Lessons from Two Years of Tropical Legumes II

Second Annual Review and Planning Meeting
16–20 November 2009, Bamako, Mali
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Contents

Programme ........................................................................................................................................ i

Opening Speech ................................................................................................................................ vi

Summaries ....................................................................................................................................... 6

An introduction to the Tropical Legumes II project ................................................................. 6

Objective 1: Targeting crop breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of sub-Saharan Africa and South Asia – an overview ................................................................. 11

Objective 1: Targeting groundnut breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone regions of sub-Saharan Africa and south Asia ......................................................................................... 15

Objective 1: Targeting chickpea breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of sub-Saharan Africa and South Asia ........................................................................ 20

Objective 1: Targeting pigeonpea breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of eastern and southern Africa ........................................................................ 25

Objective 1: Targeting common bean breeding and seed delivery efforts to enhance poverty impacts in eastern and southern Africa ................................................................. 34

Objective 1: Targeting cowpea breeding and seed delivery efforts to enhance poverty impacts in sub-Saharan Africa ......................................................................................... 39

Objective 1: Targeting soybean breeding and seed delivery efforts to enhance poverty impacts in sub-Saharan Africa ......................................................................................... 44

Objective 2: Enhancing groundnut productivity and production in drought-prone areas of sub-Saharan Africa and South Asia ......................................................................................... 49

Objective 3: Enhancing cowpea productivity and production in drought-prone areas in sub-Saharan Africa ........................................................................................................ 54

Objective 4: Developing drought resistant common bean .................................................................. 58

Objective 5: Enhancing chickpea productivity and production in drought-prone areas of sub-Saharan Africa and South Asia ........................................................................ 61
Objective 6: Enhancing pigeonpea productivity and production in drought-prone areas of sub-Saharan Africa and South Asia ................................. 64

Objective 7: Enhancing soybean productivity and production in drought-prone areas of sub-Saharan Africa ................................................................. 67

Objective 8: Developing seed systems to maximize impact for the poor in drought-prone areas of sub-Saharan Africa and South Asia – an overview......... 71

Obj. 8: Developing sustainable groundnut seed production and delivery systems for reaching the poor in drought-prone areas of SSA and SA...................... 74

Objective 8: ICRISAT chickpea seed production and delivery strategy in ESA and SA .............................................................................................................. 79

Objective 8: ICRISAT Pigeonpea seed production and delivery strategy in ESA and SA .............................................................................................................. 83

Objective 8: Bean seed production and delivery ........................................ 88

Objective 8: Developing sustainable cowpea seed production and delivery systems that will reach the poor in drought-prone areas of sub-Saharan Africa .......... 95

Objective 8: Developing sustainable soybean seed production and delivery systems that will reach the poor in drought-prone areas of sub-Saharan Africa .......... 100

Putting nitrogen fixation to work for smallholder farmers in Africa (N2Africa).... 104

The West Africa Seed Alliance (WASA) and the Eastern and Southern Africa Seed Alliance (ESASA) ................................................................................. 106

Closing remarks ............................................................................................. 109

List of participants .......................................................................................... 113
### Programme

**Saturday (14/11/09)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity/Topic</th>
<th>Presenter/Responsible</th>
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</thead>
<tbody>
<tr>
<td>AM</td>
<td>Participants arrive in Bamako</td>
<td>Organizers</td>
</tr>
<tr>
<td>PM</td>
<td>• Participants arrive in Bamako</td>
<td>Organizers</td>
</tr>
<tr>
<td></td>
<td>• Setting up Exhibition</td>
<td>Respective Teams</td>
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**Sunday (15/11/09)**

<table>
<thead>
<tr>
<th>AM</th>
<th>Participants arrive in Bamako/Setting up Exhibition</th>
<th>Organizers/TL II Scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td>17:00-19:00</td>
<td>Internal Meeting (Objective Coordinators, PIs, TL II Scientists)</td>
<td>CLL Gowda/Tsedeke Abate</td>
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**DAY ONE (Monday: 16/11/09)**

**Session 1: Opening, Introduction, and Exhibition**
*Moderators: Drs Bino Teme, CLL Gowda*

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter/Organizers</th>
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<tbody>
<tr>
<td>08:30-09:00</td>
<td>Registration</td>
<td>Participants/Organizers</td>
</tr>
<tr>
<td>09:00-10:00</td>
<td>Welcome/Opening</td>
<td>Regional Director, W. Africa; DDG-R, ICRISAT; DDG-R, IITA; DDG-R, CIAT; Sr Program Officer, BMGF; PS, MOA, Mali</td>
</tr>
<tr>
<td>10:00-10:30</td>
<td>Introducing TL II</td>
<td>T Abate, CLL Gowda, S Silim</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td>Group Photo &amp; Health Break (Refreshments Served)</td>
<td>Organizers</td>
</tr>
<tr>
<td>11:00-11:45</td>
<td>Exhibition Visits</td>
<td>Organizers/Scientists</td>
</tr>
</tbody>
</table>

**Session 2: Collaboration with Other Projects/Grants**
*Moderators: Drs David Hoisington & David Bergvinson*

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:45-12:15</td>
<td>Overview of TL I</td>
<td>Carmen de Vicente</td>
</tr>
<tr>
<td>12:15-13:15</td>
<td>Technical Tools (Available &amp; Potential) for Assisting Breeding Programs (Groundnut, Chickpea, Common Bean, Cowpea); Highlights of Phase II</td>
<td>TL I Team</td>
</tr>
<tr>
<td>13:15-14:15</td>
<td>Lunch Break</td>
<td>Organizers</td>
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</tbody>
</table>
### DAY TWO (TUESDAY: 17/11/09)

**Session 3 (Objective 1): Targeting Crop Breeding and Seed Delivery Efforts to Enhance the Impact on the Livelihoods of the Poor in SSA & SA**  <br>**Moderators: Drs Mohamed Silim Nahdy & Christian Fatokun**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30</td>
<td>Overview</td>
<td>MCS Bantilan et al.</td>
</tr>
<tr>
<td>09:00</td>
<td>Groundnut</td>
<td>Jupiter Ndjeungu et al.</td>
</tr>
<tr>
<td>09:30</td>
<td>Chickpea</td>
<td>KPC Rao et al.</td>
</tr>
<tr>
<td>10:00</td>
<td>Cowpea</td>
<td>Bekele Shiferaw et al.</td>
</tr>
<tr>
<td>10:30</td>
<td>Health Break (Refreshments Served)</td>
<td>Organizers</td>
</tr>
<tr>
<td>11:00</td>
<td>Common Bean</td>
<td>Enid Katungi et al.</td>
</tr>
<tr>
<td>11:30</td>
<td>Cowpea</td>
<td>Ousmane Coulibaly et al.</td>
</tr>
<tr>
<td>12:00</td>
<td>Soybean</td>
<td>Ousmane Coulibaly et al.</td>
</tr>
<tr>
<td>12:30</td>
<td>General Discussion</td>
<td>Moderators</td>
</tr>
<tr>
<td>13:00</td>
<td>Lunch Break</td>
<td>Organizers</td>
</tr>
</tbody>
</table>

**Session 4 (Objectives 2-7): Enhancing Productivity and Production of TL II Crops in Drought-prone Areas of SSA & SA**  <br>**Moderators: Drs Joe Tohme & Prem Warrior**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>14:00</td>
<td>Objective 2: Groundnut</td>
<td>SN Nigam et al.</td>
</tr>
<tr>
<td>14:30</td>
<td>Objective 3: Cowpea</td>
<td>Christian Fatokun et al.</td>
</tr>
<tr>
<td>15:00</td>
<td>Objective 4: Common Bean</td>
<td>Steve Beebe et al.</td>
</tr>
<tr>
<td>15:30</td>
<td>Health Break (Refreshments Served)</td>
<td>Organizers</td>
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<tr>
<td>Time</td>
<td>Session</td>
<td>Speaker(s)</td>
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<tr>
<td>16:00-16:30</td>
<td>Objective 5: Chickpea</td>
<td>Pooran Gaur et al.</td>
</tr>
<tr>
<td>16:30-17:00</td>
<td>Objective 6: Pigeonpea</td>
<td>KB Saxena et al.</td>
</tr>
<tr>
<td>17:00-17:30</td>
<td>Objective 7: Soybean</td>
<td>Hailu Tefera et al.</td>
</tr>
<tr>
<td>17:30-18:00</td>
<td>General Discussion</td>
<td>Moderators</td>
</tr>
</tbody>
</table>

**DAY 3 (WEDNESDAY: 18/11/09)**

**Session 5 (Objective 8): Developing Sustainable Seed Production and Delivery Systems for Reaching the Poor in Drought-prone Areas of SSA & SA**

**Moderators: Drs Rob Melis & Peter Craufurd**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
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</thead>
<tbody>
<tr>
<td>08:30-09:00</td>
<td>Overview</td>
<td>Louise Sperling</td>
</tr>
<tr>
<td>09:00-09:30</td>
<td>Groundnut</td>
<td>SN Nigam et al.</td>
</tr>
<tr>
<td>09:30-10:00</td>
<td>Chickpea</td>
<td>Pooran Gaur et al.</td>
</tr>
<tr>
<td>10:00-10:30</td>
<td>Pigeonpea</td>
<td>Rakesh Srivastava et al.</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td>Health Break (Refreshments Served)</td>
<td>Organizers</td>
</tr>
<tr>
<td>11:00-11:30</td>
<td>Common Bean</td>
<td>Louise Sperling et al.</td>
</tr>
<tr>
<td>11:30-12:00</td>
<td>Cowpea</td>
<td>Alpha Kamara et al.</td>
</tr>
<tr>
<td>12:00-12:30</td>
<td>Soybean</td>
<td>Alpha Kamara et al.</td>
</tr>
<tr>
<td>12:30-13:00</td>
<td>General Discussion</td>
<td>Moderators</td>
</tr>
<tr>
<td>13:00-14:00</td>
<td>Lunch Break</td>
<td>Organizers</td>
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**Session 6: Breakout/Parallel Sessions**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Chair/Secretary</th>
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</thead>
<tbody>
<tr>
<td>14:00-16:00</td>
<td>Advisory Board Meeting</td>
<td>Chair/Secretary</td>
</tr>
<tr>
<td>14:00-14:30</td>
<td>Adoption of Minutes of First Annual Review Meeting</td>
<td>S. Shanmugasundaram</td>
</tr>
<tr>
<td>14:30-15:00</td>
<td>Progress Report</td>
<td>Tsedeke Abate</td>
</tr>
<tr>
<td>15:00-15:15</td>
<td>Report on Regional Meeting (Hyderabad)</td>
<td>Peter Craufurd</td>
</tr>
<tr>
<td>15:15-15:30</td>
<td>Report on Regional Meeting (Nampula)</td>
<td>Rob Melis</td>
</tr>
<tr>
<td>15:30-15:45</td>
<td>Health Break (Refreshments Served)</td>
<td>Organizers</td>
</tr>
<tr>
<td>15:45-16:00</td>
<td>Report on Regional Meeting (Morogoro)</td>
<td>Rob Melis</td>
</tr>
<tr>
<td>16:00-17:30</td>
<td>Matters Arising and Discussion</td>
<td>Chair</td>
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<tr>
<td>Time</td>
<td>Event</td>
<td>Organizer(s)</td>
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<tr>
<td>14:00-16:00</td>
<td>Refining Work Plan 2010</td>
<td>Respective Teams</td>
</tr>
<tr>
<td>16:00-16:30</td>
<td><em>Health Break (Refreshments Served)</em></td>
<td>Organizers</td>
</tr>
<tr>
<td>16:30-17:30</td>
<td>Parallel Sessions Continued</td>
<td>Respective Leaders</td>
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<tr>
<td>19:00-21:00</td>
<td>Reception</td>
<td>Organizers</td>
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**DAY 4 (THURSDAY: 19/11/09)**

*Session 7: Presentations of Work Plan for 2010 and Second Phase*

**Moderators: Drs Said Silim & CLL Gowda**

<table>
<thead>
<tr>
<th>Time</th>
<th>Objective</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>08:30-09:00</td>
<td><strong>Objective 1: Targeting Impact</strong></td>
<td>MCS Bantilan</td>
</tr>
<tr>
<td>09:00-09:30</td>
<td><strong>Objective 2: Groundnut</strong></td>
<td>SN Nigam</td>
</tr>
<tr>
<td>09:30-10:00</td>
<td><strong>Objective 3: Cowpea</strong></td>
<td>Christian Fatokun</td>
</tr>
<tr>
<td>10:00-10:30</td>
<td><strong>Objective 4: Common Bean</strong></td>
<td>Steve Beebe</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td><em>Health Break (Refreshments Served)</em></td>
<td>Organizers</td>
</tr>
<tr>
<td>11:00-11:30</td>
<td><strong>Objective 5: Chickpea</strong></td>
<td>Pooran Gaur</td>
</tr>
<tr>
<td>11:30-12:00</td>
<td><strong>Objective 6: Pigeonpea</strong></td>
<td>KB Saxena</td>
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<tr>
<td>12:00-13:00</td>
<td><em>Lunch Break</em></td>
<td>Organizers</td>
</tr>
<tr>
<td>13:00-13:30</td>
<td><strong>Objective 7: Soybean</strong></td>
<td>Hailu Tefera</td>
</tr>
<tr>
<td>13:30-14:00</td>
<td><strong>Objective 8: Seed Systems</strong></td>
<td>Louise Sperling</td>
</tr>
<tr>
<td>14:00-15:00</td>
<td><strong>General Discussion</strong></td>
<td>Moderators</td>
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<tr>
<td>15:00-15:30</td>
<td><em>Health Break (Refreshments Served)</em></td>
<td>Organizers</td>
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<tr>
<td>15:30-17:30</td>
<td><strong>Free Time</strong></td>
<td>Participants</td>
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**DAY 5 (FRIDAY: 20/11/09)**

*Session 8: Plenary Session*

**Moderator: Dr David Hoisington**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Organizer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:30-10:30</td>
<td><strong>Presentation of Summary of TL I Phase II Proposal and Discussion</strong></td>
<td>TL I Team</td>
</tr>
<tr>
<td>10:30-11:00</td>
<td><em>Health Break (Refreshments Served)</em></td>
<td>Organizers</td>
</tr>
<tr>
<td>11:00-12:00</td>
<td><strong>General Discussion</strong></td>
<td>Moderator</td>
</tr>
<tr>
<td>12:00-12:30</td>
<td><strong>Remarks and Recommendations of Advisory Board</strong></td>
<td>Dr. Shanmugasundaram</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td>Organizer</td>
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<tr>
<td>12:30-13:00</td>
<td>Closing Remarks</td>
<td>Dr. David Hoisington, DDG-R, ICRISAT</td>
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<td>(on behalf of Dr. William Dar, DG of ICRISAT)</td>
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<tr>
<td>13:00-14:00</td>
<td>Lunch Break</td>
<td>Organizers</td>
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END OF WORKSHOP
Monsieur le Président, Honorables Membres de la Communauté des Bailleurs de Fonds, Honorable Membres du Comité Consultatif de TL II, Honorable Membres de l’Équipe de Gestion et Chercheurs de TL II, Chers invités, Mesdames et Messieurs,

J’ai l’immense plaisir de vous souhaiter la bienvenue dans notre beau pays, le Mali. C’est un pays relativement grand avec une superficie de plus de 122 millions d’hectares, et une population d’environ 13 millions d’habitants. Près de 54% (ou plus de 6.44 millions) de notre population est engagé dans l’agriculture (plus l’élevage et la pêche) et contribue presque 33% au montant total de notre PIB.

Les céréales (le sorgho, le mil, le maïs et le fonio) et les légumineuses (le niébé, le voandzou et l’arachide) sont les principales cultures vivrières du Mali. Le soja connaît également une certaine croissance. L’agriculture malienne, comme beaucoup d’autres dans la sous-région souffre de conditions environnementales très difficiles - principalement une pluviométrie irrégulière et incertaine. Les variétés améliorées de cultures et d’autres technologies agricoles n’ont pas été largement adoptées par nos paysans. À l’exception du maïs, les rendements des céréales et des légumineuses sont encore en dessous d’une tonne à l’hectare. L’exportation de la principale légumineuse du Mali, l’arachide, a baissé d’environ 17 mille tonnes métriques dans les années 60 à près de 5 mille tonnes métriques au cours de ses dernières années. La croissance de la production agricole annuelle n’a pas suivi celle de la population, qui demeure à environ 2.4%.

Honorables invités, Mesdames et Messieurs,

Les légumineuses tropicales, qui constituent l’essentiel de vos discussions pour les cinq jours à venir, jouent un rôle important dans l’agriculture malienne. Elles sont une source importante de protéines, de calories et de vitamines et améliorent le sol par la fixation de l’azote.

Les données de la FAO de 2005-07 montrent qu’en moyenne, environ 308 mille et 240 mille hectares de terre, respectivement, sont emblavées chaque année en niébé et arachide dans ce pays. Le soja est également en train d’acquérir de l’importance dans nos systèmes agricoles. Par exemple, les superficies consacrées à cette culture ont augmenté, de près de 500 hectares en 1985-87 à 2253 hectares en 2005-07.

Honorables invités, Mesdames et Messieurs,

La possibilité d’augmenter la production de légumineuses tropicales dans les zones prédisposées à la sécheresse de notre pays est très significative. Je note que TL II a pour objectif d’augmenter la productivité et la production des légumineuses tropicales de 15 pour cent.
au cours des 10 prochaines années et d’emblaver 30 pour cent des terres avec des variétés améliorées. L’une des priorités de notre gouvernement est le développement de l’agriculture, en particulier celle des petits exploitants. L’appui que notre pays reçoit de TL II et de beaucoup d’autres projets similaires, en termes d’études socio-économiques ; amélioration des cultures ; systèmes améliorés de production et de livraison de semences ; et de renforcement des capacités, nous aidera sur le long terme à atteindre nos objectifs en vue d’assurer la sécurité alimentaire et d’améliorer le bien-être des petits exploitants de notre pays.

Nous croyons en des partenariats plus forts avec les centres régionaux et internationaux. Le fait que le gouvernement du Mali ait attribué 124 ha de superficies cultivables à l’ICRISAT au centre de recherches de Samanko montre notre engagement en faveur des partenariats avec des organismes internationaux.

Nous constatons que cet investissement nous rapporte maintenant des dividendes. Par exemple, le projet d’amélioration régionale de l’arachide à Samanko a été lancé en 1995 et depuis, cinq variétés ont été mises en circulation. À ce jour, les variétés améliorées d’arachide couvrent plus de 42% du district de Kolokani ; les technologies intégrées de gestion des maladies ont aidé à réduire le risque d’aflatoxine de plus de 50%.

Nous espérons que le projet de TL II aidera à stimuler le développement de nouvelles technologies et leur adoption à grande échelle dans les zones de production de niébé et d’arachide.

Permettez-moi de rendre un hommage particulier à la Fondation Bill et Melinda Gates (BMGF) pour leur soutien au TL II. À partir de votre programme je peux constater que vous avez acquis des résultats significatifs au cours de ces dernières années. Les technologies que vous avez générées doivent être appliquées sur une plus grande échelle en vue d’une adoption plus large par les pays choisis et au-delà. Je ne doute pas que l’appui de BMGF continuera et que d’autres donateurs représentés ici se joindront également à la Fondation pour appuyer cet effort.

Honorables invités,
Mesdames et Messieurs,

Malgré votre programme trop chargé, je voudrais vous inviter à prendre un moment pour visiter notre ville (espaces culturels, musées, marché, etc.). Bamako offre également une excellente vie nocturne, remplie d’événements culturels captivants et d’une cuisine variée.

Permettez-moi de remercier les organisateurs de cet atelier pour m’avoir donné cette occasion de vous souhaiter la bienvenue dans notre pays. Je voudrais également remercier l’ICRISAT d’avoir choisi Bamako pour abriter cette réunion.

Tout en vous souhaitant d’avoir des échanges fructueux, je déclare cet atelier officiellement ouvert.

Je vous remercie !
An introduction to the Tropical Legumes II project

Tsedeke Abate, C Laxmipathi Gowda and Said Silim

General

Tropical legumes are an important component of the farming systems in sub-Saharan Africa (SSA) and South Asia (SA). They are an important source of the much needed protein supplement in the diets of the majority of smallholder farmers in these regions who can hardly afford to buy meat and other animal products; the bulk of smallholder farmers in the drought prone areas of SSA and SA heavily depend on tropical legumes for income. Furthermore, legumes fix nitrogen from the atmosphere and help keep soil health. Tropical legumes have not received the level of research funding they deserve in spite of their significant role in the livelihood, nutrition and the environment. As such, they are often referred to as “orphan crops”. Current average yields are well below one ton per ha.

The Tropical Legumes II (also known as TL II) Project, funded by the Bill and Melinda Gates Foundation (BMGF), aims to bring about significant increases in the productivity and production of tropical legumes to improve farmers’ income, nutrition quality, and livelihoods in the drought-prone areas of SSA and South SA. It is expected that the productivity and production of tropical legumes would increase by 15%; some 30% of area planted to these crops would be covered with improved varieties; and approximately 57 million poor farmers would benefit from it within 10 years, resulting in an annual aggregate additional value of over US$300 million.

The project consists of eight objectives. Two of these, Targeting Impact and Enhancing Seed Production and Delivery Systems, are implemented across target countries. The remaining six deal with Enhancing Productivity and Production of chickpea, common bean, cowpea, groundnut, pigeonpea, and soybean in selected countries. Capacity building is an integral component of all the objectives.

This is a joint project among ICRISAT, IITA and CIAT and managed by ICRISAT on behalf of the three centers. All activities are implemented in full partnership with the national agricultural research systems (NARS) of nine countries in - Mali, Niger, Nigeria, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, and India. The project also works in close partnership with other
stakeholders – non-governmental organizations (NGOs), community-based organizations (CBOs), faith-based organizations, and the private sector. One unique feature of TL II is that it builds on the successes of past achievements, in addition to developing new technologies.

The first phase of TL II was launched in September 2007 and will be completed by end of 2010. Planning and monitoring and evaluation of progress are done at national and regional levels where all national partners and project management team (PMT), consisting of objective coordinators, principal investigators and scientists, participate. An advisory board (AB), composed of four prominent, independent experts; deputy directors general of the three centers; senior program officer of the donor agency; and project manager of Tropical Legumes I, with project manager of TL II as secretary, are responsible for overseeing progress at the global level. Select members of the independent AB members also participate at regional meetings to give guidance. The project is reviewed each year.

The first annual review and planning meeting was held on 29 September to 03 October 2008 in Addis Ababa, Ethiopia, where some 50 individuals representing the Ethiopian NARS, PMT and AB participated. This second annual review and planning meeting, being held on 16-20 November 2009 in Bamako, Mali, brings together nearly 70 participants. We have invited other donors, development agencies, and other BMGF-funded project grantees. This additional mix is expected to improve the funding opportunity for TL II, and create synergy among projects as we look ahead to a possible second phase and beyond. This meeting also coincides with mid-term review of the first phase of TL II.

Countries in all regions have now completed two full crop seasons since the launching of the project. Progress has been made and milestones have been achieved (even exceeded) by all objectives over this period. This period saw, among others, i) establishment of the management team and partnerships; ii) baseline data collection and situation analyses; iii) identification and assembling of existing varieties/advanced breeding lines and production of various classes of seed for participatory variety selection (PVS) trials and use by smallholder farmers; iv) generating breeding materials to develop varieties with desirable traits; v) identification of promising lines of TL II crops that are expected to replace “ruling varieties” and improve productivity and production; vi) scaling up production of Foundation and Certified
seed; testing seed production, distribution, and marketing models; and vii) capacity building that includes training (short-term and degree programs) and infrastructure installation and/or upgrading for the partner NARS.

**Partnerships**
TL II is currently working with close to 100 institutions and 300 scientists and development agents across the nine project countries. This number is expected to grow further as we strive to bring together more grantees, donors and development agencies. Typically, our NARS partners include national agricultural research institutions, institutions of higher learning, extension departments of agricultural ministries, NGOs, CBOs, and the private sector (such as seed companies and agro-dealers).

**Targeting impact**
Situation and outlook analyses, highlighting production, trade, consumption, utilization trends and future projections, have been conducted for all TL II crops. The report for chickpea in Ethiopia is now available online (www.icrisat.org/tropicallegumesII/). Reports on groundnut and pigeonpea in the ESA region have been completed and are ready to be published on the website. Reports on the remaining crops are also ready for publication.

**PVS trials**
Large numbers of PVS trials have been conducted for all crops across the nine countries. These have helped to raise awareness about the availability of improved crop varieties and associated management practices. A total of close to 130 varieties/advanced lines with farmer- and market-preferred traits have been identified across the nine project countries and advanced for further testing under state and national trials or recommended for release. For example, a total of nine groundnut varieties have been recommended for release in Tanzania (5), Mozambique (3) and Malawi (1). A rust-resistant and high-yielding soybean line TGx 1835-10E was released in Nigeria in 2009. Nine varieties of soybean (including the early-maturing, high-yielding line TGx 1740-2F) have also been recommended for release in Malawi. The launching of the world’s first CMS-based commercial pigeonpea hybrid (ICPH 2671) by a private seed company in India was a major milestone.

**Seed systems**
The seed systems objective has refined the diverse seed production models identified during the first year. During its review meeting held in October
this year, it has identified different models for the production of different categories of seed – Foundation, Certified, Other Quality good seed. They are also testing variations of seed delivery and awareness raising models identified across target countries. This objective has catalyzed the production of a total of 3,502 metric tons of various categories of seed as at September 2009. They have also demonstrated that the use of small packet of seed (100 g to 5 kg) is a very effective way of quick dissemination of improved seed to small-scale farmers.

**Capacity building**
Each of the objectives has carried out training sessions lasting 2-30 days for all partners in the tropical legumes value chain: NARS scientists and technicians; government extension agents; agricultural development workers of NGOs and CBOs; government regulatory bodies (e.g. seed certification agencies); and agro-dealers. A total of 25 students are currently pursuing studies towards their MSc (19) and PhD (6) degrees. Among those, four each are from Ethiopia, Mozambique, and Tanzania; three from Kenya; two each from Niger, Nigeria, Malawi and India; and one each from Mali and Zimbabwe (through TL I collaboration). Discipline wise, 64% of the students are in plant breeding; 12% each in agricultural economics and seed systems; 8% in agronomy; and 4% in agricultural engineering. It is expected that two of the students would complete their studies and obtain their degrees in 2009; 17 in 2010; five in 2011; and one in 2012. Capacity building in terms of infrastructure is nearing completion. Support has been provided to various NARS to enhance their capacity for undertaking research in drought resistance. Equipment has been purchased; new irrigation facilities have been installed or existing ones upgraded; storage facilities have also been upgraded in some countries.

**Lessons learnt**
Member NARS have extremely variable capacity; this would necessitate different approaches of support to different countries. Farmers’ selection criteria for varieties focus not on grain yield alone; dual purpose varieties of some crops (such as increased biomass for use as animal feed in cowpea and improved soil fertility in soybean) is becoming an important factor. African farming systems are system-based, rather than commodity-based; it is imperative that our development approach give due consideration to this aspect. The need for strengthening crop management and post-harvest technologies (storage, processing, and value addition) has been felt and is
currently being addressed. Big seed companies are not yet ready to expand their engagement in legume seed production; small-and medium-scale seed production systems will continue to be the major seed source, at least in the short to medium term, especially in SSA.

**Challenges and opportunities**

The major challenges include 1) need for forging strong linkages with other BMGF-funded projects for increased synergy; 2) slow variety release process in many of the target countries; 3) deterrence of market uncertainty for farmers to fully engage in seed production; 4) low level of women professionals in agriculture despite women constituting the majority of farmers, at least in SSA; and 5) need for increased funding as we strive to expand the spread of technologies and knowledge gained so far to wider communities of smallholder farmers. On the other hand, there exist ample opportunities that have been created by TL II and lessons from past experiences. 1) A strong partnership base has been built and trust between farmers and researchers/development agents has been established; 2) a good number of technologies are in the pipeline; 3) extensive use of PVS, training, and demonstrations have helped to raise awareness of farmers about new technologies; 4) farmers are willing to take risk and demanding for improved technologies; 5) there are “good practice” examples on technology development and dissemination; and 6) there is a strong will by many governments to improve the performance of tropical legumes and other agricultural commodities.
Objective 1: Targeting crop breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of sub-Saharan Africa and South Asia – an overview

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ICRISAT-Patancheru, India

On behalf of ICRISAT, CIAT, IITA and NARS partners in India, Mali, Niger, Nigeria, Ethiopia, Kenya, Malawi, Mozambique and Tanzania.

Objective 1 addresses the need to target crop breeding and delivery mechanisms to enhance the project’s impacts on the livelihoods of the poor in sub-Saharan Africa (SSA) and South Asia (SA). This is achieved by assessing the role and potential uptake and impacts of improved legume varieties, providing feedback for determining breeder’s research priorities, and establishing a baseline and framework that will enable future project monitoring and evaluation.

Methodology used to achieve the desired targets

- Socioeconomic tools, sampling methods, farm-level baseline survey tools for variety traits preferences (designed for PVS implementation by breeders in Objectives 2-7) and survey instruments adapted and harmonized;

- Regional situation and outlook analyses;

- Market surveys and value chains analyses implemented covering key market players throughout the legume crop value chain;

- Analysis of constraints and uptake pathways to draw out valuable lessons and develop mechanisms that can be used to increase adoption and impacts NARS scientists’ capacity development for baseline data collection, data entry, analysis and report writing;

- Coordination meetings (virtual and actual) involving scientists from Asia, Eastern and Southern Africa (ESA) and Western and Central Africa (WCA).

Partnerships

The project is implemented in partnership with scientists in ICRISAT (Asia, ESA and WCA regions), IITA, CIAT, TSBF-CIAT and NARS from India, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Mali, Niger, and Nigeria, and that are involved in legume improvement research especially
groundnut, chickpea, pigeonpea, cowpea, common bean and soybean. ICRISAT is partnering with 32 NARs partners in Asia, WCA and ESA regions for the three legume crops (groundnut, chickpea and pigeonpea). IITA has nine partners from NARS for undertaking its research activities on cowpea and soybean; CIAT has 30 partners for research on common bean in SSA.

Key findings

**Situation and outlook:** Reports highlighting the production, trade, consumption and utilization trends of groundnut, chickpea, pigeonpea, cowpea, common bean, and soybean at global, regional and country levels are ready for the publication. The facts and trends highlighted in these reports would provide valuable direction to researchers working on these crops, research managers, stakeholders along the value chain, and finally policy makers in improving the overall efficiency of these crops to meet the demands of end users and their producers.

**Highlights of baseline studies for targeted legumes in SSA and SA**

The key findings for the baseline studies across all regions for the targeted legume crops are analyzed and synthesized with focus on the following aspects:

- Ruling varieties;
- Baseline adoption;
- Baseline yield/current yield gap;
- Preferences across the value chain;
- Gender issues;
- Marketed surplus.

**Ruling varieties:** The baseline survey results and the qualitative assessments through discussions with key informants and Focus Group Meetings clearly indicate the continued dominance of certain varieties that were introduced in the target locations several decades ago. A listing of all the ‘ruling varieties’ as they are called henceforth, by crop and region is presented below. This observation calls for an investigation of the reasons for the low uptake of the improved, high-yielding varieties resulting from the collaborative research by IARCs and NARS.
Baseline adoption: The baseline reports summarize the historical development and adoption of both local and improved varieties of the targeted legume crops in SSA and SA. The highlights are given in the full report.

Baseline yield/ current yield gap: In the traditional farming systems in which much of the tropical legumes are grown by small scale farmers with little or no input, the yields are in general low. Significant yield variation across farmers were observed both for local and improved varieties in irrigated and rainfed conditions.

Preferences across the value chain: The preferred traits by the different actors and players along the value chain were documented as part of the baseline surveys. While farmers are interested in high yields and economic gains, the processors and traders were also keen on the quality standards like uniformity in size, grain size, cleanliness and healthy grains. Consumers, on the other hand, had preferences for taste, cooking quality and time and keeping quality.

The question then that needs to be addressed is how we match the mandate and preferences of the researchers with those of the farmers right upto the consumers. What are the implications of these findings to the researchers, and to policy makers? This has to be understood in order to establish a feedback mechanism in place.

Gender issues:

An analysis of the baseline data relevant to gender issues provides important feedback for breeders and policy makers. Two examples featured in the report are:

- In West Africa, cowpea provides a source of cash income for women farmers who make and sell snacks from cowpea. Most of the green pod marketing from this nutritious legume is handled by women. In many African countries, women harvest and sell directly to consumer on roadsides, because pod prices are higher than dry grain prices. The role of gender appears to be important in grain retail trade in Africa;

- In Ethiopia, common bean production and marketing is dominated by men. Males dominate the implementation of almost all management practices except hand weeding and harvesting the crop where both genders participate. Men contribute about three times as much labour as women in the production of common bean. They are also responsible
for the bulk sale of white pea beans as assemblers and rural wholesalers. Men constituted about 87 percent of bean traders in Ethiopia. On the other hand, women sell small quantities as retailers in markets.

**Major challenges**

- The US dollar has lost its value, fuel prices have risen sharply, and inflation is much higher than expected (> 3%) across the countries since the commencement of the project;

- Francophone and Lusophone countries’ scientists prefer that their graduate students study at English speaking universities. The implication of this is that costs of training the students have increased far beyond the amounts proposed in the project’s budget. This is especially true in WCA;

- Seed exchange between scientists in different countries could be a problem due to plant quarantine regulations. This is more so in SSA.

**Major lessons learnt and vision for second phase**

- Based on the observations made in the cowpea trials, the number of lines that farmers can evaluate efficiently at a time (under PVS) is limited to no more than twenty. As the number of lines to be evaluated increased, it was observed that errors crept into farmers’ assessments. The farmers’ abilities to make judgments in variety selection were less accurate as the number of varieties increased. This observation should be considered in future conduct of the study;

- Gap analysis identified the following factors constraining research, innovation, production and utilization. This type of information can be used for a better monitoring and evaluation design and mechanism;

- Lack of synergy among the different stakeholders along the value chain is emerging as a prime stumbling block for successful dissemination and uptake of technologies. Critical analysis of institutional arrangements and policies to more effectively promote the TL II crops may be considered under the innovations systems learning framework.
Objective 1: Targeting groundnut breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone regions of sub-Saharan Africa and south Asia


General

In all regions, baseline socio-economic database from stratified farm household samples in selected target locations are under construction or achieved, baseline survey reports for groundnut are being harmonized with the NARS partners to develop synthesis reports. Analysis of market surveys implemented covering key market players throughout the legume crop value chain. And, regional situation and outlook report is drafted for peer review.

Baseline results

Ruling varieties

The baseline survey results indicate the continued dominance of certain varieties that were introduced in the target locations a few decades ago. Examples of such varieties include TMV-2, Co2; VRI2, Malai POL2, and TMV7 in Asia; Chalimbana, and CG7 in ESA; and 55-437, 47-10, and 28-206 in WCA. This calls for an investigation of the reasons for the low uptake of the improved, high-yielding varieties resulting from the collaborative research by IARCs and NARS.

Baseline adoption

In ESA, results indicate that Chalimbana is the most widely known variety (84%) followed by CG7 (53%) and Manipintar (11%) in 2007/08. In India, the baseline adoption level for TM -2 is reported to be 64-100%. In West Africa, 74% of households grow the variety 55-437, and 12% the variety RRB in Niger. In Nigeria, 72% of farmers grow the variety 55-437 and 23% reported using at least one newly introduced variety (SAMNUT21, SAMNUT 22 and SAMNUT 23). In Mali, 41% of the surveyed farmers used 47-10 and 43% of the surveyed farmers are using at least one newly introduced variety (JL 24, Fleur 11, ICGV 86124, ICGV 86015, ICG (FDRS)4).
Baseline yield/current yield gap

In Niger, the average yield estimated from the survey is 537 kg/ha against a gap of about 463 kg/ha obtained on farmers’ fields. In Nigeria, yields were estimated to be 850 kg/ha whereas the optimal yield obtained under farmers’ conductions were estimated at 1200 kg/ha. In Mali, yield levels were found to be very low, estimated at about about 676 kg/ha, with a yield gap of about 424 kg/ha.

 Marketable surplus

In Niger, households sell about 759 kg of groundnut pod, account for about 76% of the total production. In Mali, households sell about 376 kg of groundnut pod or about 74% of the total production. In Nigeria, households sell about 954 kg of groundnut pod accounting for about 64% of the total production.

Preferences across the value chain

The groundnut preferred traits by farmers include higher yield; drought, pest and disease resistance; higher oil content; better taste and keeping quality; palatability and storability of fodder; higher price; and larger grain size for marketing. Larger grain size, higher oil content, pest- and disease–free grain, higher shelling percentage, uniformity of seed and shape were reported by commission agents and traders. Higher oil content, larger grain size, cleanliness, and higher shelling percentage are preferred traits by processors whereas larger grain size, cleanliness and taste are the choice of retailers. Consumers preferred larger grain size, taste and clean oil color. The question then that needs to be addressed is how we match the mandate and preferences of the researchers with those of the farmers’ right up to the consumers.

Gender issues

In Niger, where women are involved in groundnut production, they are given the poorest land, can only plant smaller area than men (0.96 ha for women against 2.30 ha for men), but are more efficient at managing their plots. In effect, the average yield in women plots is estimated to be about 734 kg/ha against 410 kg/ha for men. There were no difference found in the access to inputs such as fertilizers, pesticides and insecticides but access to agricultural equipment was limited because men have to finish plowing their land before women have access to equipment.
Situation and outlook

In Asia, a report highlighting the production, trade, consumption and utilization trends of groundnut at three levels – global, regional and country level- is ready for publication. Future prospects of these crops under varying scenarios of yield and income growth in selected countries of Asia are addressed based on model runs using the IMPACT-WATER model. The facts and trends highlighted in these reports would provide valuable direction to researchers working on these crops, research managers, stakeholders along the value chain, and finally policy makers in improving the overall efficiency of these crops to meet the demands of end users and their producers. Though groundnut production trends in most of the Asian countries have weakened, yield improvements continue to be the main driver of growth in most countries from the situation and outlook analysis are detailed in the full report.

In ESA, the situation and outlook assessments have been completed for groundnut in Malawi. The sub-sector assessments have been already published in the TL II website for a wider use. The reports are expected to feed into regional situation and outlook reports that would outline the current production conditions, key socioeconomic and technological constraints and key interventions for unlocking the potential of the targeted legumes in the region. The future outlooks for groundnuts in Malawi seem promising; however, there are a number of constraints that negatively impact on the development of the groundnut sub-sector. The analysis has revealed weaknesses in the current seed systems as well as in the enforcement of quality standards. Although the volumes of groundnut exports remain lower than the levels seen in the late 1980s, the review has shown that Malawi maintains a comparative advantage in groundnut production and competitiveness in exports suggesting that there is scope for increasing groundnut exports once the required quality standards are adhered to. The findings suggest the need for faster productivity enhancement, strengthening seed delivery systems to reach more farmers and the development of existing value chains and alternate markets.

In WCA, situation and outlook assessment have been completed. During the last four decades, groundnut production shares declined from 23% to 15% whereas export shares decreased from 55% to 20%. China, the leading producer, has significantly increased its shares from 11% to 41%. Argentina, the leading oil exporter, has more than doubled its world share from 12% to 29%. In addition, imports from other oil seeds have significantly increased in West Africa. Soybean and palm oil imports have more than doubled. However, since 1984, groundnut production in West Africa has been increasing by about 6% annually mainly due to area expansion. Senegal and
Nigeria remain among the largest world groundnut producers. Groundnut still remains a major source of employment, income and foreign exchange in many West African countries. The competitiveness of West African groundnut in the domestic, regional and international markets has been limited by the low productivity, aflatoxin regulations, and stricter grades and standards. Relative prices of groundnut oils are higher in the international markets making these products less competitive compared to oil palms, cotton oil and others oil fruits. There are market niches for confectionary groundnut. Access to this market would require knowledge of market requirements. To regain its competitiveness, groundnut productivity and production has to increase significantly, technologies to reduce aflatoxin contamination have to be promoted and grades and standards satisfied.

Constraints

In West Africa, in all the three countries, seed availability was reported to be a major constraint by 42% of farmers in Niger, 39% in Nigeria and 34% in Mali during the the 2007/08 season. Other constraints include loss of seed due to drought (24%) and low oil content (18%) in Niger. In Nigeria, other constraints include late maturity (13%), low market value (13%), low yield (8%) and loss due to drought (2.8%). In Mali, drought and low yield were also reported as major constraints.

Major challenges

• Undue delays in submission of reports, progress of work and work plans by the partners in all regions and locations. There is a need for designing training program that will be institutionalized and funded on a continuous basis. The capacity of the NARS partners should be enhanced through on-the-job training throughout the project cycle.

• The US dollar has devalued, fuel costs have risen sharply and inflation is much higher than expected across the countries since the project inception. This has implications on academic training. This is especially true in WCA.

• Financial reporting has also been a major bottleneck in the project. There are significant difficulties by partners to report on their financial expenditures because of accounting rigidity in their institutions.

• NARES need to be strengthened in survey design, data collection and analysis, and write-up of the reports. They also need to be trained in monitoring and evaluation.
• Aflatoxin is a significant issue that needs to be tackled in the future if one has to significantly develop the groundnut market. Aflatoxin has significantly reduced trade and affects health of the rural poor who depends on groundnut for their livelihood.

**Major lessons learnt and vision for second phase**

- Need to revisit the existing PVS approach to popularize new technologies developed by IARCs-NARS collaborative effort.
- Need to emphasize the value chain approach. The integration between inputs and product markets during the 1980s with the state marketing boards was broken. The challenge is how to re-create these conditions with the private sector? Critical analysis of institutional arrangements and policies to more effectively promote sustainable arrangements is important.

- Institutionalize lines of credits or guaranteed to facilitate farmers’ access to credit to purchase quality seeds and other inputs, and access to credit or be broker-bridge-catalyst.

- Engage in product market development activities to drive uptake of technologies and innovations.

- Constraints to production and marketing and trait preferences as perceived by the end users are seemingly not recognized at the research end of the R&D continuum. These should be considered in matching research priorities and development efforts.

- The linkages among key stakeholders in the legume production and innovation process in some target regions appear to be weak. Where linkages exist, they are fragile and weak. It is important that this information is fed back to policy makers who can formulate incentives to strengthen and develop strong linkages.

- Limited government commitment to agricultural research and extension. Need for more investment complementary support for dissemination of research products and basic infrastructure.

- To the question: “Would you consider including more countries (or paring down the current ones)? “, the team prefers to stay focused on the identified target countries, and monitor the uptake process from these targeted intervention points. Even within countries, there is need for better targeting.
Objective 1: Targeting chickpea breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of sub-Saharan Africa and South Asia


General background

Chickpea is an important pulse legume in South Asia (SA) and Eastern and Southern Africa (ESA). Its productivity however is low. The overall goal of this project is to enhance the productivity of chickpea in drought-prone areas of SA and ESA through breeding of improved varieties and improving seed delivery mechanisms so as to enhance livelihoods of the poor. This is achieved by assessing the role and potential uptake and impacts of improved chickpea cultivars, providing feedback for determining breeder’s research priorities, and establishing a baseline and framework that enable future project monitoring and evaluation.

Methodology

The socio-economic component employs the commodity chain approach, and is supported by farm-level baseline surveys. The elements of this approach include (i) analysis of constraints to identify potential intervention strategies in the context of holistic value chain approaches – with research supported by situation and outlook analysis, baseline surveys of stakeholders along the value chain and (ii) analysis of constraints and uptake pathways to draw out valuable lessons and develop mechanisms that can be used to increase adoption and impacts. For this the project employed standardized survey tools to gather information from different stakeholders on the chickpea value chain in partnership with NARS.

Key Findings

Situation and outlook

A situation and outlook report highlighting the production, trade, consumption and utilization trends of chickpea at global, regional and country level has been developed and is in the publication process. The main highlights are:
India, Turkey, Pakistan, Iran and Canada together account for 87% of the global production;

Canada and Australia are the two most important exporters of chickpea accounting for 28% of the world exports; and India is the largest importer of chickpea accounting for nearly 30% of imports;

A 25% increase in yield growth rate in India has significant global impacts on production and prices in 2020 compared to the baseline business as usual scenario. However, India would continue to be a net importer: and

In ESA the results suggest that chickpea area and production in Ethiopia will show significant growth in the years ahead. Chickpea trends in sub-Saharan Africa suggest that there is a need to design a more flexible and sustainable seed systems that meet the needs of the resource poor farmers.

Adoption of improved varieties and the ruling variety

Base line surveys find that in majority of the cases the ruling varieties continue to be local varieties or the improved varieties introduced some 2-3 decades ago. In India, the baseline adoption level for desi Annigeri, is about 90%, followed by COG-2 and JG-11. This covers the two most important chickpea growing states in India namely Andhra Pradesh and Karnataka. In Ethiopia, the proportion of chickpea farmers who planted improved desi during 2007 is less than 3% while about 76% planted the local desi. About 54.5% of the chickpea area is allocated to local desi followed by shasho (21%) and ejere (11.9%).

Baseline yield and yield gap

Significant yield variation across farmers was observed both for local and improved varieties in irrigated and rainfed conditions. In India the baseline yield ranges from 780 kg/ha to 1541 kg/ha under rainfed conditions to 1946 kg/ha under irrigated conditions. The baseline yield is much below the achievable yield. In Ethiopia the chickpea yield is estimated to be 2236 kg/ha for local cultivars and 2710 kg/ha for Arerti. High pest incidence, small grain size, low market price, low recovery/shelling percentage, high disease incidence and long crop duration are main constraints to improving chickpea productivity in SA as well as ESA.
Preferred traits along the value chain

While farmers are interested in high grain yield, larger grain size, resistance to insect pests and diseases, drought-tolerance and higher fodder yield, the processors and traders were also keen on the quality standards like uniformity in size, grain size, cleanliness and healthy grains. The consumers on the other hand had preferences for taste, cooking quality and time and keeping quality. Farmers sell over 80% of their produce.

Gender issues

Women participate in almost all activities with respect to crop production; women are more heavily involved in the production chain than men. Marketing activities are carried out by men. While men take decisions on economic matters, decisions regarding crop production, and education and marriages of children are taken jointly. Participation of women farmers in mother/baby trials is limited, particularly in Asia. There was generally poor access and ownership to resources by women.

Capacity building

- Several national staff in the target countries have been trained in survey design and sampling methods. The survey instruments and modules have been shared with partners and are being adapted for other studies;

- In addition to the series of three training workshops focusing on survey design and instruments, sampling, social analysis (including the conduct of focus group meetings and key informant interviews) held in the first year of the project, two write-shops were held at ICRISAT, Patancheru from November 3-7, 2008 and 24-30 August 2009 to facilitate the sharing of issues faced during data entry, validation and preliminary analysis.

- In ESA, in the first two years of the project 29 NARS scientists (25 men, 4 women) have been trained on qualitative and quantities methods of socio-economic research.
Major challenges

- Seed exchange between scientists in different countries could be a problem due to plant quarantine regulations; this is more so in ESA;

- It is observed and commonly reported that there is an undue delay in submission of reports, progress of work and work plans by the partners in all regions and locations. This implies that partners should be motivated to be more committed to the project activities. There is seemingly a conflict of research interest between the collaborating institute and the high demands of the project activities. Rigorous follow-ups and continued engagement through frequent visits are needed for timely submission of the reports;

- Coordination is time consuming and involves high transaction costs (than anticipated). Modern means of communication such as video conferencing and Skype is needed for effective coordination. It is emphasized that participatory M&E systems be in place for maintaining effective coordination and communication among the project partners.

Major lessons learnt and vision for second phase

- There is an argent need to identify a viable approach or enhance the existing PVS approach to spread the improved technologies to users. Number of trials should be manageable for evaluation by the farmers.

- Gap analysis identified misinformation or lack of information on improved technologies or traits of targeted crops. Addressing this gap calls for a seamless interaction between researchers, farmers and other stakeholders. There is dichotomy between researchers’ objectives and farmers’ priorities. Closing the gap will lead to a significant adoption of promising new technologies. Lack of synergy among the different stakeholders is emerging as a prime stumbling block for successful dissemination and uptake of technologies. Critical analysis of institutional arrangements and policies to more effectively promote the TL-II crops may be considered under the innovations systems and learning framework.
The team prefers to stay focused on the identified target countries, and monitor the uptake process from these targeted intervention points.

**Draft work plan for 2010 and beyond**

- Implement the monitoring and evaluation in selected sites and dissemination domains on a periodic basis; and continue the process documentation of the TL-II early adoption studies, and targeting for up-scaling and mapping of impact target domains. Undertake an ex-post impact study at the end of 5 and 10 years period;
- Market promotions of new varieties to enhance further adoption;
- Joint report on farmer- and market-preferred traits reflecting gender dimensions and provide feedback to breeders for research priorities and/or research redirection based on lessons learned;
- Refine situation and outlook projections for TL-II crops globally and at country level, and in-depth analysis of institutions and policies to more effectively promote the TL-II crops; and
- A joint regional consultation in ESA and SA to be organized to analyze in detail the results of the assessment done. This consultation is intended to broaden the awareness on data and trends pointed out in the surveys. The consultation will aim to jointly analyze the individual country reports and to formulate recommendations for actions to strengthen national capacity in these regions.
Objective 1: Targeting pigeonpea breeding and seed delivery efforts to enhance the impact on the livelihoods of the poor in drought-prone areas of eastern and southern Africa and South Asia


1. Achievements

1.1 Enhanced understanding of production systems

In order to facilitate targeting, spatially disaggregated data for pigeonpea has been collected from Malawi and Tanzania. The available data at the zonal and district levels for pigeonpea has been mapped for these countries to help delineate and define the major production areas and target regions for the project in each country. Similar database and maps have been produced for chickpea (Ethiopia) and groundnut (Malawi and Tanzania). Future work needs to determine the suitability of selected varieties in the specific farming systems in the larger target environment. There is a need to link the targeting effort with larger global projects like Harvestchoice to see how the remaining gaps for the legume crops can be filled.

1.2 Analysis of situation and outlooks

The situation and outlook assessments have been completed for pigeonpea using the case of Malawi. Similar analysis was completed for chickpea (Ethiopia) and groundnut (Malawi). Data is also being collected on value chains and markets for pigeonpea in Tanzania. The secondary data collated from different sources on production, total demand, export and imports, price trends, and adoption of new varieties and productivity change was analyzed using statistical tools and modeling methods to assess the current situation and future outlooks for pigeonpea. The global food projection modeling framework of IMPACT (the International Model for Policy analysis of Agricultural Commodities and Trade) was applied to examine the future opportunities for pigeonpea in Malawi.

The analytical results show a rise in harvested area, yield and production for pigeonpea in Malawi. During the first phase of the post reform period (1995-2000) pigeonpea registered the highest annual rates of growth in
production (13%), yield (9.3%) and harvested area (5.4%). This supply response seems to have been driven by the liberalization of agricultural markets and better prices for produce. However production declined during 2000-2006 period by -1.8% per year while the period also saw a relatively lower export growth rate. This was driven by consistently falling export prices and low productivity of the crop which has led to a loss in export competitiveness for the landlocked country. The outlook analysis based on production and exports simulations shows that area, production as well as domestic demand will continue to rise. Nonetheless, Malawi continues to face numerous constraints that negatively impact on the development of the pigeonpea sub-sector. These include existing structural weaknesses in seed and technology delivery and grain marketing systems, which have an effect on the diffusion and adoption of improved technologies and consequently the on-farm productivity and profitability of this crop.

India, accounting for 84% of the cultivated area, is the largest producer of pigeonpea in the world. The analytical results indicate that the growth in pigeonpea area in India in the period 1980 to 1995 and the shift from the semi-arid temperate regions to the semi-arid tropical regions can be attributed to availability of short-to-medium duration wilt-resistant varieties. Frequent drought in the semi-arid areas, and water-logging in the temperate high rainfall areas, also cause considerable loss in production. Pigeonpea yields in India have been stagnant but highly erratic in the period 1980 to 2007 owing to shifts to harsher climates, and the over-dependence on residual moisture.

1.3 Baseline surveys completed and database established

This is one of the most demanding activities undertaken during the last two years. Baseline data has been collected for pigeonpea (and groundnut) in Malawi and Tanzania, and for chickpea in Ethiopia. About 40 staff from three countries were trained in methods for survey design, sampling and administering surveys. These surveys benefited from other related projects (e.g. Treasure Legumes project supported by IFAD) in sharing fixed costs which allowed surveying more farmers from a larger target region.

A total of 1194 randomly selected farm households were surveyed in Tanzania (600) and Malawi (594). The selected districts were those targeted under the legume projects and data was collected with the leadership of the national partners. In addition village level data was also collected from 24 villages...
in Tanzania and 47 villages in Malawi. This provided essential background information on socio-economic issues and production conditions in the target areas. About 22% and 12% of the sampled households were female-headed in Malawi and Tanzania. The data was subsequently entered into a computer at ICRISAT and transferred into STATA statistical package for archiving and analysis. The database was further checked for consistency and completeness and documented while baseline reports are being finalized for all the countries.

1.4 Baseline reports completed

1.4.1 Pigeonpea farmers and area cultivated

In both countries in the ESA region, pigeonpea is grown by poor smallholder farmers. Using the US$1 per day international poverty line, the incidence of poverty in the target areas exceeds 75%.¹ In Malawi, the average family size is 4.8 and the mean land holding sizes are very small (1.1 ha). Due to land scarcity, fallowing is uncommon and pigeonpea is mostly intercropped with maize. In Tanzania, the average family size is 6.1 and land holding size is about 4.7 ha; even here neither fallowing nor irrigation is commonly practiced. About 46% of the farm households in Malawi own a bicycle while 54% of the households own a radio. Bicycles are one of the major means of transportation both for goods and people. The level penetration of other sources of information is low – 5% for mobile phone and 3% for Television.

1.4.2 Cropping pattern, input use, yield and profitability

Malawi is predominantly a maize country - over 90% of the households planted maize in the 2006/07 cropping season. Pigeonpea is the third commonly cultivated crop (usually intercropped with maize) grown by 40% of the households (after groundnut, 55%). But this varies across the target districts. The average area cultivated for pigeonpea is 0.3 ha (similar to beans and groundnut). In Tanzania, pigeonpea is grown by 88% of the farmers in

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¹ Even using a national poverty line of 0.3 US$ per day, the poverty incidence in Malawi reaches about 70%. This is higher than the national poverty level of 55%. The data also suggests that the poverty incidence is higher for female-headed households (77%) compared to male-headed households (70%).
the target areas and the average planted area is about 1.36 ha (compares to 0.46 ha for beans), mainly through intercropping with maize. Yield results indicate that improved varieties consistently exhibit higher yields than local varieties. The improved varieties yielded about 1297 kg/ha in Tanzania while locals averaged around 1097 kg/ha. Pigeonpea is normally grown without fertilizer. The average seeding density (rate) for pigeonpea is 13.5 kg/ha in Malawi and 11.2 kg/ha in Tanzania. The net income (to land and family labor) for pigeonpea in Malawi and Tanzania was 9340 MK/ha and Tsh 388,129/ha, respectively.2 The net income from improved varieties was about 15-18% higher than the local varieties.

In India, the baseline results indicated that the yield levels for the improved varieties and local varieties are not significantly different. The yield gap remains high due to poor management and incidence of drought, pests and diseases on the farmers’ fields. The yields levels for Asha range from 864 to 950 kg/ha. This compares with the yield level of 847 to 859 kg/ha for Abhaya and 829 to 864 kg/ha for the local varieties.

1.4.3 Variety choice and adoption

The level of awareness of improved varieties of pigeonpea (at least one new variety) among the general population is generally higher in Malawi (63%) than in Tanzania (33%). However, the awareness rate for specific improved pigeonpea varieties is quite low. The level of awareness of ICEAP 00040 (most widely grown variety) is 20% in Malawi and 30% in Tanzania. The level of awareness of other promising varieties is very low – e.g. just 5% for ICEAP 00053 in Tanzania. The commonly known cultivars include Mthawajuni in Malawi (53%) and Bangili (66%) and Babati white (43%) in Tanzania. This shows the generally poor level of dissemination of information about the promising pigeonpea varieties, especially the long duration fusarium resistant cultivars. Similarly, despite the variability across districts, the level of adoption of new varieties is quite low in both countries. The variety ICEAP 00040 has the highest level of adoption ranging from 8% in Malawi to 17% in Tanzania. In Malawi the main locally mixed improved variety is Mthawajuni (27%) while Bangili (50%) and Babati White (25%) are the most widely adopted other locally mixed improved cultivars in Tanzania. The level of adoption of new pigeonpea varieties does not seem to significantly

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2 The exchange rate at the time of the survey was 1225 Tsh/US$ and 140 MK/US$. 
vary by wealth classes (based on farmland), except in Malawi where the poorest 25% of households have a much lower (2%) adoption for ICEAP 40 compared to 9% for the top 25% of households. This seems to show the pro-poor nature of the technology and the potential to reduce income disparities that would contribute to lifting the poor out of poverty. We also found a large adoption gap due to lack of awareness and inadequate access to seed and other inputs. For example, the sample adoption rate of improved pigeonpea variety in Malawi is about 10% however if the technology would have been universally known within the population, the potential adoption rate would be about 45%, implying a 35% adoption gap due to lack of awareness. In Malawi, about 60% of the farmers reported lack of seed for improved varieties as the main reason for not planting the varieties.

In terms of the preferred traits, Mthawajuni and ICEAP040 are the most preferred varieties with overall score of 4.3 and 4.1 out of 5, respectively. ICPL945 and local pigeonpea are ranked last with an overall ranking of 3.8 each. The most highly preferred varieties are liked for the four key traits: high yielding, early maturity, grain color and short time of cooking. Interestingly, mthawajuni, considered as a local variety, is highly preferred for its high yield, as well as its early maturity and its shorter cooking time.

In India, the baseline survey results and the qualitative assessments through discussions with key informants and Focus Group Meetings indicate the continued dominance of certain varieties that were introduced in the target areas a few decades ago. For example, Maruthi, Asha and Ganesh are the common pigeonpea varieties grown in the study villages of Maharashtra. These varieties were introduced about 5 to 20 years back and have spread from farmer to farmer through informal seed chains. The farmers (and the value chain actors) seem to prefer these varieties for higher yield, pest and disease resistance, bigger grain size, drought resistance, better taste, short duration and high keeping quality. Asha, the most popular pigeonpea variety, records an adoption level ranging from 58-64%.

1.4.4 Market participation and marketed surplus

Many earlier studies have shown that market access and profitability is one of the key determinants of technology adoption. In Malawi, distance to the main market varied from 5 km to 8 km. Similarly the share of households receiving market information varies from 20 to 50% of the farmers. Access to information
on product markets seems to be more limiting than input markets. This information is currently accessed from radio, private traders and other farmers. The role of agricultural extension in providing market information seems to be very limited. Other than distance, the degree of market participation appears to depend on two key factors – farm size and adoption of new varieties, which were found to increase marketable surplus of the farmers. The average market participation rate was 92% for adopters and 80% for non-adopters in Tanzania and 66% for adopters and 51% for non-adopters in Malawi. The participation rate was higher for adopters than for non-adopters across wealth (farm size) groups. Similarly the average marketed surplus of adopters in Tanzania was 685 kg compared to 464 kg for non-adopters, and this was also consistently higher for adopters across farm size groups. The major mode of transport to market pigeonpea and groundnuts is carrying on head and walking on foot (38%). However, the use of head load is particularly more prevalent among pigeonpea farmers (50%) than among the groundnut producers (27%). About a quarter of farmers use a bicycle to transport their produce.

1.4.5 Pigeonpea as source of income and food security

Pigeonpea is one of the most commonly cultivated legumes in Tanzania, Malawi and Kenya. About 88% of the households in the target areas of Tanzania grew the crop. In Malawi, this varied from none in Michinji to 86% in Balaka district – with an average of 40% of the farmers across sites growing the crop. The importance of the crop to income and food security also varied accordingly. In Tanzania 71% of the produce was sold while 21% was consumed in the family, making pigeonpea one of the major sources of cash income for the poor. In Malawi, pigeonpea is mainly a food crop – about 67% consumed at home and only 26% sold. This reflects the underdeveloped markets and the low yields and small farm sizes for the crop that limit the ability to generate a marketable surplus. In India, the marketed surplus varies from 77% to 95 % depending on the crop and the region where it is grown. In Andhra Pradesh villages, the average amount and proportion of grain output sold in adopting and control villages were 402 (95%) and 125 kg (92%) per year. The proportion of consumed grain was 11 and 8 kgs only. A similar trend was observed in all the varieties. For Asha variety, 95 percent of the grain was sold while only 3-4 per cent was retained for home consumption.

1.4.6 Seed supply system
The baseline data also provided useful information on the existing seed systems for pigeonpea and other legumes. In Malawi about 70% of the pigeonpea seed used comes from recycled seed saved on-farm. About 74% of the pigeonpea farmers depend on this informal source. About 9% comes from informal farmer-to-farmer seed exchange. Only about 17% of the seed supply comes from markets (including 4% from agrodealers). The average amount bought from different sources ranges between 3 to 6 kg, while the amount exchanged among farmers ranged from 1 kg to 10 kg with an average of 4.7 kg. A similar pattern emerges in Tanzania. Own saved seed serves about 84% of pigeonpea seed users and 86% of total pigeonpea seed used in Tanzania. Only about 7% of the pigeonpea farmers got seed from local seed producers and agro-dealers. The limited availability of seeds of improved varieties to farmers is also a major limiting factor for the pigeonpea sub-sector in India; public sector seed supply is limited and private sector is not active in pigeonpea seed production and marketing. As a consequence, farmers are highly dependent on saved seeds. There is also a general lack of information on new and appropriate varieties.

1.4.7 Gender issues

In relation to the role of gender in pigeonpea production and marketing, traditionally pigeonpea is regarded as women’s crop in many growing countries in Africa. This means that women are the main growers and managers of the crop. Our baseline study results however show that this pattern is somewhat changing over time as pigeonpea productivity and its commercial value increases due to availability of new varieties and better market opportunities. The data from our surveys shows that men now manage about 47% of the pigeonpea plots3, but women also contribute a significant amount of labor on farms managed by both men and women. The changing role of men and women and implications for family income and food security need to be investigated further. In Asia, hand weeding is the major activity performed by women. Both men and women however participate in several other production activities including seed selection and storage, variety selection, seed treatment, sowing seed, harvesting, threshing, and storage of produce.

2. Lessons learnt

3 This implies that men take control of production and marketing of pigeonpea on plots managed by them.
A number of practical and technical lessons have been learnt in the process of implementing the baseline studies and analysis of targeting the poor. Pigeonpea is an important crop for smallholder producers in both regions both as source of cash and cheap source of nutritious food for the family. Farmers in both regions, especially Malawi and Tanzania, however, face several challenges. Pigeonpea production is limited by lack of access to information on available varieties, inadequate supply of seed and underdeveloped value chains for marketing and processing and utilization of the crop. In Malawi there is an additional challenge of high population density and small farm sizes. The producers in both countries are poorly integrated into the pigeonpea value chains, but a high under utilized potential remains especially in Malawi which has a well developed processing industry. The analysis indicated that both market participation and marketed surplus would improve significantly through adoption of new varieties and linking farmers to markets. The current levels of adoption of available varieties remains very low – about 10% in Malawi and 19% in Tanzania. In India, the level of adoption is high (58-64%), but the rate of replacement of existing varieties by other new cultivars (Type B varietal change) is quite slow. This shows that the existing varieties are dominant (ruling) and still highly preferred by farmers. However, the adoption levels could have increased to about 60% in Tanzania and about 46% in Malawi if farmers had adequate awareness about the existing varieties (e.g. through demo plots and PVS). This shows a huge adoption gap that could still be enhanced through improved access to quality seed of improved varieties. The technology delivery systems remain underdeveloped and most pigeonpea farmers (74% in Malawi and 84% in Tanzania) now use only recycled seeds. The role of quasi formal and market-based seed supply is small – serving only 15-20% of the farmers. It is important to build on the strength and adaptability of the informal approaches and enhance the opportunity to increase both seed supply and quality through the participation of local seed producers, farmer groups and agrodealers with capacity building and monitoring to produce and market quality seed. The importance of quasi-formal or market based channels increases with the availability of new farmer-preferred varieties which creates incentives for the emergence of markets and trade in the supply of the new seeds. The observed low private sector participation in the seed systems may indicate a market failure and the need for stronger public support for legume seed production at least in the early stage until demand is high to attract private sector seed companies.
3. Remaining challenges and way forward

African farmers are unable to capture the growing global demand for pigeonpea (especially in India) due to intense competition for export markets and the surging demand for other substitutes. It is important to increase productivity and market linkages to help offset these threats. Farmers in both regions continue to face the challenges of low productivity and poor access to new varieties and markets for their produce. Access to new seeds and markets is particularly limited in the Africa region. In some cases farmers indicated that the existing varieties may not be suitable (especially in Asia) due to long duration, low yield, poor taste, high disease incidence, unattractive color, small grain size, and susceptibility to storage pests. This has led to dominance of varieties released in the past (ruling varieties) and slow varietal replacement.

Future work needs to tackle the following issues:

- Better understanding of the seed value chain and testing different models for local seed production and marketing
- Identify ways for increasing farmer awareness of new varieties and strengthening seed delivery systems to reach farmers who continue to rely on low-yielding and disease-susceptible local varieties
- Identify strategies for exploiting the informal seed systems through better linkages between the informal and formal seed sectors
- Better understanding of the pigeonpea grain value chains through a market study and testing alternative strategies for linking producers with buyers (e.g. producer marketing groups, market sheds, collection centers, link with P4P, etc)
- Working with the private and public sector buyers for development of existing value chains and alternative pigeonpea export markets
- Strengthen process monitoring and farmer technology choice to better understand and identify effective impact pathways
- Improved understanding of the changing role of men and women in pigeonpea farming and how this may affect the traditional role of women
- Undertake an adoption study for measuring early adoption and the first-order welfare impact of the project
Objective 1: Targeting common bean breeding and seed delivery efforts to enhance poverty impacts in eastern and southern Africa

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Background

With nearly half of the population in sub-Saharan Africa depending on common bean for either food security or cash income, improving the production and productivity of the crop is vital. Environmental stresses (such as drought, soil fertility decline) have been intensified as reducing the productivity of common bean in some countries of eastern and southern Africa (ESA). Concerns of climate change have even increased the fears that the productivity of the crop could worsen putting more people at the risk of nutritional deficiencies. Therefore, interventions that can overcome the environmental stresses are urgent. An important step in the design of appropriate interventions is to better understand existing situation, constraints and prospects for improvement.

The purpose of socio-economic research under TL II research summarized in this report was to: 1) systematically assess the circumstances in which the breeding and seed delivery work of the project were commencing so as to inform breeding and seed delivery efforts for better targeting of impact on the livelihoods of the poor in drought-prone areas and 2) provide an information base against which to monitor and assess the project progress and effectiveness during implementation and after completion. Specifically, the research was designed to: 1) analyse the situation and outlook of common bean in ESA; 2) conduct household and market surveys to assess the current status of bean production and productivity, constraints affecting productivity improvement, socio-economic and cultural constraints to the adoption of new bean technologies, farmer- and market-preferred traits and constraints in the bean seed systems; 3) contribute to the participatory variety selection; and 4) monitor and evaluate early adoption.

Common bean situation and outlook

The situation and outlook analysis for common bean was carried out in Kenya, Ethiopia, Malawi and Tanzania using secondary information. The situation is characterized by growing trade opportunities for farmers within
the region as well as challenges for development of the common bean in the region. Cross border trade has been growing and the potential for further expansion is huge but Kenya and Malawi are participating as net importers. There is also unexploited potential to export common beans to South Africa, and European market but the capacity to exploit this potential is low. Only Ethiopia has been successful in the European market because of its location advantage and low cost of production relative to its competitors (i.e. China and Canada), but improving the quality of grains at farm level remains a challenge for exporters. Low farm gate prices discourage investment in quality assurance technologies that would boost trade.

**Socioeconomic baseline studies**

The socio-economic baseline surveys were conducted in eastern Kenya, central rift valley of Ethiopia, and Southern Nations Nationalities and Peoples Region (SNNPR), covering a total of 360 households. The sample was selected to represent: 1) households that were already participating in seed delivery activities, 2) households that were expected to be incorporated into the project before ex/post evaluation survey through their participation in variety selection activities, and 3) households in “control” communities with characteristics (agro-ecological, social and economic, infrastructure and services) that were similar to participating communities. Market surveys involved interviews of 110 traders selected from 14 markets in Kenya and eight markets in Ethiopia.

**Results**

**Production and productivity:**

The study results demonstrate that common bean contributes about 55 percent of the household cash income in the central rift valley of Ethiopia, 16 percent of cash income among the sampled households in SNNPR; and ranks second in terms of food security after maize in eastern Kenya. The crop is managed jointly by the family members on most farms. Women in eastern Kenya are more heavily involved in the production chain than men, spending almost twice as many hours of work as men. On the other hand, male labour dominates common bean production (about 60 percent of labour) in Ethiopia. Common bean yield is low, averaging 0.54 ton/ha in eastern Kenya and 1ton/ha in Ethiopia during the main cropping season.
Yield also varies greatly across farms in Ethiopia - high on farms managed by well educated decision makers, those that use fertilizers and high value of farm implements. In eastern Kenya, 90 percent of farms obtain yield below 0.51 ton/ha, implying that improving the crop productivity in this area may require introduction of new technologies that are superior to the existing ones to address the current production constraints.

Production constraints

Drought is the most important constraint of common bean. Rainfall failure in any season causes substantial yield loss, estimated at about 70 percent in eastern Kenya for all the varieties grown. Unreliable rains in March-May cause reduction in area allocated to common bean by about 30 percent in eastern Kenya and majority of farmers in Ethiopia do not allocate any land to the crop. Poor soil fertility, exacerbated by poor farming methods, is also an important constraint limiting common bean productivity growth. Seed-related problems (i.e. lack of high yielding seed varieties, low availability of good quality seed, and high price) rank third important constraints to common bean production. At the time of this baseline study, there were virtually no specialized seed producers among small-scale farmers. The majority of farmers keep their own seed (about 10 percent of their harvest). The bulk of seed accessed from off-farm seed sources came from informal sources, purchased from the open air market at $0.30-0.70 per kg in Ethiopia and grain stores at about $1.00-1.50 per kg in eastern Kenya.

Varieties and their adoption

Research derived varieties have been widely adopted in Ethiopia, occupying over 90 percent of area but a few varieties (such as Mexican 142 that is longest grown in the communities) dominate. Farmers perceive new varieties to be the same as Mexican 142 in terms of production traits but Mexican 142 is perceived to be superior to some varieties in terms of market traits. Awash Melka (PAN 182, released in 1998) demonstrates a high potential to replace Mexican 142 because it is as good as Mexican 142 in terms of market traits while outperforms it in terms of yield. In eastern Kenya, GLPx92 is most widely grown variety occupying 48 percent of common bean area, despite low rating for consumption traits. Specifically, it is highly demanded among the aged, female-headed households with higher dependency ratio, who trade-off consumption preferences for production stability. The wealthier households (in terms of livestock, landholding and general consumer
durables) tend to demand both good consumption and production traits while access to off-farm employment opportunities appears to induce a shift away from production of common bean in eastern Kenya.

Low access to information by the majority of farmers was another constraint to fast adoption of new technologies. Farmers are poor with very low levels of education, particularly in Ethiopia. Poor infrastructure and lack of access to mobile phones is still a hindrance to quick communication within the rural areas of Ethiopia.

**Farmer and market preferred traits**
Farmers prefer drought tolerance, high yielding, low flatulence/good taste (in Kenya) and highly marketable varieties. These are the red/red mottled and large seeded and white and oval shaped in the central rift valley of Ethiopia. Upward growth habit is also a desirable trait in both countries. Cleanliness, not damaged by pests, mature with the right weight are key traits traders look for when selecting the beans to sell.

**Market constraints**

Most traders face constraints related with low capital, high transport costs, lack of access to information and low volumes of supply. On average, it takes traders in Ethiopia about 24 hours to get information by phone. In Kenya, traders find it easier to source supplies from neighbouring countries - about 90 percent of beans observed on the market in March 2009 were sourced from Uganda and Tanzania. Results show that traders would be hesitant to purchase a variety new on the market if they do not know it.

**Implications for future research**

Diversification in breeding targets: baseline studies have shown that drought is a complex phenomenon and the most important constraint limiting livelihood improvement. Nearly all types (low amounts of rains, mid-season gaps, rains ending early, and rains coming late) are equally likely to occur and cause substantial yield loss. Breeding for drought resistance requires targeting to improve on earliness to enhance drought escape as well as varieties that can cope with intermittent type of drought.

Enhance agronomic management: there is need to identify and promote agronomic practices such as fertilizer usage that are capable of stabilizing and increasing yield under different production environments.
On-farm links of improved bean technology and other adaptive measures: there is need to use a combination of methods to look into the patterns and trend of demand for the coping strategies and explain how farmers make choices of coping strategies. Then, this research would inform the design of on-farm links of new bean technology and other conducive and drought-adaptive technologies. There is also need for innovative ways within each context to enhance information access.
Objective 1: Targeting cowpea breeding and seed delivery efforts to enhance poverty impacts in sub-Saharan Africa

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Background

Efforts aimed at raising the productivity and incomes of smallholder farmers should involve developing technologies that address key production constraints and have the traits that are highly preferred by various end users. A growing volume of empirical work has demonstrated that farmers are unlikely to adopt new varieties and other technologies that do not meet their own criteria. While other institutional and policy factors may hinder the uptake of otherwise profitable crop varieties, addressing the needs and priorities of smallholder farmers and other actors along the value chain is the necessary condition for greater technology uptake and impacts. Better technology targeting thus helps investors achieve greater rates of return on their investments. The cowpea component of Objective 1 thus aims to facilitate the proper targeting of cowpea breeding activities with a view to maximizing adoption and poverty impacts of the resulting technologies. Targeting activities largely involve baseline data collection and analysis (household and market level), trait preference assessment, and monitoring of technology uptake processes to better inform breeding and seed dissemination efforts. The baseline studies include characterization of production systems using household surveys, situation and outlooks for cowpea using aggregate production and trade data, and identification of priority traits for farmer groups and markets using PVS. Adoption surveys to monitor uptake and impact will be undertaken in the second phase following significant multiplication and distribution of improved seed of released varieties.

Methodology

Targets were achieved through four major activities. First, baseline studies involving household surveys were conducted across target countries to establish the current food security and poverty status of cowpea producing households and to document the importance, constraints, and variety preferences relating to cowpea production. The baseline information is intended to facilitate project monitoring and impact assessment in terms of technology adoption, yields, incomes, food security, and poverty. An important aspect of the baseline studies was the design of the baseline survey
such that information on target as well as control villages and households would be available before and after the project. The approach accounts for conditions with and without as well as before and after the project, and forms part of an overall monitoring and evaluation framework aimed at measuring and attributing the short-term and long-term impacts of the project using rigorous methods. Second, standardized PVS survey tools on end-users’ trait preferences were designed and were co-implemented by breeders and socio-economists. Third, secondary data relating to cowpea production and trade were assembled from various sources and analyzed to establish the production system and market outlook for cowpeas in SSA. Fourth, seed systems surveys were conducted involving key market actors throughout the cowpea value chain.

IITA is implementing the project in partnership with NARS from Mozambique, Tanzania, Nigeria, Niger, and Mali that are involved in active cowpea improvement research. In addition, farmers and other stakeholders in the targeted legume crops are involved in the selection of breeding lines with drought tolerance and other desirable attributes, especially those that are attractive to end users.

**Key findings**

*Eastern & Southern Africa (Tanzania & Mozambique)*

- About 62% of the sample households in Mozambique live below the poverty line and 58% are food insecure. Consistent with their poorer access to land and lower adoption of improved varieties, female-headed households in Mozambique are relatively poorer than male-headed households. The target households are as poor and food insecure as the control households, implying that the project has rightly targeted relatively more needy households;

- Average farm level cowpea yields barely exceed 500 kg/ha, much lower than the potential yield of 1.5 to 2 t/ha obtained in on-farm trials;

- The most important source of information on improved cowpea varieties are fellow farmers. Over 80% of the adopters in Mozambique mentioned another farmer/neighbor as being their main source of information on varieties IT-18 and IT-16;

- The cowpea variety IT-18, which was introduced long ago, is the ruling or most popular variety in Mozambique;
• Over 50% of the sample households in Mozambique have adopted the cowpea variety IT-18. Female-headed households tend to have relatively lower adoption rates of cowpea (40%). Only 12% of adopters of improved cowpea varieties bought improved seed from agro-dealers, with the rest using their own recycled seed;

• Grain yield and earliness/drought tolerance are the most preferred traits. Over 60% of cowpea producers in Mozambique prefer varieties with high grain yield, whereas those in Tanzania prefer varieties with high grain yield as well as early maturing or drought tolerant. While price and taste are distant second and third important traits overall, female-headed households prefer cowpea taste to its price, confirming the importance of cowpea as a food crop;

• Over 70% of non-adopters of improved cowpea indicated lack of access to improved seeds as the major constraint;

• Drought is the main source of vulnerability both in Tanzania and Mozambique, followed by pests and diseases. The ex-ante risk management options include crop diversification, planting more cassava than maize, and off-farm work such as petty trade. The ex-post coping options include reduced number and quantity of meals, borrowing money to buy food, and switching to cassava; and

• Women own nearly 50% of the land and livestock and undertake most of the farming activities, particularly threshing, seed selection, and storage, but marketing is done by men, both food and cash crops, with obvious patterns of control of cash income by men. Overall, the survey results suggest that, despite their ownership of assets, women have no control over their productive assets and the resulting incomes.

West Africa (Nigeria, Niger, and Mali)

• Nigeria is the largest producer and consumer of cowpea in the world. The high demand of cowpea in Nigeria is due to high population density and substantial incomes tied to oil revenues which are used for food imports. Niger is the largest cowpea exporter in the world with an estimated 215,000 tons exported annually, mainly to Nigeria;

• Cowpea grain production in Nigeria increased by over 400% from 1961 to 1995 and about 107% increase from 1998 to 2000;
• In the semiarid zones of West Africa, farmers traditionally cultivate two main types of cowpea: early maturing varieties grown for grain and late maturing varieties that are grown for fodder production. This means that breeding efforts should target both grain and fodder yields and associated traits;

• Popular varieties (widely disseminated in each country) include: Mali: IT 89DE-58-6 and KVx542-119 resistant to Striga; CZ11-94-5C and CZ11-94-32 resistant to drought and Striga. Nigeria: IAR-1696 with high yielding potential. Niger: HTR and TN 27-80 resistant to the major pests. Other new varieties recently released to farmers in Mali include IT97K-818-35, IT95M-1072-57, and C94-23-2;

• Despite the high potential yield for improved varieties of 1.5 to 2 t/ha, the average farm level yields range from 500 kg/ha to 600 kg/ha;

• Main preferred traits of improved cowpea varieties are yield potential, pest/disease resistance, performance under poor rainfall, superior storage pest resistance, grain size, yield stability, early maturity, and drought tolerance; and

• Major constraints to cowpea production include insect pests, erratic rainfall, and parasitic weeds such as Striga, with insect pests like Maruca pod borer causing the most important losses of up to 100%. Poor physical and economic access to inputs such as seed is another constraint due to low purchasing power and underdeveloped input markets. Seeds of improved varieties are not widely available.

Major challenges

• NARS partners, especially in Southern Africa, have little or no capacity for socio-economics and impact assessment;

• Delays in report: It is observed and commonly reported that there is an undue delay in submission of reports, progress of work and work plans by the partners in all regions and locations; and

• Coordination has been time consuming and involves high transaction costs (than anticipated).

• **Major lessons learnt** Too many TL II activities by country and crop led to inadequate resources per activity and country. With inadequate resources to involve consultants/fellows, PIs spread out too thinly
with little or no NARS partner support (e.g. no senior economist with Malawi and Mozambique NARS available for TLII studies); and

- Lack of focus for TL II socioeconomics work (seed systems, PVS, markets, baseline, adoption, situation and outlook, etc, etc.).

**Vision for second phase**

- Carry out early adoption and diffusion studies of improved varieties of cowpea at the beginning of the second phase;
- Carry out impact assessment of the TL II project on poverty reduction towards the end of the second phase of the project;
- Focus on selected high potential impact areas for the socio-economic and impact studies;
- Organize impact assessment short courses in West Africa and East Africa for NARS economists as well as consultants and fellows; and
- Establish linkages with Advanced Research Institutes for hosting PhD students and visiting fellows to undertake adoption and impact studies under the co-supervision of senior TL II economists.
Objective 1: Targeting soybean breeding and seed delivery efforts to enhance poverty impacts in sub-Saharan Africa

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Background

Efforts aimed at raising the productivity and incomes of smallholder farmers should involve developing technologies that address key production constraints and have the traits that are highly preferred by various end users. A growing volume of empirical work has demonstrated that farmers are unlikely to adopt new varieties and other technologies that do not meet their own criteria. While other institutional and policy factors may hinder the uptake of otherwise profitable crop varieties, addressing the needs and priorities of smallholder farmers and other actors along the value chain is the necessary condition for greater technology uptake and impacts. Better technology targeting thus helps investors achieve greater rates of return on their investments. The soybean component of Objective 1 thus aims to facilitate the proper targeting of soybean breeding activities with a view to maximizing adoption and poverty impacts of the resulting technologies. Targeting activities largely involve baseline data collection and analysis (household and market level), trait preference assessment, and monitoring of technology uptake processes to better inform breeding and seed dissemination efforts. The baseline studies include characterization of production systems using household surveys, situation and outlooks for soybean using aggregate production and trade data, and identification of priority traits for farmer groups and markets using PVS. Adoption surveys to monitor uptake and impact will be undertaken in the second phase following significant multiplication and distribution of improved seed of released varieties.

Methodology

Targets were achieved through four major activities. First, baseline studies involving household surveys were conducted across target countries to establish the current food security and poverty status of soybean producing households and to document the importance, constraints, and variety preferences relating to soybean production. The baseline information is intended to facilitate project monitoring and impact assessment in terms of technology adoption, yields, incomes, food security, and poverty.
important aspect of the baseline studies was the design of the baseline survey such that information on target as well as control villages and households would be available before and after the project. The approach accounts for conditions with and without as well as before and after the project and forms part of an overall monitoring and evaluation framework aimed at measuring and attributing the short term and long term impacts of the project using rigorous methods. Second, standardized PVS survey tools on end-users’ trait preferences were designed and were co-implemented by breeders and socio-economists. Third, secondary data relating to soybean production and trade were assembled from various sources and analyzed to establish the production system and market outlook for soybean in SSA. Fourth, seed systems surveys were conducted involving key market actors throughout the soybean value chain.

IITA is implementing the project in partnership with NARS from Malawi, Mozambique, Tanzania, Kenya, and Nigeria that are involved in active soybean improvement research. In addition, farmers and other stakeholders in the targeted legume crops are involved in the selection of breeding lines with drought tolerance and other desirable attributes especially those that are attractive to end users.

Key findings

• Over 60% of the soybean growers in Malawi and Mozambique live below the poverty line, with 45% being food insecure in Malawi and 58% in Mozambique. Consistent with their poorer access to land and lower adoption of improved varieties, female-headed households are relatively poorer than male-headed households. The target households are as poor and food insecure as the control households, implying that the project has rightly targeted relatively more needy households;

• Over 50% of soybean growers in almost all soybean target countries in the region own radio. This points to the need for targeting radio broadcast to communicate extension messages relating to new varieties and cultural practices;

• Average farm level soybean yields are only a little over 600 kg/ha, much lower than the potential yield of 1.5 to 2 t/ha obtained in on-farm trials;

• Grain yield and earliness are the most preferred traits by soybean farmers, whereas soybean processors and traders value grain size and quality more than other traits;
• The soybean variety Ocepara-4 is the most popular in Malawi, whereas Storm is grown widely in Mozambique. In Malawi, one third of the farmers have adopted the soybean variety Ocepara-4, which is also known for suppressing nematodes in the tobacco growing areas. Other varieties include 427/5/7 and 747/6/8 with an adoption rate of 10%. In Mozambique, nearly 30% of the sample farmers use the soybean variety Storm. Improved varieties like Santa Rosa and Solitaire have much lower adoption rates. In Kenya, the popular variety is TGx 1835-10E (SB3), followed by NAMSOY 4m (SB25) and TGx 1448-2E (SB20);

• Lack of physical and economic access to seed of improved varieties remains a major constraint to soybean production. This is due to low purchasing power, coupled with poorly developed seed systems;

• The maximum willingness to pay for soybean seeds with desirable traits is on average equivalent only to the price of grain, far less than the prevailing price of certified seed of soybean. This implies that there is no premium price for improved seed and hence seed subsidies may need to form part of the overall strategy to promote adoption of improved varieties. In northern Mozambique, many farmers ventured into soybean production when a multi-stakeholder partnership project aimed at market-based development provided them with a package of integrated credit, extension, and input supply services. The survey results show that about 83% of adopters of improved soybean varieties got improved seed from NGOs (e.g., CLUSA) on credit;

• Drought is the main source of vulnerability, followed by pests and diseases. In Malawi and Mozambique, the ex-ante risk management options include crop diversification, planting more cassava than maize, and off-farm work such as petty trade. The ex-post coping options include reduced number and quantity of meals, borrowing money to buy food, and switching to cassava;

• Women own nearly 50% of the land and livestock and undertake most of the farming activities, particularly threshing, seed selection, and storage, but marketing is done by men, both food and cash crops, with obvious patterns of control of cash income by men. Overall, the survey results suggest that, despite their ownership of assets, women have no control over their productive assets and the resulting incomes;

• The leading soybean growing countries in SSA in terms of production
are Nigeria, South Africa, Uganda, Malawi, Zimbabwe, Zambia, Ethiopia, Rwanda, and D.R Congo. In Nigeria, the total production has increased over the years and the increase is the result of both area and yield increase following the introduction of IITA-improved varieties the adoption of which was driven by new processing and utilization;

- Soybean producers are beginning to respond to the growing market price incentives, with over 75% of the soybean produced being marketed. In Malawi, soybean production increased from less than 50,000 tons in 2006 to nearly 80,000 tons in 2008, whereas in Mozambique it increased from less than 1000 tons in 2006 to over 2000 tons in 2008. In Malawi, farm gate prices of soybean increased from US$200 per ton in 2006 to over US$300 per ton in 2007 and over US$600 per ton in 2008, although prices collapsed again in 2009 due to excess domestic as well as regional supply. Similarly, in Mozambique, soybean prices increased from only a little over US$200 per ton in 2006 to about US$580 per ton in 2008.

**Major challenges**

- NARS partners, especially in Southern Africa, have little or no capacity for socio-economics and impact assessment;
- Delays in report: it is observed and commonly reported that there is an undue delay in submission of reports, progress of work and work plans by the partners in all regions and locations; and
- Coordination has been time consuming and involves high transaction costs (than anticipated).

**Major lessons learnt**

- Too many TL II activities by country and crop led to inadequate resources per activity and country. With inadequate resources to involve consultants/fellows, PIs spread out too thinly with little or no NARS partner support (e.g. no senior economist with Malawi and Mozambique NARS available for TLII studies) and
- Lack of focus for TL II socio-economics work (seed systems, PVS, markets, baseline, adoption, situation and outlook, etc, etc.).
Vision for phase II

- Carry out early adoption and diffusion studies of improved varieties of soybean at the beginning of the second phase;
- Carry out impact assessment of the TL II project on poverty reduction towards the end of the second phase of the project;
- Focus on selected high potential impact areas for the socio-economic and impact studies;
- Organize impact assessment short courses in West Africa and East Africa for NARS economists as well as consultants and fellows; and
- Establish linkages with Advanced Research Institutes for hosting PhD students and visiting fellows to undertake adoption and impact studies under the co-supervision of senior TL II economists.
Objective 2: Enhancing groundnut productivity and production in drought-prone areas of sub-Saharan Africa and South Asia


Objective 2 is in operation in South Asia (India), Eastern and Southern Africa (Malawi, Mozambique and Tanzania), and Western and Central Africa (Mali, Niger and Nigeria). This summary provides major achievements during the period from November 2007 to October 2009. Highlighted are farmers participatory variety selection (PVS), raising awareness, strengthening breeding programs, and capacity building of NARS in each region.

India

After the 2008 rainy season PVS trials (7 varieties, 27 mother trials [MTs] and 63 baby trials [BTs] in 12 villages), farmers in Namakkal district in Tamil Nadu settled on ICgV 87846 as their preferred variety. In the 2009 rainy season, 237 paired comparisons (ICgV 87846 + local variety) are in progress for wider evaluation in the district. Similarly, in Erode (27 MTs and 80 BTs in 12 villages) and Thiruvannamalai (27 MTs and 54 BTs in nine villages) districts, the number of varieties for the 2009 rainy season PVS was pared down to four (VG 0104, TVG 0004, R 2001-2 and ICgV 00351). These are being evaluated in the 2009 rainy season PVS in these two districts (27 MTs and 60 BTs in nine villages in Erode and 27 MTs and 54 BTs in nine villages in Thiruvannamalai). The variety R 2001-2 is already released at the national level. The other three varieties are included in the state and national level trials to ensure their official release in due course. Official release of a variety entitles it to enjoy government subsidies extended under different schemes. Starting with 10 varieties in Karnataka in the 2008 rainy season, the number of varieties was brought down to five each in Bagalkot and Hiriyur and to six in Raichur for further evaluation in PVS (20 MTs and 20 BTs in six villages in Bagalkot, 24 MTs and 120 BTs in 12 villages in Hiriyur and 27 MTs and 54 BTs in nine villages in Raichur) in the 2009 rainy season. All PVS trials in India will be concluded after the 2009 rainy season. R 2001-2, R 2001-3, ICgV 91114 and GPBD 4 are already released varieties and the rest are included in state and national level trials for their official release. The share of released farmer-preferred varieties (FPVs) in formal seed production will be enhanced and those ‘yet to be released’ varieties will be multiplied in informal seed sector. For each FPV, a flyer
in local vernaculars will be published and widely circulated among the farming community during field days, training programs and educational visits. Information on FPVs will also be communicated to a large number of farmers through electronic and print media before the start of the next rainy season. About 680 farmers in Tamil Nadu and 2550 farmers in Karnataka participated in different training programs/field visits/field days at project locations. Forty farmers of Tamil Nadu undertook an educational tour to ICRISAT Center (20 men and 7 women) and DGR, Junagadh, Gujarat (13 farmers).

To support the PVS program and formal seed production chain in Tamil Nadu, 1.8 metric tons Nucleus seed (NS) of two varieties, 32.1 metric tons Breeder Seed (BS) of five varieties and 1.2 metric tons Truthful Seed (TS) of three varieties were produced in the 2008 rainy and 2008/09 postrainy seasons. In the 2009 rainy season, 22.4 metric tons seed of different classes is expected to be produced in the state. In Karnataka, 4.5 metric tons NS of one variety, 150.4 metric tons BS of seven varieties and 6.7 metric tons of three varieties were produced in the 2008 rainy and 2008/09 postrainy seasons. In the 2009 rainy season, 45.2 metric tons seed of different classes is expected to be produced.

The necessary infrastructure at Coimbatore for foliar diseases screening and at Tindivanam for drought screening in Tamil Nadu and at Dharwad for foliar diseases screening, at Chintamani for hybridization and at Raichur for foliar diseases screening in Karnataka was created/upgraded. Similarly, seed production facilities were also strengthened at research stations, in collaboration with other projects, in both the states. For efficient utilization of these facilities, six technicians from partner institutions were trained at ICRISAT in hybridization, breeding methodologies and seed production in groundnut. Four scientists from Tamil Nadu also upgraded their skills in the area of marker-assisted selection, breeding methodologies and seed production. The breeding programs at Coimbatore and Tindivanam in Tamil Nadu and at Chintamani, Dharwad and Raichur in Karnataka are now fully functional. They are engaged in developing breeding materials with farmer- and market-preferred traits for their regions. ICRISAT has also added to their breeding resources by supplying sets of international groundnut varietal trials and advanced breeding lines. In the 2009 rainy season, new international trials are formed, which will be made available to interested NARS before the start of the next rainy season.

**Eastern and Southern Africa**

After the repeat of 160 MTs (Malawi 60, Mozambique 36 and Tanzania
consisting of 8 – 10 varieties in the 2008/09 cropping season, farmers in Mozambique and Tanzania identified ICGV-SM # 90704 and 01731 (both Virginia types) and in Malawi, they identified ICGV-SM # 99567 and 01514 (both Spanish type) as their preferred varieties. Based on earlier evaluations, nine groundnut varieties have been proposed for release; five in Tanzania (ICGV-SM # 01711, 01721, 99555 and 99557 and CG 7), three in Mozambique (ICGV-SM # 99541 and 99568 and JL 24) and one in Malawi (ICGV-SM 96714). These and the other varieties are supported with adequate seed production program. A total of 29.8 metric tons BS (Tanzania 3.0 metric tons, Mozambique 1.0 metric ton and Malawi 25.8 metric tons) was produced. The NS of 10 varieties in Tanzania (5-50 kg each) and of 55 varieties in Malawi (5-10 kg each) was also produced. Seed fairs in Malawi (500 farmers) and Tanzania (2000 farmers) attracted 2500 farmers. A total of 1285 farmers (686 in Malawi, 378 in Mozambique and 121 in Tanzania) were trained in improved agronomic practices in groundnut production to harness the full potential of newly released/identified varieties. Flyers (2000) and booklets (1000) were also distributed in the three partner countries.

To strengthen breeding resources of partner NARS in the region, ICRISAT-Malawi made available 22 sets of regional groundnut trials (Malawi 6, Tanzania 4 and Mozambique 12) and 488 new breeding lines (Malawi 131, Tanzania 86 and Mozambique 271) to them. Tanzania has initiated a backcrossing program using ICGV-SM 90704 to introgress groundnut rosette disease resistance into their FPV, Pendo. Seven research technicians (Malawi 3, Mozambique 2 and Tanzania 2) were trained in hybridization techniques, statistical analysis and infector-row technique for disease resistance screening. One scientist each from the three partner countries attended the statistical analysis component of the training to equip themselves with skills of analyzing their own research data using the GENSTAT package.

In addition to enriching breeding resources and skill upgrades of staff, TL II, in association with TL I project, created and is continuing to upgrade infrastructure in NARS to ensure smooth and effective functioning of their breeding programs. These include refurbishment of greenhouses, purchase of fridges for cold storage of seeds, construction of rainout shelter and procurement of leaf area meter and SPAD chlorophyll meter in Tanzania, construction of rain out shelter, refurbishment of two glass houses, procurement of one portable weather station and irrigation pump and its installation at Kasinthula Research Station in Malawi.

ICRISAT-Malawi continues to make new crosses and generate breeding populations to meet the requirements of the NARS in the region. Forty-eight new crosses were completed and new breeding/germplasm lines with resistance to foliar diseases and drought have been identified. These included 92R/70-4, ICGV 941114 and ICGV-SM 86021 for rust resistance;
ICGV-SM 02536 for combined resistance to rust and early leaf spot; and ICG # 14390 and 14778 and ICGV-SM # 00537 and 03535 for drought. Second backcross generation populations incorporating groundnut rosette and early leaf spot resistance in FPVs are now available with the program.

West and Central Africa

Forty MTs and 310 BTs involving five to nine varieties were implemented in the 2008 rainy season, while 36 MTs and 362 BTs are in progress in the 2009 rainy season in partner countries. About 400 farmers are involved in these trials. From the first year of evaluation, three varieties (ICGV # 8 6124, 86015 and 97188) were selected in Mali, two (RRB and Fleur 11) in Niger, and one (ICIAT 19BT) in Nigeria.

Various pathways are being used to share information, methodologies and outputs among the stakeholders. This was achieved through hosting workshops, annual planning sessions, progress reports, user-friendly brochures and flyers; on-farm and on-station field days, farmer-to-farmer visits; radio and television coverage. To date over 2000 farmers have become aware of new improved varieties.

A wide range of improved groundnut germplasm was made available to the partner NARS. In 2008, ICRISAT supplied 300 new advanced breeding lines (Mali 77, Niger 45 and Nigeria 178) with multiple traits to enrich the NARS breeding resources. Segregating populations with enhanced resistance to groundnut rosette were also made available to IAR, Nigeria. In 2009, 397 advanced breeding lines were supplied to INRAN, Niger, and a further 92 lines in seven regional yield trial nurseries in five other countries in the sub-region.

The NS of 20 varieties and elite breeding lines ranging from 3-400 kg was produced during the 2007/08 postrainy season at ICRISAT-Bamako, Mali. This seed was used to support PVS trials in the 2008 rainy season and to enrich the breeding programs of the partners. About 4 metric tons of BS and Foundation Seed (FS) was produced to support the seed systems.

Phenotyping facilities (foliar diseases and drought screening) in Mali and Niger are being strengthened and a hybridization block at Samanko in Mali was initiated. Rehabilitation of rosette and aphid screening facilities at IAR, Nigeria, is in progress.

Two scientists from Mali, one from Niger and four from Nigeria were trained in PVS methodologies. A technical guide in PVS has been compiled. Two
Students have been admitted to local universities, one in Mali and the second in Niger for a master’s degree in breeding. Hands-on training in groundnut breeding methodology was offered to eight scientists/technicians from the partner institutions (IER, INRAN and IAR). A guide consisting of 10 training modules was compiled.

ICRISAT prepared simplified brochures on varieties grown in Mali and crop management in French for eventual translation into Bambara. Similar efforts are under way for Niger and Nigeria.
Objective 3: Enhancing cowpea productivity and production in drought-prone areas in sub-Saharan Africa

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Progress in testing existing breeding lines for drought tolerance

The number of elite cowpea breeding lines evaluated in each country differed but 16 were common among all. In both Mozambique and Tanzania, the breeding line IT00K-1263 ranked among the best performers under drought conditions according to farmers’ choice. However, line IT97K-1069-6 gave the highest grain yields in both countries (2.7 t/ha in Kilosa, Tanzania, and 1.9 t/ha in Ruace, Mozambique). In West Africa, the cowpea line IT97K-499-38 was selected under PVS in Niger while a sister line IT97K-499-35 was selected in Nigeria. The cowpea line IT00K-1263 was also favored by farmers in Nigeria because of its earliness and yield under drought. According to GGE biplot analysis, seven genotypes (including IT87K-1069-6, IT89KD-288, IT98K-166-4, IT97K-819-118, IT96D-610, IT98K-491-4 and IT99K-216-24-2) were the most responsive and following a comparison of genotypes with an ‘ideal’ one it was observed that IT98K-128-3, IT98K-311-8-2 and IT98K-626 were most desirable. On the whole, nine lines were selected in the five countries. Three breeding lines (IT98K-133-1-1, IT99K-573-1-1 and IT04K-405-5) were resistant to three important viruses (CPMoV, CABMV and CPMMV) while the following breeding lines, IT00K-1263, IT99K-1060, IT99K-1122 and IT99K-1111-1 were among the 14, with resistance to bacterial blight, a major disease of cowpea in the dry savanna. After evaluating 50 elite cowpea lines it was observed that genotypic differences in P utilization under both low and high P conditions were not extensive (P ≤ 0.05), even though IT00K-1263 appeared to have performed better under low P conditions than most genotypes.

Over 1,200 germplasm lines from the cowpea genetic resources maintained at IITA were evaluated for drought tolerance at Ibadan during the dry season of 2007/2008. About 140 lines were selected based on grain yield under drought and relatively lower percentage yield reduction due to drought. Following further evaluation in pots in the greenhouse, about twenty lines were selected which have been used for crossing to improved breeding lines and also among themselves. There are at present 38 F₄ and 88 F₃ populations
segregating for drought tolerance and other attendant traits such as *Striga* and *Alectra* resistance, seed size, and days to flower, among others. These were derived from single, three way and double crosses made between selected germplasm and breeding lines. An assessment of the gaps in collaborating scientists, extension agents and farmers’ skills was conducted. The assessment identified that a fragile and poorly defined relationship exists among stakeholders in cowpea innovation system and value chain. There are needs for linkages to be developed and or strengthened as well as more focused approach and coordination of efforts of stakeholders to bridge the gaps, boost production and increase value added as food and cash incomes. Research is needed to assess and quantify the actual and potential impact of the adoption of improved varieties of cowpea on farmers’ welfare, nutritional status, gender relations, soil fertility improvement, and crop-livestock integration systems. Two Nigerians (Messrs Habibu Aliyu and Auwalu Adamu Umar) are receiving formal training in plant breeding at MSc level. The latter’s MSc project is on genetics of resistance to aphids in cowpea. Messrs Henriques Colial and John Kaunda of Mozambique are pursing MSc degrees in plant breeding at Bunda College, Malawi. Both will contribute to strengthening capacity for research in the NARS of Mozambique. Mr. Didasi Tarimo commenced studies in September 2008 in the Department of Crop Science and Production. His MSc project title is, ‘Evaluation of land-races for drought tolerance using the box method’.

**Remaining work to be done**

- In West Africa, the selected elite breeding lines need to be tested in more farmers’ fields in Mali, Niger and Nigeria;
- The production of at least 200 kg seed of each selected line in each country;
- Crosses between lines nominated by our NARS colleagues and those with enhanced drought tolerance will continue; some of our NARS colleagues have problems in making successful crosses in cowpea;
- There is need to advance the over 100 populations segregating for drought tolerance and other desirable traits;
- Selection would commence in 2010 for resistance/tolerance to biotic and abiotic stresses in the segregating populations. Advanced populations would be shared with our NARS colleagues for evaluation in their countries;
• Some populations would be created for the purpose of identifying markers that are associated with resistance to some of the biotic and abiotic stresses; breeders’ seeds of the selected lines from the segregating populations created in this project would not be available until after December 2010;

• Workshops for more farmers participating in FPVS would continue. Regional and national workshops and planning meetings would also continue.

• Training of postgraduate students would continue and new candidates will be identified for the second phase of the project. Where necessary contacts would be made with university professors to help identify students they can supervise under the project.

Major challenges

The serious attack of aphids on cowpea seedlings even on breeding lines known to have resistance to the pest, especially in Niger, is a major concern. Efforts have commenced to ascertain if a new strain of the pest has evolved and then find sources of resistance to it. Another challenge in implementing TLII project activities is training of students at MSc level in plant breeding. In particular, in Niger and Mali, we could not secure admission to universities for students recommended by our NARS colleagues. It would be advisable to make contacts with professors in universities in Niger and Mali and with their support identify qualified students for graduate studies in plant breeding under their supervision. This would enable us to have more personnel in the countries who have trained in plant breeding. There is need to strengthen collaboration with the universities in Ghana and KwaZulu in South Africa where African students are being trained in plant breeding.

We also had problem as to how many graduate students could be trained in each country, due to high costs of tuition, etc. The costs for training vary with countries. Now that we know costs of training vary with countries and are aware of likely costs, more efforts would be made in the future to get full cost estimates from countries where formal training would be required.

Major lessons learnt and vision for second phase

• We should identify university professors with whom to collaborate in graduate students’ training. Establishing MoU with the universities
where students are being trained in plant breeding would have positive impact on the project’s training activities;

- The involvement of farmers, farmers’ groups and other stakeholders such as extension agents and NGOs help in getting developed technologies to where they would make necessary impacts. NGO’s, entrepreneurs and local Government officials were found helpful in pushing technologies to rural areas where most cowpea farmers are located.

- Increased participation in field days and farmers’ visits to others’ fields expose the farmers better to the available technologies. Such visits have positive influence on farmers and their willingness to take up new technologies which they see.

- Crop variety release process could be cumbersome in many countries. The project could facilitate the process by supporting meetings of variety release committees in the different countries.

If more funds were available to the project we would propose adding Burkina Faso in West Africa to the list of countries because cowpea is a very important crop in that country. In addition, TLI and Purdue Improved Cowpea Storage (PICS) activities are being implemented there. Kenya and Malawi would also like to be included in the next phase because the governments of both countries are promoting cowpea production and utilization. The ongoing dissemination of cowpea storage technology by Purdue University should be extended to other countries.
Objective 4: Developing drought resistant common bean

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Objective 4 is carried out within the framework of the Pan-African Bean Research Alliance (PABRA). PABRA in turn has three regional components: ECABREN (the East and Central Africa Bean Research Network); SABRN (the Southern Africa Bean Research Network); and WECABREN (West-Central Africa Bean Research Network). These networks facilitate the sharing of results among 24 partner countries. Objective 4 of TL II has three broad activities.

Fast track evaluations

In 2007 a nursery of 1700 entries was compiled, representing lines developed in ECABREN, in SABRN, and in CIAT-Colombia. These lines had been developed under several independent selection schemes for various purposes, including tolerance to low soil fertility, disease resistance, as well as drought resistance per se. Initially we planned to screen these at two sites, in Kenya (Katumani) and in Malawi (Kandeyani). The Katumani nursery was successful and selections were distributed among partners in East Africa for subsequent evaluation. The nursery in Malawi suffered attack of bean stem maggot (BSM), Ophiomyia spp., due to the fact of planting out of season to seek drought pressure.

Lines have advanced in Ethiopia (7) and in Kenya (25) and in Tanzania (23), and with farmer participation in selection. In Ethiopia, for example, one line that was preferred by farmers out-yielded elite checks by 30% at both research sites. In Malawi, in spite of problems, 23 lines from a previous project have been incorporated into the activities of TL-2 and are being evaluated on-farm, although in 2009 rainfall was adequate and did not permit discriminating drought resistant lines. Drought work was also successfully carried out in Kasinthula, Malawi in the dry (cool) season although problems of irrigation impeded progress in 2008. In Zimbabwe, a larger set of lines were taken on farm (120 lines distributed as 20 lines in each of six sites) to gain lost time.

Breeding in CIAT and NARS

Prior to TL II, practically no systematic breeding for drought resistance had been carried out in Africa, and screening of lines was very limited. The current effort
has established drought evaluation nurseries in five countries (Ethiopia, Kenya, Malawi, Tanzania and Zimbabwe), and national staff have been trained in field techniques. Common bean lines that are superior in response to drought are being identified in the five national programs in Eastern and Southern Africa. Traits that contribute to drought resistance are being elucidated. Breeding in Colombia has advanced in the development of lines in both Mesoamerican and Andean types, and interspecific crosses offer potentially unique traits. Segregating populations have been shared with four national programs in Africa. Local selection has been especially successful in Ethiopia.

In CIAT-Colombia, at least 6 ha of drought breeding nurseries have been evaluated each year. Intermittent drought prevailed in 2007 and 2008, while in 2009 terminal drought was severe. Many lines do well under both patterns of drought. Small seeded Mesoamerican lines have been recovered with drought resistance and a critical virus resistance gene (bc-3) that is necessary for most countries in Africa. Interspecific crosses with tepary bean (P. acutifolius), a drought resistant desert species, have produced progeny with unique drought resistance traits (resistance to wilting; rapid pod development). If the utility of these traits is confirmed, this opens up new potential for drought resistance. Lines from crosses with runner bean (P. coccineus) have more vigorous root systems, and the value of this trait is under evaluation.

In Ethiopia, white seeded navy bean types derived from crosses made in CIAT have been selected with drought resistance and farmer acceptance. F3.5 families derived from CAL 143 (with vigorous roots and tolerant of poor soils) and KAT B1 (excellent remobilization), show excellent potential under drought in Colombia, yielding far more than commercial checks. The same populations have now been established in 4 countries for local selection. Local crosses are being made in Ethiopia and Kenya.

**Capacity building**

Both post-graduate training and field workshops figured prominently in activities of years 1 and 2. Field workshops focused on quantification of moisture for stress-managed nurseries, and on physiological techniques to characterize drought response. Two workshops were held in 2008, in Katumani, Kenya, and in Lilongwe, Malawi. Basic research equipment was also purchased for national programs, and in 2009 an agronomist from CIAT-Colombia visited 4 countries for hands-on training in the use of equipment (e.g., chlorophyll meter; root scanner, etc).

In 2008, Dr. Charles Wortmann, who worked in East Africa for many years, visited research sites to characterize their suitability for drought work. His report will be a reference for developing a regional drought research program.
Dr Wortmann cited Selian Research Station as an excellent potential site for drought research, and an irrigation system is being installed there to facilitate drought work. Improvements in other sites are advancing as well.

Four students are being supported in graduate study, and two others have received support in research costs. An Ethiopian and a Zimbabwean are studying in South Africa for Ph.D.s, the former focusing on nitrogen fixation under drought, comparing soy and common bean. The Zimbabwean is analyzing the drought reaction of the reference (mini-core) collection developed under the GCP and TL-1. A Kenyan and a Malawian are receiving M.Sc. degrees in the University of Nairobi and in Zambia, respectively, the former on QTL analysis of a RIL population under drought, and the latter on Marker Assisted Selection for bacterial blight resistance. Other students have received support for research costs, one in Kenya on the analysis of the Fast Track nursery, and an Ethiopian who is developing drought resistant canning beans for export.

**Lessons learnt**

- Seed production needs to be planned and executed well in advance;
- Traits identified previously in Colombia contribute to drought resistance in Africa, based on physiological analysis of lines in the Fast Track nursery. In particular, photosynthate remobilization is a key trait;
- In Malawi, Kasinthula has been a more useful site to date for drought studies;
- Tolerance to BSM is a necessary component of drought resistant beans;
- Excellent lines result from parents with known tolerance to soil problems combined with drought tolerance. Overcoming soil problems may be a critical component of drought resistance. A modified ideotype for soils with poor fertility may have a longer vegetative phase combined with good remobilization;
- Interspecific crosses show potential of introgressing unique drought resistance traits into common beans.
- It is feasible to involve farmers early in the selection process, as early as F5;
- Field training has been widely and well received by national program colleagues. Drought science is a challenge that has readily been taken up.
Objective 5: Enhancing chickpea productivity and production in drought-prone areas of sub-Saharan Africa and South Asia


The chickpea activities are being conducted in Andhra Pradesh and Karnataka states of India, East and North Shewa zones of Ethiopia, Lakes Zone of Tanzania and Rift Valley of Kenya. It involves partnership of ICRISAT with Acharya NG Ranga Agricultural University (ANGRAU), University of Agricultural Sciences-Dharwad (UAS-Dharwad) and UAS-Raichur in India; Ethiopian Institute of Agricultural Research (EIAR) in Ethiopia; Kenya Agricultural Research Institute (KARI) in Nairobi; and Lake Zone Agricultural Research and Development Institute (LZARDI) in Tanzania.

PVS trials were conducted to enhance awareness of farmers to improved varieties and identity farmer-preferred varieties. In India, 20 mother trials and 217 baby trials were conducted in 23 villages involving 1181 farmers (1052 male + 129 female) in ranking of varieties. The preferred varieties included JG11, JAKI 9218 and JG 130. In ESA, over 100 PVS trials were conducted in which 2106 farmers (Ethiopia: 1444 male + 302 female Tanzania: 163, and Kenya: 197) participated. Farmer-preferred varieties identified included Habru, Ejere and Arerti in Ethiopia; ICCV 00108, ICCV 97105, ICCV 92318 and ICCV 00305 in Tanzania; and ICCV 97105, ICCV 00108, ICCV 95423 and ICCV 00305 in Kenya. One chickpea variety, BGD 103, was released and notified for cultivation in India and at least three elite lines (ICCVs 97105, 00108, 00305) are at the stage of pre-release testing in Kenya and Tanzania. Over 100 tons Breeder Seed of farmer-preferred varieties was produced by ICRISAT (12.2 tons) and NARS partners in India (85.2 tons), Ethiopia (2.1 tons), Tanzania (1.15 tons) and Kenya (0.3 ton).

Under back-up research, several promising breeding lines with high yield potential, early maturity, high resistance to fusarium wilt and market-preferred seed traits were developed at ICRISAT-Patancheru and over 200 lines (117 desi + 92 kabuli) were supplied to NARS partners in India and ESA. Early generation breeding materials were developed for resistance to Helicoverpa pod borer through interspecific hybridization and for drought tolerance through marker-assisted breeding (linked to TL I).

Under capacity building, training on various aspects of improved crop and seed production technologies of chickpea was provided to 5556 (5016 male + 540 female) farmers and 413 extension personnel (389 male + 24
female) in India and 3465 farmers and 36 extension personnel in ESA. Two one-month training courses on “Chickpea Breeding and Seed Production” were organized at ICRISAT-Patancheru in which 12 researchers (9 male + 3 female) from the NARS of Ethiopia, Tanzania and Kenya participated. One PhD student from India and one MSc student each from Kenya and Ethiopia have been registered and are conducting research on chickpea.

**Major challenges**

- The chickpea market remains highly volatile and unpredictable, exposing farmers and value chain actors to excessive risk. There is a need to promote farmer cooperatives and link these with domestic and international markets;

- The individual farmers are often reluctant to become seed growers due to lack of capabilities for seed processing and storage and difficulties in marketing. Community Seed Producer Associations may be promoted which will have better access to seed processing and storage facilities and marketing;

- Unpredicted and unfavorable weather conditions affected field trials at some locations in some years. For example, the crop was completely destroyed in Prakasam district of India during 2007-08 due to heavy rains before harvest and also during 2008-09 at seedling stage due to Nisa cyclonic rains.

**Lessons learnt**

- Farmers’ awareness of the improved varieties and availability of the seed of improved varieties are the key factors in spread of improved chickpea cultivars;

- PVS trials are very effective in enhancing awareness of farmers to improved varieties and in spreading new varieties;

- The farmers need some orientation and close follow ups for their active participation in PVS trials;

- Farmers participation in varietal selection reduces the time required for varietal testing and possible high adoption of tested varieties before or after formal release;
• In addition to yield, maturity duration and resistance to diseases, seed traits preferred by market (seed size, color and shape) were also given high weightage by the farmers in selection of improved chickpea cultivars. Thus, market-preferred traits are also important for adoption and up-scaling for chickpea improved varieties;

• The farmers’ preference for growing kabuli chickpea varieties largely depended on the price premium received over desi type;

• Lack of proper cleaning, grading and storage facilities hampers seed production by individual farmers;

• The farmers were very keen to take seed production of improved varieties provided arrangement was made for procurement of seed through national/state seed corporations or other agencies.

Vision for second phase

• The countries will remain the same. However, the activities will be expanded to new districts within the existing states/zones/regions and to additional states/zones/regions.

• Possible project expansion to highly potential countries like Malawi and Mozambique shall be explored

• Seed system will be further strengthened based on the experiences of phase I.

• The breeding materials generated through genomic approaches (MABC & MARS) under TL I will be evaluated along with breeding material generated under TL II in target environments.
Objective 6: Enhancing pigeonpea productivity and production in drought-prone areas of sub-Saharan Africa and South Asia

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In this project, a synergistic approach has been followed to address the production and seed delivery constraints in pigeonpea. In India, six farmer-preferred varieties (PRG 158, Asha, Lakshmi, AKT 8811, Trombay Tur, and ICPH 2671) have been identified through 42 PVS trials involving 683 farmers. In Tanzania, ICEAPs 00053, 00040, 00936 and 00932 have been identified as preferred varieties by 49 PVS involving 1554 farmers. A total of 6200 farmers were trained on pigeonpea production, seed production, processing and utilization. In Malawi, 48 PVS trials with 1355 farmers helped to prepare release proposals for ICEAPs 00557(entire Malawi), 01514/15 and 01167/11 (Central and Southern Malawi).

In India, launch of the world’s first CMS-based commercial pigeonpea hybrid ICPH 2671 by a private seed company was the most significant achievement. Besides, ICRISAT has developed super-early pigeonpea that flowers in just about 32-35 days and matures in 70-75 days (determinate type). Another non-determinate line flowers in about 45 days and matures in 75-100 days. A total of 12 lines from ICRISAT and 11 from ANGRAU looked promising for drought tolerance. Eighteen advance breeding lines, 12 A-/B- lines, and 22 R- lines were found resistant to both wilt and sterility mosaic diseases. PDKV Akola published two pigeonpea seed production and crop management leaflets in Marathi, while ANGRAU published three information booklets on pigeonpea seed production and integrated crop management in Telugu. More than 3700 beneficiaries (including more than 460 women) were trained in various aspects of pigeonpea. Eight medium maturity (ICEAPs 01170, 01179, 01147, 01143/8, 01487/16, 01499/7, 01532, 01485/9) and four long duration group (ICEAPs 01479, 01506, 01523, and 01527) have been identified through PVS trials in the ESA region. The accessions 128, 125, 130, 74 and 135 (Tanzania), Acc 72 (Mozambique) and Mthawajuni (Malawi) have been identified as high yielding-cum-wilt resistance sources. ICEAPs 01203, 01197, 01179, 01160, 01392, 00933, 00040, 00926 and 01499/7 were identified as wilt resistant-cum-high yielding long and medium duration genotypes by screening in the ESA region. ICEAPs 01528, 01547, and 01530 have been identified as having tolerance to pests.
A good beginning has been made in development of molecular markers for hybrid parental lines and hybrids. Short- and medium-maturity A₄ system hybrid parental lines are being characterized by SSR markers at Patancheru. A pair of diagnostic SSR markers (CCB 4 and PGM 7) for parental lines of hybrid ICPH 2438 has been successfully developed.

For the first time a set of 28 test crosses with genetic materials of African origin were made at Patancheru to develop parental lines and hybrids for ESA.

Three (including one female) PhD students are registered with various universities and are carrying out their thesis research on hybrid pigeonpea at Patancheru.

A pigeonpea production manual has been published in Malawi (English and Chichewa); a draft production manual in Kiswahili is in progress. In Tanzania, training sessions were organized on pigeonpea agronomy, business skills and value chain. Frontline extension staff was trained and a Grain Legume Taskforce meeting was facilitated in Malawi.

**Lessons learnt**

- There is a need for location-specific hybrids for better adoption and enhanced production;
- In the wake of global climate change and associated erratic monsoons, extra-early, photo-insensitive varieties must be developed;
- The new varieties and hybrids must have resistance to *Phytophthora* blight;
- Participation of women farmers need to be improved for better adoption of improved technologies;
- Low public/private funding for variety development/release/promotion hampers varietal dissemination;
- Need to reduce gap between seed demand and quality seed supply;
- Linkages among all the stakeholders to be maintained for sustained pigeonpea productivity and trade;
- Tightly linked molecular markers for important agronomic traits need to be developed for marker-assisted breeding (MAB).
Looking forward

The second phase needs to address some of the major challenges in pigeonpea as the yield plateauing, narrow planting window, susceptibility to pests, diseases, drought, salinity and water-logging. In this phase we envisage to further improve the efficiency of pigeonpea breeding by development of molecular marker for economically important traits. It also needs to address the seed production and delivery issues. All this will be done in a partnership mode. In the second phase, apart from the NARS, we propose to include private seed companies, NGOs, progressive farmers, farmers’ field schools and universities which have better resources and infrastructure, and align well with the project goals. Efforts will be made for release of farmer-preferred varieties and incorporation of crop management strategies. We plan to expand pigeonpea region to new niches such as low rainfall (< 500 mm) areas, hills, and target very poor farmers.
Objective 7: Enhancing soybean productivity and production in drought-prone areas of sub-Saharan Africa


Fast-tracking of existing soybean varieties and lines in five locations in Malawi showed that TGx 1740-2F gave the top yield of 3271 kg/ha and matured in 96 days and had the highest nodulation score. Another promising line from this trial is TGx 1835-10E, a rust-resistant variety released in Nigeria in 2009, that showed excellent performance in grain yield (2738 kg/ha). Furthermore, from an advanced yield trial of rust-resistant F₃ lines, TGx 1987-11F gave 4450 kg/ha and matured in 127 days whilst Magoye and TGx 1485-1D (rust-susceptible cultivar) gave 1832 and 1532 kg/ha, respectively. In Mozambique four farmer-preferred lines (TGx 1740-2F, TGx 1485-1D, TGx 1908-8F and TGx 1904-6F) gave an average grain yield in the range of 2136-2525 kg per ha across five locations whilst the check (Storm) gave 1735 kg per ha. During the past two years, a total of 32.6 tons of breeder’s seed was produced from different varieties in the project countries. A total of six varieties (TGx 1835-10E, Nyala, Hill, Black Hawk, Gazelle, and EAI 3600) were officially released in the past two years and another five candidates (SCS-1, Duicker, Sable, Bossier, and Tgm 237-2) are awaiting release. Nine candidate varieties (TGx 1740-2F, TGx 1895-33F, 931/5/34, 915/5/12, 917/5/16, TGx 1908-8F, TGx 1904-6F, TGx 1937-1F, TGx 1485-1D) are submitted to the National Variety Release Committees for approval and release. Work on rhizobial strains showed that indigenous *Bradyrhizobia* strains have the potential to fix more N than the introduced *Rhizobia* (USDA 110) under greenhouse conditions; however, these need to be tested for nodule occupancy and competitiveness under field condition. Based on previous work and current activities, a total of 24 parental lines have been identified for the crossing work. Major traits to be recombined are promiscuity, high yield, high biomass, earliness, rust tolerance, drought tolerance and adaptation to southern Africa conditions. So far, 30 crosses have been made and the F₂ generations are being grown in 2009. In the third year of the project and beyond, F₃ families and later generations of these crosses will be distributed to NARS for screening under specific growing constraints of the project sites.

Baseline survey on processing and other forms of value-addition in soybean has been carried out in all project countries and reports are prepared. Creating awareness on soybean processing and utilization has been carried out in all project countries in the form of training of trainers’ workshops, meetings with relevant stakeholders, TV shows, publications in newspapers, leaflets and field days. For instance, in Kenya, promotion of soybean consumption through large-scale means has been carried out using several radio and television campaigns, which is estimated to have reached more than 50,000 people. A video clip with a commentary on soybean production
and promotion strategies in eastern Africa has been prepared in Kenya. In Nigeria, project activities were broadcast on Kaduna State Radio and Television in 2009. A total of 847 people (268 female) attended field days at Chitedze and Bvumbwe Research Stations in Malawi and visited soybean varieties and processed soybean products on display on April 1 and July 17, 2009, respectively. Twelve to fifteen soy-based recipes were developed and introduced in the project sites through training. Postgraduate students Mr. David Nyongesa from KARI, Kenya, on marketing, Ms. Anica Massas from Mozambique on plant breeding, Mr. Aoondever Shaahu from Nigeria on plant breeding, Mr. Justine Mushi from Tanzania in soybean processing are pursuing their studies in different African Universities. A total of 8,049 farmers were trained in PVS, soybean production, marketing, processing and utilization across the project countries. Of these, 57% were women farmers. Workshop on Soybean *Rhizobium* Inoculum was held on 17-21 March 2008 in Tanzania and a document entitled ‘Investment Options for Adoption of Biological Nitrogen Fixation (BNF) in Soybean in Sub-Saharan Africa’ was produced. This document submitted to BMGF, led to the development of a bigger project that included several legumes under the title “Putting Nitrogen Fixation to Work in Africa”, which has been approved for funding by BMGF.

**Remaining work to be done**

- In order to identify and release varieties from the fast-track materials, the national performance test and PVS trials need to continue for one to two years. In some countries three years performance data are required before a variety is released;

- The candidate varieties submitted to the national variety release committee (say in the case of Mozambique) should be followed up during the coming year to finalize the process;

- Breeder’s seeds of the released varieties and those in the pipeline should be produced in the third year (2010) and beyond for farmers to use them;

- Selection for biotic and abiotic stresses of the segregating populations will start in the third year of the project (2010). Populations from more than 20 crosses will be made available in 2010 as F₃ generation. Particular emphasis will be given to rust resistance as this disease is limiting the production of the crop in all project countries. Targeted crosses will also be made as selection on soybean materials continue and new parental lines are identified;

- Work on field validation of the glasshouse selected strains of *Rhizobium* will continue in the third year and beyond;
• Training farmers on PVS, processing and utilization will continue.

• Training of postgraduate students will continue and new candidates will be identified for the second phase of the project;

• Work started along the value chain of soybean will continue giving special attention to linking farmers to market.

**Major challenges**

One of the major challenges we faced is serious rainfall shortage in project areas of Tanzania for crop establishment in 2009. The action taken is to repeat the experiment in the following season. Another challenge is the soybean rust disease, which was not considered as serious when the project was initiated. Now the disease has established well in most soybean growing areas of Africa and it has appeared on our materials in Malawi, Mozambique and Nigeria. To mitigate this problem, we have been successful in releasing an IITA-bred rust-resistant variety in Nigeria and several other resistant lines from the same program are in the pipeline and are likely to be released in 2010. We are also advancing early generation materials developed for rust-resistance at IITA. The soybean rust pathogen is known to be notoriously variable, and pathogen populations are known to have changed elsewhere rendering previously resistant lines as susceptible.

**Major lessons learnt and vision for second phase**

• Soybean rust caused by *Phakopsora pachyrhizi* became a major constraint to soybean production in project countries (Malawi, Mozambique, and Nigeria) and requires special attention as most lines were found to be susceptible to the disease. A multidisciplinary and multi-institutional rust research program should be initiated to monitor pathogen populations, identify and utilize new sources for resistance, develop molecular markers for various resistance genes to enable stacking resistance genes in new lines to strengthen the breeding process for developing a series of rust-resistant lines that are adapted to various regions.

• Breeding for early maturing soybeans is essential for southern African countries like Malawi and Mozambique as the season is not long enough for medium to late maturing promiscuous soybean varieties with high biomass. Multipurpose promiscuous varieties of West Africa were found to take more days to flower and mature under southern Africa condition.

• Prior to the soybean utilization trainings, farmers did not eat soybean in Mozambique. All recipes introduced received consumer acceptance among the farmers.

• There is a high demand for soybean in districts neighboring Gurue in Mozambique, which forms a niche for rapid expansion of the soybean project once released varieties are available.
• During the second phase of the project, productivity and production of soybean from varieties identified in the first phase will increase in project countries by 15-20%, more improved lines with tolerance to biotic and abiotic stresses will be identified, use of inoculants in soybean production will increase and more households in rural areas will consume soy-based products as awareness increases, and farmers income will increase from the sale of their produce to processors and traders.
Objective 8: Developing seed systems to maximize impact for the poor in drought-prone areas of sub-Saharan Africa and South Asia – an overview

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Tropical Legumes II (TL II) is a Bill and Melinda Gates Foundation (BMGF)-funded project, aiming to enhance grain legumes’ production and the incomes of poor farmers in drought-prone areas of sub-Saharan Africa and South Asia. The seed systems component has a special mandate: it aims not just to be effective— that is produce and deliver quality seed efficiently and widely— but also to reach some of the ‘hardest to reach’—those in ecologically harsh and often geographically-removed areas. Also, conventionally, legume seed is not given priority by either the public or private seed sector: it is self-pollinating and has a low multiplication rate: once farmers access new germplasm, they tend to re-sow for many seasons to come (unless the product is geared to high value markets). Hence TL II aims to stimulate heightened interest by NARS, private sector, farmers’ cooperatives and others, in the production, delivery, and marketing of a basket of legume crops. This demands new ways of thinking about cost-effective production—and novel strategies for reaching a broader base of clientele.

Initiated in September 2007, the seed systems work of TL II encompasses six crops: chickpea, common bean, cowpea, groundnut, pigeon pea, and soybean; and, during its first three years, concentrates research and development (R&D) work in nine countries: India, Ethiopia, Kenya, Malawi, Mozambique, Tanzania, Mali, Niger, and Nigeria, To encourage cross-crop comparison, as well as to accelerate lessons, the seed systems group has developed an overall project design which has comparable activity thrusts: 1) scaling up foundation and certified seed; 2) testing different means of decentralized production; 3) testing diverse means of marketing and diffusion; 4) training and capacity building; and 5) awareness raising linked with demand creation. However, sub-projects on the ground are tailoring approaches to address local opportunities and constraints— and to ensure that women and the poor are among the partners and beneficiaries.

Within TL II, a range of diverse seed production models are being tested: eight for the production of foundation seed; seven for certified seed; and 10 for ‘other quality’ good seed. Delivery (including marketing) models are also key— and 18 variations are being tested; likewise, 15 means of awareness raising. As TL II is a research- as well as impact-oriented development project, the team has agreed to
implement a comprehensive monitoring and evaluation (M&E) framework, which, if effected rigorously, should allow the project to determine which types of seed production and delivery systems are suitable for which contexts and aims. In September 2009, the seed systems cross-crop team agreed to two broad types of M&E systems. For each seed production model: the financial costs have to be assessed (versus quality, yield and risks); the overall seed amount tallied, and the qualitative costs and benefits analyzed (and for whom). For each seed distribution/delivery model: there will be five mandatory M&E variables: the number of different varieties distributed per region, the overall quantity of seed distributed, the number of farmers reached per region; the geographic zones covered (and key zones not covered), and the qualitative costs and benefits of each outreach mode—and for whom. As such, in-depth M&E cannot be effected by one-shot surveys; the large majority of field teams have already put ongoing M&E systems in place, which are largely being implemented by decentralized partners.

The cross-crop seed systems group has made important gains on the ground in its first two years of operation (representing two to four agricultural seasons, depending on the site). In terms of collaborators, at least 187 organizational partnerships have been established for seed production and delivery, with many of these formalized through contract or Memoranda of Understanding. Partners include inter alia; seed parastatals, private sector companies, government research and extension systems, non-governmental organizations, schools, universities, farmer cooperatives and associations. The scale of seed production has also been notable: overall, as of September 2009, 2391 metric tons (MT) of foundation and certified seed and 1111 MT of ‘other’ good quality seed.

To give a concrete example of the seed system R&D, marketing experiments of small packets of seed are being tested in multiple crops and countries: with groundnut in Niger, common bean in Kenya and Ethiopia, cowpea in Nigeria, and soybean in Niger. Depending on the crop and context, small packet size range from 100 g to 5 kg. The aim of the small packet approach is to: move varieties quickly; make new varieties affordable for all; and stimulate demand for high quality seed. Initial tests in Kenya showed women as likely to purchase as men; and in Niger, showed higher demand for smaller packets (1 kg) of treated seed in particular. The approach also demonstrated how small initial amounts can quickly turn into impressive production surfaces. Over 65 MT were sold in the first TL II marketing tests, partially due to substantial links with private sector companies (e.g. Premier Seeds in Nigeria, Leldet/FIPs in Kenya). Several constraints were also identified which need to be addressed: limited locations of sale, low marketing skills of local vendors, and insufficient awareness raining information on benefits of new varieties and improved seed.

The continued success of the TL II seed systems work will partly depend on our retaining and developing still greater focus. Our specific mandate is to
develop efficient seed systems to serve drought-prone regions, and a range of farmers, including the poor. These ‘drought and poverty foci’ are distinct from developing ‘just any’ seed enterprise- and the particular needs of our zones and clients should continue to shape our strategy. Further, the unusual diversity of our first phase might now benefit from a hard and rigorous evaluation among options: the truly ‘best bets’ should be moved for substantial scaling up—within countries, across a greater range of countries. Finally, TL II seed system work is cross-legume: these cross-legume synergies represent a multitude of opportunities which might be further capitalized on in actual programming and operations.
Obj. 8: Developing sustainable groundnut seed production and delivery systems for reaching the poor in drought-prone areas of SSA and SA

Lack of awareness of improved varieties and non-availability of their seeds are among the major factors responsible for low and stagnant productivity in groundnut in sub-Saharan Africa (SSA) and south Asia (SA). Limited or no participation of private seed sector in groundnut seed production and failure of public sector seed agencies/ Departments of Agriculture (DoAs) in fulfilling their obligation to meet groundnut seed demand in the regions, have forced farmers to rely on their own-saved seed year after year and on informal sources of seed such as private traders, other farmers and relatives. In Africa, ‘relief seed’ by donor or charitable agencies is another source of seed, which gives temporary relief to farmers but causes long term harm as varieties supplied often lack local adaptation. Local traders care little for varietal integrity and seed quality. A great opportunity exists for local level quality seed production of farmer-preferred varieties (FPVs) following seed village concept and organizing selected farmers as seed growers after their proper training. In areas where farmers save their own seed and those farmers elsewhere who trade/barter/exchange seed, they need to be properly trained in seed production and safe storage practices to improve the overall seed scenario in groundnut.

Objective 8 component of the the TL II project is geared to serve both formal and informal seed sectors but with a bias towards the latter. Preliminary studies carried out in West Africa indicate that basic seed, quality seed/Truthful seed (TS) and Certified seed (CS) can be produced at lower costs by farmers, farmers’ associations and the private sector. However, seed laws and regulations need to be flexible to promote and facilitate small-scale seed producers, farmers’ associations and the private seed sector.

In informal seed system in India, the PDKV model, which is self sustaining and allows seed self-sufficiency at individual farmer’s level and the Seed Village model, where both formal and informal seed sectors can operate,
are being promoted. Under formal seed system, new innovative models are being promoted/implemented. These include Seed Business Incubation model, which promotes micro seed business ventures by bringing entrepreneurial farmers together on a common platform for seed business under a common brand name and Seed Farmers’ Cooperative Society model, where a registered seed farmers’ cooperative society engages in production, processing and supply of Foundation and Certified seed. Both are amply supported in allocation of Breeder seed (BS) and procurement of Certified seed (CS) by the DoAs, in supply of BS, technical support and capacity building by state agricultural universities (SAUs) and in seed certification and quality control by state seed certification agency (SSCA). The society can also engage itself in the production and marketing of ‘Truthful’ seed without involving DoA, SAU and SSCA.

In ESA, the contract seed growers produce FS from BS supplied by ICRISAT/NARS, which is bought by ICRISAT utilizing a seed revolving fund and the seed is, then, processed, packed and sold to NGO partners running community seed production schemes and in some cases to local seed companies to produce CS again through contract farming. Proceeds from seed sales are used to replenish the revolving fund and a new cycle of seed production undertaken. ICRISAT is working with NARS to establish similar mechanisms with them so that funds realized from seed sales can be used for the production of BS and FS beyond the life of the project. Linkages have been established with donor agencies, which provide ‘relief seed’ to farmers, with a simple message – “for every one kilogram of improved seed received by the farmer, two kilograms should be paid back to the community seed bank for use by other members of the community who did not directly benefit”. This simple request is followed up and managed by the communities themselves and is resulting in a massive injection of improved seed to the community. For example, the Millennium Village Project (MVP) in Malawi involves 14,000 farmers, who contributed 140 t seed to community seed banks. Farmers’ cooperative unions – the umbrella bodies of the smallholder farmers associations in Malawi with a membership of more than 500,000 are involved in seed production. Two private seed companies in Malawi (Funwe Seeds and Seed Co) and four in Tanzania (ASA, Zenobia, Krishna, and Miombo Estate) have ventured into commercial seed production.

In WCA, two schemes are currently being tested: seed production through small-scale seed producers and farmer groups with two delivery schemes including small-scale retailers and input shops in small packets of varying sizes (0.5, 1.0, 2.0 and 5.0 kg). Marketing and business skills of shop
managers and location of selling outlets have significant bearing on the success of the seed ventures.

ICRISAT and NARS, with strengthened seed production infrastructure through the project, produce all classes of seed of FPVs and other released varieties in substantial quantities (details given in the report) to support formal and informal seed sectors and farmer-participatory varietal selection trials. In addition to the supply of required class of seed to seed growers, seed growers and traders are also supported by capacity building and farmer-friendly literature in local vernaculars on integrated crop management (ICM) and seed production; processing and storage; and marketing skills (especially traders and seed entrepreneurs). For example, 3792 farmers and seed growers including 463 women and 51 traders in India; 527 officials, farmers and seed producers, 57 technicians, 141 extension officials and 46 lead farmers in Malawi and Tanzania and 754 farmers in Mali, Niger and Nigeria were trained in seed production techniques including ICM in groundnut. About 87 seed producers in Mali and Niger were trained in market skills. About 1755 farmers attended field days organized in the WCA region. To enhance farmers’ awareness of improved varieties and importance of quality seed in crop production, several TV and radio programs were telecast/broadcast and newspaper and magazine articles were published in local languages.

To meet the groundnut seed requirement in full, it is essential to promote informal seed sector by taking up seed production in farmers’ fields, preferably under assured growing conditions, enforcing quality control to enhance not only seed replacement rate (SRR) but also variety replacement rate (VRR). A proper training to seed growers and seed entrepreneurs will be essential for the success of informal seed sector.

**Lessons learnt**

1. In rain-fed agriculture, delayed onset of monsoon or a severe drought not only do they affect the crop in the on-going season, but they also wipe out the gains made in seed production and varietal coverage over years. In the case of delayed onset of monsoon, once the planting time is passed, small farmers are forced to sell their seed as commercial commodity resulting in loss of seed. Seed availability in the following seasons is also affected as it takes time to build up the seed stock. In such situations, governments can play a significant role by buying the seed from farmers and storing it safely for the next season.

2. Creation of proper seed banks at village or block level in India, where
farmers could store their seed at a nominal rent or mortgage it at a
nominal interest rate till the next cropping season to obtain cash for
their immediate needs will ensure availability of quality seed at local
level at planting time.

3. Enforcement of quality control in informal seed sector is essential to
ensure availability of genetically pure quality seed at local level.

4. To the extent possible, seed production should be taken up under assured
growing conditions following all the recommended cultural practices
for a seed crop. Higher productivity in seed plots will ensure lower cost
of seed to farmers.

5. Cumbersome seed certification and processing procedures/requirements
discourage small and resource-poor farmers to participate in formal seed
production system. Until the seed situation in legumes improves, there
should be some flexibility in seed act and rules as a special case for legumes.

6. In addition to improving seed replacement rate (SRR), equal emphasis
should be given to variety replacement rate (VRR) so that the benefits
of research reach to farmers without much delay. However, this may
require persistent efforts on the part of scientists to persuade DoAs to
raise BS indent of newly released cultivars.

7. Knowledge empowerment of farmers is essential to improve the legumes
seed scenario in India. Informed farmers can put pressure on political
leadership and through them on DoAs to demand the best and latest in
seed.

8. Small-scale seed producers and farmers’ associations can produce and
deliver basic and certified groundnut seed at lower costs.

9. Training in seed marketing and small-scale business skills is essential
in stimulating small-scale private sector interest to engage in the seed
industry.

10. Business-oriented small holder farmers perform better in seed
production, seed storage, and seed dissemination than food security-
oriented farmers, hence these group of farmers should be involved in
seed systems.

11. Partnership with WASA/AGRA needs to be strengthened in WCA to
avoid duplications.
12. There are market niches for sales of small pack seed and small pack sales are major vehicle for variety diffusion in WCA.

13. Need for faster varietal testing and release systems to enhance the spectrum of varieties available to farmers.

14. Academic training is a prerequisite to capacity building and better interaction with partners in West Africa.
Objective 8: ICRISAT chickpea seed production and delivery strategy in ESA and SA

NVPR Ganga Rao, S Silim, PM Gaur, CLL Gowda, K Assefa, A Fikre, W Thagana, R Kileo

The chickpea seed production and delivery strategies are being implemented by ICRISAT (Nairobi and Patancheru); the Ethiopian Institute of Agricultural Research, Addis Ababa; the Lake Zone Agricultural Research and Development Institute, Ukiriguru, Tanzania; Acharya NG Ranga Agricultural University, Hyderabad; University of Agricultural Sciences, Dharwad, Bengaluru; and University of Agricultural Sciences, Raichur, Bengaluru, India.

The major constraints identified in chickpea seed production and delivery systems in South Asia include inadequate seed production by public seed sector, little involvement of private seed sector in seed production, lack of awareness among the farmers about improved chickpea varieties, lack of seed storage facilities at local level, and high transportation cost incurred in seed storage and marketing. This project is making efforts to address these constraints.

Similarly in ESA, baseline studies indicated that very limited awareness on improved chickpea varieties, due to consistent failure of public sector to supply good quality source seed, the private sector has shown little interest in seed production and most often seed is produced in high potential areas or areas with infrastructure for storage and processing far away from its area of utilization leading to high seed costs. High seeding rates further controls spread of new varieties. To overcome these constraints investments have been made in breeder and foundation seed production, and proceeds from seed sales used to re-capitalize seed revolving funds to support subsequent seed production cycles. Foundation seed has been marketed to private companies and NGOs for further seed production and dissemination. Most of the farmers rely on their own-saved seed and access to seed of improved varieties either through informal networks or relief seed. The survey also revealed that existence of two seed supply systems, i.e. informal, which are usually non-market based seed supply systems, and the quasi-formal, mainly market-based seed supply systems. The informal seed supply sources included own saved seed; gifts from family and friends; farmer-to-farmer seed exchanges and others. The importance of quasi-formal seeds seems to increase with the availability of new farmer-preferred varieties, which helps in the emergence of seed markets for improved varieties.
In India, seed availability at local level is being enhanced by strengthening the formal as well as informal seed production systems. A total of 230 t Breeder/Foundation/Certified/Truthfully labeled seed of farmer-preferred chickpea varieties was produced at ICRISAT, NARS research stations and at farmers’ fields in the project locations. Efforts were also made to establish linkages between formal and informal seed systems. For example, 92.5 t Certified seed of JG 11 produced by farmers in Kurnool district was procured by Andhra Pradesh State Seeds Corporation and National Seed Corporation. About 19 t Breeder seed was also produced at farmers’ fields under direct supervision of scientists. Chickpea Seed Producing Farmers’ Groups were established and linked to Seed Certification Agencies.

In Ethiopia, 24.15 tons of Breeder seed, 42.65 tons of Foundation seed and 619.03 tons of certified seed of seven varieties was produced over the past two seasons. Seed of three chickpea varieties planted to 21 hectares area and 25 tons of foundation seed of ICCV 97105 (8.2t), ICCV00305 (11 t), ICCV 00108 (6.5 t) are expected. One and two kg seed packs are already available in agro-dealer shops, and a preference for 2 kg packs has been established in Tanzania.

In India, training sessions were organized in the project areas on chickpea seed production, processing, storage and marketing in which 4608 farmers (4202 male + 406 female), 15 local seed traders, and 369 extension personnel (312 male + 57 female) participated. A seed production manual has been prepared and is being published in English and local languages (Telugu and Kannada). Leaflets on chickpea production technology were published in Telugu and Kannada and distributed to farmers. Electronic (3 TV talks, 5 radio talks and 5 live phone-in programs in local radio/TV channels) and print (10 popular articles/leaflets) media were used to enhance activities of farmers and extension personnel about improved chickpea varieties and seed production technologies. A total of 20 farmers’ fairs and field days were organized in which over 3000 farmers participated. A total of 1875 samples of Breeder seed (2-5 kg each) of improved chickpea varieties (JG 11, JG 130, JAKI 9218 and BGD 103) were distributed to farmers in the project locations to facilitate rapid adoption of the improved cultivars.

Two NGOs in Tanzania and three in Ethiopia are being involved in seed production and distribution. In Ethiopia, farmers’ cooperative unions are involved in seed production and distributed 25 tons of Foundation seed to members. Here, a private company, Agricultural Commodities and Supplies (ACOS), is involved in the multiplication, marketing, and export of chickpeas. Draft seed business plans have been completed. Three pro-poor seed delivery seed systems such as seed revolving fund facility, community seed banks, and farmer field schools were tested. Farmer marketing groups have been established in Tanzania - Mpeta, Mnanje B and Likokona.
Twenty six officers, 64 development agents, 22 farmers, 50 research technicians and 110 extension officers were trained in seed production and management in Ethiopia. A total of 120 (78 male and 42 female) farmers from three districts of Tanzania participated in one-day training on seed farm management, processing and grading of quality declared seeds.

Four field days on chickpea scaling up and demonstrations were held in Ethiopia with participation of 455 farmers, 30 agricultural officers, 10 research technicians, 10 technical assistants, 20 officers from Ministry of Agriculture and Rural Development (MoARD), one from the Ethiopian Seed Enterprise, three representatives of Farmers Cooperatives Unions, and other stakeholders. Due to high importance accorded to chickpea seed systems in Ethiopia, the State Minister of Agriculture and DG of EIAR were also present in one of the field days. Proceedings of all the field days were broadcast on public media (Ethiopian Television, and Ethiopian Radio, Ethiopian News Agency, and national Newspapers) in Amharic, Oromifä and in English. Television and radio broadcasts with live interviews and newspaper articles about new varieties have become a norm throughout the project sites in Tanzania.

Manuals in seed production have been drafted in Swahili (Tanzania). Flyers describing chickpea printed in Amharic and Swahili and distributed to farmers in project sites (more than 5,000 flyers).

**Major challenges**

- The individual farmers are often reluctant to become seed growers due to lack of capabilities for seed processing and storage and difficulties in marketing. Community Seed Producer Associations may be promoted which will have better access to seed processing and storage facilities and marketing.

**Major lessons learnt**

- Farmers’ awareness on improved varieties and seed availability of improved varieties are the key factors in spread of improved chickpea cultivars;

- Conduct of FPVS, field days and seed fairs are very effective in awareness creation among farmers about new varieties and generate sustained seed demand;

- Lack of proper cleaning, grading and storage facilities hampers seed production by individual farmers;
• The farmers were very keen to take up seed production provided arrangement was made for assured procurement of seed;

• Sustainable seed production by smallholders stands a better chance of success if complimented by functional seed and product markets;

• Project interventions should focus on pro-poor seed production and delivery systems that have a better chance of surviving beyond the lifespan of the project

• Need for faster varietal testing and release systems in ESA to enhance the spectrum of varieties available to farmers;

• Business-oriented small holder farmers perform better in seed production, storage, and dissemination than food security-oriented farmers, hence these group of farmers should be involved in seed systems; and

• Limited number of research and seed technicians available in ESA also hampers progress of seed dissemination.

5.2 Vision for second phase

• The activities will be expanded to new districts within the existing states/zones/regions and to additional states/zones/regions in the countries of Phase I and to new potential countries like Malawi and Mozambique;

• Establishing functional legume value-chains to stimulate seed demand;

• Seed production manuals published, awareness created through FPVS, new varietal releases – fosters better seed systems in second phase;

• Strengthening linkages between researchers, seed producers, agro dealers, private large scale entrepreneurs.
Objective 8: ICRISAT Pigeonpea seed production and delivery strategy in ESA and SA

NVPR Ganga Rao, S Silim, ES Monyo, KB Saxena, R Srivastava, S Lyimo, J Mligo, F Mizambwa, G Kananji, and F Maideni

The pigeonpea seed production and delivery strategies are being implemented by ICRISAT (Nairobi and Patancheru), NARS partners in Malawi (DARS-Lilongwe), Tanzania (SARI- Arusha, ARI-Ilonga) and in India (PDKV-Akola, KVK- Karda, KVK- Durgapura in Maharashtra; ANGRAU-Hyderabad and Adarsh Rythu in Andhra Pradesh).

In Eastern and Southern Africa, lack of awareness and limited or no access to quality seed attributed to consistent failure of public sector in supplying good quality Breeder/Foundation seed in desired quantities, private sector has shown little interest in investing pigeonpea seed production and marketing, most often seed production areas are far away from its area of utilization because of isolation requirements and availability of infrastructure for storage and processing, leading to high transaction seed costs. Through this project, selective investments have been made to overcome these constraints in Breeder and Foundation seed production, and seed sale proceeds used to create seed revolving funds for future use. Private seed companies and NGOs took the lead in acquiring Foundation seed for further seed increase and dissemination. Most of the farmers rely on self-saved seed and access to seed of improved varieties either through informal networks or relief seed. The baseline survey also points out the existence of two seed supply systems, namely informal, which are usually non-market based and the quasi-formal, mainly market-based seed supply systems. The informal seed supply sources included own saved seed; gifts from family and friends; farmer-to-farmer seed exchanges and others. The importance of quasi-formal system seems to increase with formal release new farmer-and market-preferred varieties, which helps in augmentation of seed demand and seed markets for superior varieties.

Pigeonpea seed production and delivery systems in South Asia are confronted with seed inadequacy both in quantity and quality at public seed sector, little involvement of private sector in disseminating pure line varieties, lack of awareness among the farmers about improved pigeonpea varieties, lack of seed storage facilities at local level and poor seed delivery during crop season. The various seed access points available for quality pigeonpea seed are farmers’ own-saved seed, neighboring farmers, local traders, department of agriculture (DoA), public seed sector (NSC, SSCs,
SFCl), State agricultural universities (SAUs), Krishi Vignan Kendras (KVks) and private seed companies. Efforts are being made to improve various components of both formal and informal seed systems using various seed production and delivery models.

In India, in order to strengthen the formal seed system, and establish linkages with informal seed system, a total of 75.67 tons (1.27 tons Breeder seed, 12.18 Foundation seed, 6.5 tons of Certified seed, and 15.3 tons of TL seed) has been produced by ICRISAT, PDKV Akola and ANGRAU, Hyderabad, under this project. A total of 1410 seed samples of 0.5-1.0 kg each of the farmer-preferred varieties (Asha, PRG 158, Maruti, Lakshmi, BSMR 736, AKT 8811, and PKV Trombay Tur) were distributed to farmers in their respective target districts by ANGRAU and PDKV.

In ESA, 3.5 tons of seven long duration varieties and three medium duration varieties was produced at ICRISAT-Nairobi and 2.5 tons of Breeder seed of nine pigeonpea varieties has been produced in Malawi and Tanzania, respectively. Contract growers in Malawi and Tanzania produced 31 tons of pigeonpea Foundation seed of three varieties (ICEAP 00040, ICEAP 00053 and ICP 9145) in 2007/08 and more than 30 tons is expected from the 34.5 ha under production in 2008/09. One and 2 kg seed packs are already available in agro-dealer shops, and a preference for 2 kg packs established in Tanzania.

Policy briefs such as seed certification under pigeonpea-cotton intercrop, relaxation for the requirement of same class of seed in the vicinity of seed production blocks, reduction of minimum area to be planted for seed certification and certification fee to be charged on the basis of net cropped area in an intercrop are being prepared on the issues of pigeonpea seed certification by ICRISAT and PDKV Akola.

To facilitate efficient seed production and marketing with support from ICRISAT, PDKV Akola has established linkages with Maharashtra State Seeds Corporation Limited (MSSCL) and Krishi Vigyan Kendras (KVks) at Karda and Durgapura. In Andhra Pradesh, ANGRAU, Hyderabad, has established linkage with Andhra Pradesh State Seed Development Cooperation (APSSDC) and Adarsh Rythu. In both Maharashtra and Andhra Pradesh, village level seed production societies are being formed for promotion of informal seed sector. These societies will produce Truthfully labeled (TL) class of seeds, and will advise farmers on various technical matters in quality seed production, harvesting, seed storage, processing, and market intelligence.

PDKV with technical support from ICRISAT organized a total of 45 training programs on crop and seed production of pigeonpea. A total of 926 farmers were trained which included more than 30 women participants.
In addition, seven field days were conducted by PDKV Akola in which 351 farmers were present, including 21 women farmers. Similarly, ANGRAU, in association with ICRISAT, conducted a total of eight training programs in Mahabubnagar and Ranga Reddy districts. A total of 1509 farmers attended these training programs, including 296 women farmers. ANGRAU conducted a total of five field days. These training programs were attended by a total of 332 farmers including 48 women. One training workshop in seed production technology and storage was also organized. The training program was attended by extension officials, village level workers, NGO staff, and farmers. In this training program, apart from 320 farmers (including 70 women), a total of 31 resource persons were trained.

In Tanzania, training sessions were organized on pigeonpea agronomy with participation of eight farmer groups involved in seed production and 22 extension officers. ToT training with participation of 14 stakeholders from research, extension, agro-dealers, NGOs, Agricultural Sector Marketing Programs, farmers’ organizations, in business skills and value chain. Four farmers’ field days with participation of 1554 farmers and 6200 farmers were trained on various pigeonpea technologies including quality seed production and processing and generated greater interest about new varieties among various stake holders.

In Malawi, 50 frontline extension staff (43 males and 7 females) was trained about pigeonpea package which includes quality seed production. Twenty five farmer’s field days were conducted in Central and Southern Malawi with participation of 1355 farmers also generated greater awareness on quality seed. The field day events in southern Malawi were covered on Malawi television (TVM, Malawi Broadcasting Cooperation, Zodiac Broadcasting Station and The Nation Newspaper.

PDKV, in association with ICRISAT, has prepared two pigeonpea seed production and crop management leaflets in Marathi (Pigeonpea cultivation and seed production technology, Pigeonpea cultivation technology). ANGRAU, with technical guidance from ICRISAT, has published three information booklets in pigeonpea seed production, agronomy and IPM technologies in Telugu (Pigeonpea seed production technology, Package of practices for pigeonpea, IPM technology in pigeonpea).

In ESA, television and radio broadcasts with live interviews and newspaper articles about new varieties have become a norm throughout the project sites in Tanzania and Malawi. Manuals in seed production have been drafted in Chichewa (Malawi) and Swahili (Tanzania). Flyers describing pigeonpea printed in Chichewa and Swahili and distributed to farmers in project sites (more than 5,000 flyers).
Two major NGOs have been identified in Tanzania (Dutch Connection and KIMAS) and three in Malawi (PLAN Malawi, CARE Malawi and MVP) which are actively involved in legume seed production and distribution. Draft seed business plans have been completed. Two private seed companies in Malawi (Funwe Seeds and Seed Co) and four in Tanzania (ASA, Zenobia, Krishna, Miombo Estate) venture into commercial seed production. Three pro-poor seed delivery seed systems such as seed revolving fund facility, community seed banks, and farmer field schools were tested. Farmer marketing groups have been established in Tanzania - Mpeta, Mnanje B and Likokona - while seed production groups have been established in three districts of Malawi - Mchinji, Nkotakota, and Zomba.

**Major challenges**

- Pigeonpea is an often cross pollinated crop because of insect (honey bees) pollination and finding appropriate isolation distance (500 m) for seed production has proved to be most difficult task. This situation further aggravated by stray and self sown pigeonpea plants, pigeonpea growing in backyards, homesteads, and social factors;

- Seasonal fluctuations in the preference for pigeonpea crop among the farmers and there by inconsistent seed demand over years;

- High grain prices in India during current season and coupled with delayed onset of monsoon led to distress sale of seed as commercial grain. Hunger forced farmers in ESA to sell their seed to grain traders for quick money; and

- The individual farmers are often reluctant to take up seed production due to lack of small scale seed processing and storage facilities and risks associated with un even seed demand and marketing. The best option would be Community Seed Producer Associations which will have better access to seed processing, storage facilities and marketing.

**Major lessons learnt**

- Conduct of FPVS, field days and seed fairs are very effective in awareness creation among farmers about new varieties which can generate sustained seed demand;

- Lack of small scale machinery for cleaning, grading and community based storage facilities deter seed production by individual farmers/ farmer groups
• The farmers were very keen to take up seed production based on assured buy-back arrangement;

• Sustainable seed production by smallholders stands a better option, if complimented by functional seed and product markets. Business-oriented small holder farmers perform better in seed production, storage, and dissemination than food security-oriented farmers, hence these group of farmers should be involved in pigeonpea seed systems;

• Project interventions should focus on pro-poor seed production and delivery systems that have a better chance of surviving beyond the lifespan of the project

• Seed replacement rate is very low in India and informal seed system in the target districts holds lot of promise for improving seed replacement rate. Also efficient linkages between formal and informal seed systems are critical success factors;

• Continuous varietal testing and quicker release systems in ESA will enhance the spectrum of varieties available to farmers;

• Pace of pigeonpea seed dissemination in ESA limited by limited availability of trained research and seed technicians;

• Registered societies can play a key role in maintaining seed quality standard (especially for TL seeds); and

• Training in seed production techniques should be imparted in the field to impart first hand exposure.

5.2 Vision for second phase

• The activities will be expanded to new districts within the existing states/zones/regions and to additional states/zones/regions in the countries of Phase I and to new potential countries like Kenya and Mozambique;

• Seed is the critical component for hybrid technology dissemination in south Asia, more efforts may go in this direction;

• Establishing functional legume value-chains to stimulate consistent seed demand;

• Seed production manuals published, awareness created through FPVS, new varietal releases – fosters better seed systems in second phase; and
Objective 8: Bean seed production and delivery


Background

Bean seed production in Africa has faced a series of constraints which affect its volume, geographic scope and social reach of distribution. Public sector production has not been able to multiply large quantities of initial foundation seed—as priority is given to more commercial crops, such as hybrid maize. The private seed industry also has not found the bean seed business lucrative, as once farmers get new germplasm they tend to re-sow from their own harvests, instead of purchasing seed anew from certified sources.

The demand side has also faced a number of challenges. At the most fundamental level, many farmers simply do not know about new varieties (i.e. their potential advantages, where to access them). Seed production often takes place in higher potential areas, with seed stores also being concentrated in zones of higher population density or those with better infrastructure (that is, not the stress areas). Further, when seed of promising varieties is made locally accessible, it tends to be too costly and/or sold in package sizes of interest only to the larger-scale farmers.

Approaches and initial sites

The strategy of work under Objective 8.3 has been designed to alleviate these bottlenecks. Research and Development (R&D) efforts are focused on scaling up the initial quantities of foundation and certified seed—and then on decentralizing production and distribution to many zones of action, including in stress areas. Research is testing ways to make high quality bean seed more accessible and affordable—e.g. through pro-poor small pack marketing, but also through professionally-managed seed loan systems. Research is also monitoring production costs, seed quality and the qualitative costs and benefits (e.g. for: public sector, private sector, men and women farmers, traders). Central to the R&D objective is to understand what models work where and for whom. The group is testing four foundation seed production models, four decentralized seed production models and six forms of marketing and delivery.
Project work has focused in two countries. In Kenya, project zones include the drought prone areas of western Kenya along the Lake Basins (Nyanza and Western Provinces), Central and South Rift Valley (Rift Valley Province), dry land of Central Kenya (Central Kenya Province) and Lower Eastern Province (dry land of Ukambani). In Ethiopia, project zones include southern Ethiopia, the Central Rift Valley, and drylands of the eastern and northern east parts of the country. These areas have been characterized by a series of stresses, throughout the project period. In Kenya, this includes political unrest, followed by severe droughts every season. In Ethiopia, the drought has mainly been severe in 2009. Also, in both countries, food and seed aid are routinely, and currently, being given.

Results

Partnerships

Diverse and complementary partners have been the cornerstone of this work. Some 106 partners are presently involved in TLII Objective 8.3, including with NARS, specialized seed producers, governmental and non-governmental organizations, community and faith-based organizations, and grain traders. Partners have developed a joint three-year plan for project implementation, have agreed upon roles, responsibilities and approve yearly budget allocations. Many have also signed formal Memorandum of Understanding (MOUs) and several have incorporated TL II work plans in their own organizational program plans. (Self Help Africa in Nakuru, several Catholic Dioceses, and Nangina). Such transparent and formal commitments promote the sustainability of the approach—beyond the project cycle.

Seed production

Figures- to-date show 208.8 tons of foundation seed produced (i.e. beyond the full 3-year target of 128 tons), and 732.7 tons of decentralized good quality seed (versus the three-year target of 1870). Figures are currently available only for two seasons—so the project is well on-track. Of interest is that, in Kenya, between 61.1 and 80.3% of the seed producers are women (no comparable figures are available for Ethiopia) and that even small-scale seed producers are able to reserve between 42 and 46% of their harvest for use and sale as seed specifically. Variety diversity is also being encouraged: in Kenya four varieties are being diffused for drought-prone zones; in Ethiopia, the figure is 10 varieties.
Novel agronomic practices and increased interest in bean sector

The arrival on-farm of drought-prone varieties has stimulated novel agronomic practices. In Kenya, the very short cycle (and other qualities) of the Katumani bean varieties, has motivated farmers to plant three times in a single season, versus the normal one. This strategy results in three different harvests (via staggered planting), increased food availability and the spreading of risks in these unstable environments.

The good performance of the Katumani bean varieties, in general, has also encouraged more investment in the bean sub-sector. For instance, a new producer of certified seed, Lambwe Seed Growers Association, has been recently licensed by KEPHIS (the Kenya seed health sector). In addition, the Kenya Ministry of Agriculture (fortunately or unfortunately) is supplying 200 tons of Katumani bean seeds this season Oct 2009 onwards--- as relief seed in 61 districts across Kenya.

Novel seed delivery mechanisms, via small pack marketing

The small pack marketing approach has brought results well beyond what might be expected in the first string of trials. About 40,000 packs have been sold overall, with monitoring and evaluation (M+E) showing that women are as likely to purchase as men. The sale of small packs is expanding business opportunities for seed companies – as even small farmers are now purchasing certified seed.

Specifically in Kenya, small seed packs of 70, 400 and 2000 g were marketed by Leldet Seed Company across Central Rift Valley, Central and Eastern Kenya. The packs were sold at Ksh 10, 50 and 180 respectively (1 USD=Ksh 75). In total, about 28,000 packs have been sold. About 58% of buyers were female and the majority preferred the 70 g pack - which they can afford with their domestic funds. The marketing took place during agricultural shows, field days, agro-dealers and open market places. In Ethiopia, 5000 and 6260 packs were sold in the east and southern part of the country, respectively, through farmers’ cooperative unions and in open market places. Given the very modest buying power of Ethiopia farmers - and the secondary role of beans, the lively interest in small bean was unexpected.

The magnitude of seed loans has also been a surprise. For instance, in western Kenya alone, 45,000 farmers have accessed seed through loans in just three seasons (and with no money changing hands). These local system efforts complement those of traders who are particularly playing a role in southern Ethiopia - where they have contracted trained farmers to multiply
In 2009, a single trader (buying from farmers) sold 10 tons of project-related varieties to four NGOs, and five tons to other traders.

**Mapping (GIS) seed outlets to maximize reach**

Related to marketing, and to reach 100,000s farmers in general, Objective 8.3 is a complementary project (leveraged on TL II) mapping the distribution of seed outlets in key drought-prone zones of Kenya. Such maps help to identify areas where there is a lack of coverage.

Starting with Nzau district, the first map shows just over 23% of the population is within 1-hour walk of the current seven outlets. If one new outlet were added, the population within 1-hour reach rises to 38%. A further seven new outlets would have to be added to ensure that 80% of our target population has access to seed outlets.

**Monitoring and evaluation**

An Integrated Performance Monitoring and Evaluation (IPME) framework has been built into project operations at varied levels—with the decentralized partner, the NARS, and overall with PABRA/CIAT. Specialized M+E is also being conducted on the costs of seed production, and on the quality of seed being produced by different organizations.

**Cost-benefit analysis of decentralized production models**

To date, seven models are being costed and their advantages/disadvantages analyzed. The focus has been in Kenya—and includes one public sector organization, two private companies, and four decentralized means of production (facilitated by individuals, communities, NGO and the government, respectively). Producing common bean seed proves profitable whether the product is certified or ‘other quality’, but the degree of profit is highly linked to yield. All modes are vulnerable to the effects of drought.

**Seed Quality**

Seed quality assessment research is comparing samples obtained from seed bulking farmers (trained), farmer secondary beneficiaries, and seed companies/parastatals involved in seed. As an example of results, 91 farmer beneficiaries (74% female) were randomly sampled across Kenya TLII sites. The preliminary data show that 81% of their stored seeds were of good physical quality (according to ISTA standards), with a germination was...
86.7%, and with a very good vigor. Further analysis on major seed borne diseases is near completion.

**Training and development of information tools**

Training of trainer (ToT) sessions have been held across the two countries. In Kenya, KARI and KEPHIS have trained 122 staff members of partner organizations. The trainees also subsequently have trained 6849 farmers of whom 57.8% were women. Training has covered aspects of pre and post harvest management of beans; seed quality instructions; and introduction to agri-business skills. Variety and seed-related information tools have also been developed in local languages, targeting farmers with varied levels of literacy, traders and extension staff. For instance, in Ethiopia in 2008 variety description leaflets, 1000 seed production guides and 1500 variety posters have been produced and distributed.

**Select lessons learnt**

- **Impact- oriented leadership at the top if a program is key for developing seed systems in drought-prone regions, geared to reach the poor.** A program cannot get impact unless the leader gears strategies to solving bottlenecks and reaching endusers. Otherwise, a program ends up with results like ‘lots of seed produced’-- on the supply side;

- **The professional and transparent engagement of partners is crucial for widespread success.** This includes formal clarification of expectations/responsibilities and clear budget allocations. Productive partnerships require ongoing facilitation;

- **Availability and access to foundation/certified seeds remains a bottleneck.** Despite having created high farmer demand and interest in the drought-tolerant varieties, foundation seed production remains in the sole hands of the NARS and access to new varieties and initial seed- by seed companies or other producers remains limited In addition, seed company capacity to produce certified is still very low (or non-existent), hampered by limited technical and drought.

- **Decentralized systems have proven to be durable, functioning even during times of severe production fluctuation (due to political unrest and drought).** Strengthening decentralized centers of production will become even more important as climate change intensifies;
• A small pack marketing approach has potential to reach hundreds of thousands of farmers, quickly. In both Ethiopia and Kenya, the sale of small packs has reached male and female farmers in but a few seasons, and expanded the use of certified seeds. It has also given farmers the opportunity to experiment new varieties— at minimum risk;

• Emergency seed distribution continues to clash with project goals. Emergency supply orders directly compete with project needs for foundation/certified seed. Further, free distributions clash with the project optic of selling seed and creating demand among small farmers;

• Monitoring and evaluation have been crucial for understanding project opportunity and constraints. The Integrated Performance Monitoring and Evaluation (IPME) processes have taken considerable energies to develop a (and such start-up efforts should not be underestimated) However, they have also delivered quickly, in identifying some of the quick wins.

Looking to the future

• Scale up and diversify foundation and certified seed production. While all targets have been met, demand is sharply rising for the drought-tolerant varieties. More organizations and a more diversified set of partners need to be brought into this arena of high quality seed production. The concerns are to: increase overall quantity, ensure more stabilized production and diversify risks (including risks of seed being usurped for relief efforts or political campaigns);

• Reduce and focus on ‘best bet’ decentralized production modes. In the first phase of TL II, 8.3 has been characterized by a multitude of partners. The truly ‘best bet’ modes of operating now need to be promoted (those which are sustainable, high volumes, and which can farmers;

• Professionalize small pack marketing. This small pack approach is a true win-win win—for the public sector, private sector—and for farmers. It has to quickly move beyond ‘test experiments and to large scale institutionalization, with the private sector taking the lead;
• **Identify ‘best bets’ for demand creation and awareness raising methods.** Across TL II, we have some 20 methods used for demand creation and awareness raising (many also in 8.3). As in item #2—it is time to focus on the true best bets, and, as in item #3—to professionalize this work;

• **Make Gender a true core value and strategy.** Legumes in many countries are principally associated with women (that is, until the profits roll in). TL II claimed it would be gender-sensitive—but at this point, attention to differential benefits is at the periphery of the project;

• **Expand beyond moisture stress per se- to address other production constraints in drought-prone zones, particularly associated with pests and diseases.** BSM, *Microphomina*, CBB, BCMV and Aphids (etc). are all important disease and pest constraints facing drought-prone zones. Lessening their effects can help stabilize and increase production;

• **Expand beyond varietal introductions- focus on fertilizer associated with specialized seed production.** Simply, soil fertility improvement is key for all zones, and especially stressed ones. N fixation, moderate use of P, manures (green and organic) might all be themes to pursue.
Objective 8: Developing sustainable cowpea seed production and delivery systems that will reach the poor in drought-prone areas of sub-Saharan Africa

AY Kamara, Z Kouyate, I Baoua, J Mshelia, MI Amane, D Dias, K Sibuga, J Mligo, HA Ajeigbe, L Omoigui, O Coulibaly, D Chikoye, S Boahen, and V Manyong

General

Low adoption of improved cowpea varieties is partly blamed on non-availability of seed because few companies are involved in the production and marketing of legume seeds like cowpea. Series of activities were carried out in the past two years to improve the delivery of cowpea seeds to resource-poor farmers in five countries in sub-Saharan Africa. The project is being implemented with diverse partners and institutions in Mali, Niger, Nigeria, Mozambique, and Tanzania where cowpea is a very important leguminous crop. The activities in this project are focused on making Foundation and Quality Assured/Certified Seed to farmers and other public-sector programs, with a focus on meeting the needs of the poor in drought-prone areas; designing, testing and implementing alternative seed-production arrangements which explicitly factor in cost and seed quality in relation to different clients’ needs; designing, testing and implementing alternative marketing and agro-enterprise arrangements to enhance seed business and seed delivery; enhancing local capacity to produce, deliver and market seed; and enhancing local-level awareness of released varieties so as to stimulate demand for improved seed.

At the commencement of the major activities, the project held a major planning workshop for all collaborators in the project countries to develop action plan for the implantation of the project.

In an effort to guide interventions aimed at promoting adoption of improved cowpea varieties among farmers, baseline surveys were conducted in the five countries to appraise the seed supply chain situation and prevalent seed systems. The reports were used to formulate strategies for Foundation seed production and cowpea seed supply system in the project countries.

More than 19 cowpea varieties and elite lines were selected from five countries for on-farm demonstration to enhance local-level awareness of released improved cowpea varieties and create demand for the use of improved varieties. The categories of these genotypes were: Striga/Alectra resistant, drought tolerance with diverse plant types and seed characteristics. Popularly grown local materials were also selected in each country for
comparison purpose. A research protocol was developed for the farmer-managed field test plot. Each farmer was given 2 to 3 improved cowpea varieties to compare alongside their own choice variety in a test plot size of 400 m² per variety. During the growth and development of the varieties and at harvest, farmers evaluated the varieties using their own selection criteria for several growth and post harvest economic traits. Well over 2000 demonstration plots have been established by September 2009 to popularize the potential of the improved cowpea varieties across the countries.

**Foundation seed production**

Foundation seed was produced by relevant institutions in various countries and supplied to community seed producers on cost-recovery basis. Community Seed Production Schemes were set up or encouraged to produce seed. A total of 40.63 tons of foundation seed of improved varieties of cowpea have been produced in the five countries in the last two years. These included 12.8 tons of in Nigeria, 10 tons in Mozambique, 8.4 tons in Tanzania, 5.77 tons in Niger, and 3.66 tons in Mali. These seeds have been distributed to seed companies, community seed producers and other relevant groups and organization for the production of Certified/Quality Assured Seed.

In the current reporting year, 4 ha of land were planted for Foundation Seed production by Seed Project Company, while IITA has over 1 ha of field for Foundation seed production in Nigeria. In Niger, INRAN, in collaboration with IITA, have planted over 4 ha, while a Dutch NGO, SNV, has made arrangements to also produce Foundation Seed of cowpea in the dry season.

**Production of Certified/Quality Assured Seed**

Considerable progress has been made in the production of Quality Certified/Assured Seed by community-based seed producers and seed companies in the various countries. A total of 152.98 tons of Certified/Quality Assured Seed has been produced and made available to farmers. This is made up of 107.7 tons of certified seeds of different cowpea varieties produced by November 2008 in Nigeria, 8.8 tons produced in Niger, 0.68 ton in Mali, 2.3 tons in Tanzania, and 33.5 tons in Mozambique.

**On-farm demonstrations**
Demonstration plots were established in all participating counties to popularize and showcase the performance of improved varieties to a large number of farmers. Each farmer was given two improved cowpea varieties, and in most cases one of the varieties was a *Striga*-resistant variety to compare alongside the farmer’s choice variety, in a plot of 400 m² per variety. Well over 2000 demonstration plots have been established by September 2009 to popularize the potential of the improved cowpea varieties across the five countries. It is clear that target set would be doubled before the end of the project. Twenty-six farmers’ field days and 11 mid-season evaluations were held in all the project countries to demonstrate to large numbers of farmers, other stakeholders and the general public the performances of the improved varieties and obtain feedback from farmers on the suitability of these varieties.

**Seed dissemination**

Large volumes of cowpea seed were distributed to farmers in small packs of 1 kg mini kit in all the participating countries. A total of 12.53 tons of improved cowpea varieties have been distributed to about 5000 farmers across the five countries. Over 30% of the beneficiaries were women farmers. About 5.681 tons of cowpea seed have been distributed to 3634 farmers in Nigeria and 800 kg to 1399 farmers in Niger Republic. In Mali, because of low production of Certified Seed of cowpea due to drought, 5 tons of farmer-preferred improved cowpea varieties were distributed to 2300 farmers in 1 kg packets; 1.05 tons were distributed to 545 farmers in Mozambique.

**Market linkages**

To ensure that seed producers have access to Foundation Seed and market outlet for the sales, they were linked to public institutions producing Foundation Seeds. They were also linked to small-scale input dealers and seed co-operatives for bulk sale of seeds. In Nigeria, 402 community seed producers identified have been linked to Premier Seed company, Jirkur Seed Cooperative, State Agricultural Development Project, Seed Project Company, and Grand Cereals Company in Jos. As a result of the additional market outlet, the seed producers expanded production and substantial quantities of certified seeds were sold. In Niger Republic, 22 community seed producers have been linked to INRAN, DRDA, DDA, and FUMA Seed Farmers’ group for the purchase of seed and distribution to other areas. These linkages resulted in the sales of 3.6 tons of improved cowpea varieties in small packs through inputs dealer shops and cooperative stores. In Mozambique, 121 seed growers identified in 15 communities of Zambezia
and Nampula provinces were linked to seed co-operatives and the national Agricultural Research Institute (IIAM). This resulted in the sale of over 33 tons of Quality Assured Seeds have been sold to farmers.

Training

Good progress has been made in the area of training of farmers, extension agents and technicians. The training sessions were conducted on standard field plot techniques, participatory extension methods, proper management of cowpea seed plots, seed segregation, standard, processing, storage, packing with appropriate labeling, and marketing. The skill acquired by farmers/seed producers during the exercise is expected to enhance their capacity in the production of high quality seed, seed quality control measures, and use of appropriate storage facility and packaging materials for seed distribution. More than 4000 individuals have been trained in several aspects of seed production and marketing across the five countries, over. This included a total of 2571 in Nigeria; 1522 farmers in Mozambique, 313 farmers and 56 extension personnel in Niger; 90 farmers and 10 extension agents in Mali; and 354 farmers and 9 extension workers in Tanzania.

Two postgraduate students (Mr. Habou Aboubacar from INRAN Research Station, Niger Republic, and Mr. Guilhermino Boina from Mozambique) are pursuing their MSc degree studies in seed systems.

Infrastructure development

One medium size seed store/warehouse each for Mali and Niger has been refurbished to store foundation seed for the project as well as seeds produced by farmers and partners. In Mozambique, air conditioners have been installed in a seed store to improve seed storage at IIAM in Nampula. In Nigeria and Tanzania, laboratory equipment has been procured to enhance seed testing in the seed laboratories.

Lessons learnt

Collaborating institutions have different capacities to implement project activities, leading to delays in submitting reports. Well structured regional planning meetings provided the collaborators the opportunity to understand procedures for better implementation of project activities. Frequent monitoring visits improved implementation of project activities in the participating countries. Linking farmers to markets will be critical, as this is the biggest concern among the seed producers. Progress was made in all countries real in production and popularization of improved cowpea seed.
To drive production further and increase adoption, efforts should be made to link seed producers and other farmers to the market. The involvement of more seed companies, NGOs and institutions has enhanced the implementation of the project activities.
Objective 8: Developing sustainable soybean seed production and delivery systems that will reach the poor in drought-prone areas of sub-Saharan Africa

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General

Soybean is emerging as an important food, feed as well as raw material for producing high quality protein products, which is currently grown on 1.5 million ha in Africa. The crop can be successfully grown in many areas using low agricultural inputs. Soybean cultivation in Africa has expanded as a result of its nutritive and economic importance and diverse domestic usage. Soybean has an average protein content of 40% and is more protein-rich than any of the common vegetable food sources. Soybean production is constrained by non availability of improved cultivars. A number of improved high-yielding soybean varieties have been developed but these have not reached many farmers. The major impediments in soybean adoption in sub-Saharan Africa are lack of awareness on processing and utilization, low yield, lack of market linkage with processors and consumers, weak policy support, lack of high quality seed, and low product prices. This project is making efforts to address these issues based on the experience of IITA in West Africa and that of TSBF-CIAT in western Kenya. It is believed that soybean production will increase as more farmers become aware of the potential of the crop through enhanced seed delivery systems.

Methodology

In an effort to guide interventions aimed at promoting the adoption of improved soybean varieties among farmers, baseline surveys were conducted in five countries to appraise the seed supply chain situation and prevalent seed systems. The reports were used to formulate strategies for foundation and certified seed production in the project countries. Several improved soybean varieties and elite lines were selected from the project countries for on-farm demonstration to enhance local level awareness of released improved soybean varieties to create demand. Each farmer was given two to three improved soybean varieties to compare alongside their own choice in a test plot size of 400 m² per variety.
In order to ensure availability of quality seeds to farmers, Foundation Seed was produced by relevant institutions in the five countries and supplied to community seed producers on cost-recovery basis. Community Seed Production Schemes were set up or encouraged to produce seed. In an effort to further promote community seed production among seed growers, series of meetings were held in various countries to link participating seed growers in each country with private seed companies. Awareness creation on soybean processing, packaging and marketing was carried out through training workshops and meetings with stakeholders like farmer groups in all the five participating countries.

**Foundation Seed production**

A total of 59.5 tons of foundation seed of improved varieties of soybean has been produced in the last two years for sale to community seed producers. This was made up of 18.7 tons in Nigeria, 15 tons in Kenya, 14.8 tons in Mozambique, nine tons in Malawi, and two tons in Tanzania.

**Certified/Quality Assured Seed production**

A total of 254 tons of certified/quality assured seed was produced in four of the participating countries. This comprised of 163 tons in Mozambique, 50 in Nigeria, 23 tons produced in Kenya and 18 tons in Tanzania.

**Training farming communities**

A number of training activities were carried out in the project countries with respect to seed production technologies; farmers’ participatory variety selection; field plot techniques; seed segregation and standard; storage processing and utilization; and marketing. A total of 1722 farmers comprising of 480 farmers including 128 women in Nigeria, 660 farmers of which 26% were women in Kenya, and 582 farmers of which 35% were women in Mozambique were trained.

**On-farm demonstration**

A total of 1354 demonstration plots were successfully established in the last two years across the participating countries to showcase the potential of high yielding and particularly early-maturing varieties. This is composed of 191 demonstrations in Nigeria, 600 in Kenya, 140 in Malawi, and 423 demonstrations in Mozambique.
Market linkage

Considerable progress has been made in market linkages. In Nigeria, two seed companies and a seed cooperative are involved in producing and selling seeds of soybean. These are Premier Seeds Nigeria Ltd, Project Seed Co. Nigeria Ltd (Seed companies) and Jirkur Seed Co-operative. These companies have been linked to the community seed producers since December 2008 for purchase and processing of certified seeds. Two additional seed companies (Masalha Seeds Nigeria Ltd and Alheri Seeds Nigeria Ltd.) have been linked to community seed producers for purchase of seeds in 2009 and a processing company (Grand Cereal Nigeria Limited, Jos) has also been contacted for grain purchase.

In Kenya, farmers have also been able to sell huge quantities of soybean seeds to NGOs and other development organizations such as BIDCO through linkages by the project. In Malawi, consultations are under way with Seed Trade Association of Malawi (STAM) and non-governmental organizations such as Concern Universal and community-based associations such as the Grain and Legumes Association (GALA) and the Association of Smallholder Seed Multiplication Action Group (ASSMAG) to package and sell soybean seeds through a network of seed dealers.

In Mozambique, IKURU identified 207 (134 males, 73 females) seed growers from seven communities in Zambezia and Nampula provinces and linked them to Malonda Foundation in Niassa province this growing season. IIAM linked 27 (21 males, 6 females) seed growers in four communities to two seed companies, Semente Perfeita and Qualita in Manica province. CLUSA has been linked to a group of emerging farmers [166 (130 males, 36 females)] who produce seeds for sale to CLUSA.

Use of market-friendly strategies for the delivery of soybean seed

Progress has been made in designing and testing of market-friendly strategies for soybean seed delivery. In Nigeria, seed cooperatives and seed companies have started packaging and selling their seeds to the communities in 2, 5 and 10 kg packs which is affordable to all categories of farmers. This approach has been followed in other countries while in Kenya seeds are being packaged for as low as 200 to 500 g 1 to 5 kg and packs. In Mozambique, seeds are being sold in packages of 10, 20 and 25 kg.

Lessons learnt

Well structured regional planning meetings provided the collaborators the opportunity to understand procedures for better implementation of project
activities. Frequent monitoring visits improved implementation of project activities in the participating countries. Linking farmers to markets will be critical, as this is the biggest concern among the seed producers. Progress was made in all countries, real progress was made in production and popularization of improved cowpea and soybean seeds. To drive production further and increase adoption, efforts should be made to link seed producers and other farmers to the markets. The involvement of more seed companies and other NGO’s and institutions has enhanced the implementation of the project activities. The project should also consider addressing crop management strategies that could better exploit the potential of improved soybean varieties.
Maximal rates of $N_2$-fixation recorded in the tropics reach an astonishing 5 kg N ha$^{-1}$ day$^{-1}$. We have measured more than 250 kg N ha$^{-1}$ of fixed $N_2$ in soyabean in southern Africa with associated grain yields of more than 4 t ha$^{-1}$. But often less than 5 kg N ha$^{-1}$ year$^{-1}$ is fixed by grain, forage and tree legumes when considered at farm scale in African smallholder systems. This is due to the small area cultivated with legumes in the farming systems and environmental stresses that prevent effective $N_2$-fixation. Increase of inputs from nitrogen fixation is required to achieve the increases in productivity required as part of the African green revolution that currently is gaining momentum. This paper will discuss priorities for a new research and development initiative designed to stimulate nitrogen fixation in African smallholder farming that enhance agricultural productivity in the short term.

Successful $N_2$-fixation by legumes in the field depends on the interaction:

\[(G_L \cdot G_R) \cdot E \cdot M\]

that is, (legume genotype $\cdot$ rhizobium genotype) $\cdot$ environment $\cdot$ management. Environment encompasses climate (temperature, rainfall, daylength etc) and soil stresses (acidity, aluminium toxicity, limiting nutrients etc). Management includes aspects of agronomic management (use of mineral fertilizers, sowing dates, plant density, weeding). Although much research is focused on identifying best combinations of $G_L$ and $G_R$, the E and M factors often override the potential of the legume/rhizobium symbiosis for $N_2$-fixation. Attention will be focused on identifying new socioecological niches for fitting grain, forage and tree legumes into existing farming systems, and the conditions necessary to achieve successful nitrogen fixation.

The expected project outcomes will be:

- Diversification of N2-fixing legume species that are integrated into smallholder farming systems in sub-Saharan Africa;
- Expansion in cultivation of grain and forage legumes, greater productivity in legume-based farming systems, and enhanced family incomes;
• Selection of efficient rhizobial inoculant strains and improved grain legume varieties with enhanced BNF capacities adapted to various environmental stresses;
• Establishment of a state-of-the-art laboratory and culture collection of elite strains of rhizobia for target legumes; and
• Establishment of rhizobial inoculant production in countries of West, East and Southern Africa, through partnership with the private sector.

The project vision of success is to raise average grain legumes yields by 954 kg/ha in four legumes (groundnut, cowpea, soybean, and common bean), increase average biological nitrogen fixation (BNF) by 46 kg/ha, and increase average household income by $465, directly benefiting 225,000 households (1,800,000 individuals) in eight countries in sub-Saharan Africa (DRC, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda, Zimbabwe). This project links the protein and nitrogen needs of poor African farmers directly to previously inaccessible, massive atmospheric reserves, provides them with new income-generating crop production enterprises, presents a mechanism of renewable soil fertility management and opens the door to the adoption of numerous, profitable accompanying farm technologies and value-adding enterprises. The total investment is $19.2 million, 84% of which promotes four grain (and forage) legumes among African farmers and the remainder is directed toward human capacity building and infrastructure improvement.
Paper #23

The West Africa Seed Alliance (WASA) and the Eastern and Southern Africa Seed Alliance (ESASA)

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Abstract

In West Africa there are very few established seed companies - defined as an individual or group of individuals that are willing to produce and market high quality seed under their own responsibility (Cortes, pers. comm.) - and no multinational seed companies with an established presence. There is trade in improved seed but this is largely restricted to vegetable seed and not in field crops where farmers grow local landraces, and some improved varieties that have been promoted by non-governmental organizations, research institutions, and governments themselves. In contrast there are several established seed producers’ associations that have received training in seed production, but these are dependent on NGOs and governments to buy their seed that is then distributed directly to farmers usually for free or at subsidized prices.

Commercial distribution channels for seed and complementary inputs like fertilizer and pesticides are underdeveloped and those that exist are concentrated in urban centers and are not easily accessible to rural producers. Input suppliers are not trained in safe handling procedures and are not able to provide customers with detailed information on the products they market. In some countries sales of fake seed are common.

Research has shown that the development of a commercial seed industry requires that there is a regular demand for seed. To stimulate demand, improved seed has to be differentiated from own-saved seed and locally available seed in grain markets. The introduction of hybrids is a strong incentive for commercial seed companies because of the yield and quality reduction that occurs from seed recycling. In West Africa public breeding programs are only now beginning to develop hybrid cereals, and most farmers have never been exposed to the hybrid technology. The benefits of improved varieties including non-hybrids are also not well known by farmers as much of the seed presently distributed to farmers is of poor genetic and even physiological quality. Small-scale demonstrations have proven that there is a demand for improved quality seed but attempts to scale-up dissemination are compromised because of poor varietal maintenance and non-commercial approaches to seed marketing.

WASA was launched in mid-October 2007 with the goal of establishing a
sustainable commercial seed industry capable of ensuring that small-scale farmers have affordable, timely and reliable access to adapted genetics and traits in high quality seeds and planting materials; playing a leading role in the growth and development of viable agricultural inputs systems; supporting the overall growth of the West Africa agricultural sector; and improving the agricultural enabling environment.

WASA is working towards this goal in four ways. By providing technical support and business development services to existing seed companies, entrepreneurs interested to establish seed companies, to agro dealers, and by improving the enabling environment that will facilitate seed trade by all parties. WASA is contributing to the development of an enabling seed policy environment by providing technical support to the 15 ECOWAS countries plus Chad and Mauritania – that are members of CILSS – in seed trade harmonization. This support is focused on the establishment of a regional variety release system and a regional seed catalogue, the development of regional seed certification standards and accreditation, and plant quarantine pests list based on science supported by seed import/export manuals.

WASA is working at regional level (ECOWAS) on seed trade harmonization, and at national level on seed sector development. Eight countries are currently included; Benin, Burkina Faso, Ghana, Mali, Nigeria, Niger, Senegal and Togo, but WASA is open to expanding support subject to the availability of adequate resources, and where there is expressed demand from the commercial seed sector and political support for the establishment/strengthening of a commercial seed sector.

A regional technical team comprising of a Senior Seed Production Specialist, a Senior Agribusiness Adviser, a Senior Advisor on Public Partnerships and Seed Policy, and a Program Coordinator has been established in Bamako, Mali, which provides technical support to established country teams that include seed and agri-business specialists.

WASA was developed under the framework of the USAID Global Development Alliance and brings together USAID (USAID West Africa, and bilateral missions from Ghana, Mali, Nigeria, and Senegal), the Alliance for a Green Revolution in Africa (AGRA), Monsanto, and Pioneer as resource partners. Resources from USAID are channeled to WASA through a cooperative agreement with ICRISAT that includes CNFA, Inc., and the Seed Science Center at Iowa State University as implementing partners. The resources from the two commercial seed companies are channeled to the alliance through the African Seed Trade Association (AFSTA), which has recently established a regional office in Bamako, Mali. The alliance is governed by a steering committee made up of representatives of the
resource partners, and a full time WASA coordinator is in the process of being recruited whose responsibilities will include being the executive secretary of the steering committee, to further expand the alliance, and to develop and implement a monitoring and evaluation plan that will include tracking resource flows committed to the alliance.

In eastern and southern Africa the development of the seed sector is more advanced than in West Africa, and greater emphasis is being given to reinforcing the role of the private sector, and strengthening the national seed trade associations that are playing an increasingly important advocacy role. AFSTA is spearheading this work and has signed a memorandum of understanding with the Common Market for Eastern and southern Africa (COMESA) to expand on the seed trade harmonization agreements already developed and approved by the Southern Africa Development Community (SADC).
Closing Remarks

Giving tropical legumes their due place under the sun

William D Dar, Director General, ICRISAT

His Excellency Agathane Ag Alassane, Minister of Agriculture, Mali; Dr Christian Fatokun, representing the DDG-R, International Institute of Tropical Agriculture; Dr Joe Tohme, representing the DDG-R, International Centre for Tropical Agriculture; and Dr David Bergvinson, Senior Program Officer, the Bill & Melinda Gates Foundation; Objective Coordinators, Principal Investigators, scientists, and ladies and gentlemen, good morning and welcome to the Tropical Legumes II (TL II) second annual review and planning meeting.

First of all, please accept my apologies for not being able to participate from the very beginning of this important meeting because of other urgent commitments that needed my attention over the last three days.

During the last few years, we have seen unparalleled changes in the global community and financial markets. Unprecedented global economic expansion led to growth

in the world’s most populous developing countries.

Rising incomes guided skyrocketing demand for energy, livestock products, and feed grains. Food needs too rose to record levels. The negative impact of these events fell more severely on the urban and rural poor living in the low-income countries of the semi-arid tropics. Today, smallholder and subsistence farmers are facing a much more risky world.

Together with anticipated population increases, the recent food price spikes, disruptions of financial markets and economic stagnation, energy demands, and effects of climate change are creating the perfect storm, and are challenging the food security scenario.

Considering the role of agriculture in social and economic progress and the vulnerability of agricultural systems to the impacts of climate change, a renewed agenda for agricultural research, more aggressive investments in and better management of agricultural research and knowledge will go a long way towards improving the productivity and production of food crops.

In this context, the TL II project’s goal to bring about significant improvements in the productivity and production of crops and hence improve the food security, nutrition quality, and income of small farmers in the drought-prone

1 Presented by Dr. David Hoisington, DDG-R, ICRISAT, on behalf of Dr. William D Dar
areas of sub-Saharan Africa and South Asia is unique.

The project involves three international agricultural research centers, nine countries, and eight objectives. It envisages that the productivity and production of tropical legumes would increase by 15%; some 30% of the area planted to these crops would be covered with improved varieties; and approximately 57 million poor farmers would benefit from it within 10 years.

During its two-year period, nearly 100 institutions and 300 scientists, technicians, extension personnel, seed producers, agro-dealers, and policy makers, among others, have worked in synergy. I am truly encouraged that the team has achieved all the milestones it set for itself and beyond.

The targeting team has given us situation and outlook analyses, highlighting production, trade, consumption, utilization trends and future projections.

It is rather encouraging to see that some 130 varieties/advanced lines with farmer- and market-preferred traits have been identified across the nine project countries and advanced for further testing under state and national trials or recommended for release. Nine groundnut varieties have been recommended for release in Tanzania (5), Mozambique (3) and Malawi (1). The launching of the world’s first CMS-based commercial pigeonpea hybrid ICPH 2671 was a major milestone in India.

Coming to the seed systems objective, diverse seed production models identified during the first year have been refined. Variations in seed delivery and awareness raising models are also being tested across target countries. The production of over 3500 metric tons of various categories of seed and use of small seed packets have been catalyzed.

Coming to capacity building, training sessions lasting up to 30 days for all partners in the tropical legumes value chain have been carried out.

The project has led to the building of a strong partnership base and trust between farmers and researchers/development agents. A good number of technologies are in the pipeline. There has been an extensive use of participatory variety selection, training and demonstration. More importantly, it has generated a strong will among many governments to improve the performance of tropical legumes and other agricultural commodities.

We have learnt a few lessons along the way. We realize that member NARS’ variable capacity necessitates different approaches of support to different countries. Our development approach has internalized that African farming systems are system-based rather than commodity-based. The need to strengthen crop management and post-harvest technologies is also being
addressed.

With the continued vigor and enthusiasm shown by the TL II team, these results have great potential to bring about significant improvements in the productivity and production of TL II crops. This is just the beginning. The knowledge gained so far has to be put to good use on a wider scale.

The goal of developing a sustainable system for tropical legumes can be achieved, for which I seek your support. A speedy variety release procedure is essential to get the promising varieties out to the farmers. Donor support would be crucial to expand the use of improved technologies on a wider scale.

Finally, allow me to extend our gratitude to those who helped TL II become a reality. This project would not have been a success without the generous funding support of the Bill & Melinda Gates Foundation (BMGF) and that of Dr David Bergvinson, our senior program officer. I am very grateful to the Advisory Board members for overseeing the project’s progress; the Government of Mali for hosting us; the scientists who worked hard to ensure the project’s success; and to the organizing committee of this meeting, Dr Bonny Ntare and his team.

Thank you.
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