PROJECT SUMMARY

TITLE OF PROJECT: African acacias: study and assembly of the genetic resources. Phase 2 (extension).
R NUMBER: R5655
RNRRS PROGRAMME: Forestry
PROGRAMME MANAGER: OFI
SUB-CONTRACTOR: OFI
RNRRS PROGRAMME PURPOSE: The use of trees within farming systems, including community and farm woodlots, optimised.
RNRRS PRODUCTION SYSTEM: Semi arid
COMMODITY BASE: Tree fodder, fuelwood, charcoal, poles, sawn timber and non-timber forest products.
BENEFICIARIES: Resource-poor farmers, pastoralists
TARGET INSTITUTIONS: Forestry research institutions, ICRAF
GEOGRAPHIC FOCUS: Cameroon, Ghana, Kenya, Malawi, Namibia, Nigeria, Zimbabwe

START DATE:01/05/93**FINISH DATE:**30/04/95
TOTAL COST:£164,535

1. Project purpose:

Increases in the productivity of cultivated and non-arable land are essential requirements for improving the quality of life of rural populations in many of the semi-arid regions of Africa. Trees have important socio-economic roles in these land-use systems, especially those of the genus *Acacia*, which is unrivalled in its wide ecological adaptations and extensive geographical range. The appropriate management of this resource has a vital role to play in maintaining soil fertility, combating land degradation and protecting land-use systems that are vulnerable to the damaging effects of possible climate change. Key species are *Acacia erioloba*, *A. nilotica*, *A. senegal*, *A. tortilis* and *Faidherbia albida*, each of which has a distinctive ecology and is used for a wide variety of purposes. Before effective development interventions can be proposed, however, thorough knowledge is needed of the genetic variation in the species and its practical management implications. Therefore, a programme of research was implemented to study the natural ranges and taxonomic variation of these five species, and to collect materials with which to support collaborative initiatives for assessing and evaluating their genetic variation. The first phase of the programme was implemented as R4348 (01/04/87 to 31/03/90). A second phase began with R4583 (01/05/90 to 30/04/93) and was concluded by the two-year extension R5655. This will pave the way for **identifying multipurpose tree species genetic material with improved performance and promoting its use.**

2. Outputs:

The overall aim of the project was to complete the sampling of the five species in the under-collected areas of their natural ranges. Consequently, the specific objectives were a continuation of those identified for R4583 at the beginning of Phase 2:

1)To assemble rangewide seed and *Rhizobia* nodule material of *Faidherbia* (*Acacia*) *albida*, *A. erioloba*, *A. nilotica*, *A. senegal*, and *A. tortilis,* supplementing existing provenance collections as necessary, for evaluation, domestication and conservation;
2)To gain further information on the phenology, distribution and morphology of all species through herbarium and field studies;
3)To distribute seed for evaluation of the main provenances of all five species, with recommendations for trial design and management;
4)To carry out studies on selfing levels, breeding systems and genetic variation by providing structured seed collections in selected populations for other projects;
5)To collect material of close relatives and other species of African *Acacia* for collaborative studies as the opportunity arises.

The project successfully concluded the eight-year programme of research, the overall achievements of which are summarised below.

Seed collections representative of the variation in all five species (objective 1) were completed. The total acquisition of over 2,000 seedlots represents 141 provenances, with many collections from individual mother trees kept separate.

The selection of locations for seed collections was guided by the concurrent acquisition of information on the distribution, phenology and morphological variation of the individual species (objective 2), and on genetic variation as indicated by molecular studies in the laboratory (objective 4). Central to the successful achievement of

objective 2 was the extensive use made of BRAHMS (Botanical Research And Herbarium Management System), for which the main design development took place on the allied *A. karroo* research scheme R4526. Details were entered of over 11,500 herbarium specimens held in 17 herbaria in 11 countries. This made possible the production of nomenclatural summaries, specimen citation lists and species distribution maps, and the synthesis of information such as altitudinal ranges, vernacular names and phenological characteristics.

Molecular studies were undertaken by other organisations whose collaboration was sought by the project. The project's role was to identify the research areas, collect a structured set of materials to provide a sound research basis, and provide an input to the interpretation and publication of the results. The most intensive studies concerned *F. albida* as part of a collaborative project between CIRAD-Foret (Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement, France - Department Forestier), ISRA (Institut Senegalais de Recherche Agricoles), IRBET (Institut de Recherche en Biologie et Ecologie Tropicales, Burkino Faso) and OFI. These studies showed a clear division between the populations south of Tanzania and those north of this line, which enabled refinement to the provenance sampling to be implemented during R5655. The results of this research on all five species will be of great importance to designing the composition of the field evaluation trials.

A wide range of materials was collected for the study of areas of taxonomic confusion in collaboration with other organisations (objective 5). These included herbarium voucher specimens of associated species, dried leaf material for cpDNA (chloroplast DNA) analyses, wood samples, gums and photographs. The results of objective 4 will also assist taxonomic studies but the single greatest contribution to work in this field is the information assembled in the BRAHMS database (objective 2). Also collected were *Rhizobium* samples in support of the five-year programme of research undertaken by the University of Dundee (R4677, R4714, R6150), as a result of which an inoculum of strains appropriate for the five *Acacia* species is now available.

Wood samples from a range of *Acacia* species revealed that in most species narrow bands of marginal parenchyma are laid down at the end of the dry season and that these can be used for age determination. This has been used for growth modelling in a natural stand, a technique that adds another tool for evaluating the species.

In preparation for seed distribution (objective 3) early collaboration was initiated with organisations involved in complementary *Acacia* research in West Africa, which led to the formation of the African *Acacia* Trials Network. The European organisations involved in the network are CIRAD-Foret, DANIDA Forest Seed Centre, FAO and OFI. Seed is now being distributed in response to increasing demand from Network members.

A major dissemination initiative undertaken throughout the eight-year programme of research was the assembly of information on all aspects of each of the five species. Comprehensive annotated bibliographies were published on *A. nilotica* and *A. tortilis* during R4583. Combined annotated bibliographies and species reviews on the remaining species have been drafted and await publication.

The project final report includes detailed accounts for each species of the seed collected and the research undertaken by collaborating organisations, with summaries of its implications.

3. Contribution of outputs to project goal:

The project's main outputs were the seed and other materials that continue to be distributed to a growing number of African *Acacia* Network members for laboratory and field studies. This will ultimately result in contributions to the knowledge needed for **the use of trees within farming systems to be optimised**.

4. Dissemination products:

See PROREC output.

5. Follow-up:

The African *Acacia* Trials Network will continue the research. At a meeting of participants to agree the guiding principles of field trial design, it was decided that there should be one main trial centre in each of the four main phytochoria in which African acacias are dominant. These centres will be supplemented by smaller satellite trials that will be the responsibility of local collaborators. Seed has already been made available for field trials at the first main centre in Zimbabwe, which was set up in 1994 under research scheme R5653 - *Genetic evaluation of African* Acacia *species: phase 1* (01/01/94 to 31/12/96).