, for example the all-important resistance against the *Maruca* bug, it appears that only transgene approaches are viable. Because genetic transformation of cowpea is only now being achieved, transgenic

approaches inevitably will extend beyond the 1–3 year period of phase 1 and into phase 2. In contrast, some aspects of MAS can be advanced by PCR marker deliverables that can be available within one year. When cowpea transformation becomes an available technology, MAS remains the method of choice for cowpea improvement for genes already available in some form in the cowpea pool, and MAS will be essential for the deployment of *Maruca* resistance and other new transgenic traits in elite cowpea cultivars.

Thus, genetic improvement of cowpea requires an integrated program that will simultaneously advance transgene introduction and MAS. Specifically, the TF proposes that the goal of facilitating MAS and transgene technology by developing valuable DNA markers, transforming cowpea to resistance against *Maruca* and for other traits, and applying MAS to the creation of elite cultivars bearing valued conventional genes and transgenes.

## Marker-assisted selection (MAS)

- MAS is poised to have an immediate impact on production and delivery of improved cultivars to the growers increasing food security and productivity.
  - Within 1–3 years markers for many major constraints can be made available (Horizon 1).
  - Within 3–5 years use of MAS can be integrated into breeding activities across cowpea breeding areas in Africa (Horizon 2).
- To establish effective MAS one requires improved marker development techniques as well as capacity building in both marker development and its application in breeding programs.
- As a general principle, it must be recognised that MAS will not be applicable in the absence of an unequivocal assay for the desired trait. The least developed assays are for pod sucking bugs and viruses.
- There is a need to establish an easily accessible database of advanced breeding populations that have been scored for various traits. These would be used for MAS testing and verification, and marker development.

### *Horizon 1 – MAS testing and verification*

Markers for *Striga* are the most developed.

- Markers exist for races 1 and 3, need testing/verification in 9 to 12 months.
- Markers are under development for race 2 and 4. This should be done in 12–18 months.
- Markers for race 5 exist but not the testable assay. This is expected in 6–9 months.

### *Horizon 2 – Marker development*

- Populations (RILs) segregating for many important traits already exist (*Striga*, root knot nematode, bacterial blight, weevil, CABMV, aphids and drought). Parents have been characterised, but the progeny lines have not all been scored.

- PCR-based co-dominant markers do not exist for most traits. A global set of >250 markers (one marker per <2Mbp of DNA; average of <5cM from any gene) is needed. The set can be rapidly screened to discover markers that are useful in cowpea breeding and can be exploited to generate closer markers (Appendix A). Annotation of R-gene data needs to be done on the existing BACs libraries. A one year program is proposed.
  - Obtain sequences of single ends from >5,000 members of the existing bacterial artificial chromosome (BAC) library [single nucleotide polymorphisms (SNPs) are too rare in cowpea protein-encoding sequences to expect to generate markers from cDNA libraries]
  - Primers for sequencing genomic DNA – discovery of sequences suitable for cleaved amplified polymorphism sequences (CAPS) and for other sequencing and CAPS primers to be distributed to AATF community members, including breeders.
  - PCR sequencing of genomic DNA from 2–3 parental types, 15,000 sequences
  - Robot time, bioinformatics and supplies
  - Technical assistance
  - Indirect costs (possibly partially or wholly avoided)
- Researchers at two sites in Africa to apply CAPS markers to two specific cowpea breeding goals of interest; travel to CAPS generating laboratory for training if necessary per diem (see Appendix A)
- Some breeders are already trained in the use of MAS in some African countries, for example Burkina Faso – Jeremy Ouedraogo; Ghana – Francis Padi; and Cameroon – Ousmane Boukar. Other breeders need to be identified in other regions/countries.
- In some of these countries the physical capacity can be easily strengthened to use MAS, but in many countries there is a need to develop capacity.

## Genetic engineering

- Transformation will be done in specific varieties that will then need to be back-crossed.
- IP and biosafety audits need to be done for each transgenic event which is expected to be released as a product.
- *Maruca* resistant cowpea (*Bt*)
  - Obtain *Bt* gene from Monsanto (soybean optimised sequence)
  - Construct expression cassettes and vectors (flower preferred promoter, 6m)
  - Transform large number of explants
  - Field testing and backcrossing
  - Seed increase for biosafety (done in parallel with field testing)
  - Environmental effects of gene flow (done in parallel with field testing)
  - Biosafety testing (done in parallel with field testing)
  - Integrated pest management studies (done in parallel with field testing)
  - Agronomic testing of transgenics, including efficacy of trait

- Variety registration
- Seed increase and distribution (done in parallel with registration)
- Farmer participatory education (done in parallel with release)
- The best long term approach to developing a *Maruca* resistant cowpea is one that incorporates two different genes that are effective against *Maruca*. Thus, another gene needs to be identified and incorporated in addition to the *cry1Ab* gene. This will reduce the likelihood of development of resistance.

## Cowpea transformation

The genetic engineering groups are confident that they will have a viable gene transfer system for cowpea. The new system appears robust and should be reproducible from lab to lab. At least two African laboratories will be capable of setting up the optimised transformation system. Training of Africans in transformation technology is anticipated via 12-month training periods in laboratories active in cowpea transformation.

### General discussion

**Participant:** The geographic focus of the TF activities is not clear, what would this be?

**TF:** *The geographic focus covers all areas in which Maruca affects cowpea.*

**Participant:** The budget needs more detailed elaboration. There is also need to re-structure the task force report to conform with the pattern in other TF reports.

## Sub-project proposal: Field Constraints

### Activity: Improved varieties

### Enhancing livelihoods in Sub-Saharan Africa through integrated use of emerging cowpea technologies

#### Introduction

Cowpea plants are affected by insect pests, parasitic weeds such as *Striga*, viral, bacterial and fungal diseases and plant parasitic nematodes. After harvesting, cowpea grain is often lost to cowpea weevils and other vermin. Collectively, these biotic pests and diseases, together with abiotic stresses like drought, severely constrain cowpea yields and reduce the availability of cowpea as food. To address these constraints, potential biotechnological interventions are proposed and prioritised.

For those traits not available in domesticated cowpea, for example cowpea resistant to *Maruca*, the transgenic route is the only viable approach to obtain the desired trait. A

cowpea transformation system is being developed for the introduction of *Bt* genes: this will result in the production of a cowpea variety that is resistant to *Maruca*. For those traits whose genes are already available within the cowpea germplasm pool, marker-assisted selection is the method of choice. DNA markers will be developed for specific traits using two different approaches – the inbred line approach and the genome-wide approach. MAS will be used to fast track backcross selection in both conventional and transgenic breeding.

### Objectives/goals

To produce superior-performing cowpea varieties that will be resistant to *Striga*, cowpea weevil, aphids, root knot nematodes, bacterial blight, cowpea aphid borne mosaic virus, *Maruca* and drought. These varieties will be made available to all cowpea breeders and subsistence farmers. Capacity building for marker-assisted selection will be developed in different regional centres. The capacity to genetically engineer cowpea will be developed at IITA and the University of Zimbabwe in the first instance. Selected aspects of genetic engineering will gradually be introduced to national centres to assist with its breeding programs.

### Development of DNA markers linked to specific traits using inbred lines

Recombinant inbred lines are available for the following traits: resistance to the cowpea weevil, aphids, nematodes as well as drought tolerance. These recombinant inbred lines are excellent material for marker development. Markers closely linked to the above traits will be developed using either the AFLP technology or the cDNA-AFLP technology, depending on the trait. Using AFLPs, a large number of loci is produced from a single assay with no requirement for prior sequence data. Using cDNA-AFLPs, a large number of differentially expressed transcripts (ESTs) is produced. The markers will be converted to SCARs, or other forms that are easily applied in MAS. This work will be done in South Africa at CSIR. This work could be shared with other laboratories that offer a similar marker development technology using inbred lines.

*Striga* markers have been developed for races 1 and 3 and need to be verified in segregating populations. Markers are being developed for races 2 and 4. For race 5 markers are available but the testable assay is under development. This work will be done in the USA at University of Virginia using the existing technology.

### Development of a genome-wide DNA marker set

A set of 600 co-dominant DNA markers and rapid screening techniques will allow breeders to obtain markers that are on the average within 3cM of their locus of interest.

**1. Obtain >600 DNA markers**

12,500 BAC single-end sequence reads and PCR sequencing of parental lines is expected to reveal >600 co-dominant markers of the simple sequence repeat (SSR) and cleavable amplified polymorphic sequence (CAPS) types.

**2. Place 600 DNA markers on the cowpea map**

Map the 600 markers on an existing cowpea map using available recombinant inbred lines. Select a 60-marker uniformly distributed “signpost” subset. Distribute subset and the remaining >540 primer pairs to the cowpea research community.

**3. Select markers most closely associated with loci of interest to breeders**

Using DNA bulks segregated for their traits of interest, African cowpea breeders identify the most closely associated signpost markers. These results to direct analysis of a few map-selected markers out of the >540 primer pairs and identification of those markers in the entire >600 set that are most suited to MAS of the trait of interest.

**Genetic engineering of cowpea with *Bt***

Selected cowpea varieties will be transformed with *Bt* gene using *Agrobacterium tumefaciens*. This work will be done in Australia at CSIRO. Current research is focused on the development of an efficient genetic engineering (transformation) system using model genes and different selectable marker genes. The next phase is to obtain and re-construct two *Bt* genes with different mechanisms of action so that they will be expressed in flowers and young developing pods of cowpea.

**Intellectual Property Rights (IPR)**

In order to address legal and regulatory issues a preliminary intellectual property list has been assembled and it needs to be formulated fully in order to secure the freedom to operate (FTO). The AATF Legal Counsel in collaboration with an outsourced law-firm will carry this out. The external law firm will perform an extensive search and determine what needs to be negotiated and what will already be in the public domain. Furthermore it will determine the constraints under which the African countries can access the IP and offer advice on how to proceed. Additionally, this IP list needs to be subjected to a biosafety audit in order to look at issues such as: conditions for contained use; field trials; commercial approvals, food and feed safety; environmental impact; socio-economic impact and molecular characterisation of the transgenic materials thereof. A biosafety plan will be developed and implemented.

**Introgression of genes using MAS**

The *Bt* gene that will be initially introduced into a transformable cowpea line will be introduced into the other cowpea varieties and local cultivars by backcrossing and making use of MAS. This work will be done in the identified regional centres where capacity is available and the resistance to *Maruca* is required.



## Capacity building

### 1. Use of MAS in breeding

- Provide cowpea breeders with molecular markers linked to traits of interest.
- Provide several West Africa cowpea breeders with training on the use of markers in MAS.
- Where needed, provide several cowpea-breeding facilities with equipment for MAS: PCR thermocycler, capabilities for rapid cowpea DNA purification, gel electrophoresis apparatus, gel documentation instrument.
- Train breeders to apply bulk-segregant analysis using the subset of 60 primer pairs to identify markers most closely associated with their loci of interest (crude mapping).

### 2. Use of transformation techniques

- Transformation system will be transferred to the IITA lab at Ibadan and the Biochemistry Department at the University of Zimbabwe where additional genes will be introduced to cowpea germplasm.
- Selected aspects of the genetic engineering protocols such as analysis of the transgenic plants needed for backcrossing programs will be transferred to additional African labs on an as needed basis. This will overlap with and complement the capacity building in MAS breeding.

### 3. Intellectual Property Rights

- Collaborating partners will be trained in IPR during the course of the year, preferably as a satellite meeting during a workshop
- Biosafety regulatory framework will be enhanced through collaboration with existing initiatives in the region (Program in Biosafety Systems, PBS).

## Deliverables

Improved cowpea varieties resistant to *Striga*, cowpea weevil, aphids, root knot nematodes, bacterial blight, cowpea aphid borne mosaic virus, *Maruca* as well as drought.

Molecular markers linked to the above traits that will enable the efficient selection of newly bred cowpea plants produced from the donor varieties by backcross breeding. These markers will enable gene pyramiding of more than one trait in one variety.

Trained breeders in MAS, including the deployment of transgenic varieties, with the ability to convert their local varieties into improved varieties by backcross breeding.



## Milestones and time frame

### Horizon 1: Short term (1 to 3 years)

#### **1-Development of DNA markers linked to specific traits using inbred lines**

##### Milestone 1

- *Striga* markers.
- *Striga* markers for races 1 and 3 → 9 to 12 months
- *Striga* markers for races 2 and 4 → 12 to 18 months
- *Striga* markers for race 5 → 6 to 9 months

##### Milestone 2

- Markers (single trait) linked to specific traits using the cDNA-AFLP technology.
- Markers (single trait) linked to weevil, aphids, root knot nematode, bacterial blight, cowpea aphid borne mosaic virus and drought → 12 to 18 months.

##### Milestone 3

Training of breeders to implement MAS in their breeding programmes at regional and national centres or even in other African labs like CERASS (Senegal) and CSIR (South Africa) → 24 to 36 months.

#### **2-Development of genome-wide DNA marker set**

##### Milestone 1

A set of 250–300 CAPS markers distributed across the cowpea genome that could be potentially used in MAS, using the CAPS technology → 12 months.

##### Milestone 2

Linkage of the above set markers to specific traits using the inbred lines available for resistance to weevils, aphids, root knot nematode, bacterial blight, CABMV and drought → 12 to 24 months.

#### **3-Genetic engineering of cowpea with Bt**

##### Milestone 1

Obtain *Bt* gene from Monsanto or other providers and construction of expression cassettes and vectors → 6 months.

##### Milestone 2

Transformation of *Bt* genes into a large number of cowpea explants from specific transformable varieties → 24 to 36 months.

4- Introgression of genes using MAS

Milestone 1

Backcrossing of *Bt* transformed cowpea varieties into local varieties using MAS  
→ 30 to 36 months.

Horizon 2: Medium term (3 to 6 years)

Milestone 1

Environmental effects/gene flow studies while field-testing *Bt* cowpea varieties done in different countries in parallel → 3 to 4 years.

Budget summary

Activity	Amount required (US\$)	Comments
Development of <i>Striga</i> markers	120,000	
Global markers	635,000	For development of >600 DNA markers and providing marker sets to African cowpea breeders in a two-year effort
Capacity building	400,000	
Development of markers	350,000 (@ 50,000/marker)	The markers to be developed are those linked to weevils, aphids, root knot nematode, bacterial blight, CABMV and drought using RILs (recombinant inbred lines) and verification of the markers
Transformation	1,570,000	
IPR	139,000	
<b>Total</b>	<b>3,214,000</b>	

Annex to Field Constraints TF report

Proposal for development of a global set of cowpea CAPS DNA markers for marker assisted breeding (MAS)

A global set of co-dominant DNA markers, covering the cowpea genome, is needed to accelerate the application of MAS to numerous cowpea breeding efforts, including gene pyramiding and selection for single and multiple recessive genes. CAPS are PCR-based DNA markers that are co-dominant. A co-dominant marker is more reliable than a dominant DNA marker (which is interpreted as a PCR product versus a non-PCR product) because absence of the PCR product may result from a PCR failure as well as from absence of the marker in the DNA template.

CAPS reactions are easy to perform, requiring only the materials and instruments (PCR, electrophoresis and restriction enzymes) that are typical of other DNA marker assays. The target sequence is amplified by PCR from genomic DNA, and the PCR product is incubated with a restriction enzyme targeted to the polymorphic sequence. After gel electrophoresis of the incubated PCR product, the pattern for each DNA template is scored as representing cleaved or un-cleaved product.

The TF proposed an AATF-approved near term (1–3 years) project in which a set of 250 or more CAPS DNA markers (PCR primer pairs) would be prepared, corresponding to one CAPS marker per 2Mbp or less of cowpea DNA on the average and one CAPS marker per 10cM on the average. The primers should be made available to the cowpea research community. The CAPS markers would not be selected for their close association with any particular gene but would be a community resource of randomly distributed markers available for screening DNA from any polymorphic cowpea population. The source for discovering the CAPS markers will be a cowpea BAC (bacterial artificial chromosome) genomic library. A cowpea cDNA library will not have a sufficient frequency of polymorphisms.

*Approach to preparation of CAPS markers.* If a BAC library were to be the source of the CAPS markers, 4,000 or more BAC single end sequences of 600 or more bp would be determined. Four thousand BAC end sequences are expected to yield 250 CAPS, based on the frequency of single polynucleotide polymorphisms (SNPs) in cowpea. The determined sequences would direct the synthesis of 4,000 primer pairs. These primer pairs would be tested with genomic template DNA from 2–4 cowpea parental lines in a search for polymorphisms suitable for cleavage by a restriction endonuclease, seeking >250 restriction polymorphisms.

The preparation of 250 CAPS markers (500 primers) would require robot use, sequencing of BAC ends and PCR products, bioinformatics management and analysis of sequences, synthesis of 9,000–10,000 primers (including high scale synthesis for CAPS primers to be distributed), PCR reagents, restriction endonucleases, various supplies and technical assistance. The deliverables at this stage in the project will be annotated cowpea genomic sequences filed to public databases (for example NCBI), and CAPS primer pairs distributed into three 96-well plates and made available to interested AATF members at no charge for the first set. Additional CAPS primer sets to AATF members and sets to other qualified investigators would be made available at the cost of synthesis, plating, handling and shipping of the primers.

With contingencies for failed sequences and re-synthesis of some primers, and at the proposed scale of 250–300 CAPS, the cost for preparing the set of primer pairs is estimated to be about US\$ 250,000 to US\$ 300,000 exclusive of indirect costs of about US\$ 1,000 per CAPS marker. This is significantly less than the typical cost of discovering RAPD, AFLP and other markers and converting them to co-dominant, single-product-priming markers (>US\$ 40,000). The project period should be one year, but the CAPS primers would be available within 6–9 months of initiating the project.

*CAPS marker demonstration project.* To encourage greater application of MAS and the value of the CAPS markers in cowpea breeding, one or more actual cowpea breeding problems are to be selected and addressed. It is preferable that this part of the project be carried out in Africa, with a training component or other capacity building component. We present here an example of a search design capable of identifying CAPS markers located as close as 1cM from a particular trait. DNA would be prepared from 96 F2 cowpea progeny that had been scored unequivocally for the trait in question. The F2 DNAs would be pooled in 12 sets of 8 for “bulk segregant analysis”. The 250 CAPS primer pairs would be used in 14 PCR reactions, using the 12 “bulks” and DNA from the two parents. Products are analysed by gel electrophoresis. Primer pairs that give rise to patterns most closely correlated with the pattern seen for the trait-positive parent, that is for the greatest proportion of bulks would be tested on all 96 progeny DNA samples individually. From the results, the approximate distance of the marker from the trait-specifying gene would be calculated in cM. Where the scored F2 progeny already are available, identification of linked CAPS markers could be done at a cost of a few thousands of dollars per trait.

*Other outcomes.* The >4,000 BAC end sequences and polymorphisms to be identified and made publicly available as outcomes of the proposed project are deliverables of value both generally in cowpea research and for the development of non-CAPS DNA markers. The value of the cowpea CAPS markers themselves would be increased substantially by their location on the existing cowpea genetic map and eventually by their assembly into a physical map. When prepared as suggested here, each CAPS marker already is mapped to a BAC. Genetic and physical mapping of the CAPS markers could be an expanded and longer-term part of this proposed project. However, we believe the mapping should be a distributed and community effort. Recipients of the CAPS primer set should pledge to make results of utility in mapping available on the AATF website as soon as possible after they become available.

## Intellectual Property Task Force

### Members

**Idah Sithole-Niang** – *Chair*  
**Eugene Terry**  
**Ed Southern**  
**Patricia Kameri-Mbote** – *Rapporteur*  
**Joe Huesing**  
**Walter Alhassan**

### Summary of recommendations

AATF to secure IP position

- FTO
- Ownership

AATF to deal with liability

- AATF legal status
- Insurance

AATF to work on Biosafety plan

- Biosafety audit
- National capacity building

Agree on project management plan

- Networks and linkages

This Task Force defined legal issues as covering all aspects of contractual, regulatory and IP issues related to proprietary technology and non-proprietary technology (chemical, mechanical or biological) as they relate to the cowpea productivity and utilisation project.

### *How and who to manage particular aspects of the project*

The overall management of the project should be interpreted to mean: reporting, monitoring and dissemination of information regarding progress in this project. Among the instruments to use will be:

- overall project coordinator and individual principal investigators for the specific aspects of the project
- organising stakeholder meetings to review progress made
- website
- annual general stakeholder meeting and meeting of coordinators as progress tracking mechanisms); [the Bean/Cowpea Collaborative Research Support Program (B/C CRSP), the Network for the Genetic Improvement of Cowpea for Africa (NGICA); AATF; Consultative Group on International Agriculture Research (CGIAR) Centres; Sub-Regional Organisations (SROs); National Agricultural Research Systems (NARS); National Agricultural Research and Ex-

tensions (NAREs); Kirkhouse Trust; IP holders; international funding agencies, Non-Governmental Organisations (NGOs) and other biotechnology support programmes); and articulation of stakeholders

- group mandated with the task of management of genetic manipulation, modification and transfer.

#### ***Other proprietary technology relating to the project***

- Genes and constructs:  $\alpha$ -amylase inhibitor gene; *galactinol synthase*; *Bacillus thuringiensis* toxin gene and vectors
- Methods: agrobacterium-mediated and biolistics transformation
- Marker assisted technologies including novel genes and methods of detection

Liability, FTO, ownership, biosafety as described for *Bt* relate to the above.

#### ***IP generated in the project***

- The arrangements for ownership of IP developed in the project will recognise the rights of the organisation to which the principal investigator is affiliated.
- There will be an expectation that the institution will grant a royalty-free license to AATF for exploitation of the technology in Africa.

#### ***Other IP issues***

- IP awareness critical.
- IP group recommends that there be IP training for project partners.

#### ***Problem overview***

- Need to secure FTO for *Bt* cowpea.
- AATF needs to define its IP statement.
- Regulatory plan: Understand regulatory landscape and tailor the AATF to work towards that.
- The AATF needs to participate in developing regulatory systems.

#### ***Major constraints***

- Freedom to operate: formulate an IP plan in order to ensure that FTO is fully secured.
- Ownership.
- Liability.
- Biosafety: Formulate an insect resistance management plan.
- National regulatory capacity in terms of human resources; infrastructure and absence of legislation.

#### ***Approaches to addressing the constraints, potential partners and networking arrangements***

- Freedom to operate: Formulate IP plan.

- Ownership: Formulation of negotiation strategy.
- Liability: Subject to liability regimes in different countries. Richard Boadi of AATF to look at incorporation agreement for AATF.
- Biosafety audit: Conditions for contained use; field trials; commercial approvals; food and feed safety; environmental impact; socio-economic impact and molecular characterisation; conclusion of the biosafety audit.
- National regulatory capacity: Network connections with regional and sub-regional organisations such as UNECA, NEPAD, ASARECA, CG centres, NARS, NARES and universities.

### ***Opportunities available now or in the future to address the constraints***

- Freedom to operate: Process towards providing substantive response to select technology request(s) is progressing well.
- Collaboration: The way the AATF is structured provides an opportunity to broker collaboration across a wide range of stakeholders; including the private sector for technology generation. AATF provides the mechanism for management of individual project IP portfolio.
- Liability: This pilot project will provide an opportunity to contribute to ongoing liability framework/regulation development in partner countries.
- Biosafety audit: This pilot project provides an opportunity to develop and test a realistic template of the biosafety regulatory framework in collaborating countries.
- National regulatory capacity: This and other pilot projects will provide a realistic opportunity for regional and national capacity building in biosafety framework development and implementation.

### ***Benefits derivable from alleviating the constraints***

The categories of beneficiaries are primary, secondary and tertiary.

- Freedom to operate: This covers a wide range of users across the entire value chain especially scientists.
- Ownership: AATF, collaborating institutions and breeders.
- Liability: AATF, IP holders/donors, sublicensees.
- Biosafety audit: Public, scientists, policymakers, AATF and all other stakeholders.
- National regulatory capacity: Public, AATF, policymakers, scientists, regulatory agencies and resource-poor farmers.

### ***Milestones and time frame***

- Freedom to operate for *Bt* cowpea
  - (a) Identification and audit of IP needs
  - (b) Review of IP required and identification of IP holders (4–6 weeks)
  - (c) Formulate and finalise the IP plan (6–8 weeks)
  - (d) (i) Approach technology holders  
(ii) Agree on Heads of Terms  
(iii) Draft License agreements (6–12 months)
  - (e) Sign agreement (4 weeks after draft agreement)



- (f) Transfer/acquisition of technology
  - Ownership: N/A
  - Liability: N/A
  - Biosafety audit
    - (a) AATF to consult Muffy Koch/NGICA on results of the biosafety audit (4 weeks)
    - (b) Consultation between AATF and appropriate bodies for identification of the biosafety requirements for this project (8 weeks)
    - (c) Development of biosafety plan
    - (d) Implementation of biosafety plan
  - National regulatory capacity, here the geographical focus will determine timeline

### *Estimate cost of approaches and potential funding sources*

Activity	Party	Cost (US\$)
Freedom to operate		
1. IP audit	Law firm	9,400.00
2. IP plan	AATF	
3. Negotiation strategy	AATF	100,000.00
4. Draft agreement	AATF and law firm	
5. Negotiation and agreement	AATF and law firm	
6. Signing agreement	AATF	
7. Consultancy costs	Consultants	100,000.00
Subtotal for FTO		209,400.00
Ownership		
1. Negotiation	Law firm to law firm	3,000.00 per case
2. Licensing	AATF	3,000.00 per case
Sub-total for ownership		6,000.00 per case
Liability		
Insurance	AATF	15,000.00 per year
Sub-total for liability		15,000.00 per year
Biosafety		
1. Biosafety audit (identification of biosafety requirements)	Consultant	12,000.00
2. Consultation with appropriate regulatory bodies	AATF	2,000.00
3. Development of biosafety plan		12,000.00
4. Implementation of biosafety plan		
• Acquisition and creation of containment facility	AATF	
• Miscellaneous	AATF	
• Outreach	AATF	
• Presentation and cost for staff	AATF	20,000.00
Sub-total for biosafety		46,000.00
Capacity building		
IP training	AATF	30,000.00
Sub-total		30,000.00
Grand total		306,400.00

**IPR needs for molecular genetic improvement of cowpea**

A preliminary IPR audit of all the technologies currently being used in the genetic engineering of cowpea has been prepared. Included are the names of at least some of the institutions that may have some claims to the technology. This preliminary audit does not purport in any degree to establish the validity of those claims. Briefly, the components for which IPR is needed can be divided into:

- *Agrobacterium* mediated gene transfer for dicots, in particular cowpea – Bayer Crop Sciences (BCS)
- binary vectors (Syngenta)
- selectable marker genes and their promoters (BCS and CSIRO)
- insect resistance genes and their promoters (Monsanto, Syngenta and Dow Agro Sciences)
- other genes such as those involved in energy (galactinol synthase – DuPont)
- enabling technologies (RNAi – Syngenta and CSIRO).

Discussions are at an advanced stage with Monsanto Company for one insecticidal gene (*cry1Ab*) and with CSIRO for one selectable marker gene and RNAi technology. Discussions should be initiated with Bayer Crop Sciences for access to the *Agrobacterium* gene transfer system and for one selectable marker gene. Likewise, discussions should be initiated with Syngenta for binary vectors and RNAi technologies and for a second insecticidal gene (*vip3A*) for control of *Maruca*. Dow Agro Sciences is also a possible source of a second insecticidal gene (*cry1F*) and DuPont is a source for Galactinol Synthase.

The statement of the McKnight Foundation on IP was suggested as one that might be adopted by AATF or one that might work for the project (see Annex VI).

**Annex to IP Task Force report****Biosafety review of the constructs to be used in the cowpea insect tolerance project****General**

The project needs to subscribe to a high level of biosafety integrity and practice. Movement of genetically modified biological strains, tissue culture material and planting material may all require an advanced informed agreement (permit/letter) from the receiving country. In general, developed countries do not require this for research materials, but some developing countries do. Greenhouse trials, field trials, commercial releases and commodity imports mostly require permits.

Permit reviews, especially for new crops, may take many months; this needs to be worked into the project planning. For example in South Africa, even with a fairly experienced review process, seven months and two sittings of the decision makers are

allowed for field trial approvals and permit issue. This gives enough time to address additional information needs without missing the planting date for the crop.

## Genetic elements

Element	Previous commercial approval
Vector backbone (pPZP200)	Not found
<i>CaMV</i> 35s promoter	Approved
<i>bar</i> – phosphinothricin tolerance	Approved
ocs terminator	Approved for trials
SCSV1 promoter – subclover stunt virus1	Not found
<i>nptII</i> – neomycin antibiotic marker	Approved
SCSV3 terminator	Not found
PHA-L prom, bean phytohemagglutinin L gene promoter, seed specific expression	Not found
$\alpha$ -AI-1 – bean $\alpha$ -amylase inhibitor 1 gene	Not found
PHA-L term, bean phytohemagglutinin L gene terminator	Not found
<i>Vsp2</i> prom – <i>Arabidopsis</i> vegetative storage protein promoter	Not found
<i>Cry1Ab</i> CDS – from MON810 event	Approved
<i>vic</i> term – pea vicilin gene	Not found

## Contained use

The biological activity of the amylase inhibitor gene was not specified, but needs to be assessed for possible negative impact on human health in the lab. It is also necessary to assess mobility of the genes, if accidentally released from the contained facility and possible negative environmental impact of accidentally released GM strains.

The biological activity and human and animal safety of the *cry1Ab* gene are well understood. Possible negative environmental impact of accidental release of the gene will need to be assessed. This risk assessment, including accident clean up procedures, may need to be documented.

## Field trials

Approval for the field trials will need information on:

- sexually compatible wild relatives
- pollination range and pollinator activity in the release area
- confinement conditions to minimise pollen flow
- mechanisms to prevent seed distribution

- procedures for monitoring and destruction of volunteers
- recommendations on land use following the trial.

### Commercial approval

The regulators will look closely at all elements that have not received previous regulatory approval. The questions that will be asked are as follows.

- Might this element facilitate the development of new plant pathogens?
- Might this element enhance mobility of the gene in and between organisms?
- Might this element enhance instability in the gene or genome?

Full molecular characterisation will be needed for varieties that are commercialised, including:

- copy number
- insert characterisation
- unintended fragments
- insert position
- additional, non-functional DNA in the insert
- gene stability
- expression levels in tissues and with time
- biological activity of the new proteins
- any other requirements raised by these genes in this crop.

Food and feed safety data will need to be collected for all new, expressed proteins. These data will include:

- toxicology studies
- digestibility
- allergenicity
- nutritional changes, including endogenous anti-nutritional factors
- unintended effects
- processing changes
- any other concerns raised by these genes in this crop.

Many of these require comparison with statistical standards in the conventional crop. Are these baseline data available? Some whole food studies may be required.

Environmental impact of the GM crop will need to be assessed. This will include:

- the stability of the gene in the field
- the likelihood and consequence of gene flow (especially important for GM crops released in their centre of origin)
- ecotoxicity studies and impact on non-target organisms
- impact on weediness
- impact on invasiveness
- impact on biodiversity (natural and agricultural) in the release area

- impact on non-living components of the release environment, for example air, soil and water.

*Socio-economic impact:* will be carried out by the national review process. This will include:

- comparison of the benefits of the new crop with respect to the needs of the target group, the current farming practices and other available technology
- accessibility of the technology to farmers, that is technology delivery
- sustainability of the technology in the target areas
- changes in traditional practices
- impact on culture
- marketability of the new product, including impact on trade
- acceptance of the new product in the target communities (variety, flavour, taste and ethics)
- input costs (affordability) and dependence on suppliers of planting material
- reduced use of agrochemicals.

## Conclusion

The project needs to consider biosafety requirements from the outset. Timely assessments, for example early allergenicity reviews will prevent a waste of money and effort on technology that will not receive regulatory approval in the near future. Planning and anticipation will ensure a smooth flow of technology development unhampered by regulatory delays.

## General discussion

**Participant:** Is IP focused on conventional transformation or on MAS as well?

**TF:** *Activities will include MAS.*

**Participant:** Would conventionally bred cowpea require IP protection in the long run?

**TF:** *Yes the TF will rephrase the report to reflect this issue.*

**Participant:** To what extent will all the materials developed go into the public domain?

**TF:** *The process will involve protection of the organisation that developed the material as the owners of the technology, before considering other potential beneficiaries.*

**Participant:** What would be the pattern of funding and what would be the role of AATF?

**AATF:** *The approved AATF funding pattern will be adopted, in which AATF funds 75% of the project formulation costs and 25% of project implementation costs.*

**Participant:** In IP projects, what are the merits of joint ownership against royalty free arrangements for the technologies generated?

**TF:** *Royalty-free option rather than joint ownership is preferred. However, it is important to understand the implications of joint ownership arrangements.*

## Storage and Utilisation Task Force

### Members:

Larry Murdock – *Chair*  
 Esther Sakyi-Dawson – *Co-Chair*  
 Francis Padi – *Rapporteur*  
 Ousmane Boukar

### Summary of recommendations

#### Storage

- Create storage IPM technologies appropriate for individual project sites.
- Disseminate these IPM packages through training, for example Farmer Field Schools (FFS) model, training of trainers programmes with partners.
- Use of public communications channels such as radio, TV and pamphlets.
- Link to other project components – seed production, field IPM, marketing and trade.

#### Utilisation

- Carry out a participatory needs and opportunities assessment at the outset of the project area(s).
- Fostering value-added products through promotion of cowpea traditional foods, for example weaning foods and cowpea flour, especially targeting urban markets.
- Creation of smallscale cowpea processing businesses which may evolve into larger businesses, for example company of women who manufacture, package and market cowpea based products locally and to urban markets.
- Facilitate where possible linkages between producers and largescale business, for example Nestle.
- Provision of training for associated packaging technologies both equipment and materials.
- Assistance for access to larger markets.
- Facilitate access to inputs.
- Guidance is needed in deciding which cultivars to select for project activities.
- Possible use of credit with education programmes for training purposes.

#### Overview of the problem

- Loss of grain/seed in storage to bruchids resulting in economic and nutritional losses.
- Inadequate availability of value-added cowpea products resulting in less opportunity for income generation and improved nutrition.



## Major constraints

Some key constraints seriously affect effective storage and utilisation of cowpea, these include:

- inadequate dissemination of storage and utilization technologies – inadequately structured systems/ fora for technology transfer
- inadequate resistance genes for cowpea bruchids
- lack of information about the potential value of cowpea utilisation technologies
- input availability – capital, raw materials and equipment
- lack of markets for existing products – inadequate information about demand for cowpea products.

## Challenges and opportunities

These constraints pose interesting challenges and offer opportunities for minimising them.

### *Challenges*

- Inadequate resources such as appropriate cultivars, equipment, capital, physical inputs, training, market information.
- Resistance to change in food habits.
- Creating balanced awareness of future biotechnology products.

### *Opportunities*

- Existence of several storage IPM technologies.
- Availability of food processing technologies – fortification of traditional foods, cowpea flour production technologies suitable for smallscale entrepreneurs.
- Experiences from existing Farmer Field Schools.
- Development of cowpea varieties with traits suitable for specific food uses, for example white eyed cowpea, sweet cowpea and green cowpea.
- Possibility of the development of transgenic cowpeas using the alpha-amylase inhibitor gene.

## Approaches

Project activities will be designed to provide:

- training on storage technologies
- access to inputs
- access to appropriate equipment
- market information
- training on value-addition technologies
- identification or development of cultivars with traits suitable for specific food uses
- Potential partners to be identified; to include NGOs, FAO, universities, NARS, Bean/Cowpea CRSP, IITA, AATF and NGICA

- Networking through webpage, email, newsletters and personal contacts.

### Benefits derivable from project implementation

- High quality seed for farmers will lead to higher yields hence increased income and better nutrition.
- Better access to markets.
- Access to more capital.
- Supply of better quality grains to traders therefore higher incomes.
- Consumers (rural and urban) will have better quality grains.
- Increased product base of cowpea products can lead to more utilisation and better nutrition.

### Milestones

- Achievement of the socio-economic assessments (needs assessment and participatory input from end users, 3–6 months)
- Assembly of appropriate packages of technologies (1 year)
- Farmer Field Schools in storage IPM technologies (year 2 and 3)
- Creation of core value-added business plan (18 months)
- Implementation of business plan (2–3 years)

### Task Force report

Cowpea grain is severely afflicted by a stored grain pest, the cowpea weevil or cowpea bruchid.

Harvested grain comes into the granaries on the farms in Africa with a very low level of infestation, for example a few seeds out of 1,000 are infested in the form of an egg on the harvested cowpea pod or a larva in the seed. Cowpea bruchid larvae develop rapidly and produce adults that immediately mate and produce 20–40 eggs. This rapid cycle of reproduction can cause serious losses within 2 or 3 months. Within a few months the store can be completely lost – unless measures are taken to prevent the loss.

Plant breeding has had a measure of success in stemming the losses. There is a single known source of resistance discovered by IITA scientists about 30 years ago in a landrace of cowpea called TVu2027. Unfortunately this resistance is moderate and only slows the development of severe infestation – the resistance is said to “break down” with time.

New and better sources of bruchid resistance are needed. The  $\alpha$ -amylase inhibitor gene from common bean can be used to produce bruchid resistance.

It has been discovered that the  $\alpha$ -amylase inhibitor gene into garden pea – the gene transfer essentially renders the garden peas immune to cowpea weevil damage.

But this  $\alpha$ -amylase inhibitor gene is not in cowpea yet because cowpea cannot be transformed. Moving the  $\alpha$ -amylase inhibitor gene into cowpea would be equivalent to moving a gene from one edible food legume to another edible food legume.

However, it has been discovered that combining the  $\alpha$ -amylase inhibitor gene with that of the TVu2027 resistance would create a cowpea that one could store for a year easily. This would solve the storage problem.

In addition to biotechnology, CRSP projects in Senegal and Cameroon have devised a series of simple, low-cost technologies that stop cowpea weevil infestations.

- Storage of cowpea grain in sealed metal drums using hermetic sealing – it works by O<sub>2</sub> exhaustion.
- Storage of the grain in triple plastic bags.
- Solar disinfestation – use of the sun's rays to heat the grain to 60°C or higher, which kills all stages of the cowpea weevils. If this grain is then subsequently stored such that it doesn't get re-infested, it can be kept indefinitely without further loss.

These technologies work extremely well when done properly. They are competitive with insecticides in effectiveness and in costs. But there are barriers to their adoption.

- The most important barrier is the availability of inputs. Many areas in Sub-Saharan Africa have no ready supply of good metal drums. In this region Senegal seems to be the exception. Good plastic bags are often not readily available in the countryside, and the same is true for the plastic materials used in the solar heaters.
- People do not know about the technologies and so cannot try them though some NGOs like WVI and projects like PRONAF/PEDUNE managed by IITA have actively been helping build awareness in Nigeria.

## Constraint

This TF sought to address the question below.

1. Is there a project activity where a storage technology package could be disseminated and promoted to help producers (and indirectly, consumers) have a supply of quality cowpea grain?
2. Producing and storing cowpea is not enough, the grain needs to reach consumers so they can benefit from the high value nutrition. Over the years CRSP, IITA and other organisations have explored to find ways to improve cowpea processing and utilisation. Village mills was one experiment to save the labour of women who have to process the grain.
3. Other cowpea-based processed foods like weaning foods, and pre-cooked cereals and cowpea rice – some of which can be produced with simple equipment offer possible ways to bring benefits to cowpea consumers. In Ghana, a company supported by USAID is involved in commercial processing of cowpea. There may be opportunities for technology transfer in processing and packaging.

## General discussion

- Participant:** There seems to be public perception regarding consuming stored cowpea grain contaminated with pesticides; how do we deal with this matter?
- TF:** *Pesticides not approved for use on stored cowpea should not be used for this purpose. Numerous storage technologies now available do not use insecticides. If these technologies were in use, there would be no worries about insecticide residues. One thing people can do is demand of their governments that storage practices that avoid unsafe insecticide residues should be developed and disseminated.*
- Participant:** How do we disseminate information on successful grain storage technologies for farmers?
- TF:** *Information dissemination is an on-going process but the TF will promote this activity particularly using the IPM/FFS model. Storage technology information will also be disseminated through the AATF/NGICA project collaborating closely with NGOs and other relevant partners working directly with smallholder farmers.*
- Participant:** To increase income, it would be useful to develop a cowpea storage and marketing business plan to promote small village businesses.
- TF:** *Partnerships with NGOs such as TechnoServe would be developed for implementation of these small village businesses.*

## Sub-project proposal: Storage and Utilisation

### Seed storage by farmers and seed producers

**Objective:** To increase availability of improved cowpea seed in the hands of cowpea growers in the Nigerian grainshed.

**General approach** is to train cowpea farmers and cowpea seed producers in the use of available technologies to stem losses to cowpea weevils in cowpea stores and thus help them have available undamaged quality cowpea seed for planting in the subsequent growing season.

### Activities to be undertaken

- Carry out a participatory needs and opportunities assessment in selected areas where improved cowpea seed is not widely available.
- Disseminate to farmers and seed producers in selected country sites through training schemes a package of site-appropriate existing storage technologies (solar dissemination, sealed bags or other sealed containers, co-storage with ash, insecticides as necessary) to enable preservation of cowpea seed from har-

vest until planting time the following year. Improved seed should be appropriate to the local ecology and current or potential markets.

- Train traders and entrepreneurs about the required materials and use of storage technologies for the purpose of helping make needed inputs available and foster input-supply related businesses.
- Work with seed-producing sub-projects to enable weevil-safe storage of seed prior to marketing.

### ***Geographical focus***

Initial year: southern Niger and northern Ghana, followed by Burkina Faso and southern Mali in the second year, adding activities in northern Nigeria and Cameroon during the third year. Specific village or area sites in each country will be those where availability of quality cowpea seed is a proven constraint.

**Partners:** NGOs, FAO, National Agricultural Research Programs, scientists, PRONAF, Bean/Cowpea CRSP and other public and private sector entities in Africa and USA.

**Methodologies:** Training course for entrepreneurs, village-participation technology demonstrations including FFS, dissemination of informational brochures, development of tapes for national TV and radio.

**Deliverables:** Built capacity for post-harvest seed storage with the number of trained farmers using the technology and the number of trained seed producers as metrics. Enhanced seed storage input delivery. Better quality seed in use by farmers in project areas.

### **Milestones**

#### ***Year 1***

**6 months:** Seed storage needs assessment conducted in prospective project villages in Niger and northern Ghana

**6–12 months:** design and carry out first entrepreneur training session in Niger and Ghana; complete storage videotapes (French, English) and radio messages

#### ***Year 2***

Seed storage needs assessment in Burkina Faso and Mali; and entrepreneur training. Farmers trained in first year (Ghana and Niger) train farmers in adjacent villages in seed storage technologies. Broadcast videos (TV) and radio messages.

#### ***Year 3***

As in year 2, except expand project to northern Nigeria and Cameroon. At end of third year conduct project impact evaluation.

## Budget (US\$)

Item	Year 1	Year 2	Year 3	Total
Needs assessment	15,000	15,000	15,000	45,000
Farmer/seedsman training (3 villages in 2 countries for each of 3 years)	20,000	20,000	20,000	60,000
Radio/TV storage technology tapes	30,000	-	-	30,000
Training of entrepreneurs	20,000	20,000	20,000	60,000
Project management	20,000			20,000
Project vehicle	35,000	-	-	35,000
<b>Total</b>	<b>140,000</b>	<b>55,000</b>	<b>55,000</b>	<b>250,000</b>

## Activity 2: Fostering increased cowpea utilisation

**Objective:** To increase availability of improved cowpea-based foods – value-added products and high-quality grain – to cowpea consumers in villages as well as urban markets in the Nigerian grainshed.

**General approach** is to train women's groups to use value-adding technology and establish sustainable businesses based on manufacturing and marketing of labour-saving or high nutrition products based on convenient versions of traditional cowpea foods; farmers in surrounding areas will be informed of additional markets where there is demand for high quality grain.

*Activities to be undertaken:*

- Carry out needs assessment in southern Niger for the Niamey and Kano, Nigeria markets and in northern Ghana for the Accra market. Conduct training in additional country sites in second and third years.
- Develop appropriate training package and business plans for transfer of processing technology and training for each country.
- Provide processing equipment and capital for start-up of village-based women's businesses.
- Train women's groups in Ghana and Niger to manufacture and market cowpea-based traditional products for which there is demand in Accra, Niamey or Kano as well as other urban centres in additional countries.
- Foster links between women's group value-added products and urban markets.
- Foster links between traders, urban processors and cowpea farmers producing bulk high grain in participating villages to link high quality grain producers to consumers.
- Provide training to farmers and women's groups in cowpea storage technologies to guarantee improved availability of quality cowpea grain.

*Geographical focus:* Initial year: southern Niger and northern Ghana followed by Cameroon and additional countries in the second and third years. Specific village or area sites in each country will be those where availability of quality cowpea seed is a proven constraint and where cowpea producers are capable of producing high quality grain for manufacture of value-added products and sale into distant markets.

*Partners:* NGOs, FAO, regional Food Science Institutes, National Agricultural Research Programs, scientists and administrators, PRONAF participants, Bean/Cowpea CRSP.

*Methodologies:* Training course for women groups, village-participation, value-added product manufacturing technology. Convene and inform traders, value-added product manufacturers and cowpea producers about opportunities to produce and sell high quality grain and value added products.

*Deliverables:* Built capacity of women's groups to manufacture and sell cowpea-based value-added products in three or more cowpea-producing counties. Better quality grain available to traders, urban manufacturers and consumers.

## Milestones

### *Year 1*

**6 months:** Seed storage needs/opportunities assessment conducted in prospective participating project villages in Niger and northern Ghana

**6–12 months:** Design and carry out first entrepreneur training sessions in Niger and Ghana.

### *Year 2*

Value-added products needs/opportunities assessment in Cameroon and additional countries in the Nigerian grainshed and entrepreneur training. Initiate training packages in Cameroon and additional countries to be identified.

### *Year 3*

As in year 2, except expand project to additional countries in the Nigerian grainshed. At the end of the third year conduct project impact evaluation.



**Budget (US\$)**

Item	Year 1	Year 2	Year 3	Total
Needs/opportunities assessment	15,000	15,000	-	30,000
Value-added training packages,	10,000	5,000	5,000	20,000
Women's group training (3 villages in 2 countries for each of 3 years)	20,000	20,000	20,000	60,000
Coordination activities/meetings with traders, manufacturers, cowpea producers in individual markets (2 each year)	20,000	20,000	20,000	60,000
Project management	20,000	20,000	20,000	60,000
<b>Total</b>	<b>85,000</b>	<b>80,000</b>	<b>65,000</b>	<b>230,000</b>

**Notes for sub-project proposal on post-harvest constraints****1. Background**

As agreed at the 10–11 July 2003 constraints to cowpea production and utilisation in Sub-Saharan Africa meeting in Nairobi, a partnership between AATF and NGICA will spearhead the promotion of appropriate technology interventions for the improvement of cowpea production, storage and utilisation in Sub-Saharan Africa. During the meeting five cowpea production constraint areas were identified namely seed production, field production problems, storage and utilisation, marketing and intellectual property. It is the purpose of the Accra Cowpea Stakeholders' Workshop to develop a technology plan that will bring the benefits of modern technologies to farmers and consumers in Africa. The ultimate objective is to come up with a linkage of modern technologies that are developed, improved and disseminated in a manner that will have long-term benefits to African producers and consumers.

**Issues pertaining to cowpea storage and utilisation constraints****Introduction**

Cowpea (*Vigna unguiculata*) is a very important indigenous legume crop in African smallholder farming systems (Padulosi and Ng 1997). The crop has a high level of drought and heat resistance and is an important source of protein in human diets as well as a nitrogen fixer. Cowpea is considered nutritious with a protein content of about 23%, fat content of 1.3%, fibre content of 1.8%, carbohydrate content of 67% and water content of 8–9%. Cowpeas are also valuable sources of vitamins and minerals including folate, thiamin and riboflavin (Phillips et al 2003). As in most legumes, the amino acid profile complements that of cereals. However, cowpea production in most parts of Africa has been hindered by loss of yields to pests.

**(a) Storage constraints**

Cowpea is prone to insect infestation; both in the field and in storage. Initial infestation occurs in the field and is carried to storage. One of the most critical problems that all smallholder farmers face in SSA is the post-harvest handling of cowpeas to keep grain loss to bruchids (*Callosobruchus sps* L. Fabricus.) at minimal levels. Stored cowpea grain is often lost with losses of up to 95% even being recorded in as little as three months of storage and it is also commonplace to find infested cowpea seeds in commercial stocks and in households. Much of the grain harvested is at risk to attack in storage by the seed-eating bruchids and if conservation and storage techniques are not adequate, high losses occur resulting in most farmers selling their harvested crop earlier in the marketing season for low prices. The financial and nutritional losses of cowpea to storage pests in SSA are not well documented, but are clearly very high (Murdock et al 1997), and in most markets when damage exceeds one emergence hole per seed, the price is usually discounted.

Another post-harvest constraint to utilisation of cowpea is the prolonged cooking that results from storage conditions of high temperature and relative humidity (Phillips et al 2003). This phenomenon is called the hard-to-cook (HTC) defect and is distinguish from “hard seed coat” which is related to impermeability of the seed coat to water. Liu et al (1992) confirmed that storage of cowpea at high temperature and relative humidity (RH) causes the firmness of cooked grain to increase. Cowpeas stored for 6 months at -18°C or at 30°C and 35% RH produced little change in texture of cooked peas compared to fresh seeds, while storage conditions of 30°C/64% RH, 25°C/75% RH and 37°C /75% RH produced hard to cook seeds about 2.5 times greater.

**(b) Utilisation constraints**

Cowpea has been consumed by humans since the earliest practice of agriculture and been ascribed medicinal and nutritional roles (Phillips and McWatters 1991). In Africa cowpea is primarily grown for its edible seeds; however, young cowpea leaves are harvested and consumed. Many researchers have examined and reported on the nutritional quality of cowpea. But despite their excellent nutritional quality, cowpea contains a number of anti-nutritional factors that lower their potential utilisation levels. The limited availability of diversified value added products (VAPs) in most households has also been identified as another constraint to cowpea utilisation.

The nutritional quality of cowpea is also limited by the presence of both the labile and heat stable anti-nutritional factors or anti-nutrients. The most important of these is the trypsin inhibitor and flatulence-causing indigestible oligosaccharides, raffinose, stachyose and verbascose. These sugars are not utilised by humans (being monogastric animals) because of the lack of specific  $\alpha$ -galactosidase enzyme needed to digest them. This often leads to abdominal discomfort (flatulence) and as a result many African mothers are hesitant to utilise cowpea as a component of weaning food (Uwaegbute 2000). While there are technologies that reputedly reduce the levels of oligosaccharides, they involve extra labour and in many cases are not practical.

**(c) Limited expansion of utilisation of VAPs**

Currently, cowpea in west Africa is mainly sold as grain and/or processed into value added products. A variety of cowpea-based value added products have been developed by food scientists, but there has been limited adoption of VAPs. This has largely been attributed to lack of an effective extension programme.

Very little to no large scale industrial processing is presently occurring. Processors require technology, equipment, packaging materials, preservatives, skilled labour and an effective demand for their products.

**Options for resolution of constraints****Introduction**

It is of benefit to both farmers and the consumers to have a production system that adds value to cowpea from the first stage of production to final processing. Improved storage and utilisation methods are part of the package of technologies that will add value to cowpea along the production chain. To maximise adoption of technologies, it is important to take into account the socio-economic situation of the targeted farmers and the feasibility of the technologies.

The following proposed technology interventions are designed to be implemented in short, medium and the long term phases of the programme.

**Storage goals****Goal 1**

To expand the use of already developed storage techniques in the focus countries (short term phase)

**Objective**

To develop an effective extension programme (Farmer Field Schools, Training of Trainers, as well as simple and easy to follow extension publications).

**Background**

To minimise the damage, a range of conservation and storage methods have evolved over the years to suit different farmer situations. Besides the traditional techniques, efficient methods for large scale storage have also been developed and these include: proper storage facilities, fumigants and residual insecticides.

The USAID-funded Bean/Cowpea Collaborative Research Support Program (CRSP), started in the 1980s resulted in storage technologies being developed in Cameroon and Senegal through research efforts at Purdue University (Murdock et al 2003). Storage technologies developed in this programme included:

- solar disinfestation technique

- improved ash storage procedure
- triple bagging technology
- combined seed and pod resistant varieties
- drum storage technology.

Impact assessments in Cameroon and Senegal show that storage research has benefited large numbers of people and is generating a substantial economic benefit. In Senegal, the CRSP drum technology is used for over 80% of stored cowpea. About 10% of cowpea in northern Cameroon are stored using techniques developed by the IRAD/Purdue CRSP team.

There is, however, need to strengthen the levels of adoption in focus countries through technology transfer programmes that take into account the socio and economic status of different target groups.

*Indicator of progress in achieving goals* will be in the levels of adoption observed through technology impact assessments as well as economic loss research.

## **Goal 2**

Further research on other storage technologies.

### **Objective**

To develop improved storage technologies for use by traders and cowpea stockers who store large amounts of cowpea over long periods of time.

### **Background**

Hitherto, storage research has focused primarily on the needs of small scale cowpea producers and consumers. Little or no attention has been given to large scale traders who purchase and store large amounts of cowpea, often for many months. These individuals may use insecticides in ways that are not approved and are potentially unsafe for future consumers and operators.

### **Approach**

- Baseline survey by socio-economists of storage practices in use by large scale cowpea traders/storers in major urban cowpea trading centres.
- Assessment of the opportunities and constraints for new storage technologies to be used by cowpea traders/storers.
- Research/development of improved cowpea storage technologies, including insecticides for use by traders.

## Budget (US\$)

Activity	Year 1	Year 2 & 3	Year 4	Total
Assessment of storage practices in use and opportunities/constraints for new storage technologies	15,000			15,000
Development/testing of new storage technologies for large scale storers of cowpea grain		12,000	12,000	24,000
Dissemination of new storage technologies for traders			12,000	12,000
<b>Total</b>				<b>51,000</b>

### Goal 3

To enhance levels of bruchid resistance in moderately resistant cultivars (long-term phase)

### Objectives

Genetic transformation of high yielding and consumer preferred varieties for bruchid resistance.

- Optimise a regeneration and transformation system of cowpea plantlets from cell cultures.
- Genetic transformation with the  $\alpha$ -amylase inhibitor gene.

### Background

Through conventional breeding efforts at IITA, modest levels of resistance to *maculatus* have been attained (Singh et al 1997). To enhance these modest resistance levels, efforts have been under way to identify plant genes that affect *maculatus* development. A number of genes have been identified as candidate genes for bruchid resistance. Transgenic pea and azuki seeds containing the bean IX-amyl inhibitor are resistant to bruchid. Once a transformation system for cowpea becomes routine this gene for  $\alpha$ -amylase inhibitor can be introduced in a high yielding consumer preferred cowpea variety. Genetic modification offers a novel way of transferring the gene for bruchid resistance without other undesirable traits being transferred also.

Indicator of progress will be the availability of a routine regeneration and transformation system and the production of mature plants carrying the  $\alpha$ -amylase gene. Concerns of the stakeholders did not support an initiative to create a genetically-modified cowpea expressing the  $\alpha$ -amylase inhibitor gene. Therefore, no budget is prepared for this activity.

## Additional utilisation goals

### **1. Increase the use of cowpea as a means of contributing to the enhancement of the nutritional status of target populations**

#### **Objectives**

To develop improved value added products. As a means of adding value to cowpea grain and food products to promote increased utilisation and consumption the following technologies are proposed.

- *Blended cowpea and cereal flour*  
Flour-like products can be processed fairly easily from mature dry cowpeas. Blending cowpea with cereals improves the protein quality of the blend. Bakery products, such as bread, muffins and doughnuts can be produced from extruded cowpea flour.
- *Fortified traditional foods and snacks*
- *Weaning foods*
  - One of the most important food applications for cowpea is weaning foods for infants.
  - Optimal formulations for cereal–cowpea blended weaning food have been developed from ingredient cost and nutrient profile information (Phillips et al 2003).
- *Reduction of the levels of flatulence caused by oligosaccharides in cowpea products through:*
  - (i) Gene silencing: advances in molecular biology have now made it possible, in principle, to block the biosynthetic pathway leading to production of oligosaccharides, making it possible to produce flatulent-free cowpeas.
  - (ii) Controlled germination for reduced flatulence: Studies focusing on the use of beans as a weaning food have shown that fermenting the beans reduces the oligosaccharide levels, which will reduce problems of flatulence and discomfort for small children. Nnanna and Phillips (1988) also found out that germination at 30°C for 24h reduced flatulence in cowpea consumed as a result of lower oligosaccharides levels. Ibrahim et al (2002) reported that long-time soaking (16h) in bicarbonate solution caused remarkable reduction in the anti-nutritional factors. Pressure cooking was more effective than ordinary cooking in reducing flatulence. Cooking pre-germinated cowpeas was the most effective treatment. Fermentation completely removed trypsin inhibitors and oligosaccharides.

### **2. Expand the utilisation of VAPs in focus areas**

#### **Objectives**

- To determine consumer preference for cowpea products.
- To develop an effective extension programme on the use of VAPs.



## Background

Creating new foods from cowpea, especially convenient items like snacks, is a promising way to increase cowpea consumption (Phillips et al 2003), with the overall goal being to make cowpea-based food products available to consumers. This requires information on consumer preferences and market opportunities for the products, since the most important hurdle for any food product is consumer acceptance.

## Budget (US\$)

Activity	Year 1	Year 2	Year 3	Total
Determination of consumer preferences in focus areas	15,000	15,000		30,000
Development and implementation of an effective extension programme		30,000	30,000	60,000
Research on product development			35,000	35,000
<b>Total</b>				<b>125,000</b>

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## Project Formulation Task Force

### Members of the Task Force

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### Summary of recommendations

- Goal of the project is the genetic improvement of cowpea through modern technology: Explicitly producing transgenic cowpea initially by transformation followed by introgression into the local varieties.
- One entity should manage the whole effort to co-ordinate all the parts with time lines to ensure that activities are contributing to achievement of the project goal.
- Cowpea transformation and the necessary processes should be done in collaboration with CORAF in a country which has the required facilities and enabling environment.
- Dialogue should be initiated between AATF and CORAF regarding the hosting of the suggested co-ordinator.
- AATF should lead fundraising effort for the project, but other members must take an active role in these efforts, that is by approaching donor agencies in their respective countries.

### Improvement of livelihoods through the application of appropriate technologies to cowpea productivity in Africa

#### Product

The product of the project will be seed of an improved cowpea variety. However, seed is only one component of technologies required by farmers to realise the full potential of the improved cowpea. Furthermore, no single cowpea variety will have all the qualities that are needed.

This emphasises that while biotechnology applications will be significant in advancing improvement of cowpea, other factors will be required for its success.

The product will need to be demonstrated in farmers' fields and to capture the interest of seed companies. It should be aimed initially at African smallholder farmers, processors, traders and consumers. However, all these categories of beneficiaries should be

able to move up the economic scale through use of the technology embedded in the new cowpea varieties.

Therefore, the project will provide innovative technologies, including new varieties, which will contribute to improved productivity and utilisation of cowpea. This will be realised through activities consistent with AATF's mission of accessing technologies royalty free and facilitating their transfer to end-users.

### Project structure and management

The TF wishes to emphasise the importance of making suitable arrangements for management to ensure success of the whole project. It is desirable to have a centralised co-ordinated management of the overall project and its component parts. One of the key objectives of the management will be to keep the different actors in communication with each other, to retain coherence and keep the whole project intact and focused. The project should be structured in modules such that an investor will be free to support the particular modules they find attractive. The Task Forces were asked to discuss each of the modules. AATF works through existing networks, in which each member operates responsibly and agrees to share the necessary responsibilities and obligations.

There are remaining questions about who owns the project and its outputs (products). This refers to methods and technologies applied because where the final product is a self-pollinated crop, the product will in effect be in the public domain. This is different from ownership arrangements required for crops such as wheat and maize, or others like cassava which are utilised in the starch industry.

It is recommended that the breeding of cowpea be retained as the focus with the objective of taking advantages of advances in biotechnology. Cowpea is particularly suitable to the application of biotechnology because of the number of fruits that it has and its early maturity. In this regard it is noted that genetic resistance to *Maruca* is low but could be addressed by pyramiding of genes which would be facilitated by collaboration between breeders and molecular biologists working on the transformation of this crop.

### Opportunities for partnerships and networking arrangements

NGICA was founded to stimulate interest and research in genetic improvement of cowpea varieties. The network is important because the new varieties from different regions will have to be adapted and incorporated into the farming systems.

AATF will support research on the adaptation and deployment of technologies for the benefit of African smallholders.

The Bean/Cowpea CRSP invests in long-term collaborative research and training, and institutional capacity building through partnership with NGOs and NARS. CRSP technologies are adapted and transferred to end-users.

National systems are needed to incorporate the transgenes into locally adapted cowpea lines of appropriate market classes; SROs, NEPAD, FARA, TRANSLEG are needed for issues that cross national boundaries.

International centres: IITA and ILRI both of which have global mandates and are collaborating on cowpea research.

Private sector: Monsanto, CSIRO, growers of associations, seed companies that deal in cowpea, NGOs, companies that have moved crops through regulatory systems in different African countries.

UN and other government programs: UNEP-GEF, Agricultural Biotechnology Support Program (ABSP) II, University of Michigan and Cornell, Biosafety Support Program (BSP) for both east and west Africa

Biosafety: Countries that have signed the Cartagena Protocol are obligated to have functional biosafety systems. However, some may need to be constantly reminded to actually do this. AATF should work with other agencies to achieve this. Some of the programmes, that is BSP, ABSP, UNEP-GEF, assist individual countries and SROs to operationalise biosafety systems.

NARS: Deployment of project products in individual countries will depend on having operational biosafety systems and functional NARS. AATF will work as a partner of the NARS. Conditions under which a product is released will be negotiated individually with each country. This process will require considerable legal capacity in IP.

#### Participation of African countries in the project

Individual African countries should be encouraged by AATF to invest in the project, so they can be co-owners of any intellectual property that may arise. There is also need for consideration of opportunities and technologies, which already exist in Africa.

This approach will make the countries protective of their IP rights. It is the responsibility of individual countries to protect their own IP rights, AATF should help raise awareness among African countries of danger of loss of intellectual property rights such as is happening with certain teas and appetite depressants.

#### Working with the private sector in technology development

Although it was possible in the past for scientists to work in the laboratories of the private sector, this is no longer possible, for a variety of reasons. Several models for collaborating with the private sector were considered:

- they could develop products entirely on their own and pass this to national programmes through AATF

- they could provide technology for adaptation and training on technology use through contract work undertaken by another laboratory in a developing or a developed country
- they can donate technology they have and let those interested do the required modifications/adaptations. It is doubtful that the private sector will be interested in investing in physical structures, such as containment facility for generating and handling the transformation crops. This will require collaboration with regional centres of excellence being set up in Africa.

The private sector is more likely to license a technology through an intermediary such as AATF who would then deal with the third party. Whether donated for humanitarian reasons, the company may still impose conditions to protect them from liabilities and to ensure compliance with the terms of the license, a process that is easier done through an agency such as AATF.

The private sector is generally reluctant to be involved in the management of projects that are not entirely their own, that is collaborative projects. Thus although it would be desirable to work in partnership with the private sector in product development, exactly how this would be done has yet to be clarified, and may vary with each company. Getting this arrangement right will be the key to getting USAID funding for this project within the context of a Global Development Alliance that requires private/public partnerships in product development as one of the conditions.

### NGICA structure and relationships

There are questions that need to be considered about the future role of NGICA. These include:

- how best can it continue to be linked with AATF
- should it be hosted wholly in the institutions where its director(s) work
- what is its relations with Bean/Cowpea CRSP
- is it necessary for NGICA to be able to receive funds or should it be limited to a coordinating and sponsoring function, with individual institutes raising and managing their own funds.

NGICA's membership was primarily geneticists but now embraces cowpea development. NGICA has a vital role to play in coordinating cowpea improvement. Mali is the only west African country that is not a member of NGICA and consideration should be given to enrolling it. NGICA is not a legal entity so consideration must be given to the hosting of its management. There are various options that may be considered. Among the options are:

- AATF especially in the early days to catalyse action
- CORAF/WECARD with the individual hosted and a CORAF member institution such as Ahmadu Bello University
- FARA along with ABSP II.

There is need for understanding of the overall environment in which the improved cowpea will be deployed, but the focus on biotech must be retained. *Bt* is just the first biotech advance that can be anticipated. There are only a few labs (for example Arkansas, Purdue, Davis, CSIRO and IITA) working on the transformation of cowpea, but no consensus has been reached regarding the varieties that should be transformed. To get cowpea up to its potential requires more than a single technology so AATF may be interested in other aspects of cowpea improvement.

### Estimated cost of approaches and potential funding sources

AATF has a resource mobilisation function and can put in joint grant applications, add its endorsement to ongoing projects, or fund its contribution to aspects of ongoing projects. AATF can join in writing new proposals or may endorse them.

The Global Development Alliance requires a three to one match for grants but they will accept in-kind donations. This source has indicated a nominal figure of US\$ 300,000, but they have given a range of grants above and below this.

The Kirkhouse Trust is prepared to finance Post Doc [to be quantified in monetary terms] while Monsanto is prepared to donate one or both of the cry genes, 1 and 2 genes [to be quantified in monetary terms].

It was suggested that other companies that may have technologies relevant to cowpea should be asked to be involved in the initiative. Cowpea is unique and has the advantage that other crops do not have, in that there is no concern about competition with producers in the OECD countries.

### Conceptual framework for the project formulation

In a plenary session, the workshop discussed the purpose and mechanism for formulation of the project and the process for its approval. The purpose of the discussion was to:

- agree on the primary objective of the project
- formulate an appropriate title for the project
- prioritise project activities linked to clearly defined deliverables
- agree on time horizons for achieving impacts
- design a management structure for project implementation
- agree on a funding strategy based on the approved AATF model.

The procedure for formulating the cowpea project concept note will conform to the AATF model project formulation, which consists of the following steps:

- the project concept note is developed in close consultation with key stakeholders and must include consideration of technical, commercial, financial and associated legal/regulatory issues
- the concept note is subjected to a peer review process and finalised
- the revised concept note is submitted to the AATF Board for approval

- a full business plan for the project is developed after approval.

### The project “road map”

After extensive discussion of the “road map” for the project, the workshop adopted the following framework for the development of the cowpea project concept note.

#### Title

The suggested title for the project was: Enhancing livelihoods through improved cowpea productivity and utilisation in Africa.

Suggested changes to this title were given as:

- Enhancing livelihoods with integrated use of emerging cowpea technologies in Africa.
- Enhancing livelihoods in Africa with emerging cowpea technologies.

The workshop gave AATF management the discretion to revise this title to reflect more accurately the key ideas discussed. Special effort should be made to ensure that the title captures the key words/concepts that reflect current rural development issues such as food security, improved nutrition, rural livelihoods, poverty alleviation, income generation and improved standards of life.

#### Project focus

The primary focus for the project product would be cowpea varieties that are:

- socially acceptable
- meet the needs of the variety of end users
- highly productive
- resistant to biotic and abiotic stresses
- address food security issues
- improve nutrition
- generate income for resource-poor farmers in Sub-Saharan Africa.

An alternative product focus would be seeds of high yielding and pest resistant cowpeas for enhanced food security and better livelihoods in Sub-Saharan Africa.

#### Project activities

Activities should be linked to deliverables. The broad areas of project activities required were identified as:

- strengthening cowpea seed production and marketing systems in Sub-Saharan Africa
- setting up a project management system
- developing and applying a genetic transformation system for cowpea
- developing and applying a marker assisted selection approach for the improvement of cowpea



- developing dual-purpose cowpea varieties to extend the utilisation of cowpea
- better understanding of consumer preferences concerning GM cowpea
- extending non-chemical cowpea storage technologies that respond to consumer demands
- establishing FTO for cowpea biotechnologies
- setting up a risk management plan for transgenic cowpea in Sub-Saharan Africa
- extending cowpea processing technologies that respond to consumer demands.

The activities will be implemented to yield the following deliverables:

- *Bt* gene in market acceptable cowpea varieties widely available to smallholder farmers in Africa
- efficient local systems for delivery of high quality cowpea seeds
- increased capacities in cowpea systems including research, seed distribution and cowpea processing
- genetic markers for specific biotic and abiotic stresses including *Striga*
- more rapid development of elite cowpea varieties for resistance to *Striga* and other biotic and abiotic stresses using marker selection systems.

### Project management structure

The project structure will be constituted in a modular form, each sub-project making up the component modules. Each of the modules will be coordinated by an individual module leader, task force leader or task coordinator. The AATF and NGICA partnership will have the responsibility of overall coordination of the project. It was suggested that when necessary, a project manager would be hired to undertake the task of day-to-day coordination of the project module leaders.

The mechanism for overall project implementation will consist of technical sub-committees to provide oversight for each component module. Strong partnerships with relevant national, regional and international institutions and agencies will be established for effective project implementation. Periodic monitoring and evaluation will form an essential and integral part of the project implementation process.

### Funding strategy

The entire project could be funded by a single donor, but it is more likely that different donors will fund modules that are of particular interest to them. The approved AATF funding formula will be adopted, which is that in the project formulation stage, AATF funds 75%, while 25% will be sought as matching funds; at the project implementation stage, AATF funds 25% while 75% will be sought from donors.

The Global Development Alliance Secretariat of the United States Agency for Development (GDA/USAID) has expressed an interest in certain aspects of the AATF/NGICA cowpea project; therefore, efforts will be made to complete the preparation of a proposal for submission to GDA/USAID.

## Outlining of the cowpea project concept note

It was agreed that Chairs of the different Task Forces would constitute the Project Formulation Task Force, specifically deliberate on over-arching issues and to reach a consensus on an outline of a cowpea project concept note. This group met on 13 February 2004.

Present at the meeting were:

Eugene Terry – *Chair*  
 Phelix Majiwa – *Vice-chair*  
 Tony Youdeowei – *Rapporteur general*  
 Mohammed Ishiyaku – *Seeds*  
 Idah Sithole-Niang – *Intellectual property*  
 Ousmane Coulibaly – *Marketing and trade*  
 Larry Murdock – *Storage*  
 Eugenia Barros – *Field constraints*  
 Larry Beach – *USAID*  
 George Bruening  
 Nancy Muchiri – *AATF*

## Fundamental principles underlying project formulation

The group agreed that:

1. the project objectives should stress critical issues of enhancing rural livelihoods, food security, improved nutrition for farming families, increased household incomes, use of emerging technologies (including biotechnology, information technologies and chemical technologies), sustainability, presidential initiatives, effects of HIV/AIDS, geographical focus and impacts on livelihoods of small-holder farmers in Sub-Saharan Africa
2. focus will be on generic technologies, giving examples of technologies/tools that will be used to achieve the project objectives
3. interventions will be made so that their impact on cowpea production and utilisation can be realised within a set of time horizons, namely immediate (short term), medium term and long term
4. activities will involve integrating approaches from different collaborating institutions/time frames/technologies and geographic foci. The work of institutions will be integrated in such a manner that relevant technologies are captured in various areas
5. the project should build the foundation for the use of modern and sophisticated technologies to achieve early impact
6. intellectual property rights issues will be integrated within the framework of the improved varieties subproject. The institution and mechanism for managing IPR issues during project implementation has been identified
7. it is recognised that different project deliverables will go to farmers, consumers, traders, researchers and technology developers

8. the project concept note will be prepared to conform with the guidelines for the GDA/USAID
9. to facilitate preparation of the concept note, relevant information will be sought from Chairs of Task Forces where necessary
10. names of specialists may be suggested for the Peer Review Panel as required by AATF for project development and approval.

## Agreed outline for cowpea project concept note

### *Title*

Enhancing livelihoods in Sub-Saharan Africa through integrated use of emerging cowpea technologies

### *Introduction*

- Economic importance of cowpea will outline mode of production, utilisation and income generation
- Current productivity constraints and gaps
- Partnerships both past and on-going that continue working to address constraints
- Expected benefits from project implementation
- Impact of the project activities on a time frame

### *Objectives/goals*

To enhance livelihoods in Sub-Saharan Africa through emerging cowpea technologies, to include a definition of enhanced livelihoods, improved nutrition, income generation, emerging cowpea technologies, including biotechnology, information technology and chemical technology.

### *Deliverables*

These will constitute the focus of the project.

- Improved varieties – seed, grain and fodder.
- High quality seed – for seed storage.
- Seed quality control – seed laws and biosafety issues.
- High quality grain for processing, utilisation/storage and consumption.
- Improved cropping/production systems and practices – adopting the Farmer Field Schools participatory model to address all constraints, soil/water management, pests/diseases, storage, processing and utilisation, and market information.
- Improved cowpea processing.
- Market plans for cowpea in various grainsheds in SSA.
- Information for business plan and opportunities.
- Model for cowpea business plan.
- Investment options.

- Capacity building for compliance with seed laws.
- Enhanced livelihoods: The following deliverables will contribute to enhancing livelihoods:
  - efficient seed delivery system
  - seed companies
  - ease to attract markets, manage risks and reach new markets
  - efficient storage to address pest infestation
  - production of quality grain and fodder.

## Activities

The Project Formulation Task Force agreed on a set of activities to be conducted as modular components of the project. Details of each of the activities would be elaborated by members of respective Task Forces under the co-ordination of TF leaders. The activities will consist of the following:

- overview of the problem/constraint
- objective of the sub-project
- rationale/justification
- activities to be undertaken
- geographical focus
- partners to be involved
- methodology
- deliverables
- milestones based on AATF time horizons
- budget in US\$.

## *High quality seed (HQS)*

- Non-chemical cowpea storage technologies.
- Certified cowpea seed distribution.
- Production of high quality seed.
- Seed quality control; best available cowpea seed storage technologies; certified cowpea seed distribution system, production of high quality seeds, production of nuclear seeds.

Capacity building (produce and store quality seed) for compliance with seed laws, farmers capacity to produce and store high quality seeds, capacity to enforce seed quality control measures – seed handlers and extension agents.

## *Improved varieties (IV)*

- Introgression of genes for resistance (MAS).
- Development of genome-wide DNA marker set.
- Development of DNA markers linked to specific traits using inbred lines.
- Introgression of genes using MAS.
- Genetic transformation of *Bt* into cowpea.

- Capacity building for application of MAS – (initial offer for support from the Kirkhouse Trust):
  - use MAS in breeding (regional/national levels by breeders)
  - use transformation techniques.

### ***Intellectual property (IP)***

All related issues to be handled here.

### ***High quality grain (HQQ)***

- Extension of storage and packaging technologies to be closely linked with activities on resistance against storage weevils.
- Characterisation of cowpea grain.
- Capacity building:
  - farmers to deliver high quality grain
  - traders to deliver high quality grain to processors
- entrepreneurs to recognise business opportunities arising from income generation such as deliver solar heaters and deliver inputs.

### ***Improved cowpea production systems (IPSC)***

- Cowpea crops/livestock production system.
- Integrated production and pest management:
  - cultural crop management
  - cultural pest management.
- Integrated cowpea crop management systems:
  - inter-cropping
  - monoculture
  - use of fertilisers.
- Capacity building of farmers to adapt and adopt improved production systems:
  - farmers to adopt IPPM technologies for cowpea production
  - change agents to introduce, validate and adapt production technologies.

### ***Cowpea marketing and trade (M&T)***

- Seed sub-sector analysis.
- Consumer preference studies relating to grain, seed and processed products.
- Farming system changes and impact analysis:
  - changes in farming/production systems, feed/fodder
  - impact analysis: *ex ante* and *ex post* analysis to be conducted at each of the following levels: farm, community, country and sub-regional.
- Trade analysis: supply and demand for grain and processed cowpea and trade analysis (food safety issues).
- Dissemination of the information from these studies to stakeholders of the project and to impact on priority setting for the other project components.

- Capacity building for:
  - farmers, traders and processors on cost/benefit analysis
  - development agents/change agents and NGOs, social scientists, biological scientists, social scientists and food safety experts to conduct impact assessment and market studies.

*Improved cowpea processing (ICP)*

- Opportunity assessment of needs using participatory approaches:
  - technology needs
  - barriers to technology acceptance by end-users
  - barriers to consumer acceptance of products.
- Extension/adoption of value-added cowpea products.
- Food safety studies in relation to *Bt* cowpea and processing.
- Capacity building on:
  - the creation and management of small to medium scale cowpea processing enterprises
  - public awareness in food safety issues.

Summary

Specific IP issues will be handled under ‘improved varieties’ within ‘field constraints’. Only capacity building and public awareness will be handled as a stand-alone activity. For each module/sub-project, the text will be prepared using an agreed format under the sub-headings as outlined below:

- Objectives of the sub-project
- Activities to be undertaken
- Geographical focus
- Partners to be involved
- Methodologies to be applied
- What will the activities deliver
- Milestones:

Horizon 1	1-3 years
Horizon 2	3-6 years
Horizon 3	beyond 7 years
- Budget

Action plan

A uniform set of notes from presentations made by Task Force leaders and rapporteurs, should be given to Tony Youdeowei, the Rapporteur General. These will be shared according to the following schedule.

- |                           |  |
|---------------------------|--|
| 20 <sup>th</sup> February | The report would be sent from Tony to Phelix                                 |
| 25 <sup>th</sup> February | Phelix would circulate preliminary draft of the concept note to PFTF members |
| 29 <sup>th</sup> February | The PFTS members would send to Phelix  |

# Annexes

## Annex 1 (a)

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## Annex 1(b)

### Background information on participants

Participant	Background
Walter S Alhassan	<p>Walter S Alhassan holds a PhD in Animal and Poultry Science from the University of Guelph, Ontario, Canada and a Masters in Dairy Science from the University of Wisconsin, Madison, USA. His undergraduate training in Tropical Agriculture was at the Kwame Nkrumah University of Science and Technology in Kumasi, Ghana.</p> <p>He is currently the West and Central African Coordinator of the Agricultural Biotechnology Support Project II (ABSP II) as well as the sub-region's coordinator of the Program for Biosafety Systems (PBS). Prior to this, he was the Director-General of the Ghana Council for Scientific and Industrial Research (CSIR), a position he held for nine years till retirement in 2002. Under consultancy assignment for FAO in 1999, Walter conducted extensive studies on the status of agricultural biotechnology in eastern, western and southern Africa. In 2000 and 2002 he conducted more detailed studies on the status and application of agro-biotechnology in a cross section of countries in west and central Africa within the CORAF/ WECARD mandate area. These studies were funded by the International Institute of Tropical Agriculture and the United States Agency for International Development.</p> <p>Walter has taught and conducted extensive research in animal agriculture in universities in Ghana and Nigeria. He rose to the position of Full Professor in Animal Science and Dean of Agriculture at the Abubakar Tafawa Balewa University in Bauchi, Nigeria in 1990. As Director General of the CSIR, he coordinated agricultural and other scientific research in the Ghana CSIR and was chief adviser to the Ghana government on science and technology. He has interacted extensively with the National Agricultural Research Systems in West Africa and with various development partners. Walter is a Fellow of the Ghana Academy of Arts and Sciences and also a Networking Member of the Commonwealth Partnership for Technology Management (CPTM).</p>
Eugenia Barros	<p>Molecular biologist and research fellow at CSIR – Bio/Chemtek in South Africa. She has over ten years experience in molecular marker development for marker assisted selection in agricultural crops and forest trees. Eugenia has worked briefly on the development of drought tolerant markers for cowpea. She is currently a steering committee member of NGICA, the Network for the Genetic Improvement of Cowpea in Africa.</p>
Larry R Beach	<p>Larry has been a plant molecular biologist for over 20 years. Currently he is based in Washington, DC and employed at the United States Agency for International Development as biotechnology advisor for Africa. Prior to working with USAID, he was with Pioneer Hi-Bred Intl Inc for over 17 years where he led the team on nutritional enhancement of maize and soybean. The effort included enhancements to oil, protein and starch via genetic engineering.</p>
Boukar Ousmane	<p>Ousmane Boukar is a cowpea breeder with the Institute of Agricultural Research for Development, Maroua, Cameroon since 1990. He became interested in Marker Assisted Selection during his PhD studies (1999–2002) where he identified AFLP and AFLP derived SCAR markers associated with <i>Striga gesnesrioides</i>.</p>
George Bruening	<p>Dr George Bruening works in the Department of Plant Pathology, University of California (UC) at Davis. He has worked with cowpea for more than 30 years and currently is pursuing cowpea transformation and the production of cowpea co-dominant polymerase chain reaction markers in collaboration with Dr Ivan Ingelbrecht of IITA Ibadan and Dr Douglas R Cook of UC, Davis.</p>

Ndiaga Cisse	Ndiaga Cisse is a plant breeder at the Institut Senegalais de Recherches Agricoles since 1983. He has developed two successful varieties Mouride and Melakh. These varieties are adapted to the semi-arid zones of the Sahel and are resistant to major insects (aphids, thrips and bruchids), diseases (bacterial blight and CabMV) in Senegal. He obtained in 1999 the president's of Senegal award for science and technology for the development of these two varieties.
Ousmane Coulibaly	Ousmane Coulibaly is an Agricultural economist with the International Institute of Tropical Agriculture. He works on the economics of integrated pest management at the Biological Control Centre for Africa in Cotonou, Benin. Ousmane does capacity building of national agricultural research and extension systems and rural development projects funded by state and various donors like IFAD, AfDB and World Bank. The courses are focused on the impact assessment of agricultural technologies and institutional arrangements on food security, poverty reduction and environment protection. Ousmane has collaborative activities with universities in Africa, US, Europe and Australia. He is the regional coordinator of the cowpea project for Africa (PRONAF).
Issa Drabo	Issa Drabo is a cowpea breeder from INERA, Burkina Faso. He is particularly interested in breeding for pest and Striga resistance in cowpea. He has 25 years experience in cowpea breeding. He is also interested in biosafety and intellectual property rights issues of biotechnology. He is one of the PI of the bean/cowpea CRSP project.
Jeff Ehlers	Jeff Ehlers works at the Department of Botany and Plant Sciences at the University of California, Riverside. He conducts a breeding program to develop improved cowpea varieties and undertakes genetic studies of important traits. He has been working on cowpea at the University of California for the past 13 years as part of a USAID funded bean/cowpea CRSP project and interacts regularly with west African cowpea breeders. Prior to this he worked for IITA for three years while based with ICIPE in Kenya.
Salvador Fernandez-Rivera	He is a ruminant nutritionist working at the International Livestock Research Institute in Addis Ababa, Ethiopia. His professional interest is aimed at increasing the productivity of mixed crop-livestock farms in developing countries through improved production and use of food-feed crops and other feed resources, better livestock nutrition and efficient use of natural resources. He is the Coordinator of the CGIAR System-wide Livestock Programme.
TJ Higgins	T J Higgins main research focus is the application of gene technology for plant improvement. He is particularly interested in improving the nutritive value of plants for feed and food uses. Born in Ireland, TJ's first degrees were from the National University of Ireland. He gained his PhD from the University of California at Davis. TJ is the Deputy Chief of CSIRO Plant Industry, Canberra and is a Fellow of the Academy of Technological Sciences and Engineering.
Joseph Huesing	<p>Joe is a Research Entomologist with Monsanto Company in St Louis, Missouri, USA. He has long been affiliated with the discovery of insecticidal proteins for use in the genetic enhancement of crop plants.</p> <p>His research areas include: development of automated robotics solutions for insecticide discovery, database design for use in high-throughput screening for leads identification, digestive physiology of crop pests and the interface of intellectual property and research.</p> <p>He has a long association with efforts to make use of genetic technologies for the improvement of farming options for low-resource farmers.</p>
Mohammad Faguji Ishiyaku	Mohammad Ishiyaku is a cowpea breeder based at the Institute for Agricultural Research of the Ahmadu Bello University, Zaria, Nigeria. He specialised in the development of cowpea varieties with resistance to pests, disease and drought tolerant using conventional and modern biotechnology tools. He is interested in disseminating improved varieties to African farmers as well as public awareness on the benefits of biotechnology. He has engaged in cowpea breeding and working with farmers since 1989 and currently is a member of two regional cowpea projects.

Louis EN Jackai	<p>Louis E N Jackai, has a PhD in Entomology from the University of Illinois in Urbana-Champaign. He worked on Integrated management of legumes principally cowpea and soybean at the International Institute of Tropical Agriculture (IITA). This work involved upstream as well as downstream research targeted at resource-poor farmers in Africa and other parts of the tropical world. The bulk of his work centred on the use of resistant cultivars as a component of an integrated pest management program. He has conducted extensive research on the bionomics and control of the cowpea pod borer, suckers and other cowpea pests. He has served as coordinator of the legume IPM project implemented at IITA in close collaboration with several international partners for the development of an extensive database on the pests of cowpea as well as ecologically sound and biointensive approaches for their control.</p> <p>He has been the coordinator of International Projects in the College of Agriculture. He serves as Joint Team Leader or member of a number of development and other projects in the US and Africa. Louis also teaches entomology and environmental science. He is a member of the National Cowpea Association Advisory Board in the US.</p>
Jess Lowenberg-DeBoer	<p>Jess Lowenberg-DeBoer is a professor of agricultural economics at Purdue University and West Africa Regional Facilitator for the bean/cowpea Collaborative Research Support Program. He has 16 years research experience in economic assessment of agricultural technology in Africa, including long term experience in Niger and Burkina Faso. He works with engineers and biological scientists in developing technology, extension personnel in disseminating technology and in impact assessment. Because of his experience as a farmer (1972–1976) and journalist (1977 –1980), he brings a private sector perspective to his work.</p>
Nancy Muchiri	<p>Nancy Muchiri is a public relations practitioner with over 14 years experience gained in the private and not-for-profit sectors. Nancy holds a BA degree and a postgraduate Diploma in Mass Communication from the University of Nairobi. She also has a Diploma in Management from the Kenya Institute of Management. Before joining AATF in January 2004, Nancy worked for three years with SOS Children's Villages, Kenya an affiliate of SOS-Kinderdorf International, a world wide child welfare organisation where she established and headed the Fund Raising and Communications Department. Prior to that, she worked with the East Africa Portland Cement Company Ltd as head of the Public Relations section for 11 years, providing corporate and product communications needs.</p> <p>Currently she works at AATF, managing the Foundation's Public and Donor relations.</p>
Phelix Majiwa	<p>Phelix Majiwa is a molecular biologist with over 20 years of professional hands on engagement in work on the molecular biology of parasites, pests and pathogens of human, livestock and crops, most of it done while employed at the International Livestock Research Institute Nairobi, Kenya. Phelix has a longstanding and keen interest in safe application of biotechnology, specifically molecular biology and genomics, for the improvement of human welfare in the developing world. His technical expertise is in the area of initial identification and development of molecular diagnostics and vaccine candidates, and the deployment of these for better understanding of the epidemiology and control of diseases common in the developing world.</p>
Larry Murdock	<p>Larry Murdock is an Entomologist with the Department of Entomology, Purdue University, W Lafayette in USA. He has long-term interests in cowpea insect pests and post-harvest storage of cowpeas; mobilisation of technology for cowpea production, storage, and utilisation in Sub-Saharan Africa; physiological and biochemical systems in insects as targets for novel approaches to insect control; and genes for insect resistance in plants. He has 17 years of experience collaborating with African colleagues on research related to cowpea production and storage primarily with the bean/cowpea CRSP. He has organised and co-organised four cowpea-related symposia or workshops in West Lafayette (1993), Dakar (2001), Capri (2002), and Accra (2004). He is the co-chair of NGICA with Idah Sithole-Niang.</p>

Francis Padi	Francis Padi is a plant breeder and molecular geneticist at the Savanna Agricultural Research Institute (SARI) in Ghana. His research focus is to improve cowpea-based cropping systems for the savannah ecologies. Currently he leads the Cowpea Improvement Programme in SARI.
Jacob Quaye	Jacob Quaye has worked as Administration and Finance Manager of AATF, WARDA, IITA, ILRI and ICRAF.
Esther Sakyi-Dawson	Esther Sakyi-Dawson is Senior lecturer in the Department of Nutrition and Food Science, University of Ghana. Her area of expertise is food processing and food quality evaluation (sensory and chemical) with special interest in legumes (cowpea), cereals and other starchy crops. She also works extensively in the area of improvement and extension of traditional food processing techniques. She has been involved in cowpea utilisation research for close to ten years. Since September 2002, she is the Principal Investigator (University of Ghana) of the utilisation component of the west Africa project of the bean/cowpea CRSP which is a collaboration between the Food Science departments of University of Georgia and University of Ghana.
BB Singh	<p>BB Singh is the cowpea breeder and officer-in-charge at the Kano Station of the International Institute of Tropical Agriculture (IITA). Dr Singh has been at IITA since 1979 and his work on cowpea genetics and breeding is well recognised with release of over 40 improved cowpea varieties in 65 countries resulting in the global increase of cowpea production from less than one million tons in 1980 to over 4 million tons in 2003. His work on 60-day cowpea varieties and medium maturing grain and dual-purpose cowpeas with combined resistance to major diseases, insect-pests and Striga as well as tolerance to drought and heat is specially acknowledged worldwide.</p> <p>Dr Singh has guided thesis research of over 30 MS and PhD students most of whom are now leading scientists in different countries. Dr Singh has published over 200 papers in reputed international journals, books and conference proceedings. His recent leadership on participatory evaluation of cowpea-based improved crop-livestock systems in northern Nigeria has attracted support from USAID, DFID, The Gatsby Foundation and DANIDA. This work has paved the way for sustainable increases in food production for household food security and empowering rural farmers in the dry savannas of West Africa. Prior to joining IITA Dr Singh worked at Pant University in India as Associate professor /Senior Research Officer (Soybean Breeding) and National Soybean Research Coordinator.</p>
Idah Sithole-Niang	Idah Sithole-Niang is a molecular biologist based at the University of Zimbabwe in Harare. She is especially interested in biosafety issues, intellectual property rights and public awareness of biotechnology. Ida has over 12 years experience working in the field of cowpea biotechnology. She is currently the co-chair of NGICA.
Sir Ed Southern	Ed Southern is a molecular biologist and founder/chairman of the Kirkhouse Trust. He has a long-standing interest in genomics, in particular the development of techniques for the analysis of genome structure and genetic analysis.



Eugene R Terry	Eugene Terry is a plant pathologist and an agricultural research and development specialist with 36 years of professional experience in research, research management, technology generation and dissemination. He has held leadership positions in capacity building and institutional management in universities, international agricultural research institutes and international development agencies. He holds a BSc in agriculture and an MSc in plant pathology from McGill University, Montreal, Canada and a PhD in plant pathology from the University of Illinois, Urban-Champaign, USA. He has been associated with the University of Sierra Leone and has held the position of Plant Pathologist and Director of International Cooperation and Training at the International Institute of Tropical Agriculture, Ibadan, Nigeria. Dr Terry was the first Director General of the West Africa Rice Development Association, Bouake, Cote d'Ivoire, a position he held for nine years before joining the World Bank in Washington DC, first as an Advisor (Agricultural Research and Extension Group-ESDAR), and then later as Crops Advisor, in the Rural Development Department. Eugene is currently the implementing Director of the African Agricultural Technology Foundation. He is also the chairman of the Board of Trustees of the World Agroforestry Centre in Nairobi, Kenya. He has served (until November 2002) as a Trustee of the International Water Resources Management Institute in Colombo, Sri Lanka.
Michael P Timko	Michael P Timko is a Professor of Biology at the University of Virginia. Major interests are in plant molecular genetics, genomics and genetic engineering. He has been involved in Striga research for over 15 years. Currently pursuing studies aimed at further developing functional genomic techniques for cowpea and characterisation of pest and disease resistance genes.
Ralph von Kaufmann	Ralph von Kaufmann is an agricultural economist with varied experience in the University of Nairobi, Institute for Development Studies, the Kenyan Agricultural Finance Corporation, the World Bank, the Botswana National Development Bank and with ILCA now ILRI in Botswana, Nigeria, Ethiopia and Kenya. From 1978 to 1991 he led the ILCA Sub-humid Zone Programme based in Nigeria which conducted participatory research on forage legumes in semi-pastoral and smallholder systems. Since 1991 as Director for External Relations at ILRI, he has been involved in resource mobilisation and programme development. He was the Senior Resource Person at FARA which has its headquarters in Ghana. He is now a consultant to FARA.
Irvin E Widders	Irvin is the Director of the bean/cowpea Collaborative Research Support Program (CRSP). The Bean/Cowpea CRSP, funded by USAID, has a global mandate of building the human and institutional capacity of agricultural universities and national agriculture research systems, and of enhancing bean and cowpea consumption, utilisation and food security through collaborative research and training in Africa, Latin America and the United States. He is also a Professor of Horticulture at the Michigan State University. Dr Widders also manages the Bean Health Research Program through the International Alliance to Promote the Health Benefits of Dry Beans and Other Pulses (Beans for Health Alliance).
Anthony Youdeowei	Anthony Youdeowei was Professor of Agricultural Entomology at the Faculty of Agriculture and Forestry, University of Ibadan, Nigeria from 1973 to 1990. From 1990 to 1997 he was appointed and served as Director of Training and Communications at the West Africa Rice Development Association, an international agricultural research centre of the CGIAR based in Cote d'Ivoire. Anthony is a specialist in Integrated Pest Management, and has also developed interest and competence in agricultural education, training and scientific communication. Currently, Anthony is an international consultant IPM specialist and advises African Governments, the Food and Agriculture Organization of the United Nations, the World Bank – Africa Region, GTZ and other development agencies on integrated pest management policies, planning and field implementation of IPM programmes. He is also consultant to CTA in The Netherlands on training and agricultural communication issues. Anthony has vast experience of agricultural development in African and other third world countries and is the author of several books in agriculture and integrated pest management. He is a Founding Fellow of the African Academy of Sciences and a Fellow of the Third World Academy of Sciences.

## Annex 2

### Workshop programme

Tuesday, February 10	
8:30	Welcome and introduction <i>Chair: Emmanuel Owusu-Bennoah, Chief Scientific Officer and Acting Director General, Council for Scientific &amp; Industrial Research</i>
<b>Plenary presentations: Chair – Emmanuel Owusu-Bennoah</b>	
9:00	Comprehensive update on the AATF <i>Eugene Terry, Implementing Director, AATF</i>
9:30	Update on NGICA <i>Idah Sithole-Niang, University of Zimbabwe</i>
9:50	General aims and procedures of this workshop <i>Larry Murdock, Purdue University</i>
10:20	Group photograph and coffee break
10:45	Cowpea marketing and trade: An update <i>Ousmane Coulibaly, IITA/Benin</i>
11:10	Potential economic and trade impacts of <i>Bt</i> cowpea <i>Jess Lowenberg-DeBoer, Purdue University</i>
11:35	Genetic transformation of cowpea – State of the art <i>TJ Higgins, CSIRO/Australia</i>
12:00	Lunch
1:30	Plenary session with Task Force leaders <i>Chair – Tony Youdeowei</i> <i>Ousmane Coulibaly, Mohamad Ishiyaku, Laurie Kitch, Phelix Majiwa, Larry Murdock and Idah Sithole-Niang</i>
2:30	Specific guidance for Task Forces <i>Tony Youdeowei (Rapporteur), and Phelix Majiwa</i>
2:45	Task Force breakout group meetings
4:15	Coffee break
4.30	Kirkhouse Trust programmes – <i>Ed Southern</i>

**Plenary presentations**

- 4:40** Dual purpose cowpea and fodder cowpea: Collaborative research within the CGIAR Systemwide Livestock Programme.  
*Salvador Fernandez-Rivera, ILRI/Ethiopia*
- 5:00** Potential and constraints of improved cowpea in increasing the productivity of cowpea-cereals systems in the dry savannahs of west Africa  
*BB Singh, IITA/Nigeria*
- 5:25** Task Forces resume deliberations
- 7:00** Cocktails at the M Plaza Hotel

**Wednesday, February 11, 2004***Chair – Idah Sithole-Niang***Plenary presentations**

- 8:30** Plenary session: Cross-cutting issues  
*Phelix Majiwa, AATF/Kenya*
- 9:30** Getting technology into farmers' hands: Increasing farmers' income through improved quantity and quality grain production  
*Ouendeba Botorou, INRAN/Niger*
- 10:00** Task Forces to continue deliberations
- 12:00** Lunch
- 1:30** Task Forces to continue deliberations
- 6:30** Collective dinner at Maquis Tante Marie Labonne

**Thursday, February 12, 2004****Plenary sessions- Reports from Task Forces***Chair – Jess Lowenberg-DeBoer*

- 8:30** Marketing and Trade Task Force  
*Ousmane Coulibaly*
- 9:00** Seed Constraints Task Force  
*Mohamad Ishiyaku*
- 9:30** Coffee break
- 10:00** Field Constraints Task Force  
*Eugenia Barros*

10.30	Intellectual Property Task Force <i>Idah Sithole-Niang</i>
11:00	Storage Task Force <i>Larry Murdock</i>
11:30	Project Formulation <i>Phelix Majiwa</i>
12.00	Task Forces break up sessions to finalise reports
1.00	Lunch
2:30	Plenary discussion <i>Chair – Phelix Majiwa</i>
4.00	Summing up <i>Eugene Terry</i>
<b><i>Closing: Chair Emmanuel Owusu-Bennoah</i></b>	
5:00	Closing remarks <i>Emmanuel Owusu-Bennoah</i>

Friday, February 13, 2004

*Chair: Eugene Terry, Implementing Director AATF*

**8.30 to 4.00** Discussion on conceptual framework for the cowpea project concept note  
*Working group on Project Formulation*

## Annex 3

### Composition of Task Forces

Seeds	Storage
Mohammed Ishiyaku – Chair Vincent Gwarazimba Ndiaga Cisse Issa Drabo BB Singh Jeff Ehlers	Larry Murdock – Chair Ousmane Boukar Esther Sakyi-Dawson Francis Padi Eugene Terry
Intellectual property	Field constraints
Idah Sithole-Niang – Chair Joe Huesing Walter Alhassan Sika Gbegbelegbe Ed Southern Patricia Kameri-Mbote	Eugenia Barros – Chair TJ Higgins Larry Beach Phil Roberts George Bruening Ivan Ingelbrecht Jeremy Ouedrago Mike Timko
Marketing and trade	Project formulation
Ousmane Coulibaly – Chair Sam Sefa-Dedeh Ouendeba Botorou Salvador Fernandez-Rivera Jess Lowenberg-DeBoer Nancy Muchiri	Phelix Majiwa – Chair Louis Jackai Irv Widders Ralph von Kaufmann Tony Youdeowei Emmanuel Owusu-Bennoah

## Annex 4

### Opening and closing addresses

Opening Address by Prof E Owusu-Bennoah, AG Director-General, CSIR, Ghana

#### *Distinguished ladies and gentlemen*

*It is with great pleasure that I extend a hearty welcome to you at this all-important International Cowpea Stakeholders' Workshop. We are happy to note that Sir Edwin Southern, Founder and Chair of both Kirkhouse Trust and Oxford Gene Technology Limited is here with us as a guest. On behalf of the government and the people of Ghana I want to say a big AKWAABA to Sir Southern and all our distinguished participants. We in Ghana are particularly happy and grateful to the African Agricultural Technology Foundation (AATF) for choosing Accra to host this workshop.*

*If I really accepted to preside over the opening ceremony of this workshop, it is because I believe in the community effort aimed at helping to shape plans for mobilising new or better technologies to increase cowpea productivity and utilisation in Africa. Cowpea is estimated to be one of the most important food grain legume crops in Ghana. It is cultivated extensively in the northern savanna zone of the country. The role cowpea plays in ensuring food security and in the improvement of the livelihood of both rural and urban poor in this country cannot be underestimated. This is especially true, given the potential of the crop, in firstly meeting the protein requirements of humans; secondly, providing feed, forage, hay and silage for livestock; and thirdly, improving or maintaining the fertility or productivity of soils.*

*It is in the light of the importance of cowpea that this workshop must be seen as a step in the right direction. Indeed, this workshop is the result of a number of initiatives, one of which is the meeting of the African Agricultural Technology Foundation (AATF) and the Network for the Genetic Improvement of Cowpea for Africa (NGICA) in Nairobi, Kenya in July 2003. A previous meeting under the theme "Genetic improvement of cowpea" had been held in Dakar in January 2001. The Nairobi meeting resulted in the formation of a Technical Steering Committee which was tasked to guide the development of a project aimed at increasing cowpea productivity and utilisation in Sub-Saharan Africa. It is on the basis of work undertaken by this Technical Steering Committee that we are today witnessing this workshop.*

*I must pay special tribute to the collective efforts of scientists and specialists, who out of the desire to improve the productivity of the crop, have worked hard and tirelessly to ensure the holding of this all-important workshop.*

*This workshop, in my opinion, is one of the most appropriate and timely initiatives, coming at a period when all efforts are being made to address the issue of meeting the food requirements of people in the African continent.*

*I am especially delighted that the Council for Scientific and Industrial Research of Ghana (CSIR) and the University of Ghana have played active roles in this noble initiative. Indeed, the main objective of this workshop is also at the heart of efforts currently being made by agricultural research institutes of the CSIR to fulfil their mandate of developing improved crop varieties and agronomic practices to ensure increased productivity and thus enhance food security in Ghana. Research in breeding and integrated crop management has resulted in the following achievements:*

- 1. release of 12 cowpea varieties by Crop Research Institute and Savanna Agricultural Research Institute*
- 2. appropriate integrated crop management (agronomic and IPM) practices have also been developed for cowpea as sole crop or in association with cereals and roots and tuber crops.*

*Also the CSIR Food Research Institute has developed appropriate technologies to remove the tannin content from the seeds of some cowpea varieties so as to increase digestibility. This is essential in the preparation of weaning blends and other formulations for vulnerable groups like lactating mothers and children.*

*Ladies and gentlemen, the main objective of this workshop, I am informed, is to develop a process and device a plan for bringing the benefits of modern cowpea plant improvement technologies in the form of superior-performing cowpea cultivars with novel traits.*

*Many would agree with me that the generation of technologies alone might not be enough. They must be linked to plans and mechanisms that would engender development in a sustained manner. Indeed, technologies must be disseminated in a way that would provide long-term benefits to end-users.*

*It is in the light of this fact that I would urge you to consider ways and strategies that would ensure that high quality genetically improved cowpea seeds reach farmers so that the benefits of genetically improved cowpea cultivars could be realised.*

*Ladies and gentlemen, one of the difficulties in our attempts at ensuring increased productivity of the cowpea crop has been the problem of seed production systems. As you have gathered here, I would entreat you to give much consideration towards the issue of creating viable and effective seed production mechanisms and facilities. There is, undoubtedly, the need to address the issue of producing and disseminating seeds to growers, in the light of the failure of seed-production schemes in most African countries. There has been a few, mostly small scale but promising cowpea seed production operations in this country, which may serve as a model for you in the creation of viable and effective seed production schemes for countries of the continent.*



*In addition to making recommendations about agronomic and consumer-preference characteristics of genetically improved cowpea resulting from this project, I will also ask that you consider the development of tentative business models for possible implementation of cowpea production technology.*

*The problems associated with storage, insect pests, parasitic weeds, viral, bacterial, and fungal diseases of cowpea should also engage your attention. It is my hope that you would take the opportunity to review each of these field limitations, identify those for which new technology or new approaches are available and review the feasibility and potential benefits of technology interventions.*

*I hope participants would be able to agree on a common strategy towards developing improved technologies to increase cowpea productivity and utilisation for the benefit of African cowpea producers and consumers.*

*We in the Council for Scientific and Industrial Research and indeed Ghana National Agricultural Research System (NARS) look forward to increased collaboration with international networks such as NGICA and continental organisations such as the AATF and FARA in public education programmes with objective and balanced presentations concerning positive and negative effects associated with the adoption of these new technologies.*

*I wish all participants and guests a resounding success in your deliberations and a pleasant stay in Ghana.*

*Distinguished ladies and gentlemen, it is with great honour and pleasure that I declare this workshop officially open.*

*Thank you.*

**Closing Address by Prof E Owusu-Bennoah, AG Director-general of CSIR, Ghana*****Distinguished ladies and gentlemen***

*It is my pleasant duty to address the closing session of the three-day international cowpea stakeholders' workshop, which had as its theme "Creating a technology plan for African cowpea farmers and consumers". The workshop which was jointly organised by the African Agriculture Technology Foundation (AATF) and the Network for the Genetic Improvement of Cowpea for Africa (NGICA) primarily sought to bring together technical specialists who are interested in increasing cowpea productivity and utilisation in Africa. This workshop could not have been held at a more opportune time than now since most African governments south of the Sahara are busy working towards the attainment of the Millennium Development Goals of reducing poverty, hunger and ensuring food security.*

*In my opening address, I charged participants to consider ways and strategies that would ensure that high quality genetically improved cowpea seeds reach farmers so that the benefits of genetically improved cowpea cultivars could be realised. I am happy to note that participants have worked hard during these three days to develop an attractive project to increase cowpea productivity and utilisation for Sub-Saharan Africa.*

*This workshop has also given the opportunity to some of us to understand clearly the set objectives and ideals of the African Agriculture Technology Foundation (AATF). In my opinion, this is an excellent Foundation, which should be supported by all African governments, and I wish to take the opportunity to commend the founding fathers of this noble foundation. I shall plead with the AATF board that the activities of the Foundation should be popularised for the benefit of poor African farmers. We have also had the privilege to hear more about the Network for the Genetic Improvement of Cowpea in Africa (NGICA). I am excited that this successful stakeholders' meeting in Accra has laid a solid foundation for a cowpea project that would be jointly implemented by the AATF and NGICA. I wish to commend all the working groups and their respective chairmen for the great efforts put in coming out with their recommendations.*

*Given the complexity of this undertaking, a number of organisations and people have provided their facilities and time to ensure that this workshop succeeded. To all these people and organisations, I say a big thank you on behalf of the organisers.*

*Sir Southern, who found time to be with us I say thank you. To you the participants, your contributions have been very much appreciated.*

*I hope participants enjoyed their brief stay in Ghana.*

*Finally, on behalf of the Government and people of Ghana, I wish you all bon voyage. Ladies and gentlemen, it is with great honour and pleasure that I declare the workshop officially closed.*

*Thank you and God bless.*

## Annex 5

### PowerPoint presentations

1. Technological advances, IPR, food security and poverty in Africa – *Eugene Terry*
1. AATF draft communications and development strategy – *Nancy Muchiri*
2. Update on NGICA Network for the Genetic Improvement of Cowpea for Africa – *Idah Sithole-Niang*
3. Biosafety audit – *Muffy Koch*
4. Socio-economics of cowpea in Sub-Saharan Africa: Production, marketing and trade – *Ousmane Coulibaly*
5. Potential economic and trade impacts of *Bt* cowpea – *Jess Lowenberg-DeBoer*
6. Establishment of a gene transfer protocol for cowpea (*Vigna unguiculata*) – *TJ Higgins*
7. Dual purpose and fodder cowpea: Collaborative research within the CGIAR System-wide Livestock Programme – *Salvador Fernandez-Rivera*
8. Potential and constraints of improved cowpea varieties in increasing the productivity of cowpea-cereals systems in the dry savannas of west Africa – *BB Singh*
9. Getting technology into farmers hands: Increasing farmers income through improved quantity and quality grain production – *Ouendeba Botorou*
10. AATF/NGICA workshop on cowpea productivity and utilisation – Guidelines for Task Forces – *Phelix Majiwa and Anthony Youdeowei*
11. Project formulation – *Phelix Majiwa*

## Annex 6

### McKnight Foundation IP statement

#### Statement on expectations regarding protection of intellectual property

##### Overview

This statement sets forth The McKnight Foundation's expectations regarding protection of intellectual property (IP) resulting from work it funds through the Collaborative Crop Research Program (CCRP). We expect each grantee and its partners to subscribe to this policy and to develop a management plan based on the implementation principles listed below. IP management plans will be reviewed by the Foundation, and release of year two funds will be contingent upon the Foundation's approval of the plan.

##### IP and how it is protected

Intellectual Property is a term that collectively includes all the products of creativity, invention, and know-how (intellectual property) as well as biological materials and devices. Means of formally protecting such property that results in the creation of intellectual property rights (IPR) can include patents, trade secrets, and copyright.

<sup>1</sup> Access to protected IP often involves the use of various agreements, such as IPR License or Royalty Agreements to control their distribution. IP assets such as cell lines, plant varieties, or monoclonal antibodies often are not protected formally and their dissemination can be controlled by material transfer agreements, signed by both the providing and receiving parties. <sup>2</sup> In addition, biological materials are often subject to international and national legislation governing the ownership of biodiversity assets.

##### Values underlying the Collaborative Crop Research Program

The Foundation's mission is "to improve the quality of life for present and future generations and to seek paths to a more humane and secure world." Values specific to the CCRP include:

- encouraging and supporting the free flow of advanced scientific knowledge and research materials, primarily in the form of public goods

<sup>1</sup> Statutory protection regulations will vary according to national legislation. Types of IP protection mechanisms may include utility patents, innovation patents, trademarks, copyrights, database rights, and trade secrets, as well as other types of protection mechanisms.

<sup>2</sup> These materials sometimes are referred to as "tangible property or TP" to reflect their inherent tangible nature.

- empowering resource-poor people in less developed countries to make their own decisions regarding food security that are appropriate to their circumstances
- building and sustaining a strong public agricultural sector in developing countries
- valuing, conserving and utilising genetic resources, while upholding national and international biodiversity regulations.

### McKnight policy on protection of IP

The McKnight Foundation's Collaborative Crop Research Program seeks to contribute to the security of food production and human nutrition in the developing countries of Asia, Africa and Latin America through sustained support of research and training that is closely and strategically linked to issues of food crop production in those countries. The Foundation requires that knowledge and materials resulting from the research and training that it funds be used for the maximum public benefit of resource-poor people in less developed countries. Results of research supported by the Foundation should contribute, through a series of collaborative projects and transfers of technology, to the production of improved seed and other material and know-how used by farmers. Participants in the program must commit to facilitating the sharing and transfer of technology and research products for both research and commercial use benefiting resource-poor people in developing countries. McKnight Foundation Grantees should also use IP that belongs to others in a responsible manner <sup>3</sup> that respects the rights of the IP owners.

### Implementation of this policy

Through implementation of this policy, we expect grantees to increase their capacity to understand the various approaches to, advantages of, and limitations surrounding legal protection of intellectual property in the context of their research, institution and country.

Each partnership shall propose a plan for management of intellectual property that best fits its situation and the policies of the partner institutions. In doing so, projects shall ensure that ownership of all intellectual property rights (IPR) arising directly or indirectly from the project is equitably allocated. Equitable allocation considers:

- the intellectual contribution of each partner in the collaboration to the ongoing project (foreground IP)
- the contribution of intellectual property, materials, research effort, and preparatory work of each partner brought to the project (background IP)
- the facilities provided by each partner
- to a lesser degree, the financial contribution of each partner
- other considerations determined by the partners to be relevant.

<sup>3</sup> IP for which ownership has been established is often referred to as "Proprietary property or technology."

Grantees should be guided by the following principles in developing their plan for protection of intellectual property:

### Ownership

The McKnight Foundation does not hold or claim ownership rights over intellectual property or intellectual property rights resulting from research it funds. The Foundation instead requires that investigators and research institutions it supports protect their McKnight-funded IP only if protection is needed to ensure that this IP will be available for their own future research and for public-sector benefit. All IP arising from McKnight-funded projects should be clearly identified and inventoried to assure that ownership is clearly documented.

We require that valid and enforceable mechanisms be in place to ensure that inventions, improved germplasm, know-how, and materials developed with funding from the McKnight Foundation be protected from any limitations on their use to advance the causes of food security and the improvement of the lives of poor people around the world.

In some cases, the interest of food security and the improvement of the lives of the poor can best be advanced by placing the results of work supported by the Foundation rapidly in the public domain, such as through scientific publication. In such cases, appropriate publication effectively prevents others from patenting the same or similar inventions.

In other cases, the public interest will be advanced by applying for statutory protection, such as patents owned by or assigned to public institutions. In these cases, we require that mechanisms be adopted so that inventors will disclose, license, or assign ownership of their rights to their invention to their public-sector employer, or, where appropriate, to another institution whose mandate for a transfer of rights is to benefit resource-poor people in the developing countries. When rights are allocated in this way, employment agreements or other forms of commitment should be in place between the investigators and the research institutions, ensuring that any IP generated through work funded by the Foundation will be appropriately managed according to the IP Plan developed by the project partners.

All patents or other forms of claiming formal ownership of the results of McKnight-funded research shall be managed by the owner in a manner that ensures a reasonable time of royalty-free access for public (non-commercial) entities operating in developing countries, and/or shall give McKnight royalty-free license with the ability to sub-license for humanitarian purposes. The Foundation also requires that institutions be willing to license or assign rights to an appropriate international public agricultural research system ITP portfolio, should one be developed, to facilitate use of research results to help food insecure subsistence farmers in developing countries.

## Use of materials for public benefit

Within the context of existing institutional IP policies, project partners shall take all reasonable steps to:

- provide reasonable and ready access by public-sector beneficiaries to property, materials and processes
- avoid unreasonable commercial exploitation of such material and processes for purposes that diminish growth of public-sector agriculture in developing countries
- avoid encumbering materials and processes in statutory protection such that they cannot be used for public benefit.

## Respect for biodiversity regulations

The exchange of genetic materials is governed by national and international legislation. Grantees must be informed about, and fully respect, all relevant regulations, laws and procedures (both national and international). Regulated genetic materials may include wild relatives of crops, land races, varieties, and breeding lines; other organisms; and derived genetic material such as DNA and DNA sequence information.

## Publication

We strongly encourage public disclosure of results from McKnight-funded research through publications in the scientific literature, in print and/or electronic form. We prohibit maintaining such results as trade secrets. We encourage timely publication of research results, but recognise the prerogative of scientists to retain control of their data prior to publication.

## Costs

The project budget shall make allowance for costs relating to registration and maintenance of intellectual property and to manage licensing of protected property. The Foundation will not make available additional funds for this purpose.

## Partnership

In developing plans for protection of intellectual property, partnerships should bear in mind the collaborative nature of the McKnight program and their work and all partners are encouraged to take reasonable steps to meet the needs and comply with the regulations of all project partner institutions.





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