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International Institute of Tropical Agriculture
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Mission statement

IITA, with its national partners, aims to enhance the food security, income, and well-being of resource-poor people in sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources.

Mission

Ensemble avec ses partenaires nationaux, l'IITA s'efforce d'accroître la sécurité alimentaire et d'améliorer les revenus ainsi que le bien-être des populations démunies de l'Afrique subsaharienne, et ce grâce à la recherche et aux activités connexes visant à augmenter la production agricole, améliorer les systèmes alimentaires et gérer de façon durable les ressources naturelles.

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Start by crawling

The story of Dorothy Kabuye and the women experts of Vvumba

It's difficult to imagine what Dorothy Kabuye and her friends in Vvumba, central Uganda have lived through during the past 15 years. They have been eyewitnesses to war, brutality, poverty, near starvation and now, thankfully, some prosperity. Their perseverance and tenacity in the face of terrible adversity provides a lesson for all who work in the developing world.

"This area has seen many wars, torture, over the years," she says. "People were displaced, could not farm. They ran for their lives."

For years under successive, repressive regimes and civil war Dorothy Kabuye and her family faced unspeakable hardship. They were farmers and during the awful strife maintaining a home was difficult, keeping the farm going impossible.

Cassava was the main crop for farmers in her district. It was more than a subsistence crop. They sold it in the market for cash. But with civil war no one could farm and what cassava survived was not harvested.

When the war ended and stability began to return to Uganda, the people of Vvumba village settled back to what they expected would be a happy recovery with profits from cassava farming again giving them the kind of life they had hoped for—not an easy life but a decent one. It was not to be. What war had started, nature itself completed. Tears come to Dorothy's eyes as she recalls what happened.

"Then in the 1990s the mosaic disease came and took all our cassava away. It made us very poor. Our children couldn't go to school. My children had to drop out. I have painful memories of that time."

The farmers in her village were at a loss. They faced ruin, even starvation. The devastation which came from a new virus, now called *East African Cassava Mosaic Virus*–Uganda Variant (EACMV-Ug), was total. Carried from plant to plant by the tiny whitefly, the mosaic virus moved in a front that destroyed all the cassava in its path. At the time, the farmers didn't know the cause of the problem, speculating among themselves that it was due to air pollution. For the women of Vvumba it was more than the loss of food. The impact on family stability was severe.

"Women normally don't ask their husbands for money, but had to do it. Our husbands got tired of us." Dorothy recounts.

She and other women began to talk about forming a group that might be able to take action. Starting with just a few they decided to mobilize others, going house to house, recruiting members. They faced stiff opposition from many husbands who had seen women's groups collapse in the past, with the membership fees disappearing as well. But Dorothy and her friends persevered, often going on their hands and knees begging. It was not easy but they eventually had 37 members.

Soon rumors spread through the village that people had seen cassava that was not affected by the mosaic disease at the Uganda National Agricultural Research Organization's (NARO) station at Namulonge, just 20 km to the south. This was the first cassava mosaic resistant material that had originally come to Uganda from IITA's headquarters in Nigeria. In a bold move the women decided, albeit

D'abord marcher à quatre pattes

L'histoire de Dorothy Kabuye et des femmes experts de Vvumba

Il est difficile de s'imaginer ce que Dorothy Kabuye et ses amies de Vvumba, au centre de l'Ouganda, ont vécu ces quinze dernières années: la guerre, la brutalité, la pauvreté, la faim; et grâce à Dieu, un peu de prospérité à présent. Leur persévérance et ténacité devant une adversité épouvantable offrent une leçon à tous ceux qui travaillent dans les pays en développement.

« Cet endroit a connu beaucoup de guerres et de tortures au fil des ans » déclare-t-elle. « Les gens ont été déplacés, et ne pouvaient donc cultiver. Ils courent cherchant à sauver leur vie ».

Des années durant, sous des régimes répressifs successifs et la guerre civile, Dorothy Kabuye et sa famille ont vécu des misères indicibles. C'était des cultivateurs, et au milieu de ces conflits atroces, il était difficile d'entretenir une famille et impossible de poursuivre les activités champêtres.

Le manioc était la culture la plus répandue dans son district. C'était plus qu'une culture de subsistance. Il était vendu au marché pour de l'argent liquide. Mais avec la guerre civile, nul ne pouvait cultiver et le peu de manioc survivant n'était pas récolté.

A la fin de la guerre, alors que la stabilité revenait peu à peu en Ouganda, les populations du village de Vvumba commençaient à espérer un heureux retour des profits générés par la culture du manioc, et donc les conditions de vie auxquelles elles aspiraient, pas une vie facile mais une vie décente. Mais point n'y fit. Ce que la guerre a entamé, la nature elle-même devait achever. Dorothy ne put retenir ses larmes devant ces souvenirs.

« Puis dans les années 1990, la maladie de la mosaïque arrive et ravage tout notre manioc. Elle nous a rendues très pauvres. Nos enfants ne pouvaient plus aller à l'école. Les miens ont dû abandonner. J'en garde des souvenirs très douloureux ».

Les agriculteurs de son village ne savaient plus à quel saint se vouer, confrontés qu'ils étaient à la ruine, voire la famine. La dévastation provoquée par un nouveau virus appelé EACMV-Ug (*East African Cassava Mosaic Virus*–Uganda Variant) fut totale. Transporté d'un plant à un autre par une petite mouche blanche, le virus de la mosaïque s'est déplacé en front détruisant ainsi tout le manioc sur son passage. A cette époque, les paysans ignorant la cause du mal se lançaient dans des conjectures et culpabilisaient la pollution atmosphérique. Pour les femmes de Vvumba, c'était plus qu'une crise alimentaire, car graves en étaient les conséquences pour la stabilité familiale.

« D'habitude, les femmes ne demandent pas de l'argent à leurs maris, mais elles devaient le faire. Nos maris se sont lassés de nous » raconte Dorothy.

Elle et d'autres femmes ont commencé à parler de la formation d'un groupe qui pourrait entreprendre des actions. En petit nombre au départ, elles ont décidé de mobiliser et de recruter d'autres membres en faisant du porte-à-porte. Elles rencontrèrent une opposition farouche de la part d'un grand nombre de leurs maris qui ont vu des groupements féminins s'effondre avec les cotisations. Mais Dorothy et ses amies ont persévéré, adoptant souvent des attitudes de mendiants. Ce n'était guère facile mais le groupe a finalement atteint 37 membres.

Très tôt, des bruits ont commencé à courir dans le village faisant état de manioc exempt de mosaïque que certains auraient vu à la station de l'Organisation nationale de la recherche agricole

Dorothy Kabuye is proud of her improved cassava –
Dorothy Kabuye est fière de son manioc amélioré

with great trepidation, to go to the research station to find out if it could help them.

"We thought it would not be easy for the learned to mix with the unlearned," says Dorothy. "But what we thought was not what we saw. We were welcomed."

The group that marched on Namulonge went away with resistant cassava cuttings to distribute among their now 57 members. "We treasured them," Dorothy recalls.

The women became regular visitors to Namulonge. Uganda's national agricultural research program helped train them and soon they were participating in trials of Nigerian yams from IITA as well as cassava. They learned high density planting techniques and other innovative ways to improve their crops.

"With cassava we always planted 3 meters apart but the scientists told us we could grow meter by meter and still avoid tangles. We went from 250 stands per acre to more than 4000."

It was during this time that the Government of Uganda invited IITA to establish a formal research station in East Africa to continue the cassava work and to launch a program to restore the productivity of African Highland bananas. Over the years, diseases and pests had reduced their yields by half. The Sendusa research station, adjacent to and sharing facilities with Namulonge, was the result and ESARC—IITA's Eastern and Southern Africa Research Center was born.

Today, Dorothy's group participates in many initial trials and selections at the station. Twenty members, people Dorothy calls the "experts group", come onto the station right at the beginning of new cassava breeding work.

"So we became the researchers, involved in trials because we know what we want," she says. "We work hand in hand with researchers, we are researching with them."

de l'Ouganda (NARO) à Namulonge, à vingt kilomètres en allant vers le sud. Ce fut le tout premier matériel de manioc résistant à la mosaïque venu du siège de l'IITA au Nigeria. Audacieuses qu'elles étaient, les femmes décidèrent, quoique avec beaucoup d'inquiétude, de se rendre à la station de recherche pour demander de l'aide.

« Nous avions pensé que les savants auraient du mal à se mélanger avec les ignorants que nous étions » déclare Dorothy. « Mais nous avions tort, nous étions chaleureusement accueillies ».

Le groupe qui a marché sur la station de Namulonge est reparti avec des boutures de manioc résistant à distribuer aux membres qui sont désormais au nombre de 57. « Nous les gardions précieusement » rappelle Dorothy .

De nos jours, les femmes visitent souvent la station de Namulonge. Le programme national de recherche agricole de l'Ouganda a aidé à les former et, dès lors elles participent à des essais sur des ignames du Nigeria et des variétés de manioc venant de l'IITA. Elles se sont familiarisées avec les techniques de plantation à forte densité et avec d'autres façons culturales novatrices.

« Nous avons toujours laissé une distance de 3 mètres entre deux pieds de manioc mais les chercheurs nous ont dit que nous pouvons planter à chaque mètre sans que les plants ne s'entremêlent. Alors nous sommes passées de 250 pieds par acre à plus de 4000 ».

C'est à cette époque que le gouvernement ougandais invita l'IITA à implanter une station de recherche en Afrique de l'Est pour poursuivre ses travaux sur le manioc et pour lancer un programme sur la restauration de la productivité des bananiers de hautes altitudes en Afrique. Au fil des ans, les maladies et les ravageurs ont réduit les rendements de moitié. La station de recherche de Sendusa qui jouxte celle de Namulonge dont elle partage les installations abrita ainsi le Centre de recherche d'Afrique orientale et australe de l'IITA (ESARC).

Aujourd'hui, le groupe de Dorothy participe à plusieurs sélections et essais initiaux en station. Vingt membres du groupe que Dorothy appelle « le groupe des experts » vont à la station dès que démarrent de nouveaux travaux de sélection sur le manioc.

Cassava profits will help repair Dorothy's house – Les profits générés par le manioc aideront à la réparation de la maison de Dorothy

The group measures germination rates and evaluates new clones at a very early stage for many of the traits they believe are essential for good cassava. That has helped immeasurably in improving the cassava breeding program, shortening the breeding cycle. In recognition of their efforts one of the official release varieties (NASE 12) is called "Vvumba".

The new varieties have changed the face of cassava fields in Uganda as the mosaic disease, the virulent EACMV-Ug, is now rarely seen. The women have more cassava than ever and are now looking to do more postharvest, value-added work to their harvests and to link better with markets through programs like FOODNET. And for the women of Vvumba there is another mission—to pass on their good fortune and their knowledge to others. They give clean planting material to non-members to help them out and most afternoons you will find Dorothy in the little school in Vvumba teaching children about the new ways she has learned to farm.

IITA is now applying the lessons of Vvumba to combat new outbreaks of EACMV-Ug in several central African countries, including the Democratic Republic of Congo, where hot spots of disease have appeared almost simultaneously in several parts of the country. In Nigeria, the precursors to the disease have been found and now IITA is embarking on an ambitious preemptive program to ensure the valuable Nigerian cassava crop does not suffer the fate of cassava in Uganda during the early years of the outbreak.

Dorothy Kabuye says her group had to start by crawling. They learned, and as they learned they grew. Today they are 280 members strong and include some men as well as women. Crawling works. As we now bring more of our research-for-development activities to southern Africa, where once again the need is so great, it is important to remember that IITA also started by crawling.

« Ainsi, nous sommes devenus des chercheurs impliqués dans les essais, car nous savons ce que nous voulons » dit-elle. « Nous travaillons la main dans la main avec les chercheurs, nous faisons la recherche ensemble ».

Le groupe apprécie la levée et évalue de nouveaux clones dès les premiers stades, pour bon nombre des caractéristiques qu'il juge essentielles pour une bonne variété de manioc. Ceci a énormé-ment aidé à améliorer le pro-gramme de sélection de manioc, en raccourcissant le cycle de sélection. En récompense de leurs efforts, l'une des variétés officiellement diffusées (NASE 12) a été baptisée « Vvumba ».

Les nouvelles variétés ont changé le visage des champs de manioc en Ouganda, la mosaïque du manioc, l'EACMV-Ug virulent, étant devenue une maladie rare. Les femmes récoltent plus de manioc qu'auparavant et voudraient s'intéresser davantage aux activités post-récolte pour valoriser leurs récoltes et établir de meilleurs liens avec les marchés, par le biais de programmes tels que FOODNET. Les femmes de Vvumba se sont assigné une autre mission: transmettre leur bonheur et leurs connaissances à d'autres personnes. Elles fournissent du matériel indemne aux non membres pour les aider et la plupart des après-midi, on voit Dorothy dans la petite école de Vvumba en train d'enseigner aux enfants les nouvelles pratiques culturales qu'elle a acquises.

L'IITA applique les leçons de Vvumba pour combattre les nouvelles attaques de l'EACMV-Ug dans plusieurs pays de l'Afrique centrale, y compris en République Démocratique du Congo où les points chauds de la maladie sont apparus presque au même moment dans plusieurs régions du pays. Au Nigeria, les symptômes précurseurs de la maladie ont été trouvés, et l'IITA se lance actuellement dans un ambitieux programme préventif afin d'assurer que le précieux manioc nigérian ne subisse le même sort que le manioc ougandais pendant les premières années de l'attaque.

Dorothy Kabuye raconte que son groupe a commencé en marchant à quatre pattes. Elles apprenaient, et en apprenant, elles grandissaient. Aujourd'hui, le groupe compte 280 membres y compris des hommes. On peut réussir en marchant à quatre pattes. Maintenant que nous transférons un plus grand nombre de nos activités de recherche-pour-le-développement en Afrique australe où les besoins sont à nouveau plus accentués, il importe de se souvenir que l'IITA aussi a commencé en marchant à quatre pattes.

Research highlights

A reorganized research agenda, same research priorities

In 2001, IITA reorganized its research-for-development programs to make their management more efficient. Instead of 14 separate projects, the research work has been grouped into six themes (called projects), each with a coordinator. Three follow the traditional research disciplines of IITA's former research divisions (Projects A, B, and C), three are multidisciplinary and based on the agroecoregional zones in which IITA works (Projects D, E, and F).

The following pages present highlights based on the new project portfolio.

Project A
Preserving and Enhancing Germplasm and Agrobiodiversity

Germplasm management

- A cowpea core collection (2078 accessions) was established from the world cowpea collection (> 15 000 accessions) at IITA; 133 yam accessions were added to the in vitro genebank; and the Bambara groundnut collection (1169 accessions) was rejuvenated.
- Genetic variation in Ugandan banana cv. Sukai Ndizi and the genetic diversity in East African highland bananas and their putative ancestors was established with DNA markers.

Genetics of key agronomic and quality traits

- Studies on the genetics of resistance to the cassava mosaic disease (CMD) in African cassava landraces showed that the additive gene effect was more important in predicting progeny performance. Data from F_1 progenies suggest polygenic inheritance of the trait.
- Analysis, through inductively coupled plasma (ICP) spectrophotometry, of kernels from 240 early-maturing varieties of maize grown at three sites showed variation in iron (16.9–20.7 mg/kg) and zinc (18.5–21.2 mg/kg) contents. Environmental, varietal, and variety x environment interaction effects were highly significant.
- Inheritance was elucidated for cowpea seed characteristics, plant pigmentation, flower color, pod color, photosensitivity, and resistance to *Ascochyta* blight.
- Multivariate statistical analysis of 56 quantitative and qualitative agrobotanical traits of 504 African landraces and 398 improved cultivars of cassava identified 12 cluster groups for the African landraces and nine for the improved germplasm. Twenty-two clusters were formed from the joint clustering of the African landraces and improved cassava germplasm.

Biotechnology tools for crop improvement and germplasm management

- Molecular markers were identified for important traits, e.g., DNA markers associated with quantitative trait loci (QTL) for resistance to the cowpea bruchid (*Callosobruchus maculatus*) (one of

Repères de la recherche à l'IITA

Nouvel agenda de recherches, mêmes priorités

En 2001, l'IITA réorganise ses programmes de recherche-pour-le-développement pour rendre leur gestion plus efficace. Au lieu de 14 projets séparés, les travaux de recherche ont été regroupés sous six thèmes (appelés projets), chaque projet ayant son coordonnateur. Trois projets s'alignent sur les thèmes traditionnels de recherche à l'IITA confiés aux anciennes divisions de recherche (Projets A, B, et C). Trois sont pluridisciplinaires et sont basées sur les zones agro-écologiques relevant du mandat de l'IITA (Projets D, E, et F).

Les pages suivantes présentent les points phares de la recherche sur la base du nouveau portefeuille de projets.

Projet A
Conservation et valorisation du matériel végétal et de l'agrobiodiversité

Gestion du matériel végétal

- Une collection de base du matériel de niébé (2078 obtentions) a été mise en place à partir de la collection mondiale de niébé (> 15 000 obtentions) à l'IITA; 133 obtentions d'ignames ont été ajoutées à la vitrothèque d'ignames; et la collection de voandzou (1169 obtentions) a été rajeunie.
- La variation génétique chez la banane ougandaise cv. Sukai Ndizi de même que la diversité génétique des bananes des hautes altitudes d'Afrique de l'Est et celle de leurs ancêtres putatifs, ont été établies à l'aide de marqueurs d'ADN.

Génétique de caractères agronomiques et qualitatifs clefs

- Des études sur la génétique de la résistance à la mosaïque du manioc (CMD) impliquant des cultivars locaux de manioc africain ont montré que l'effet de gène additif était plus déterminant dans la prédiction de la performance des descendants. Des données se rapportant aux populations F_1 suggèrent une transmission polygénique du caractère.
- Une analyse à l'ICP (inductively coupled plasma spectrophotometry) des graines de 240 variétés précoces de maïs cultivées sur trois sites a présenté une variation de la teneur en fer (16,9–20,7 mg/kg) et en zinc (18,5–21,2 mg/kg). Les effets environnementaux, variétaux et de l'interaction variété x environnement étaient hautement significatifs.
- L'héritage génétique a été élucidé en ce qui concerne les caractéristiques de la graine de niébé, la pigmentation, la couleur de la fleur, la couleur de la gousse, la photosensibilité, et la résistance à l'ascochytose.
- L'analyse statistique à plusieurs variables de 56 caractères agrobotaniques, quantitatifs et qualitatifs, chez 504 cultivars locaux africains et 398 cultivars améliorés de manioc a permis d'identifier 12 groupes de cultivars locaux africains et 9 groupes de cultivars améliorés. Vingt-deux groupes ont été formés en rassemblant cultivars locaux africains et matériel de manioc amélioré.

Outils biotechnologiques pour l'amélioration des cultures et la gestion de matériel végétal

- Des marqueurs moléculaires ont été identifiés pour des caractères importants ex: marqueurs d'ADN associés aux loci de traits quantitatifs (QTL) pour la résistance à la bruche du niébé (*Callosobruchus maculatus*) (l'un des QTL était responsable d'une variation de ce caractère atteignant 76%); les marqueurs SSR et AFLP associés à la résistance à

the QTL accounted for up to 76% of the variation for this trait); an SSR marker associated with resistance to CMD in cassava (accounting for 57.41% of the total phenotypic variation for the trait); SSR and AFLP markers associated with QTL affecting *Striga* damage symptom ratings and maize yield under *Striga* infestation; QTL for resistance to flower bud thrips detected at five regions of the cowpea genome that explained 76% of the variation for the trait.

- RAPD markers for resistance to virus (white yam) and anthracnose (water yam) and genetic linkage maps for white and water yams were published.
- Cowpea gene flow studies showed outcrossing (0.021%) 10 m from the marker line.

Source breeding populations and parental lines

- New sources of several important traits were identified, e.g., root knot nematode (*Meloidogyne incognita*) resistance in soybean; resistance to black sigatoka in the *Musa* Kikundi; pulp color, bunch characteristics, and nematode resistance in *Musa* germplasm from Papua New Guinea; resistance to major diseases, grain quality, and tolerance to specific abiotic stresses in cowpea; resistance to root rot in cassava; resistance to root knot and yam nematodes in *Dioscorea dumetorum*; tuber quality in white and water yams; drought tolerance, high β-carotene content and vitamin A equivalent, and resistance to *Striga* and *Aspergillus flavus* in maize.
- Improvement of broad-based and special trait populations continued for all mandate crops.

NARS capacity for crop improvement and germplasm management

- Seeds were delivered for international trials, e.g., 63 sets of regional uniform variety trials (RUVT) of maize and 41 of the regional *Striga* variety trials (early and extra-early maturity) to partners of West and Central Africa Collaborative Maize Research Network (WECAMAN); and 409 sets of cowpea trials to 105 partners in 24 countries. Based on results of 2001 RUVTs, 120 kg of seed of selected maize varieties were also delivered to NARS partners on request.
- IITA's Institutional Biosafety Committee (IBC) was inaugurated and a workshop was organized for would-be-members of national biosafety committees from five countries in West Africa.
- Several postgraduate students conducted thesis research on the mandate crops in germplasm management and crop improvement.

Project B
Developing Biological Control Options

- Mild strains of the pandemic-associated cassava mosaic virus, EACMV-Ug, were shown to provide a cross-protective effect against superinfection by severe strains of the same virus.
- Some 30 highland bananas and 20 plantain hybrids with improved resistance against the nematode *Radopholus similis* have been identified.
- The importance of organic mulching (particularly using the weed *Tithonia*) in improving crop production and suppressing nematode damage has been demonstrated in field trials.
- Aflatoxin management packages allowed a 30% reduction of aflatoxin contamination compared with traditional maize production practices in Bénin and Togo.
- The occurrence and spread of the gray leaf spot pathogen *Cercospora maydis* on experimental and farmers' maize fields in Plateau State and at Mokwa, Nigeria was confirmed. Similarly, widespread occurrence of soybean rust (*Phakopsora pachyrhizi*) has been confirmed at the IITA-Ibadan farm.

la CMD chez le manioc (responsable de 57,41% de la variation phénotypique totale du caractère); les marqueurs SSR et AFLP associés au QTL affectant l'évaluation des symptômes des dégâts causés par *Striga* et le rendement du maïs sous infestation de *Striga*. Des QTL pour la résistance aux thrips floricoles ont été détectés au niveau de cinq régions du génome de niébé, justifiant 76% de la variation de ce caractère.

- Les marqueurs RAPD liés à la résistance au virus (igname blanche) et à l'anthracnose (igname aqueuse) et les cartes de liaison génétique des ignames blanches et aqueuses ont été publiés.
- Des études sur le flux génomique du niébé ont révélé des cas d'exogamie (0,021%) 10 m par rapport à la lignée de référence.

Populations de sélection de départ et lignées parentales

- De nouvelles sources ont été identifiées pour plusieurs caractères importants; ex: la résistance au nématode à galle (*Meloidogyne incognita*) chez le soja; la résistance à la cercosporiose noire chez le cultivar *Musa* Kikundi; la couleur de la pulpe, les caractéristiques du régime et la résistance aux nématodes dans le matériel végétal *Musa* de la Papouasie Nouvelle-Guinée; la résistance aux principales maladies, la qualité de la graine, et la tolérance à des stress abiotiques spécifiques chez le niébé; la résistance à la pourriture racinaire chez le manioc; la résistance au nématode à galle et aux nématodes d'igname chez *Dioscorea dumetorum*; la qualité du tubercule de l'igname blanche et de l'igname aqueuse; la tolérance à la sécheresse, la teneur élevée en β-carotène et en équivalent vitamine A , et la résistance à *Striga* et *Aspergillus flavus* chez le maïs.
- L'amélioration des populations à base large et à traits spécifiques se poursuit pour toutes les cultures faisant l'objet de recherche à l'IITA.

Capacité des SNRA en matière d'amélioration végétale et de gestion du matériel végétal

- Des semences ont été livrées pour des essais internationaux; ex: 63 jeux d'essais RUVT sur le maïs et 41 des essais variétaux régionaux sur le *Striga* (matériel précoce et extra-précoce) ont été envoyés aux partenaires de WECAMAN; 409 jeux d'essais sur le niébé ont été livrés à 105 partenaires dans 24 pays. Sur la base des résultats des RUVT 2001, 120 kg de semences de variétés sélectionnées de maïs ont été également livrés sur demande aux partenaires des SNRA.
- Le Comité institutionnel sur la biosécurité (IBC) de l'IITA a été inauguré et un atelier a été organisé pour les futurs membres des comités nationaux de biosécurité de cinq pays d'Afrique de l'Ouest.
- Plusieurs étudiants ont effectué leurs thèses de doctorat en gestion du matériel végétal et en amélioration culturale sur des cultures relevant du mandat de l'IITA.

Project B
Mise au point d'options de lutte biologique

- Il a été démontré que des souches non virulentes du virus de la mosaïque du manioc associées à la pandémie, EACMV-Ug, ont un effet de protection croisée contre la surinfection par des souches sévères du même virus.
- Une trentaine d'espèces de bananier de haute altitude et 20 hybrides de plantain dotés d'une meilleure résistance au nématode *Radopholus similis* ont été identifiés.
- L'importance du paillage organique (en particulier à l'aide de l'adventice *Tithonia*) dans l'augmentation de la production culturale et l'élimination des dégâts dus aux nématodes a été démontrée dans des essais en plein champ.
- Des paquets de lutte contre l'aflatoxine ont permis une réduction de 30% de la contamination par rapport aux pratiques traditionnelles de maïsiculture au Bénin et au Togo.
- L'apparition et la propagation du pathogène de la cercosporiose grise, *Cercospora maydis*, dans des parcelles expérimentales et des exploitations paysannes de maïs, dans l'Etat du Plateau et à Mokwa (Nigeria) ont été

- Samples of *Beauveria bassiana* and *Metarhizium anisopliae* were found to be highly virulent to the cowpea bruchid in small experimental stores and also to laboratory populations of the pod bug (*Clavigralla tomentosicollis*) leading to complete control of these pests.
- The industrial production of Green Muscle™ (recently rated by FAO as environmentally safe and posing low risk to humans) against locusts and grasshoppers in West Africa has been demonstrated to be economically feasible at a price competitive with synthetic pesticides, and in Niger, farmers have started buying it in large quantities.
- Studies on the interactions between cassava cultivars and the exotic phytoseiid predator *Typhlodromalus aripo* in a range of agroecologies indicated that the predator's preference for cassava cultivars with large hairy apices is widespread. In greenhouse studies, *T. aripo* produced up to four times more offspring when exudates were available, boosting biological control of cassava green mite (*Mononychellus tanajoa*).
- Where *T. aripo* has persisted for two or more years in the field, cassava green mite (CGM) abundance has declined substantially and cassava yields have increased between 15 and 45%, and at times, up to 85% on varieties susceptible to cassava green mite damage and favorable for the predatory mites.
- Mango mealybug and spiralling whitefly infestations (checked in Bénin, Burkina Faso, and Côte d'Ivoire) were again generally low with a dry season peak particularly in big cities. In all samples, all exotic parasitoid species were common.
- The exotic thrips parasitoid *Ceranisus femoratus* was recently recovered 390 km north of the original experimental release site in southern Bénin, 1 1/2 years after the initial release, indicating faster spread than anticipated.
- The SP-IPM pilot site farmers gained a 20% increase in maize yields by integrating resistant varieties with habitat management against *Striga* and stemborers in Kenya; they also reduced *Striga* emergence by 63% by integrating resistant varieties and cropping patterns in northern Nigeria and resuscitated faba bean production in Egypt and Morocco through resistant varieties and improved agronomic practices against *Orobanche*.
- Over 70% of vegetable consumers in Ghana and Bénin are aware of potential health risks linked to the misuse of pesticides and are willing to pay up to 60% of the premium price for organically grown vegetables, whereas vegetable farmers are willing to pay 30–60% of the premium price for new biopesticides, which could increase expected incomes by at least 10% while decreasing health hazards and environment pollution.
- A total of 41 peer-reviewed journal articles and book chapters were published in 2002 by the 18 "core" project scientists.
- A research paper relating aflatoxin exposure to impaired child growth was published in the prestigious *British Medical Journal*.
- Faunistic surveys conducted in various ecological regions of Bénin, Cameroon, Ghana, Nigeria, and Togo, led to the preservation of more than 20 000 new specimens and enabled the IITA insect reference collection to be updated with 1000 newly identified species.

Project C
Impact, Policy, and System Analysis

- The impact of globalization on African agriculture shows that a few countries have experienced a positive real growth in gross domestic product in the last two decades. Highly competitive global markets and increases in the production of raw products led to about a 76% decline in commodity

confirmées. De même, une infestation répandue de la rouille du soja (*Phakopsora pachyrhizi*) a été confirmée dans les parcelles expérimentales de l'IITA à Ibadan.

- Des échantillons de *Beauveria bassiana* et *Metarhizium anisopliae* se sont avérés très virulents à la bruche du niébé dans de petits entrepôts expérimentaux, et aux populations de la punaise des gousses (*Clavigralla tomentosicollis*) élevées en laboratoire, ce qui a permis la maîtrise totale de ces ravageurs.
- La production industrielle du Muscle Vert™ (récemment jugé sans risque pour l'environnement et avec un faible risque pour l'homme) dans la lutte contre les criquets et les sauterelles en Afrique de l'Ouest, s'est avérée économiquement faisable à un prix compétitif par rapport à celui des pesticides synthétiques. Au Niger, les paysans en achètent déjà en grandes quantités.
- Des études sur les interactions entre les cultivars de manioc et le prédateur phytoséiide exotique *Typhlodromalus aripo* dans diverses agroécologies ont indiqué une préférence très répandue du prédateur pour des cultivars de manioc à apex large et pubescent. Dans des études conduites en serre, T. *aripo* a produit quatre fois plus de descendants en présence d'exsudats, ce qui a renforcé la lutte biologique contre l'acarien vert du manioc (*Mononychellus tanajoa*).
- Aux endroits où T. *aripo* a persisté pendant deux ans ou plus au champ, l'abondance de l'acarien vert du manioc (CGM) a considérablement baissé et les rendements de manioc ont augmenté de 15 à 45%, et parfois même jusqu'à 85% pour les variétés sensibles aux dégâts de l'acarien vert du manioc, donc favorables aux acariens prédateurs.
- Les infestations de la cochenille du manguier et des aleurodes à spirale (maîtrisées au Bénin, au Burkina Faso et en Côte d'Ivoire) étaient à nouveau généralement faibles avec une pointe de saison sèche, surtout dans les grandes villes. Dans tous les échantillons, toutes les espèces parasitoïdes exotiques étaient couramment rencontrées.
- Le parasitoïde exotique des thrips *Ceranisus femoratus* a été recouvré à 390 km au nord du site de lâchers dans le sud du Bénin, 1 an et demi après le lâcher, ce qui indique une progression plus rapide que prévue.
- Les paysans du site pilote SP-IPM ont enregistré une hausse de 20% du rendement de maïs, en combinant variétés résistantes et gestion de l'habitat dans la lutte contre le *Striga* et les foreuses de tiges au Kenya; ils ont réduit l'émergence du *Striga* de 63% en combinant variétés résistantes et assolement dans le nord du Nigeria; et réhabilité la production de fève en Egypte et au Maroc, grâce à l'utilisation de variétés résistantes et de pratiques agronomiques améliorées contre *Orobanche*.
- Plus de 70% des consommateurs de légumes au Ghana et au Bénin sont informés des risques éventuels pour la santé d'une mauvaise utilisation de pesticides et sont disposés à payer jusqu'à 60% du prix fort des légumes organiques. En revanche, les producteurs de légumes veulent payer entre 30 à 60% du prix fort des nouveaux produits biopesticides, ce qui pourrait augmenter les bénéfices attendus d'au moins 10%, tout en diminuant les risques pour la santé et l'environnement.
- Au total, 41 articles de revue révisés par les pairs et chapitres de livres ont été publiés en 2002 par les 18 principaux chercheurs des projets.
- Une communication scientifique établissant un lien entre l'exposition à l'aflatoxine et le retard de croissance chez l'enfant a été publiée dans la célèbre *British Medical Journal*.
- Des enquêtes faunistiques conduites dans diverses régions écologiques au Bénin, Cameroun, Ghana, Nigeria et Togo, ont permis de conserver plus de 20.000 nouveaux échantillons et de mettre à jour la collection entomologique de référence de l'IITA en y ajoutant 1000 espèces nouvellement identifiées.

Projet C
Impact, politique et analyse systémique

- L'étude de l'impact de la mondialisation sur l'agriculture en Afrique a montré que quelques pays ont enregistré une croissance réelle positive de leur produit intérieur brut au cours des deux dernières décennies. Des marchés mondiaux très compétitifs et des hausses de production de matières premières ont entraîné une chute d'environ

prices. Some of the interventions for African agriculture to become competitive and to benefit more from globalization are strengthening the capacity of countries in trade negotiations, stimulating the production of added-value products, diversifying exports, improving access to information technology, and increasing regional trade.

- The analysis of the urban food demand structure in the dry savanna of Nigeria shows that rice (imported and local) represents about 65% of the household expenditure for cereals, followed by maize (20%), sorghum (9%), and millet (6%). Cross-price elasticities indicate that maize is a substitute for sorghum and rice.
- The spatial and economic analysis of the fresh cassava supply in Yaoundé identified 15 urban markets where the product is being sold and 65 villages supplying the four main markets. Most of the villages are located within a traveling distance of 2–3 hours. These villages will be the major sites for further research and development actions.
- Aflatoxin contamination was detected in 99% of the serum samples from 200 children aged 18 to 36 months in Bénin. The contamination was higher in the southern Guinea savanna than in the coastal savanna. It increases from February to November in both zones. Contamination was also found in the samples of white maize, a staple in the study area. Stunting of growth in children, 40% on average, was higher in the aflatoxin high-exposure zone than in the low-exposure zone.
- The potential is high for the use of biopesticides for vegetable production because both producers (about 80% of 372 respondents in Ghana and Bénin) and consumers (70% of 220) are aware of the health risk from chemical pesticides. Farmers are willing to pay between 30 and 60% more as the price premium for yield increases of between 10 and 25%. Consumers are willing to pay 50% more as a price premium for cabbage and tomato free from chemical residues.
- A new scheme for small groups of farmers of between 5 and 10 people is proving successful in the four pilot states of the Rural Sector Enhancement Program (RUSEP) project in Nigeria. About 4300 farmers belong to 550 groups linked up with private seed companies, 960 with banking institutions, and 860 with tractor-hiring services for sustainable access to modern agricultural inputs. Similarly, RUSEP is facilitating the supply of raw materials by farmers' groups to agro-industries worth about US$2.7 million. This amounts to about a 20% increase in farmers' income and a 15% reduction in cost for the agro-industries.
- FOODNET continues to improve the market information systems in Uganda, including 2–3 broadcasts per week, and the use of a local SMS service provider to enable text messaging for 17 commodity prices to be available via mobile phone. Similarly, RUSEP is facilitating the broadcast of market information on 20 agricultural commodities in Nigeria through local radio and a website.
- About 100 entrepreneurs benefited from training on agro-enterprise and product development in Nigeria and Uganda.
- The economic analysis of legume fallow for soil fertility maintenance in yam production shows that intercropping yams with *Gliricidia sepium* is economically viable with a marginal rate of return of about 7% from a survey of 153 farmers in Bénin. Similarly, 65% of 631 survey farmers in Nigeria applied inorganic fertilizer to yam. The intensity of fertilizer application was higher for male farmers, those with large holdings, and those who produce crops for sale.
- Farmers' requests for seeds of herbaceous legumes show a sharp increase after only three years in eight villages of the derived savanna in Bénin (times 2.2) and northern Guinea savanna in Nigeria (times 7.6). The main driver is livestock feed for Nigeria and soil fertility improvement for Bénin.
- The profile of an ideal yam variety to guide breeding activities was constructed from an ex-ante adoption study on a sample of 1347 respondents located in the yam belt of Bénin, Côte d'Ivoire, Ghana, Nigeria, and Togo. Results from Nigeria (631 respondents), as an example, show differences in

76% des prix des produits de base. Certaines des interventions visant à rendre l'agriculture africaine compétitive et à tirer un meilleur profit de la mondialisation renforcent la capacité de négociation commerciale des pays, stimulent la génération de produits à valeur ajoutée, diversifient les exportations, améliorent l'accès à la technologie de l'information et augmentent les échanges régionaux.

- L'analyse de la structure de la demande alimentaire urbaine dans la zone de savane sèche au Nigeria a montré que le riz (importé et local) représente environ 65% des dépenses céréalières du ménage, suivi du maïs (20%), du sorgho (9%), et du mil (6%). L'élasticité croisée des prix indique que le maïs est un substitut valable pour le sorgho et le riz.
- L'analyse spatio-économique de l'offre de manioc frais à Yaoundé a permis d'identifier 15 marchés de vente urbaine et 65 villages qui approvisionnent les quatre marchés les plus importants. La plupart des villages sont situés à une distance de 2 à 3 heures par la route. Ces villages seront ciblés pour une recherche approfondie et des actions de développement.
- La contamination à l'aflatoxine a été détectée sur 99% des échantillons de sérum prélevés sur 200 enfants âgés de 18 à 36 mois en Bénin . Le niveau de contamination était plus élevé en savane sud-guinéenne qu'en savane côtière. Elle augmente de février à novembre dans les deux zones. La contamination a été également notée sur les échantillons de maïs blanc, aliment de base dans la zone d'étude. L'arrêt de croissance chez les enfants, en moyenne 40%, était plus marqué dans la zone à forte exposition à l'aflatoxine que dans la zone à faible exposition.
- Le potentiel d'adoption de biopesticides dans la production de légumes est élevé. En effet, les producteurs (environ 80% des répondants au Ghana et au Bénin) aussi bien que les consommateurs (70% de 220) sont bien au courant des risques pour la santé de l'emploi des pesticides. Les paysans sont disposés à payer un prix plus fort entre 30 et 25% pour des gains de productivité de 10% à 25%. Les consommateurs veulent bien payer un prix majoré de 50% pour des tomates et choux exempts de résidus de produits chimiques.
- Un nouveau plan pour de petits groupements paysans (de 5 à 10 personnes) remporte du succès dans les quatre Etats pilotes du projet RUSEP au Nigeria. A peu près 4300 exploitants agricoles appartiennent à 550 groupements liés à des sociétés semencières, 960 à des institutions bancaires, et 860 à des services qui louent des tracteurs pour promouvoir un accès durable aux intrants agricoles modernes. De même, RUSEP facilite l'approvisionnement des agro-industries en matières premières par les groupements paysans, à concurrence de 2,7 millions de dollars des Etats-Unis; ce qui représente environ 20% d'augmentation de revenus pour les paysans, et 15% de réduction de coûts pour les agro-industries.
- FOODNET continue d'améliorer les systèmes d'informations sur les marchés en Ouganda. Deux ou trois diffusions sont ainsi prévues chaque semaine en plus du recours à un fournisseur local d'accès SMS pour permettre la communication par téléphone mobile de messages en mode texte sur 17 prix de produits de base. De même, RUSEP facilite la diffusion, par la radio locale et le site Web, d'informations sur les marchés de 20 produits agricoles au Nigeria.
- Environ 100 entrepreneurs ont bénéficié d'une formation sur l'agro-entreprise et l'élaboration des produits au Nigeria et en Ouganda.
- Dans le cadre d'une enquête menée auprès de 153 agriculteurs en Bénin, l'analyse économique du rôle de la jachère à base de légumineuses dans le maintien de la fertilité du sol a montré que l'igname cultivée en association avec *Gliricidia sepium* est viable avec un taux marginal de rentabilité autour de sept. De même, 65% des 631 paysans enquêtés au Nigeria ont appliqué l'engrais inorganique à l'igname. L'intensité d'application de l'engrais était plus forte chez les exploitants agricoles de sexe masculin, les gros exploitants, et ceux qui cultivent pour la vente.
- Les demandes de semences de légumineuses herbacées enregistrèrent une hausse nette, après seulement trois ans, dans huit villages de la savane dérivée au Bénin (2,2 fois) et en savane nord-guinéenne au Nigeria (7,6 fois). La raison essentielle de cette hausse réside dans l'alimentation du bétail au Nigeria et l'amélioration de la fertilité du sol au Bénin.
- Le profil d'une variété idéale à cibler par les activités de sélection, a été élaboré à partir d'une étude d'adoption ex-ante portant sur un échantillon de 1347 répondants dans la ceinture d'igname au Bénin, en Côte d'Ivoire, au Ghana,

users' preferences for yam attributes for the three major identified yam products: pounded yam, boiled yam, and *amala*.

- High adoption rates of IITA technologies were recorded in the dry savannas of Nigeria. IITA maize (largely varieties Oba Super 1 and 2) was found in nine out of ten villages and accounted for more than 45% of the maize planted. Results for soybean (largely TGX1019-2EN and TGX1448-3E) were in eight out of ten villages and 44% of the area planted. Six years ago, soybean was mentioned in only two villages. Results for cowpea (largely IT93K452-1 and IT90K277-2) were in six out of ten villages and 26% of the area planted. In the forest zone of Cameroon, new cassava from IITA (largely 8034 and 8017) was grown in over 64% of the area planted to this crop from a sample of 320 households.
- A user-friendly procedure for annual project planning and management was developed and is available in the form of a CD-ROM. The procedure is based on a multicriteria scoring approach that IITA is developing for a more transparent and structured system for setting priorities within the Institute.
- Two international workshops were successfully organized, one in collaboration with the World Bank and the second with the CGIAR Systemwide Initiative on Malaria and Agriculture.

Project D
Starchy and Grain Staples in Eastern and Southern Africa

- Ninety stakeholders participated in a regional workshop to develop strategies for transforming the cassava subsector to assure food security, income generation, and economic growth in Eastern, Central, and Southern Africa. Participants identified opportunities within the food, feed, and industrial sectors with varying potentials across countries. Demand for feed was estimated at 535 000 t in Madagascar, 500 000 t in Kenya, and 18 750 t in Uganda. Constraints to industrial transformation included policy, grades and standards, marketing system, volume, prices, supply, production, processing and storage technologies, credit, market information and intelligence, and the lack of a private-sector led lobby group.
- FOODNET conducted market studies (46) that aimed to assist research institutes, international NGOs, governments, donors, and private-sector clients to gain a better understanding of their market opportunities and challenges on both a territorial and commodity-specific basis.
- Tools for monitoring and evaluating the business performance of processing equipment manufacturers have been developed with banks and microcredit institutions to assist in the scaling out process. In western Kenya, five processing units have been installed and tested to enhance and develop the income generating potential of cassava, and transform fresh roots into stable, market-grade, intermediate products.
- SARRNET brokered the involvement of an additional 20 industries within the SADC region in commercial cassava production and utilization from a base number of less than four in 1990. This has increased the industrial utilization of cassava from 8166 t in 2001 to 11 700 t in 2002. Farmers' associations have been established in pilot production and processing centers and linked to industrial users in Malawi (3) and Tanzania (2). A cassava business center has been created in Tanzania while a "Cassava Task Force" was inaugurated in Malawi.
- *Typhlodromalus aripo* is confirmed established since its release between 1995 and 1998 across different agroecologies in Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia. Impact surveys indicate a reduction in CGM populations and a 15–40% increase in storage root yields. The

au Nigeria et au Togo. Les résultats du Nigeria (631 répondants), par exemple, ont présenté des différences en termes de préférence des utilisateurs pour certaines caractéristiques d'igname chez les trois principaux produits à base d'igname identifiés: igname pilée, igname bouillie et *amala*.

- De forts taux d'adoption des technologies de l'IITA ont été enregistrés dans les zones de savane sèche au Nigeria. Le maïs mis au point par l'IITA (notamment les variétés Oba Super 1 et 2) a été retrouvé dans neuf villages sur dix et représentait plus de 45% du maïs semé. Les résultats relatifs au soja (essentiellement TGX1019-2EN et TGX1448-3E) concernaient huit villages sur dix et 44% des emblavures de soja. Il y a six ans, le soja n'avait été mentionné que dans deux villages. Pour le niébé, il s'agissait surtout de IT93K452-1 et IT90K277-2 dans six villages sur dix et 26% des emblavures de niébé. En zone forestière au Cameroun, de nouvelles variétés de manioc fournies par l'IITA (notamment 8034 et 8017) poussaient sur 64% des terres consacrées au manioc pour un échantillon de 320 ménages.
- Une procédure conviviale de planification et d'administration de projet, sur une base annuelle, a été élaborée et est disponible sous forme de CD-ROM. La procédure est basée sur une méthode d'évaluation multicritères que l'IITA élabore en vue de doter l'institut d'un système plus transparent et mieux structuré pour l'établissement des priorités.
- Deux ateliers internationaux ont été organisés avec succès, l'une en collaboration avec la Banque Mondiale et l'autre avec l'Initiative sur le Paludisme et l'Agriculture à l'échelle du système du GCRAI.

Projet D
Féculents et céréales alimentaires de base en Afrique orientale et australe

- Neuf parties prenantes ont pris part à un atelier régional afin d'élaborer des stratégies pour la transformation de la filière du manioc et, partant, d'assurer la sécurité alimentaire, la génération de revenus et la croissance économique en Afrique orientale, centrale et australe. Les participants ont identifié les opportunités potentielles existant dans les divers pays en matière alimentaire, fourragère et industrielle. La demande d'aliment de bétail était estimée à 535.000 t à Madagascar, 500.000 t au Kenya, et 18.750 t en Ouganda. Les contraintes liées à la transformation industrielle touchent aux aspects suivants: politiques, grades et normes, système de commercialisation, volume, prix, offre, production, technologies de transformation et de stockage, crédit, services d'informations et de renseignements sur les marchés, et besoin d'un groupe de pression conduit par le secteur privé.
- FOODNET a effectué des études de marché (46) visant à aider les instituts de recherche, les ONG internationales, les gouvernements, les bailleurs de fonds et les clients du secteur privé à mieux appréhender les opportunités de marché et les défis aussi bien sur une base territoriale que sous l'angle de produits.
- Des outils ont été mis au point, grâce au concours des banques et des institutions de micro-crédits, pour évaluer et suivre la performance en affaires des fabricants d'équipements de transformation et favoriser ainsi l'expansion du processus. Dans l'Ouest du Kenya, cinq unités de transformation ont été installées et testées pour valoriser et développer le potentiel du manioc en matière de génération de revenus, et convertir des racines fraîches en produits intermédiaires stables et commercialisables.
- SARRNET a facilité l'entrée dans la production et l'utilisation du manioc, de 20 autres industries dans la région de la SADC, alors qu'elles étaient moins de 4 en 1990. Ceci a augmenté l'utilisation industrielle du manioc qui est passée de 8.166 tonnes en 2001 à 11. 700 tonnes en 2002. Des associations paysannes ont été formées dans les centres pilotes de production et de transformation et reliées à des utilisateurs industriels au Malawi (3) et en Tanzanie (2). Un centre d'affaires manioc a vu le jour en Tanzanie, tandis qu'un « Groupe ad hoc sur le manioc » a été investi au Malawi.
- L'établissement de *Typhlodromalus aripo* a été confirmé depuis ses lâchers de 1995 à 1998 dans différentes zones agroécologiques au Kenya, au Malawi, au Mozambique, en Tanzanie, en Ouganda et en Zambie. Les études d'impact ont indiqué une réduction des populations de l'acarien vert du manioc, ce qui s'est traduit par une hausse

CMD pandemic was newly reported from two districts of northwestern Tanzania and large areas of DR Congo and Republic of Congo. A coordinated "Plan of Action" for research-for-development on CBSD was developed by the principal stakeholders.

- Large shoot tips, and compact and hairy apices are major determining factors for suitability to T. *aripo*. No interaction was observed between CGM infestation and CMD infections at Kumi, Uganda where CGM densities are very high. T. *aripo* did not discriminate against varieties infected by CMD with similar numbers/tip recorded on MH 95/0414 (resistant to CMD, slightly tolerant to CGM) and Ebwanatereka (susceptible to both CGM and CMD).
- A spreadsheet, accessible at http://www.iita.org/info/soilmass.zip, was developed using more precise methods than previously published to simplify determination of soil nutrient stocks.
- A competitive production cost for cassava was estimated to be obtained from 25 to 30 t/ha with an economic return of about US$800 to US$1000/ha.
- Field and feed trials were initiated with commercial feed millers in Malawi and Tanzania to develop and validate feed production systems for poultry, pigs, and cattle. Crude protein levels of cassava leaves (fresh and dried) were 2 to 3 times higher than other fodder crops (fresh and dried alfalfa, napier hay, and brachiara). Application of chicken manure on the cassava variety Kiroba, planted at 33 000 plants/ha yielded the highest amount of silage. Variety Silira also had the highest yields in Malawi at similar densities. A 30% increase in milk production was recorded from dairy cattle fed on cassava silage in Malawi and Tanzania.
- The functional quality characteristics of 832 elite genotypes for potential end-uses were assessed and cassava starches, in particular, compared favorably with corn starches. Genotype MM96/0161 produced the highest quantity of *gari* per unit area, estimated at 11.8 t *gari*/ha equivalent to US$6820/ha.
- Over 200 000 cassava seedlings were screened in Kenya, Malawi, Mozambique, Tanzania, and Uganda for multiple disease resistance with emphasis on cassava brown streak disease (CBSD) and quality characteristics. Over 2000 elite genotypes from IITA and ESARC and other advanced locally selected lines are being evaluated in various countries. Over 500 ha of primary multiplication sites were established by NGOs, CBOs, and farmers. Production areas in Malawi under improved cassava and sweetpotato genotypes increased from 9.77% in 2001 to 13.5% for cassava and from 15.66% in 2001 to 29.4% for sweetpotato.
- Open quarantine facilities have permitted exchange of over 3800 improved clones to eight countries, significantly reducing the cost of establishing cassava using tissue culture material, shortening the time from evaluation to release of varieties, and providing an efficient regional solution for the CMD pandemic. The participatory on-farm evaluation involving NGOs, farmer groups, extension services of the Ministry of Agriculture, and church organizations has permitted farmers to apply their own criteria to identify suitable varieties and enriched the diversification of improved varieties in farmers' fields. This has proved essential in meeting the diverse food and other needs of households.
- Kikundi, a male-sterile but female-fertile cultivar, is being used as a new resistance source for black sigatoka in banana germplasm development. Landraces of Papua New Guinea with good variations in pulp color, bunch characteristics, and resistance to *Radopholus similis* were identified. There are strong indications of different pathotypes among R. *similis* populations in Uganda. *Tithonia* mulch improves initial EAHB (cv. Mbwazirume) development, crop production, and suppression of nematode damage.
- *Pratylenchus sudanensis* has been demonstrated to be pathogenic on yams in Uganda, though varietal differences exist in response to it. Monoxenic cultures of *Pratylenchus sudanensis* have been established using carrot discs.

du rendement en racines de 15 à 40%. La pandémie de la CMD a été nouvellement signalée dans deux districts du nord-ouest de la Tanzanie et sur de vastes domaines en République Démocratique du Congo et en République du Congo. Les acteurs clefs ont élaboré un « plan d'action » coordonné de recherche sur l'évolution de la CBSD.

- De grosses pousses ainsi que des apex pubescents et compacts constituent les principaux facteurs qui déterminent l'adaptabilité à T. *aripo*. Aucune interaction n'a été observée entre l'infestation par CGM et les attaques de CMD à Kumi, en Ouganda où les densités de CGM sont très élevées. T. *aripo* n'a pas fait de distinction entre les variétés attaquées par CMD, les mêmes nombres ayant été notés par pousse sur la MH 95/0414 (résistante à CMD et légèrement tolérante au CGM) et Ebwanatereka (sensible à la fois au CGM et à CMD).
- Un tableur, accessible au http://www.iita.org/info/soilmass.zip, a été élaboré à l'aide de méthodes plus précises que celles précédemment publiées afin de simplifier la détermination des stocks de nutriments dans le sol.
- Un coût de production compétitif a été estimé pour le manioc à partir de 25 à 30 t/ha avec une rentabilité économique d'environ 800 $EU à 1000 $EU/ha.
- Des essais en plein champ ainsi que des essais d'alimentation humaine et animale ont été initiés avec des meuniers exploitants de fourrage au Malawi et en Tanzanie, afin de mettre au point et de valider des systèmes de production de nourriture pour volaille, porcins et bovins. Des teneurs en protéine brute de feuilles de manioc (fraîches et séchées) étaient 2 à 3 fois plus élevées que celles d'autres cultures fourragères (feuilles fraîches et sèches de la luzerne, d'herbe à éléphant et de brachiara). L'application de fumier de volaille à la variété de manioc Kiroba, semée selon une densité de 33.000 plants/ha, a présenté la plus forte quantité d'ensilage. Au Malawi, la variété Silira a aussi présenté les plus hauts rendements aux mêmes densités. Un gain de production laitière de 30% a été enregistré chez les vaches laitières nourries à l'ensilage de manioc au Malawi et en Tanzanie.
- Les caractéristiques qualitatives fonctionnelles de 832 génotypes d'élite ont été évaluées pour des utilisations finales potentielles, et les amidons de manioc, notamment, ont favorablement résisté à la comparaison avec les amidons de maïs. Le génotype MM96/0161 a produit la plus forte quantité de *gari* par unité de surface, estimée à 11,8 t *gari*/ha; ce qui équivaut à 6,820 $EU/ha.
- Plus de 200.000 plantules de manioc ont été criblées au Kenya, au Malawi, au Mozambique, en Tanzanie et en Ouganda pour une résistance multiple aux maladies (avec l'accent sur CBSD) et pour les attributs de la qualité. Plus de 2000 génotypes d'élite de l'IITA et de l'ESARC, et d'autres lignées avancées, sélectionnées localement, sont en cours d'évaluation dans différents pays. Des sites de multiplication primaires de plus de 500 ha ont été mis en place par les ONG, les CBO et les agriculteurs. Au Malawi, les zones de production sous génotypes améliorés de manioc et de patate douce sont passées respectivement de 9,77% en 2001 à 13,5%, et de 15,66 en 2001 à 29,4%.
- Des installations de quarantaine à ciel ouvert ont permis l'échange de plus de 3.800 clones améliorés avec huit pays. Ainsi, on a pu réduire significativement, par la culture des tissus, le coût d'établissement du manioc, raccourcir la durée d'évaluation requise pour la diffusion de nouvelles variétés et trouver, à l'échelle régionale, une solution efficace au problème de la pandémie de la mosaïque du manioc. L'évaluation participative en milieu réel associant les ONG, les groupements paysans, les services de vulgarisation du Ministère de l'Agriculture, et les organisations d'église, a permis aux agriculteurs d'utiliser leurs propres critères pour identifier des variétés appropriées et d'enrichir la gamme des variétés améliorées plantées par les paysans. Elle s'est aussi avérée un outil capital dans la satisfaction des divers besoins en nourriture et autres besoins familiaux.
- Kikundi, un cultivar androstérile mais fertile est utilisée comme nouvelle source de résistance dans la création de matériel végétal résistant à la cercosporiose noire du bananier. Des cultivars locaux de la Papouasie Nouvelle-Guinée, dotés de caractères variés quant à la couleur de la pulpe, le régime et la résistance à *Radopholus similis* ont été identifiés. Il existe de fortes indications de la présence de différents pathotypes au sein des populations de *R. similis* en Ouganda. Le paillis de *Tithonia* améliore le développement initial de l'EAHB (cv. Mbwazirume) et la production culturale, et facilite l'élimination des dégâts causés par les nématodes.
- Il a été démontré que *Pratylenchus sudanensis* est pathogénique sur les ignames en Ouganda, bien qu'il existe des différences variétales pour ce qui est de la réponse qui lui est offerte. Des cultures monoxéniques de *Pratylenchus sudanensis* ont été établies à l'aide de disques de carotte.

- Sampling methods for banana weevil (*Cosmopolites sordidus*) were improved through the use of damage to the central cylinder, which is the key parameter in banana weevil yield loss assessment. The positive effect of crop sanitation on weevil pest status (reduced weevil densities and damage) was demonstrated on-farm. Semiochemicals aggregate banana weevil, while the ant *Pheidole* sp. predates on immature banana weevils thereby reducing weevil damage. Searches for natural enemies in Indonesia revealed several new predators but no parasitoids for either eggs or larvae.
- Training courses were conducted on marketing, agro-enterprise development, market information, statistical analysis, and CGM management using different approaches, including learning alliance, field days, and farmer field schools. Ten partners participated in an agroprocessing study tour in Vietnam, hosted by the Vietnamese Postharvest Technology Institute.

Project E
Diverse Agricultural Systems in the Humid Zone of West and Central Africa

- In order to facilitate distribution of improved plantain and banana hybrids to farmers, six pilot multiplication centers were established in collaboration with four public extension agencies and two nongovernmental companies in Nigeria. Similarly, three multiplication centers were established in Ghana. At least 500 farmers received training in rapid plant multiplication techniques and pre- and postharvest management of plantain through farmers' field days held at five locations in Nigeria. At the same time, 10 improved plantain hybrids and five banana hybrids were distributed to 60 farming communities via farmer participatory demonstration plots located in those communities.
- Thermal (hot water and boiling water) treatments outyielded the control, ash-coating (traditional), and nematicide (carbofuran) application. Paring, in combination with thermal treatment, had no positive effect, thus this labor-intensive exercise can be regarded as unnecessary if suckers are treated with hot water (20 minutes at 52 °C) or submerged for 30 seconds in boiling water.
- Diagnostic surveys of cassava in western regions of the DR Congo and central and northern Republic of Congo showed CMD to be the most widespread and damaging production constraint, with more than 70% of all plants diseased, severe symptoms predominant, and mixed virus infections frequent. To tackle the expanding CMD pandemic, a multifaceted CMD management program was initiated in the Republic of Congo, and included the field establishment of >100 elite CMD-resistant clones, hot spot evaluation of 17 "rescued" IITA varieties, training of Congolese researchers in cassava plant health management techniques, and the establishment of a national stakeholder network for cassava research for development.
- It has been clearly established that P and K are the primary limiting nutrients for cassava production on the structurally stable *terre de barre* soils of southern Bénin and Togo. In three years of continuous cropping, cassava yields were maintained above 20 t/ha with NPK and 18 t/ha with PK, while unamended yields fell to 13 t/ha.
- Participatory evaluation of several improved cassava varieties in the forest margin benchmark of Cameroon was completed, with the best three varieties retained for mass multiplication and distribution to farming communities.
- Populations of *Dioscorea rotundata* developed for high yield and pest resistance formed the basis for identification of superior new clones by partners in each of the five major yam-producing countries of West Africa (Bénin, Côte d'Ivoire, Ghana, Nigeria, and Togo). New clones of *Dioscorea alata* selected

- Des méthodes d'échantillonnage du charançon du bananier (*Cosmopolites sordidus*) ont été améliorées par le biais du dégât au cylindre central, paramètre clef dans l'évaluation des pertes de rendement provoquées par ce ravageur. L'effet positif de l'assainissement cultural sur les ravages du charançon (réduction des densités et des dégâts du charançon) a été démontré en milieu réel. Les produits semiochimiques agrègent les charançons du bananier tandis que la fourmi *Pheidole* sp. se nourrit des imagos du charançon du bananier, réduisant ainsi les dégâts causés par ce ravageur. Des recherches d'ennemis naturels entreprises en Indonésie ont permis de découvrir plusieurs nouveaux prédateurs mais aucun parasitoïde d'œufs ou de larves.
- Des cours de formation ont été organisés sur la commercialisation, le développement de l'agro-entreprise, l'information sur le marché, l'analyse statistique et la lutte contre le CGM au moyen de différentes méthodes dont l'alliance pour l'apprentissage, les journées agricoles et les champs écoles. Dix partenaires se sont rendus au Vietnam dans le cadre d'une visite d'étude sur l'agrotransformation organisée par l'Institut vietnamien de technologies post-récolte.

Project E
Divers systèmes agraires dans les zones humides de l'Afrique occidentale et centrale

- Afin de faciliter la distribution de matériel amélioré de plantain et de bananier hybrides aux pays, six centres pilotes de multiplication ont été établis en collaboration avec quatre agences publiques de vulgarisation et deux sociétés non gouvernementales au Nigeria. De même, trois centres de multiplication ont été ouverts au Ghana. Au moins 500 paysans ont reçu une formation en techniques de multiplication rapide des végétaux et en gestion pré et post-récolte du plantain, dans le cadre de journées agricoles organisées dans cinq localités au Nigeria. Parallèlement, 10 hybrides améliorés de plantain et cinq hybrides de bananier ont été distribués à 60 communautés agricoles à travers les parcelles de démonstration participatives installées dans ces communautés.
- Les traitements thermiques (eau chaude et eau bouillante) ont permis des rendements supérieurs à ceux du traitement traditionnel (enrobage à la cendre) et du nématicide (carbofuran). Le parage allié au traitement thermique n'a pas eu d'effet positif; ainsi l'on peut bien se passer du parage à forte intensité de main-d'oeuvre si les rejets sont traités à l'eau chaude (pendant 20 minutes à 52 °C) ou submergés pendant 30 secondes dans l'eau bouillante.
- Des enquêtes diagnostiques conduites sur le manioc dans l'ouest de la République Démocratique du Congo, et dans le centre et le nord de la République du Congo, ont montré que la mosaïque du manioc est la contrainte à la production la plus répandue et la plus dévastatrice touchant plus de 70% des pieds de manioc. Les symptômes sévères sont prédominants et la maladie se trouve souvent mélangée à d'autres affections virales. Pour faire face à la pandémie grandissante de la CMD, un programme pluridimensionnel de lutte contre cette maladie a été lancé en République du Congo, et comprenait l'établissement en plein champ de >100 clones d'élite résistants à la CMD, l'évaluation au point chaud de 17 variétés « sauvées » de l'IITA, la formation de chercheurs Congolais en techniques phytiatriques du manioc, et la création d'un réseau national de partenariat pour la recherche et développement sur le manioc.
- Il a été clairement établi que P et K sont les tous premiers nutriments limitants dans la production du manioc sur les terres de barre structurellement stables du sud du Bénin et du Togo. En trois ans de culture continue, les rendements de manioc dépassaient 20 t/ha avec NPK, et 18 t/ha avec PK alors que les rendements sans amendements sont tombés à 13 t/ha.
- L'évaluation participative de plusieurs variétés améliorées de manioc dans la zone de référence de la bordure forestière au Cameroun a été achevée. Les trois meilleures variétés retenues ont été destinées à la multiplication massive pour distribution aux communautés paysannes.

for high tuber yield and food quality as well as anthracnose resistance were delivered to, and evaluated on-station with partners in Nigeria (18 clones) and Côte d'Ivoire (36 clones). Selections from earlier introductions are under on-farm evaluation with farmers in Côte d'Ivoire.

- At least 95% of producers in surveyed zones in Côte d'Ivoire, Ghana, and Togo would consider adopting improved yam varieties. Most farmers in Côte d'Ivoire and Ghana, but not in Togo, are willing to pay more than the current market price of local yams for varieties with desirable characteristics.
- Nine-month legume fallows produced between 1.3 and 2.0 times more maize grain than the natural fallow in southern Cameroon, with maize grain yields being around 4 Mg/ha after the best legume fallows, such as *Cajanus*, *Mucuna*, and *Pueraria*. P fertilizer application increased the maize grain yield further in combination with some, but not all, legumes. N fertilizer application (70 kg N/ha) after natural fallow gave higher though comparable grain yields (4.5 Mg/ha).
- GIS and market survey tools were used successfully to identify the supply system in Yaoundé for fresh cassava roots. The supply system is fragmented and most of the supplying villages are located within 2–3 hours travel time. Transport costs represent about 30% of the consumer price. The carriers complain about bad road conditions, harassment by police, and the lack of space to unload the commodities in the urban markets.
- Farmers' organizations associated with the Sustainable Tree Crops Program (STCP) have been able to increase the prices they receive for cocoa by 10–15% through organized sales in Cameroon, Côte d'Ivoire, and Nigeria.
- Recommended application rates of fungicide appear to be necessary to maintain cocoa yields against black pod disease in southern Cameroon. Regarding trade-offs between ecological sustainability criteria, there was no significant advantage of reducing fungicide rates to earthworms, the major "ecosystem engineer" in the system. However, relative to the forest system, casting levels ranged from 24 to 36% in cocoa plantations.
- Two years after a farmers' organization was established in Akok village, southern Cameroon, and a farmer-managed credit system set up around the cocoa crop, farmers are actively seeking new income-generating opportunities and diversifying their agricultural base.
- A participatory mapping approach was developed. Through an interactive process of mapping and reiterated validations, local communities in southern Cameroon will become familiar with the concept and practices of geographic representation. They will then be able to sketch land use, clan and lineage lands, hunting areas, etc. on a georeferenced base map. This will provide new insights into the management of landscapes by local communities.
- A study of natural fallows in southern Cameroon revealed that farmers identified a total of 174 useful plant species, about 58% of which were collected in fallows of less than 10 years old. This demonstrates the importance of short fallow systems as a reservoir of forest product species and their significance in the socioeconomic and cultural lives of rural communities, particularly in landscapes where forests are rapidly disappearing.
- The prototype CamFlores model was developed to improve understanding of interactions between farmers and land, and to evaluate the effects on productivity, livelihoods, and landscape of interventions in farming systems. It was then modified and expanded to simulate a forest margin benchmark village in Cameroon. The model has demonstrated the critical role of labor availability in food production, as well as the need to model interhousehold cooperation.
- A new user-friendly version of LEXSYS (Herbaceous Legume Expert System) has been made available on the internet (ftp://ftp.bangor.ac.uk/pub/departments/af/LEXSYS/) through collaboration with the University of Wales at Bangor's School of Agricultural and Forest Sciences.

- Les populations de D*ioscorea rotundata* créées pour des rendements supérieurs et la résistance aux ravageurs, constituent la base sur laquelle de nouveaux clones supérieurs seront identifiés par les partenaires dans chacun des cinq principaux pays producteurs d'ignames en Afrique de l'Ouest, à savoir le Bénin, la Côte d'Ivoire, le Ghana, le Nigeria, et le Togo). De nouveaux clones de D*ioscorea alata* sélectionnés pour de hauts rendements en tubercules et les caractéristiques organoleptiques, et pour la résistance à l'anthracnose, ont été livrés et évalués avec les partenaires au Nigeria (18 clones) et en Côte d'Ivoire (36 clones). Des sélections faites à partir d'introductions précédentes sont en évaluation en milieu réel avec les paysans en Côte d'Ivoire.
- Au moins 95% des producteurs dans les zones enquêtées envisageraient d'adopter des variétés améliorées d'igname en Côte d'Ivoire, au Ghana, et au Togo. En ce qui concerne les variétés possédant des caractéristiques désirables, la plupart des paysans en Côte d'Ivoire et au Ghana, contrairement au Togo, sont désireux de payer plus cher que les prix courants des variétés locales d'igname.
- Des jachères de légumineuses de neuf mois ont produit entre 1,3 et 2,0 fois plus de graines de maïs que la jachère naturelle dans le sud du Cameroun, les rendements en graines de maïs se situant autour de 4 Mg/ha après les meilleures jachères de légumineuses telles que *Cajanus*, *Mucuna* et *Pueraria*. L'application de P a davantage augmenté le rendement en graines de maïs en combinaison avec quelques-unes mais pas toutes les légumineuses. L'application de N (70 kg N/ha) après la jachère naturelle a donné des rendements en graines supérieurs mais comparables (4,5 Mg/ha).
- Le SIG et des outils d'étude de marché ont été utilisés avec succès pour identifier le circuit d'approvisionnement en racines fraîches de manioc au Cameroun. Ce circuit est fragmenté et la plupart des villages fournisseurs sont situés à 2 ou 3 heures de route. Les coûts de transport représentent environ 30% du prix à la consommation. Les transporteurs se plaignent du mauvais état des routes, des harcèlements policiers et du manque d'espace pour décharger les produits dans les marchés urbains.
- Les associations paysannes concernées par le Programme ligneux durable (STCP) ont pu augmenter de 10 à 15% les prix qu'ils perçoivent pour le cacao grâce à des ventes organisées au Cameroun, en Côte d'Ivoire et au Nigeria.
- Les doses de fongicides recommandées semblent nécessaires pour le maintien des rendements du cacao devant la menace de la maladie de la fève noire dans le sud du Cameroun. Pour ce qui est de l'équilibre entre les critères de durabilité écologique, aucun avantage significatif n'a été observé quant à l'effet de la réduction des doses de fongicides sur les vers de terre, les principaux « ingénieurs de l'écosystème ». Toutefois, pour ce qui est du système forestier les niveaux de turricules oscillent entre 24 et 36% dans les plantations de cacaoyers.
- Deux ans après la création d'une organisation paysanne dans le village Akok du Cameroun méridional, et l'installation autour du cacao d'un système de crédit géré par les paysans eux-mêmes, ces derniers recherchent activement de nouvelles opportunités génératrices de revenus et veulent à tout prix diversifier leur base de production agricole.
- Une approche de cartographie participative a été élaborée. Aussi les collectivités locales du sud du Cameroun pourront-elles se familiariser avec le phénomène habituel de représentation géographique grâce à un processus interactif de cartographie et de validations répétées. Elles seront alors à même d'esquisser sur une carte de base géoréférencée l'utilisation des terres, les terres claniques et familiales, les zones de chasse, etc. Ceci offrira un nouveau regard sur la gestion des paysages par les communautés locales.
- Une étude des jachères naturelles dans le sud du Cameroun a révélé que les agriculteurs ont identifié au total 174 espèces végétales bénéfiques dont 58% ont été collectées dans des jachères de moins de 10 ans. Ceci démontre l'importance des jachères courtes comme réservoirs d'essences forestières ainsi que leur rôle dans la vie socio-économique et culturelle des communautés rurales, en particulier dans les paysages où les forêts disparaissent rapidement.
- Le modèle prototype CamFlores a été développé pour obtenir une meilleure compréhension des interactions entre le paysan et la terre, et pour évaluer les effets sur la productivité, les conditions de vie, et la pérennité du paysage, des interventions dans les systèmes agraires. Le modèle a été modifié et élargi pour simuler un village de référence réel en bordure forestière au Cameroun. Il a permis de démontrer le rôle crucial de la disponibilité de la main-d'oeuvre dans la production agricole, ainsi que le besoin de modéliser la coopération entre les ménages.

Project F

Improving and Intensifying Cereal–Legume Systems in the Moist and Dry Savannas of West and Central Africa

- In the degraded soils of Shika farm (Zaria, Nigeria), representing the northern Guinea savanna, maize yields did not show any significant response to nitrogen applied at 30 to 120 kg N/ha (the maize yields ranged from1.4 to 2.1 t/ha). However, a supplementary application of 40 kg P/ha, 29 kg Ca/ha, 25 kg Mg/ha, and 26 kg S/ha in the form of TSP and Epsom salts (9.9% Mg, 12.7% S), the same N treatments showed a highly significant response (the maize yields ranged from 2.2 t/ha to 5.12 t/ha) suggesting that these degraded soils are not only deficient in N but also deficient in P, Ca, Mg, and S.
- A participatory on-farm fertility trial in the northern Guinea savanna showed that maize yields were similar (about 3.5 t/ha) with 136 N + 20 P + 37 K kg/ha (mineral fertilizers) and with 86 N + 9 P + 17 K kg/ha (mineral fertilizers) + 6 t/ha animal manure. However, in the same fields, soybean yielded about 3 t/ha without any fertilizer. Also, the residual effect of soybean on maize in the following year was equal to 6 t/ha of animal manure. The results indicate the importance of cereal–legume rotation and crop–livestock integration in reducing the need for mineral fertilizers and efficient management of natural resources.
- Several high yielding maize varieties were developed combining drought tolerance, *Striga* resistance and ability to perform well under low fertility (30 kg/ha). Some of the promising varieties are TZE COMP 3 DT, ACR94 TZE COMP-5W, TZE COMPI C5, DTSRW-CO, and LN PC3. A total of 113 open-pollinated variety trials, 63 hybrid trials, and 24 inbred line trials were distributed to various countries on request.
- A number of early, medium, and late maturing soybean varieties were developed combining high grain and stover yields with good nodulation, enhanced nitrogen fixation, and low shattering. The most promising varieties were TGX 1910-11F (early), TGX 1905-2F (medium), and TGX 1910-8 (late) with about 2 t/ha grain and 2 to 3 t/ha stover yields. Forty-two sets of soybean international trials involving 20 improved varieties were sent to 36 collaborators in 21 countries on request.
- A range of improved grain and dual-purpose cowpea varieties were developed with combined resistance to major diseases, insect pests, and *Striga* for the northern Guinea savanna (NGS), Sudan savanna (SS), and the Sahel. The most promising varieties were IT97K-568-18, IT97K-499-35, IT99K-573-1, and IT00K-1260 for NGS; IT98D-1399, IT98K-409-5, IT98K-491-4, and IT97K-499-39 for SS, and IT97K-568-18, IT98D-1399, IT98K-131-1, and IT00K-1205 for the Sahel. A total of 409 sets of cowpea international trials involving 140 improved varieties were sent to 105 collaborators in 24 countries.
- The results of an IPM trial to control cowpea insects at Minjibir (Nigeria) representing the Sudan savanna showed some beneficial effects of soap and neem leaf but much less compared to synthetic insecticide. The mean grain yield of the improved cowpea variety IT90K-277-2 was 361 kg/ha without insecticide spray; 516 kg/ha with soap spray; 509 kg/ha with neem leaf (extract) spray; 1352 kg/ha with two sprays of synthetic insecticide spray, and 2430 kg/ha with three sprays of synthetic insecticide sprays.
- It was demonstrated for the first time that stem exudates of cowpea, maize, and soybean can stimulate more germination of *Striga hermonthica* seeds than root exudates. It was further shown that cowpea varieties caused 42–70% germination of S. *hermonthica* compared to 24–36% germination by soybean varieties. Cowpea variety IT94K-440-3 was the most effective causing 70% germination whilst TGX1844-18E was the most effective soybean variety causing 36% germination.

- Une nouvelle version conviviale de LEXSYS (Herbaceous Legume Expert System) est disponible sur Internet (ftp://ftp.bangor.ac.uk/pub/departments/af/LEXSYS/) grâce à la collaboration avec le School of Agricultural and Forest Sciences de l'University of Wales, à Bangor.

Projet F

Amélioration et intensification des systèmes à dominantes céréales-légumineuses dans les zones de savane humide et de savane sèche en Afrique occidentale et centrale

- Dans les sols dégradés de la ferme de Shika (Zaria, Nigeria), représentative de la savane nord-guinéenne, le rendement maïsicole n'a pas présenté de réponse significative à un apport azoté de 30 à 120 kg N/ha (les rendements du maïs variant entre 1,4 et 2,1 t/ha). Toutefois, avec un apport additionnel de 40 kg P/ha, 29 kg Ca/ha, 25kg Mg/ha, et 26 kg S/ha sous forme de sels TSP et Epsom (9,9% Mg, 12,7% S), les mêmes traitements azotés ont présenté une réponse hautement significative (les rendements de maïs allant de 2,2 t/ha à 5,12 t/ha), ce qui suggère que ces sols dégradés ne sont pas seulement carencés en N mais manquent aussi de P, Ca, Mg, et S.
- Un essai participatif conduit en milieu réel sur la fertilité du sol dans la savane nord-guinéenne a montré que les rendements maïsicoles étaient similaires (environ 3,5t/ha) avec 136 N + 20 P + 37K kg/ha (d'engrais minéraux), et avec 86 N + 9 P + 17K kg/ha (d'engrais minéraux) + 6 t/ha de fumier animal. Toutefois, dans les mêmes parcelles, le rendement du soja était d'environ 3 t/ha sans apport d'engrais. En outre, l'effet résiduel du soja sur le maïs l'année suivante équivalait à 6 t de fumier animal. Les résultats démontrent l'importance de la rotation céréale-légumineuse et de l'intégration culture-élevage dans la réduction du besoin d'engrais minéraux et une gestion efficace des ressources naturelles.
- Plusieurs variétés à haut rendement de maïs ont été créées combinant la tolérance à la sécheresse et la résistance à *Striga* avec un bon comportement dans des sols pauvres (30 kg/ha). Certaines des variétés prometteuses sont: TZE COMP 3 DT, ACR94 TZE COMP-5W, TZE COMPI C5, DTSRW-CO et LN PC3. Au total 113 essais sur les variétés à pollinisation libre, 63 essais sur les variétés hybrides et 24 essais sur les lignées endogames ont été distribués sur demande à différents pays.
- Un certain nombre de variétés à cycle précoce, intermédiaire et tardif de soja ont été créées combinant de hauts rendements en graines et fourrage à une bonne capacité à noduler, une meilleure fixation de l'azote et un faible taux d'égrenage. Les variétés les plus prometteuses étaient TGX 1910-11F (précoce), TGX 1905-2F (intermédiaire), et TGX 1910-8 (tardive) avec environ 2 t/ha de graines et 2 à 3 t/ha de fourrage. Quarante-deux jeux d'essais internationaux de soja impliquant 20 variétés améliorées ont été envoyés sur demande à 36 collaborateurs dans 21 pays.
- Un éventail de variétés de niébé à graines et à double usage, incorporant la résistance aux principaux insectes nuisibles et maladies et à *Striga*, ont été créées pour la savane nord-guinéenne (SNG), la savane soudanienne (SS), et le Sahel. Les variétés les plus prometteuses étaient IT97K-568-18, IT97K-499-35, IT99K-573-1, et IT00K-1260 pour la SNG; IT98D-1399, IT98K-409-5, IT98K-491-4, et IT97K-499-39 pour la SS, et IT97K-568-18, IT98D-1399, IT98K-131-1, et IT00K-1205 pour le Sahel. Au total, 409 jeux d'essais internationaux impliquant 140 variétés améliorées ont été envoyés à 105 collaborateurs dans 24 pays.
- D'après les résultats d'un essai de lutte intégrée contre les insectes nuisibles du niébé conduit à Minjibir (Nigeria), site représentant la savane soudanienne, les traitements au savon et aux feuilles de neem ont présenté des effets bénéfiques mais beaucoup moins que l'insecticide synthétique. Le rendement en graines moyen de la variété améliorée de niébé IT90K-277-2 était de 361 kg/ha sans traitement insecticide, 516 kg/ha avec le savon, 509 kg/ha avec le traitement à base d'extrait de feuilles de neem, 1352 kg/ha avec deux pulvérisations d'insecticide synthétique, et 2430 kg/ha avec trois traitements à l'insecticide synthétique.
- Pour la première fois, il a été démontré que les exsudats de tiges de niébé, maïs et soja peuvent stimuler une meilleure germination de graines de *Striga hermonthica* que les exsudats de racines. En outre, il a été montré que les

- A weed control experiment in maize revealed that a new herbicide, "Nicosulfuron", was very effective in controlling weeds at a low dose of 35 g a.i./ha. The mean maize grain yield in the control plot was 968 kg/ha and the herbicide treated plot (35 g a.i.) yielded 3070 kg/ha compared to 2800 kg/ha in the hand weeded (weed free) plot. The grain yields in plots treated with the higher doses (70, 105, 210, and 420 g a.i/ha)of the herbicide did not differ significantly from 35 g a.i./ha.
- The farmer participatory evaluation of the IITA/ILRI/ICRISAT improved crop–livestock system has proved very successful and the number of participating farmers in Nigeria was increased from about 50 in 2001 to 160 farmers in 2002, using the special project support from DANIDA and Gatsby. The project will now also cover Burkina Faso, Ghana, Mali, Niger, and Nigeria from 2003. A series of stakeholders' meetings were held to develop the work plans, and field days were held to show the trials to farmers, policy makers, scientists, NGOs, and extension workers.
- The farmer-to-farmer diffusion of improved cowpea variety IT90K-277-2, which started in Kano State (Nigeria) in1997 through GTZ assistance, covered 140 primary farmers and 27 375 secondary farmers in 2002 who together produced a total of 578 065 kg of seed. This project will be extended to other states in 2003 through a special grant from USAID.
- The project made a significant contribution in training and capacity building of NARS. Over 60 PhD and MSc students conducted their thesis research in 2002 under the supervision of Project F scientists.

variétés de niébé ont causé 42 à 70% de germination de S. *hermonthica*, contre 24 à 36% de germination pour les variétés de soja. La variété de niébé IT94K-440-3 s'est avérée la meilleure avec 70% de germination et la variété de soja TGX1844-18E était responsable de 36% de germination.

- Une expérimentation de lutte contre les adventices dans des parcelles maïsicoles a révélé qu'un nouvel herbicide « Nicosulfuron », était très efficace dans la maîtrise des adventices à une faible dose de 35 g a.i./ha. Le rendement en graines moyen de maïs dans la parcelle témoin était de 968 kg/ha; la parcelle traitée à l'herbicide (35g a.i.) a produit 3070 kg/ha contre 2800 kg/ha pour la parcelle désherbée à la main (exempte d'herbicide). Les rendements en graines dans les parcelles ayant reçu les plus fortes doses (70, 105, 210, et 420 g a.i/ha) d'herbicide n'ont pas présenté de différence significative par rapport à 35g a.i./ha.
- L'évaluation avec le paysan du système amélioré culture-élevage IITA/ILRI/ICRISAT a connu un grand succès, et le nombre de paysans participants est monté de 50 environ en 2001 à 160 en 2002 au Nigeria, grâce à l'appui du projet spécial DANIDA et Gatsby. Le projet couvrira le Burkina Faso, le Ghana, le Mali, le Niger et le Nigeria à partir de 2003. Une série de réunions des parties prenantes a été organisée en vue de préparer les programmes de travail; des journées agricoles ont été tenues afin de montrer les essais aux paysans, décideurs, chercheurs, ONG et vulgarisateurs.
- La diffusion d'un paysan à un autre de la variété améliorée de niébé IT90K-277-2, qui a commencé dans l'Etat de Kano (Nigeria) en 1997 grâce à l'assistance de la GTZ, a couvert 140 agriculteurs primaires et 27.375 paysans secondaires en 2002. Ensemble, ils ont produit un total de 578.065 kg de semences. Ce projet sera élargi à d'autres Etats en 2003 grâce à une subvention spéciale de l'USAID.
- La contribution du projet à la formation et au renforcement des capacités des SNRA est fort appréciable. Plus de 60 étudiants en doctorat (PhD) et en MSc ont préparé leurs thèses en 2002 sous la direction des chercheurs du Projet F.

Graduate research

completed at IITA in 2002

Name	M/F	Country of Nationality	University	Research location	Sponsor	Research topic
MPhil Fellow						
Moyib, O.	F	Nigeria	University of Ibadan	Ibadan	Self	*Molecular characterization of released cassava cultivars and popularly grown landraces in Nigeria by sample sequence repeats (SSR) markers
MSc Fellows						
Osae, M.Y.	M	Ghana	University of Ghana	Cotonou	DANIDA	*Transmission of the granulovirus of the diamond-back moth *Plutella xylostella*
Magaji, A.	M	Nigeria	University of Ibadan	Ibadan	Self	*Evaluation of maize genotypes for resistance to the pink stem borer, *Sesamia calamistis*, Hampson (*Lepidoptera: noctuidae*)
Agbonifo, O.	F	Nigeria	University of Ibadan	Ibadan	Self	*Construction of genetic linkage map for cassava *Manihot esculenta* (Crantz) with amplified fragment length polymorphism (AFLP) markers
Akinbo, O.	M	Nigeria	University of Ibadan	Ibadan	Self	*Development of molecular marker for cassava anthracnose disease
Opabode, J.	M	Nigeria	Obafemi Awolowo University, Ile-Ife	Ibadan	Self	*Comparative morphology and physiology of two alley tree species: *Leucaena leucocephala* and *Gliricidia sepium*
Lasisi, J.	M	Nigeria	University of Ibadan	Ibadan	Self	Evaluation of 25 newly developed cassava genotypes for early bulking in the inland valley ecosystem
Maman, G.	M	Niger	Ahmadu Bello University, Zaria	Ibadan	IITA	*The mechanisms of field resistance to insect pests in different varieties of cowpea (*Vigna unguiculata* L. Walp.)
Wallays, K.	M	Belgium	Katholieke Universiteit Leuven (KUL)	Ibadan	BNMS	*Economic analysis of promising balanced nutrient management systems in northern Nigeria
Vandeplas, I.	F	Belgium	Katholieke Universiteit Leuven (KUL)	Ibadan	BNMS	*Options for production of legume biomass over a range of soil types
Ajaero, J.	M	Nigeria	Federal University of Technology, Owerri	Ibadan	GTZ	*Seed multiplication and preservation under alternative technologies in northern Nigeria
Ricker, I.	F	Germany	University of Hohenheim	Ibadan/ Kano	Self	*Legume diversity and ethnobotany in the northern Guinea savanna of Nigeria
Weldeab, B.	M	Eritrea	KVL, Denmark	Ibadan	DANIDA	*The role of natural soil supressiveness on *Striga* development
Otim, M.H.	M	Uganda	Makerere University, Kampala	Uganda	Self	*Assessment of the potential of biological control of the whitefly vector of cassava mosaic viruses using parasitoids

Graduate research completed in 2002

Name	M/F	Country of Nationality	University	Research location	Sponsor	Research topic
PhD Fellows						
Haimanot, A.	F	Ethiopia	Addis Ababa University	Addis Ababa	SDC *Striga* Project	*The biological control of termites
Hoffstadt, T.	M	Germany	Hannover University	Benin	Self	*Biocompetitive control of *Aspergillus flavus* Link
Aihou, K.	M	Benin	University of Gent Belgium	Benin	IITA	Interaction between integrated organic input [*Cajanus cajan* (L.) Millsp.] and inorganic fertilizers to a maize cropping system in the derived savanna of Benin Republic
Ngobo-Nkongo, M.	F	Cameroon	University of Wales, Bangor	Cameroon	IITA	*Plant community composition and characteristics of shortening fallows in southern Cameroon
Kekeunou, S.	M	Cameroon	Université de Yaoundé	Cameroon	Self	*Effets types de vegelatiors Jechères sur les populations de *Zonocerus verie*
Fregene, B.T.	F	Nigeria	University of Ibadan	Ibadan	Self	Poverty assessment of fishing communities in Lagos State, Nigeria
Sangoyomi, T.	F	Nigeria	University of Ibadan	Ibadan	Self	*Postharvest deterioration of yams due to fungi
Endondo, C.	M	Cameroon	Ahmadu Bello University, Zaria	Ibadan	IITA	*Effects of spatial arrangement and cowpea genotype on production efficiency and intercrop competition in cotton/cowpea intercropping system
Raji, A.A.	F	Nigeria	University of Ibadan	Ibadan	IITA	*Assessment of genetic diversity and heterotic relationship in African improved and local cultivars of cassava
Lokko, Y.	F	Ghana	University of Ghana	Ibadan	RF	*Genetic analysis of host plant resistance to the African cassava mosaic disease
Kombiok, J.	M	Ghana	Ahmadu Bello University, Zaria	Ibadan	Pudune	The influence of tillage practices and inter-cropping partner on soil moisture, nitrogen fixation and yield of cowpea intercropping system levels in northern Ghana
Nwoke, O.	M	Nigeria	University of Ibadan	Ibadan	IITA	Assessment of phosphorus in soils of the benchmark areas of the moist savanna zone of West Africa
Osatuyi, O.	F	Nigeria	University of Ibadan	Ibadan	Self/IITA	*Search for new insectostatic/insecticidal compounds from nature
Fagwalawa, L.D.	M	Nigeria	Bayero University	Kano	Self	*Agrophysiological characterization of early, medium, and late maturing cowpea varieties under sole and intercrop
Mustapha, Y.	M	Nigeria	Bayero University	Kano	Self	*Inheritance of plant pigmentation and seed coat color in cowpea
Rotimi, M.O.	F	Nigeria	Katholieke Universiteit Leuven (KUL)	Onne	BMZ-West Africa	*Assessing losses in plaintain due to plant-parasitic nematodes in West Africa Project
Ousmane, B.	M	Cameroon	Purdue University	Onne	Self	*Marker assisted selection for *Striga* and aphid resistance in cowpea
Talwana, H.A.	M	Uganda	Katholieke Universiteit Leuven (KUL)	Uganda	RF	Spatial distribution and effect of plant-parasitic nematodes on root systems and plant nutritional status of bananas in Uganda

* Provisional thesis title

Financial information

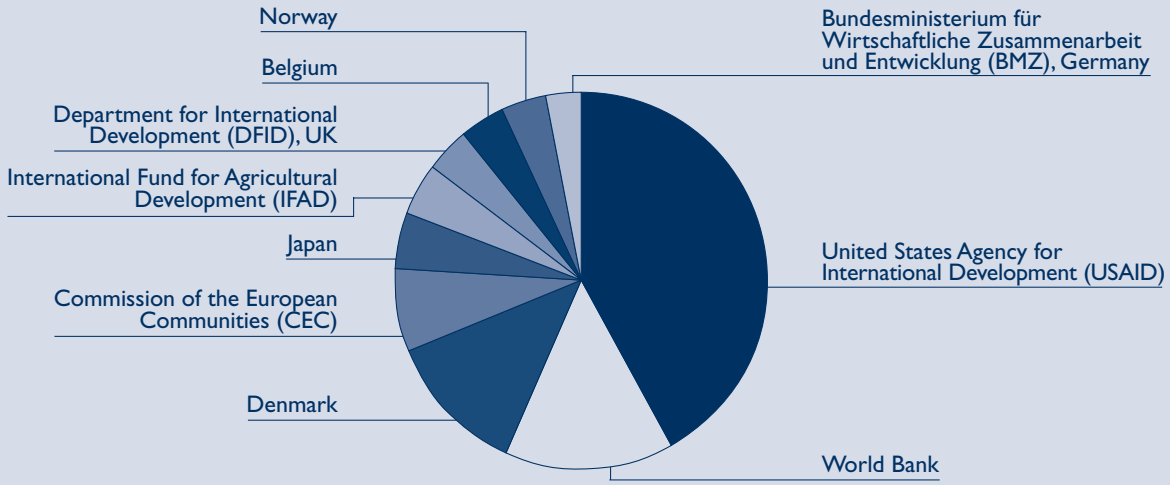
Funding overview

Funding for 2002 was US$32.494 million, of which 94% came from CGIAR investors and 6% from other sources. Expenditure was US$32.678 million, of which 83% was used for program expenses and 17% for management and general expenses. The governments and agencies that provided the largest share of our funding in 2002 are shown in Figure 1 (top 10 donors). IITA's allocation to five research outputs of the CGIAR is shown in Figure 2.

Coup d'oeil sur le financement

L'enveloppe financière 2002 s'élevait à 32,494 millions de dollars américains dont 94% provenaient des investisseurs du GCRAI et 6% d'autres sources. Les dépenses montaient à 32,678 millions $EU dont 83% ont été consacrés aux programmes et 17% à l'administration et aux frais généraux. La figure 1 présente les gouvernements et les agences qui ont contribué le plus gros montant à notre budget en 2002 (les 10 premiers bailleurs de fonds). Les allocations de l'IITA concernant cinq résultats de recherche du GCRAI sont présentées à la figure 2.

Figure 1 Funding top 10 donors, 2002



Funding top 10 donors, 2001

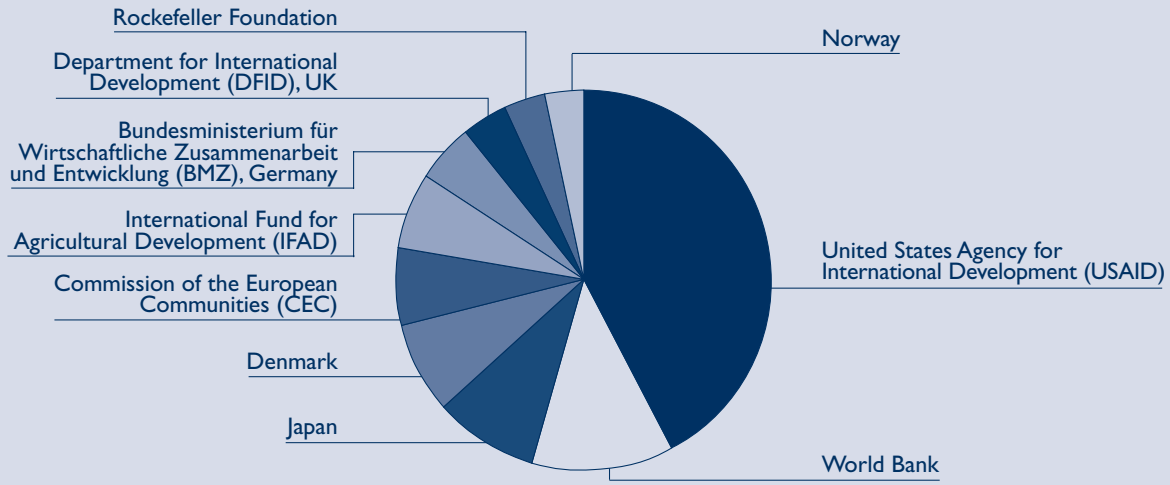
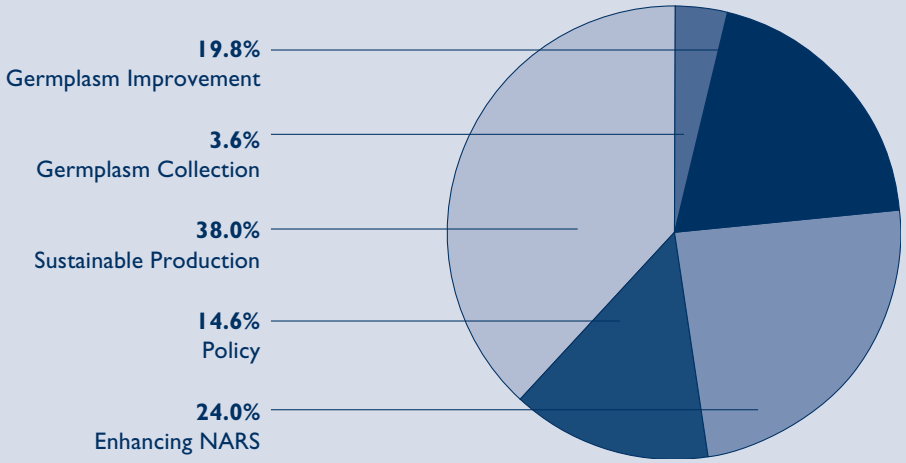
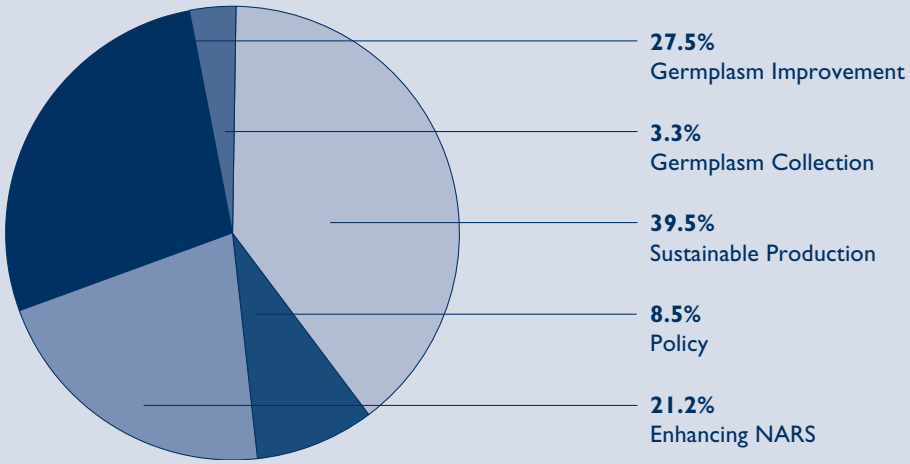


Figure 2 Core research expenditure by CGIAR output, 2002



Core research expenditure by CGIAR output, 2001



Publications

Contributions by IITA staff to scientific literature that became available during 2002, including journal articles, books and book chapters, papers in monographs or conference proceedings, published abstracts, research notes, and disease reports. Also included are publications based on work done by IITA staff prior to their joining IITA, especially where the work reported is of interest to IITA, and publications by staff who have left IITA, which are based on work done while they were at the Institute.

Journal articles

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Southern Africa Root Crops Research Network (SARRNET)
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Statistics

New appointments	38
Resignations/terminations	29
Country citizenships	40
Female/male ratio	ca. 1:3

Abbreviations used in this report

AFLP	amplified fragment length polymorphism
BMZ	Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung (German Federal Ministry for Economic Cooperation and Development)
CBO	community-based organization
CBSD	cassava brown streak disease
CGM	cassava green mite
CMD	cassava mosaic disease
CSIR	Council for Scientific and Industrial Research (Ghana)
DANIDA	Danish International Development Agency
DFID	Department for International Development (UK)
DNA	deoxyribonucleic acid
EACMV-Ug	*East Africa cassava mosaic virus*-Uganda Variant
EAHB	East African highland banana
EARRNET	Eastern Africa Root Crops Research Network
ESARC	Eastern and Southern Africa Regional Center
FAO	Food and Agriculture Organization of the United Nations
GIG	Global Issues Group
GIS	geographic information system
GTZ	Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation)
IBC	IITA's Institutional Biosafety Committee
ICP	inductively coupled plasma
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
IIBC	International Institute of Biological Control
ILRI	International Livestock Research Institute
LEXSYS	Legume Expert System
NARO	National Agricultural Research Organization (Uganda)
NARS	national agricultural research systems
NGO	nongovernmental organizations
NGS	northern Guinea savanna
NRI	Natural Resources Institute (UK)
QTL	quantitative trait loci
PESA	private enterprise support activities
RAPD	random amplified polymorphic DNA
RUSEP	Rural Sector Enhancement Program
RUVT	regional uniform variety trials
SADC	Southern Africa Development Community
SARRNET	Southern Africa Root Crops Research Network
SMS	short message service
SP-IPM	Systemwide Program on Integrated Pest Management
SS	Sudan savanna
SSR	single sequencing reaction
STCP	Sustainable Tree Crops Program
WECAMAN	West and Central Africa Collaborative Maize Research Network