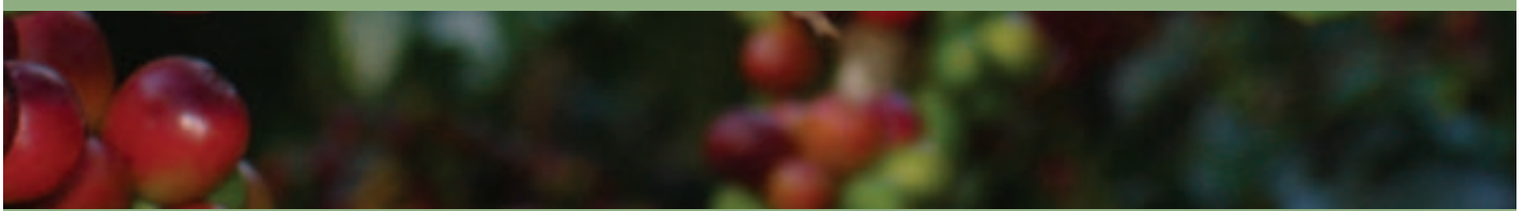
TaCRI
TANZANIA COFFEE RESEARCH INSTITUTE

Tanzania Coffee Research Institute

Annual Report 2006



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Chairman's Statement

Mr Edwin I.M Mtei,
Chairman, TaCRI Board of Directors

As always, it is a pleasure for me to write the introduction to this latest Annual Report of the Tanzania Coffee Research Institute.

I am glad to say that my task has been made easy by the excellent performance of the Management and staff of TaCRI under the able leadership of the Chief Executive Director, Professor James Teri. On behalf of the Board I would like to congratulate them and to urge them all to maintain, and where possible improve, on their performance in the coming year. This last year we have achieved some major milestones, more of which you will read about in the body of this report.

As reported before, immediately after its launch TaCRI responded to its stakeholders' most pressing needs. Amongst these was first, the selection of disease-resistant, high yielding hybrid Arabica coffee varieties in order to tackle the debilitating Coffee Leaf Rust and Coffee Berry Disease. Secondly, the Institute had to start dealing effectively with the threat of the Coffee Wilt Disease afflicting Robusta coffee in Kagera Region.

Both these tasks have had very positive results this last year. Nine new hybrid varieties of the Arabica type have been formally released by the Government; and TaCRI is now engaged in perfecting technologies for their multiplication and distribution to coffee growers to facilitate early replacement of disease-prone coffee trees. TaCRI has also developed practical technologies to help farmers fight CWD. These are being disseminated in affected areas of Kagera Region.

I have singled out for first mention TaCRI's achievements and operations connected with the new varieties, and the fight against CWD, in order to highlight how the Institute's objectives are being pursued. In this way, it is being demonstrated that the Institute's vision of contributing to the transformation of the coffee industry to enable it to reach sustainable profitability, is being fulfilled. Besides these efforts, TaCRI is also making important inroads into its mission to develop and disseminate technologies to improve productivity and quality in order to raise the competitiveness of Tanzania coffee. The ultimate objective of course, is to increase incomes and decrease poverty on the part of the ordinary coffee grower.

It was explained last year that TaCRI was implementing a 5-year Strategic Action Plan (SAP) which was developed in 2003 by Management with the help of consultants. TaCRI's on-going work is based on that SAP, with financing from the European Union under the STABEX arrangements.

The recurrent budget of the Institute was, of course financed by the research cess levied on producers' coffee proceeds at the rate of 0.75 % of the auction price of their crop. In the 2005/06 financial year, the Government set aside an additional TShs100 million as a subvention to coffee research. This was in addition to the undertaking originally given when the Institute was launched, to formally transfer the assets that had been previously utilised by the government department responsible for coffee research, to TaCRI.

As noted in the Audited Accounts, our External Auditors' only major comment is that TaCRI should have a complete record of fixed assets, and implement depreciation policies in accordance with accepted international accounting standards. This is a repeat of the previous year's qualification, and it arises because the Government had not, at the time of audit, given the formal consent for the transfer of the assets to TaCRI. My hope is that these formalities will be completed before the next annual audit.

Chairman's Statement

During the year under review, TaCRI strengthened stakeholders' participation and became more nationally and internationally recognised. It participated in national, regional and international conferences and attracted more international collaboration.

I should note that a substantial portion of the STABEX funds made available to TaCRI (Euro 6 million), has been set aside for the creation of an Endowment Fund for the Institute. The Fund is being administered as a separate financial entity from TaCRI by a Board of Trustees, but its earnings will be made available in future to bridge gaps that may occur in the ordinary revenues of the Institute. Under the terms of the Trust, TaCRI's Board of Directors appoints two Trustees and the Government appoints one Trustee. The Board appointed Professor Bruno Ndunguru who has served as a Member of TAP since TaCRI's inception and Mr A. P. M. Kavishe, a prominent Accountant now serving as Chairman of KNCU. The Government's appointee is Dr Jeremiah Haki, the Director of Research in the Ministry of Agriculture, Food Security and Cooperatives. On behalf of our stakeholders I would like to express gratitude to the European Union for making this possible.

Further in connection with finances for the Institute, the Government last year decided that Crop Boards would be financed entirely from central government revenue, thereby ending the deductions of levies and cesses from producers' crop proceeds that had been used to fund board operations. Following this decision, a coffee stakeholders' conference was held in Moshi to review how TaCRI would be affected. During the conference, it was agreed that the Research Levy of 0.75% of the auction price of coffee would be continued for this year. This will be reviewed at the following annual stakeholders' conference on the basis of TaCRI's experience in the disbursement and use of the Government subvention for coffee research.

Finally, I should note that the 4-year term for Members of the Technical Advisory Panel expired last year and the Board re-appointed Prof. Martin Kyomo and Prof. Bruno Ndunguru for a term of two years. It also appointed Dr Roshan Abdallah, Prof. Emmanuel Mbiha and Dr Francis Shao for a term of 4 years. In order to maintain continuity on the panel, it is expected that those who will replace the TAP Members serving for only two years will be appointed for a 4-year term in accordance with our Articles of Association.

I should like to take this opportunity to record the Board's and stakeholders' appreciation for the valuable contribution made by the first TAP Members, Dr Hussein O. Mongi, Mr Simon Muro and Dr Ali Mbwana, who have retired. Together with those who have been re-appointed, they helped in shaping the Institute's initial research and technology transfer agenda which, as I have said before, has had resounding success in the interest of producers in the coffee industry.

Edwin I. M. Mtei
Chairman, TaCRI Board of Directors


Endowment Fund Board of Trustees

Chief Executive Director's Statement

Professor James Teri,
Chief Executive Director, TaCRI

I would like to join the Chairman of the Board of Directors in expressing TaCRI's profound gratitude to our stakeholders for the strong support during the year. The Technical Advisory Panel (TAP) and the Board of Directors continued to play crucial roles in guiding our activities.

One of the milestones during the year was the official and historic release of nine improved Arabica coffee varieties and the pre-release of one additional variety that will be officially released in due course. This is an historic milestone since it marks the successful culmination of more than 50 years focused on meticulous coffee improvement at Lyamungu, in order to get improved Arabica varieties that combine exceptionally good beverage quality and resistance to the most economically important coffee diseases in Tanzania - coffee leaf rust (CLR) and coffee berry disease (CBD). This milestone was also on the top of stakeholders' priorities for the new institute when it started operating in 2001 and as laid out in the Strategic Action Plan, 2003-2008.

Widespread cultivation of these new disease-resistant varieties will increase growers' incomes by 30-50%. This will be created through a combination of the elimination of costs associated with the management of the diseases as well as enhanced income from the higher productivity and beverage quality of the new varieties.

We also made progress with preparations for the modernisation of TaCRI's research facilities and infrastructure by launching tenders for the supply of laboratory equipment and rehabilitation works at the four sub-stations.

One of the most important new structures will be a fully-fledged Soils Laboratory at Lyamungu that will provide the essential service of soil and leaf analysis to support advisory work in integrated soil fertility management. All the Sub-Stations - Lyamungu, Maruku, Mbimba and Ugano - will be appropriately modernised in order to provide appropriate services to coffee growers in all the major zones.

Finally, I would like to express my gratitude to my colleagues at TaCRI and our collaborating partners, for working diligently during the year to meet our promises to our stakeholders.

Professor James Teri
Chief Executive Director
TaCRI

TaCRI's Technical Advisory Panel in session

Crop Improvement

The Crop Improvement Department (CID) continued with its meticulous breeding programme to develop, evaluate and propagate high yielding CBD and CLR resistant varieties with good bean size and cup quality, for both Arabica and Robusta coffees. The department was strengthened during the year with the recruitment of Dr. Linus Masumbuko, a coffee breeder with expertise in bio-technology. The department also benefited from the implementation of service contracts with CIRAD, France, for the establishment of a research tissue culture laboratory at Lyamungu and another service contract with CIFC, Portugal, for breeding for durable resistance to CBD and CLR. Dr. Herbert van der Vossen made his fourth mission with support from PUM in the Netherlands, and Dr Dick Walyaro continued with his breeding backstopping visits under a separate service contract. Two staff members, Deusdedit Kilambo and Damian Mtenga, successfully completed their course-work at SUA for their MSc. studies, and returned to Lyamungu to continue with research for their dissertations.

Plant Breeder & current Head of Department, Dr Linus Masumbuko

On track to finish their MSc studies; Mr Damian Mtenga (left) and Mr Deusdedit Kilambo

Achievements and Milestones 2005 - 2006

Partnerships in coffee improvement: Dr. Herbert van der Vossen (left), Dr. Vitor Varzea (second left), and Dr. Dick Walyaro (centre) with CID staff

National Variety Release & Seed Committee

The biggest and most historical milestone during the year was the official release of nine improved Arabica coffee varieties as highlighted in both the Chairman's and the Chief Executive Director's statements. The characteristics of these varieties, including the pre-released KP423-2, are shown in Table 1 on the next page.

In order to keep one step ahead of known biotic constraints, a decision was taken to "pyramid" disease resistance genes in the next generation of Arabica coffee hybrids. On-station trials of potential "varieties" with CBD-resistant genes from two sources (Rume Sudan and Hibrido de Timor), were established. The coffee breeding programme has been divided into three parts:

1. Short term programme - Multiplication of second generation tall crosses

This was listed as the number one priority in last year's annual report. Focus has been on the selection and testing of the best progenies among advanced generations of earlier crosses, represented by multiple and backcrosses in Fields 23 and 27. Such progenies should combine CBD and CLR resistant genes from two sources (Rume Sudan and Hybrido de Timor), thus pyramiding the disease-resistant genes in the next generation of hybrid varieties (Table I). The crosses are high yielding, with good bean size and cup quality. These will constitute the second generation of the tall disease-resistant hybrids. Clonal propagation of the best 14 crosses from Field 23 is underway to get sufficient planting materials for multilocational trials. Whilst multiplication is on-going, the first trial for these materials was planted in May 2006 at Lyamungu. This trial will form part of a multilocational trial to be planted at least six sites in the country.

The department continued with the selection and clonal multiplication of materials for evaluation, in which 21 multiple crosses were made from Field 27. A total of 420 seedlings from the best crosses from Field 27 (group IV-VI) have been planted in the nursery. In time, these will be planted in the clonal mother garden for further multiplication, to provide sufficient materials for multi-locational trials.

Table 1: Characteristics of improved coffee varieties in comparison to traditional coffee varieties (N39 & KP423)

Variety Name	Clone Selection	Potential Yields (kg/ha clean coffee)	Beverage Quality[b]	Bean size AA+%	Class	Type
N 39-1	SC 4	2,058	Good acidity; good body; good flavour;pleasant aroma	77	4++	BOURBON
N 39-2	SC 5	2,708	Good acidity; good body; good flavour; pleasant aroma	77	4++	BOURBON
N 39-3	SC 8	2,763	Good acidity; good body; medium flavour; pleasant aroma	74	5+	BOURBON
N 39-4	SC 12	1,961	Good acidity; good body pleasant aroma	80	4+	BOURBON
N 39-5	SC 3	2,633	Light medium acidity; light medium body; medium flavour; pleasant aroma	62	5+	BOURBON
N 39-6	SC 9	2,891	Good acidity, good body; full flavour; pleasant aroma	72	4+	BOURBON
N 39-7	SC 11	2,526	Good acidity; good body; good flavour; pleasant aroma	72	5+	BOURBON
KP 423-1	SC 10	2,225	Good acidity; good body; good flavour; pleasant aroma	80	4++	KENT
KP 423-2 (Pre-released)	SC	1,851	Medium acidity; medium body; medium body; medium flavour; fair pleasant aroma	68	5+	KENT
KP 423-3	SC 14	1,578	Medium acidity; good body; medium flavour; pleasant aroma	77	5+	KENT
Old, highly susceptible varieties						
N 39		1,283[a]	Good acidity; good body; good flavour; pleasant aroma	57	4++	BOURBON
KP 423		1,500[a]	Good acidity;good body medium flavour; pleasant aroma	75	5+	KENT

[a] Yields obtained with heavy application of fungicide sprays
[b] Assessed by a panel of independent liquorers selected by the coffee industry

Table 2: Expected resistance to CBD & CLR of various Arabica hybrids

Code /Name	CBD Resistance	CLR Resistance
1. Clonal hybrids released by TaCRI, tall		
N39-1 (SC4)	+	+
N39-4 (SC12)	+	+
KP423-1 (SC10)	+	+
2. Clonal hybrids, 2nd generation, tall		
Mult.Cross 1	+++	+
" 2	+++	+
" 3		
3. Compact types		
PN1 086	+	+++
PN1 088	+	+++
PNO 127	+	+++
Braz. Catimor	-	+++
4. Clonal & F1 seed hybrids, 3rd generation, compact		
	+++	+++
	+++	+++
	+++	+++
5. Ruiru II (composite variety based on several F1 hybrids)		
Hybrid 1	+++	+++
" 2	+++	+++
" 3	+++	+++

A compact coffee hybrid

2. Medium-term programme - Development of compact type hybrid varieties

Tall coffee varieties are normally trained as capped single or multiple-stem. However, this technique tends to result in excessive vegetative growth which requires more pruning and thus becomes costly in terms of labour.

Compact varieties, on the other hand, have shown to be easy to manage, as well as being much more economic since growers can cultivate plant populations that are two and half times larger than the tall varieties, thus contributing to higher productivity per unit area. In 2003-2004 the department made 11 crosses between male progenitors from Field 23 and dwarf Colombian female parents which resulted in 986 seedlings after CBD pre-selection. Both the male and female parents showed good CBD and CLR resistance. The resulting seedlings were raised and planted in an on-station trial in April 2006. A further, 1700 seedlings were planted in an on-station agronomic trial to develop agronomic packages for compact varieties. In addition, about 23 crosses were made in 2004-2005 resulting in about 4000 seeds.

These crosses were between F23 pollen parents and Colombian dwarfs PNI 086, PNI 088 and PRO127 that have good cup quality. About 700 seedlings were set aside for an on-station trial in order to develop crop husbandry packages for compact varieties. An on-station trial of the test crosses was planted at Lyamungu in December 2006. These will be evaluated for combining ability, based on yield, cup quality, disease resistance, and genotype x environment (G x E) interaction. Male parents with the best attributes will be selected as progenitors for the seed garden. In 2005-2006, eighty-two crosses were made between F23, F24 and F 27 pollen parents and dwarf accessions PNI 086, PNI 088 and PNO127, resulting in 4,760 berries. These will undergo CBD pre-selection testing, screening for CLR and will

later be planted on multiple locations. Table 2 above shows the increasing nature of CBD and CLR resistance from the first released hybrids (moderate CBD and CLR resistance), the second generation hybrids (higher CBD resistance and moderate CLR resistance), compact female parents (higher in CLR resistance and moderate CBD resistance), through to the compact hybrids (higher CBD and CLR resistance). Ruiru 11 has been included for comparison. (NB. higher resistance is designated by "+++" signs).

Efforts to meet the high demand for seedlings of the improved hybrid varieties

The anticipated massive replanting programme of the newly released hybrid varieties to rejuvenate the Tanzania coffee industry depends on massive multiplication and distribution of seedlings of the improved hybrid varieties. In addition to the clonal multiplication and grafting described in the previous annual report, the department has also begun the production of hybrid seed and coffee micropropagation via somatic embryogenesis, as described below:

Establishment of F1 hybrid seed garden

The demand for improved coffee varieties is so high that while clonal multiplication of the existing tall varieties is underway, the department has sought alternative ways to provide improved coffee varieties through seeds as an efficient way of meeting the demand. This is possible through production of F1 hybrid seeds. Establishment of the coffee hybrid seed gardens is underway and in April/May 2006, 3000 dwarf accessions (female parents) seedlings with proven good cup quality were planted. The clonal multiplication of progenitors, for the proposed seed garden from the best crosses from Fields 23, 24 and 27 (Group IV-VI) is also underway. To date, there are 700 seedlings from male parents from Field 23 and 24 which will be planted around the female parents' blocks as enough material for each progenitor becomes available. In the meantime further test crosses are being carried out.

A side view of the compact hybrid seed garden

Coffee micropropagation through somatic embryogenesis

Somatic embryogenesis, which has a very high multiplication rate, could become the preferred propagation method. In a bid to use in-vitro multiplication as a method of propagating coffee, TaCRI has established and equipped a new tissue culture laboratory in collaboration with CIRAD, France. Two laminar flow hoods, an autoclave, a pH meter, a water purification system, a stirrer, a microwave oven, and a 50 RITA bioreactor include some of the crucial equipment that has been provided. Coffee leaves will be used as ex-plants and a special clonal garden is being established to supply ex-plants for the laboratory. The trees will be given special care:

- they will be prevented from flowering or producing seeds since the focus is on the leaves only. This will keep the plants in the proper physiologic state for a good response in culture.
- the trees will receive frequent fertiliser and fungicide application, in order to reduce the micro-organism load on ex-plants and to maintain them in a healthy state. These measures will improve the ex-plants response in-vitro by ensuring the plants are cultivated in an optimum physiological state.

Two of the other benefits of having a special clonal garden will firstly be the minimisation of risks of error when sampling for culture, and secondly convenience because of the garden's proximity to the laboratory. An

The new tissue culture laboratory has state-of-the-art facilities and equipment

CID staff test the newly installed Rita bioreactors

Table 3: Genotypes in the Ethiopian collection with strong CBD resistance (hypocotyl inoculation test at CRF Kenya, 1978)

Introduction No.		Tree no.	Introduction no.		Tree no.
TaCRI	FAO	TaCRI	TaCRI	FAO	TaCRI
F23	E256	858	F88	E67	4612
F24	E257	876/886/902	F89	E68	4612
F40	E273	1729	F90	E71	4660
F41	E274	1755	F96	E87	4767
F45	E87	2051/2061/2081	F99	E114	4794
F50		2196/2230	F103	E117	4839
F56		2504/2505	F118	E174	4978
F62	E118	3447	F121	E178	5003/5004
F71	E581	3858	F130	E224	5039/5062
F79	E35	4475	F131	E225	5077
F81	E38	4520/4526/	F154	E449	5205/5206
		4532/4533	F163	E458	5249
F83	E52	4573	F167	E464	5261
F85	E58	4575	F194	E126	5557

Note: Total 39 CBD resistant genotypes including 11 with homozygous dominant R gene (in colour)
Source: Der H. van de Vossen (personal communication)

acclimatisation facility for hardening seedlings from the laboratory before field planting will be constructed during the on-going rehabilitation works.

Coffee breeders assessing berries produced from controlled pollination

TaCRI coffee breader (left) on a cupping course organised during the Arusha EAFCA Conference

3. Long-term breeding programme

Part of the long-term breeding plan has involved a crossing programme between accessions within the Ethiopian collection and some of the individuals in the on-going breeding programme. This is aimed at making use of the agronomically-useful genes present in the Ethiopian accessions that have not been tapped since the collection was planted in 1964. A half-diallel cross that included Colombian line CRF 127 Rume Sudan, N39, and Ethiopian accessions was set up in 2005-2006. The crossing was cut short (only 13 crosses were done) when new more elaborate data were made available by Dr. van der Vossen on Ethiopian accessions (Table 3 above), that necessitated selection of new accessions for the diallel crosses. The new data provide information not only on CBD and CLR resistance but also on the nature of the resistance.

4. Other related activities

Cup quality assessment: an essential component of variety development

Liquoring to assess cup quality is done regularly on samples at different stages of variety development, as well as on potential varieties, since for all released varieties breeding work goes hand in hand with efforts to ensure a good cup quality. During the period, around 52 samples were collected and sent out for independent cupping to confirm beverage quality. Results showed "Good to light body, very good to light acidity" and cases of "speciality coffee grade".

Robusta samples from Maruku were also sent for liquoring. Of these, a total of eight were wet processed and three were conventionally processed. Cupping results indicated that wet processing produced a better cup quality than conventional processing. The overall statement from the cupper was "Good body to slightly thin body, good to fair flavour, acidity to light acidity, slightly sweet to very slightly harsh after-taste. Good to fair Robusta flavour"

Robusta coffee improvement and coffee wilt disease (CWD)

TaCRI maintains a Robusta germplasm collection at Maruku with 216 accessions. The accessions are evaluated for disease-resistance (CWD, CLR and red blister), cup quality and yield. A consultant plant breeder and the TaCRI plant breeder paid a visit to Maruku during the period. The visit was aimed at:

- examining the current status of the Robusta coffee improvement programme and compiling a synopsis of production constraints.
- Assessing the results of on-going pre-selection for CWD resistance and the performance of accessions that have proved resistant to CWD, as well as the

Symptoms of CWD on Robusta coffee

status of their multiplication, for further testing.

- Advising on long-term breeding strategies for Robusta coffee, including details on possible hybridisation schemes and further selection and advancement within such programmes.

Until recently Robusta coffee did not have serious biotic constraints, but of late CWD has become the most serious threat to Robusta. Currently there are 273 Robusta clones from individual trees which are resistant to *Fusariam xylaroides* (the CWD causative-agent), which have been selected as a result of screening materials from both on and off station. Cuttings from these clones have already been transplanted at Maruku station and these will be the source of the first CWD-resistant Robusta clones. Inoculations of 900 clones in September 2005 at Ibosa village has left only 50 survivors which are still under observation. This will be a continuous exercise until we find promising Robusta clones.

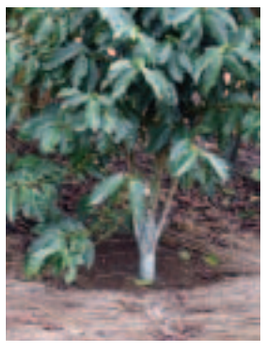
Management of CWD

The effects of various interventions in CWD-affected areas have been very encouraging. An integrated approach which involves eradication of CWD-infected trees and improved coffee husbandry practices (for example pruning, weeding, fertilizer/farm yard manure or compost application, construction of water retention ditches and mulching) have doubled the yield from old Robusta coffee trees and lowered disease incidence and spread. This is evident in the farmer field schools' (FFS) trials which were established in Karagwe and Bukoba districts.

Eradication of CWD-affected trees

Several measures are being employed to control CWD. These include: heat-sterilisation of farm implements such as machetes, hoes, and pruning sears that have come into contact with diseased trees before being used on healthy coffee trees; avoiding the spread of CWD spores by discouraging the use of CWD-infected coffee trees as fire wood; and the uprooting of any coffee trees showing CWD symptoms and burning them in-situ. The use of these simple techniques has significantly reduced CWD incidence and spread. At Omukagando village in Karagwe for example, disease incidence has been reduced to 2.7% and at Nyakatuntu village, incidences of CWD-infested coffee trees were reduced from more than 65 coffee trees in 2003 to 13 coffee trees in 2006. During the reporting period, a total of 2,200 trees have been uprooted, more than 90% being from Bukoba district, and in total since the eradication scheme began, 8,103 coffee trees have been uprooted (5,203 in Bukoba, 400 in Muleba and 2,500 in Karagwe).

CWD resistant Robusta seedlings ready to be planted out



Mulching is one of th e effective CWD intervention packages

Farmer Field Schools are used to disseminate information on CWD

A farmer destroying CWD infected coffee by uprooting and in-situ burning

Coffee micropropagation

Leaf segments are the most widely used ex-plant in coffee micropropagation. The leaves are collected from selected mother plants in the field, washed in tap water and then disinfected in a sterilising solution containing 1% Tween 80. Once disinfected, the leaves are rinsed several times with sterile water, cut into approximately 1 x 1 cm^2 segments excluding the midvein and margins, and then put in culture with the abaxial surface upward.

There are two types of processes where leaf segments have been used as explants:

- 'Low frequency' somatic embryogenesis (LFSE): here embryos are obtained in approximately 70 days, on only one medium. Also known as direct somatic embryogenesis, a small number of somatic embryos (a few to 100 per explant) are generally obtained.
- High frequency somatic embryogenesis (HFSE) (protocol currently in use): this protocol employs two media, a medium for

primary callogenesis (otherwise known as induction medium), and a secondary regeneration medium to produce the embryogenic friable callus that will eventually regenerate several hundred thousand somatic embryos per gram of callus. The high frequency procedure (from leaf explants to somatic embryos) takes about 7-8 months for *C. canephora* and *Arabusta*, and 9-10 months for *C. arabica*. This process enables the use of a liquid medium for both the embryogenic tissue proliferation and the regeneration phase, and it is consequently preferred for scale-up and development of mass propagation procedures.

Germplasm maintenance and use

TaCRI has one of the most comprehensive germplasm collections in the world, which includes a duplicate of the FAO 1964 Arabica coffee accessions from Ethiopia, plus others from all over the world. Tanzania also boasts one of the finest Robusta collections in the world and a number of wild diploid coffees known to exist in the Arc Mountains, the forest reserves in Kagera, the Indian Ocean coastal strip, and the Southern Highlands. Data is collected from the ex-situ collections on-station at Lyamungu (Arabica) and Maruku (Robusta). Efforts are underway to create a database containing the basic information used for the general management of accessions. Two new accessions have been added to the existing collection, which consist of 740 Robusta and 232 Catimors. Routine maintenance and agronomic practices such as weeding, fertiliser application, pruning, cross checking and labelling, gap filling to replace dead trees, fencing, and shade pruning are carried out routinely. The department has decided to tap into the variation available in the Ethiopian collection by having it included in the long-term breeding programme. The accessions are included in a set of diallel crosses with some individuals from the current breeding programme. Dwarf varieties are also being used in the development of a new generation of compact varieties.

Priorities for 2006-2007

1. Continue with the short, medium & long-term breeding programmes as spelt out in the SAP
2. Get the tissue culture laboratory operational and fully utilised in the micropropagation of research materials.
3. Continue with the establishment of multi-locational trials of second generation tall hybrids in the sub-stations and on-farm trials
4. Qualify pre-released clone SC-13 (KP423-2) for release by including it in the multi-locational variety trials.
5. Continue with the establishment of the hybrid seed gardens at Lyamungu, Ugano and Mbimba sub-stations.
6. Establish seed storage facilities in stations with seed gardens.
7. Continue with Robusta coffee improvement i.e. screening for CWD resistance and variety development.
8. Train departmental staff on large-scale pollen harvesting, processing and storage.

Case Study 1: Coffee Varieties with Durable Resistance to CBD and CLR

Amongst the many socio-economic and technical constraints encountered by Arabica coffee growers, coffee berry disease (CBD) and coffee leaf rust (CLR) constitute a real threat to the long-term survival of the Tanzanian coffee industry. Therefore the continued development and distribution of new Arabica cultivars that have a high level of durable resistance to these two fungal diseases, is unanimously seen as the most important target.

In collaboration with CIFC, TaCRI has been working in the following areas:

- Screening resistance of TaCRI improved hybrids using strains/races of CBD and CLR that are known to exhibit the highest level of virulence world-wide.
- Characterisation of rust samples obtained from coffee ecosystems in Tanzania, where improved coffee hybrids will be established.
- CIFC are also supplying a collection of coffee differentials which will enable characterisation and detection of new CLR races, which can be performed at TaCRI Lyamungu.

TaCRI has developed a collaborative research project with CIFC whose objectives are to:

- Characterise the variability of the population of *H. vastatrix* and *C. kahawae* from different coffee genotypes and from different coffee growing areas of Tanzania
- Establish the evolution spectrum or the virulence of *H. vastatrix* & *C. kahawae* from the last resistance screening on-station
- Search for new coffee differentials (new resistance genes for CLR/ CBD) and in CLR races and CBD isolates (new genes for virulence)
- Evaluate resistance in TaCRI coffee selections, to CBD & CLR races
- Provide a unit for characterisation of rust variability at TaCRI, with CIFC providing coffee differentials and technical know-how.

The resulting output will be comprehensive knowledge on CBD (*Colletotrichum kahawae*) and CLR (*Hemileia vastatrix*) that will assist in developing coffee varieties with durable resistance to the two diseases.

A range of strains/races resistant to CBD and CLR exist across the different coffee regions in Tanzania but there is great possibility of evolution spectrum or change of the virulence of these strains/races or new introductions from other coffee growing countries. To avoid breakdown of resistance, samples/isolates will be collected and virulence of strains/races established. The strains/races will then be used to test resistance of improved coffee hybrids for durability.

1. **Characterisation of the variability of the population of *H. vastatrix* and *C. kahawae* from different coffee genotypes and from different coffee growing areas of Tanzania.** The characterisation revealed race II (v2,5) in 28 samples; race I (v2,v5) in 1 sample; and race XXII (v5,6) in 2 samples. For the

Case Study 1: continued

first time in Tanzania, race XXII was detected. The remaining samples are currently being studied.

2. **Evaluation of resistance in TaCRI coffee selections to CBD & CLR races**
Sixty six progenies of *C. arabica*, Hibrido de Timor (HDT) and HDT derivatives (*C. arabica* x HDT) from the CIFC collection were tested against rust races of different spectra of virulence. Some progenies from HDT and HDT derivatives showed high levels of resistance. Different degrees of susceptibility on progenies of *C. arabica* and HDT derivatives were also found. Some coffee plants from different progenies, are under study with the objective of discovering new coffee differentials. In this task 66 progenies were evaluated.

Crop Improvement Team

3. **Establishment of a rust variability characterisation unit at TaCRI, Lyamungu.**
CIFC has provided 18 coffee rust differentials which were planted in the nursery at Lyamungu. The organisation is also supplying technical know-how and in this context Dr Varzea visited TaCRI from 16th to 30th August 2006. Two TaCRI staff will be attached to CIFC during 2006/7 to continue with this work.

Progress made:
Since the inception of the partnership in July 2005, the following actions have been achieved:

- Shipment of the seeds from 114 coffee genotypes to CIFC for screening resistance to CBD and CLR, in order to utilise availability of strains/races collected worldwide at the centre. A total of 50 Robusta coffee genotypes were also sent to CIFC for screening against CLR.
- Characterisation of 53 Arabica CLR samples and 52 Robusta CLR samples have been initiated at CIFC since March 2006. Progress is good.
- An indication that some of the Lyamungu hybrids are resistant to the most aggressive CLR isolate. A full report on these results will be presented in the 2007 annual report.
- The characterisation of rust races tested by CIFC concluded that there is one new race prevailing on Robusta coffee; XXII. More CLR samples will be sent to CIFC from the Southern highlands.
- 40 coffee seed samples were sent to CIFC for CBD testing, against isolates from Cameroon, Zimbabwe and Malawi.
- 25 CBD isolates were sent to CIFC for characterisation testing of the levels of aggressiveness, morpho-cultural and molecular characterisation.
- Preliminary work done at Lyamungu on 25 CBD isolates indicates that strains exist in Tanzania with different levels of aggressiveness.

Crop Productivity & Quality Improvement

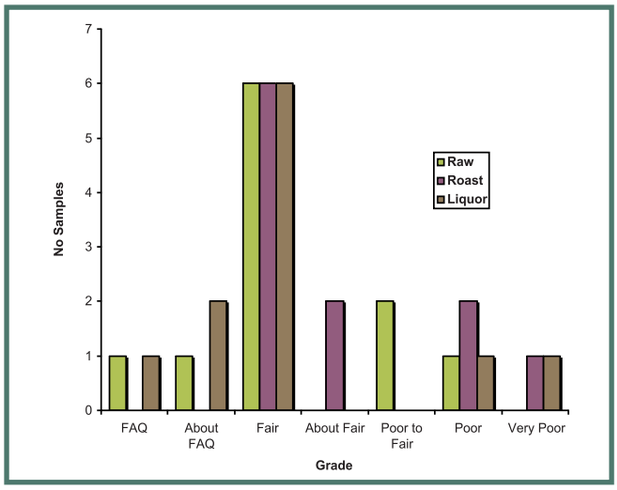
During the year under review, the Crop Productivity and Quality Improvement Department (CPQI) continued to address itself to its key result areas. Emphasis during the year was on improved primary processing for quality, grafting to convert old coffee varieties to the new varieties, IPM, and integrated soil fertility management (ISFM).

Mr Godsteven Maro, Head of Department

Achievements and Milestones 2005 - 2006

Quality improvement activities:
Evaluation of the performance of new pulperies installed at Lyamungu and the sub-stations was carried out. These have all now run through one full season and data are now available from all stations. The first set of data to be submitted were from Maruku where from a total of 11 entries, the 8 wet processed ones had generally acceptable quality which varied with washing rounds and fermentation times. The 3 dry-hulled entries were of poor quality, implying that wet processing is a better approach depending on market demands (natural vs wet produced Robusta) (Fig. 1).

Fig 1: The cup quality results of Robusta coffee samples

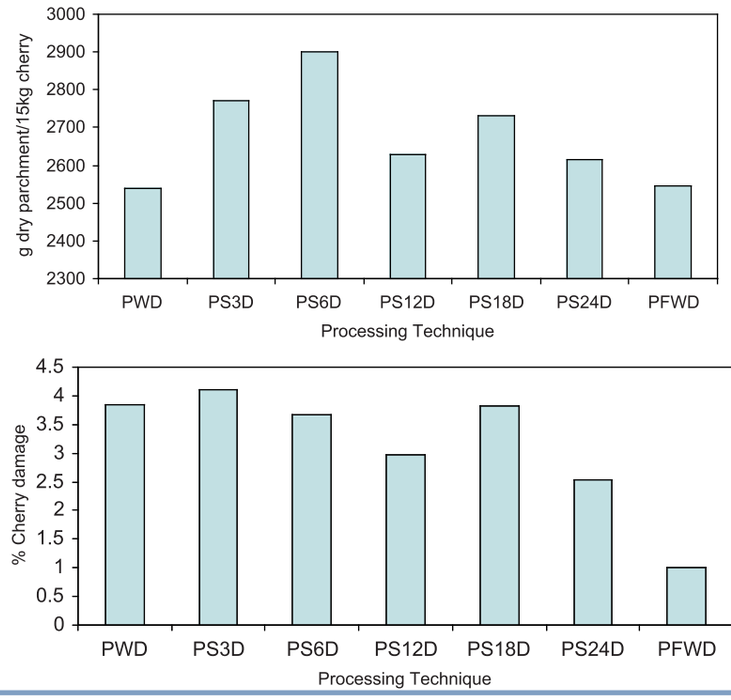


The Lyamungu trial tested a traditional pulper against a new ecological pulper using the traditional disc pulper in conjunction with 2 days fermentation, washing, an extra soaking for 24 hours and then drying, created an excellent cup quality, with fair to good raw coffee, fair average roasted coffee quality and about fair average quality in the cup. These results set against the new ecological pulper (3 hours soaking, washing and drying or no soaking at all) showed no significant difference between the two. Preliminary results show that prolonged soaking in excess of 3 hours may have adverse affect on quality. It was tentatively recommended that farmer groups who are using a "Penagos" pulper (the ecological one) similar to the one installed at Lyamungu, should adopt 3 hours soaking as a standard. The trial is running for another season and results will be presented in the next annual report.

Data for Mbimba (Fig. 2) included weights of parchment at various stages of processing, and the number and percentage of unpulped and damaged cherries (with nipped or squeezed-in beans). The difference in mean dry weights between machines or blocks was not significant. The problem of damage to unpulped cherries was highly marked with the disc pulper, which suggests that the machine may not have been well calibrated. In contrast, the disc pulper recorded the lowest percent cherry damage. A detailed report is being prepared on the same, and the trials have all been extended for one more season.

The Tanzania Coffee Association (TCA) has shown interest in collaborating with TaCRI

Fig 2: Variations in mean dry weights (a) and percent cherry damage (b)



Key

PWD: Pulp, wash & dry. No soaking
PS3D: Soak 3 hours
PS6D: Soak 6 hours
PS12D: Soak 12 hours
PS18D: Soack 18 hours
PS24D: Soak 24 hours
PFWD: Control. Normal fermentation, disk pulper

in screening different pulping machines. The TCA has also showed readiness to procure some pulping machines and install them at Lyamungu. Negotiations and research protocols have been worked out, and the TCA is currently communicating with potential suppliers, so it is expected that this project will take off very soon.

Integrated Pest Management activities: The major achievement in this area during the year was the significant expansion of the botanical garden. This was started in 2003/04 with only two plant species (*Tephrosia vogellii* and *Azadirachta indica*) and it now covers an area of roughly 1 ha and includes seven species that have been reported (by farmers or through literature) to have pesticidal effects. Detailed information on the plant species in the botanical garden that are being used for multiplication, laboratory and field assessment, and ultimately the establishment of their active chemical ingredients, is given in Table 4.

An IPM baseline survey was conducted in Hai and Moshi Rural districts as part of collaborative research with Sokoine University of Agriculture, involving a total of

Table 4. Insecticidal plants established for IPM evaluation

Common Name	Scientific name	No. Trees Established	Target pest
Tephrosia	*Tephrosia vogellii*	31	Antestia bug, scales WCSB, thrips, leafminer, termites
Lemon grass	*Cymbopogon citratus*	57	Thrips
Neem	*Azadirachta indica*	188	Antestia bug, scales WCSB, thrips, leafminer
Tithonia	*Tithonia spp*	5	Green scale
Sweet soap	*Annona squamosa*	7	Leafminer, mealybugs, thrips
Simarubaceae,	*Quassia amara*	19	Mealybug, antestia bug, leafminer, mites
Rubber hedge	*Euphorbia tiricalii*	7	Antestia bug, scales, leafminer, termites, aphids

120 farmsteads. The survey revealed areas where more effort is needed to make an impact, and these will be included in future plans.

Perfection and release of various technological packages

A total of 11 leaflets and one poster were developed during the year and have been printed for circulation to different stakeholders within the industry. They provide hands-on information on various crop productivity improvement strategies and problem-solving approaches in subjects such as the integrated control of stubborn pests, best farm practices, plant nutrient management and good processing techniques that result in high quality coffee. Leaflets are freely provided to stakeholders during backstopping missions and at special events.

The department was represented by 2 scientists at this year's ASIC Conference held in Montpellier, France where two posters were presented. Abstracts for these posters are given later in this report.

A field note on the management of white coffee stem borer (questions normally asked by farmers), a poster and a leaflet on the importance of soil analysis at farm level, are in their preliminary stages. These will be included in the 2006/07 releases.

Review of Consultants' Reports

The report on the fertility status of Tanzanian coffee soils by consultants from Sokoine University of Agriculture, as well as the one on the advisory mission related to crop nutrition by Dr. Bert Janssen (PUM, The Netherlands) were jointly reviewed during the year. It was noted that the cause of low productivity was attributed much more to poor fertility management than low natural fertility. By way of follow-up, a campaign "Know your farm" was initiated (see Case Study 3 below), which included farmers from Arumeru, Rombo, Mwanga, Same, Lushoto and Kibondo. The training had a great impact on the farmers, who wanted their soils to be analysed immediately. However, the soil and nutrition laboratory at Lyamungu is under renovation, and is expected to be operational by mid-2007. After that, we expect to acquire a range of modern equipment and as soon as practical, will be improving on the speed and efficiency of analytical services.

In a bid to develop and use modern quantitative approaches to plant nutrient management, a draft fertiliser advice model called SAFERNAC (Soil Analysis for Fertility Evaluation and Recommendations on Nutrient Application to Coffee), is being developed in collaboration with experts from the Netherlands. The pilot test conducted recently indicated that it is possible to develop models for quick fertiliser advice, which are applicable to Tanzania. Data from 25 clonal gardens around Hai and Moshi gave linear and logarithmic regression equations for N and P respectively, with an irregular trend in K. Plans are being made to input more data in order to continue perfecting the model.

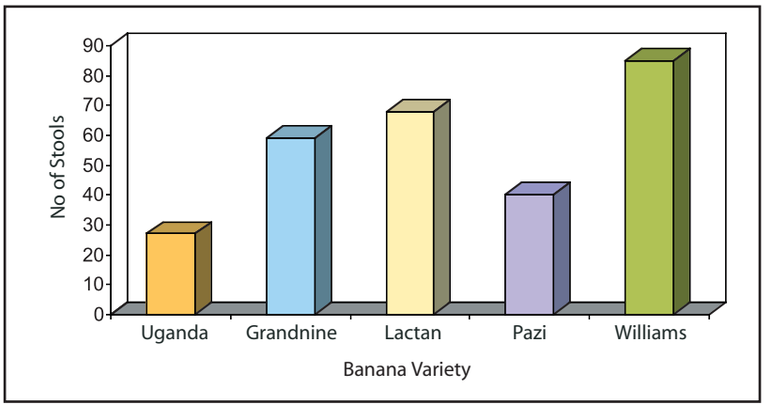
Crop Husbandry

The emphasis in crop husbandry has been to develop relevant technologies that will complement the new varieties. A study was started during the year on the effect of shaded and non-shaded coffee production on bearing, quality and pest incidence. Another study involving compact varieties, was also started at Lyamungu, and two others will be planted for evaluation of agronomic practices (spacing, fertilizer and intercropping with banana) for compact varieties. Farmer training on strategies of farm rehabilitation, with particular emphasis on grafting, was continued successfully with a total of 540 people trained from 4 estates and 12 farmer groups. The grafting success rate was 75-85%.

Grafting on old stumps to convert old trees to the new varieties at Lyamungu

A commercial block at Lyamungu (Usagara), which had long been abandoned, was partially rejuvenated this year by stumping. A

Fig 3: Distribution of Improved Banana Varieties from the Lyamungu Garden



demonstration plot was established there to show stakeholders that using grafting as a means of changing old trees into new improved varieties, is realistic. A total of 805 old KP 423 stumps were grafted with N39-3 and KP 423-1 scions, with a very good success rate of over 80%. Gap-filling was done using 278 grafted seedlings of the same combination. Further plans include using part of the rejuvenated farm for a trial on the tonic effect of using copper sprays for grafted new varieties.

Following the interest shown by coffee stakeholders in the Northern coffee zone to adopt the coffee banana intercropping system, it was decided that it would be effective to package this technology with a supply of quality banana suckers. During the year, a banana sucker garden was established. To date a total of 279 stools have been distributed (see Fig 3).

The improved banana sucker garden at Lyamungu

Grafting at Finagro Estate

The macadamia garden

Case Study 2: Grafting - A success story

Grafting is one way of converting old coffee farms to new improved varieties. It is a technique that has been perfected by TaCRI, with an impressive success rate of between 90 and 95%. Over the period, information about grafting has been disseminated to coffee growers. Two estates in Karatu (Finagro and Edelweiss) showed interest in the technique, and a training session involving 30 estate workers was organised in April, 2005. A follow-up farmers' open day conducted at Finagro in December, 2005 received very good feedback indicating that the adoption has been very good. Periodical backstopping has been going on since then.

In a recent visit by TaCRI staff to the estates, a grafted block of 7 acres , which had been grafted in April, 2005 was inspected. The early grafted primaries are yielding very well, clearly showing the traits of the new hybrid varieties. In almost all bushes, there is only one original sucker left, and these will be stumped after this crop, so that the trees are fully transformed to new hybrids. The incidence of these single original suckers means that copper fungicides are still being applied, but this will stop after the full transformation.

Priorities for 2006-2007

1. **Recruitment of staff:**
   This includes the recruitment of an agronomist (who will be in charge of coffee husbandry research, farm rehabilitation techniques and agro-meteorology); and secondly a quality improvement specialist, or processing engineer, to deal with factory and CPU maintenance, improvisation of home-made and industrial pulpers, with emphasis on the 10 golden rules of processing, OTA awareness and the residual effects of agrochemicals in coffee beans. In the longer term, the department will need to consider recruiting a senior technician and 3 analysts for the soil laboratory.

2. **Evaluation of different pulping technologies:**
   The department plans to collaborate with TCA and other stakeholders in evaluating the performance of different pulping technologies. An agreement has already been reached, and TCA is communicating with potential suppliers of various different pulper brands for evaluation.

3. **Research on grafting:**
   To continue with the assessment of different aspects of grafting for better perfection and adoption (including the seasonal suitability of grafting old rootstocks and adaptability of scions to different rootstock seedlings). Other plans are to continue with backstopping visits to farmers who have already adopted the technique earlier and to train new farmers.

4. **Integrated pest management:**
   There are plans to do further research and collect more information on the improved management of White Coffee Stem Borer, with an emphasis on IPM. Along the same lines, further research will be undertaken on the cultural control of Coffee Berry Borer through trapping with local and cheaply available alcohols, and the promotion of these to smallholder farmers. Longer term strategies could include the use of colour traps against berry moths and leaf miners, and the establishing the screening and chemistry of bio-pesticides.

5. **Coffee husbandry:**
   The department will continue to conduct research on the agronomic behaviour and requirements of the new varieties, both tall and compact (including spacing, shade, pruning, organic versus conventional farming, and integrated soil fertility management).

6. **Analytical services:**
   Subject to timely completion of the rehabilitation of the soil laboratory and acquisition of equipment, plans are underway to raise the Institute's analytical services to international standards by establishing quality control mechanisms and ensuring scheduled equipment maintenance, prompt data interpretation, and reporting. It is also hoped that the data created will be enough to validate and perfect the SAFERNAC model.

7. **Soil and water conservation:**
   In collaboration with the Technology Transfer Department (TTD), there are plans to put some effort into sensitising farmers on the importance of soil and water conservation measures, including shade management, mulching, planting of fibre-rooted plant species (like Setaria splendida) along contours amongst others. The planting of trees in the catchment area at Ziwani will also continue.

8. **Technology dissemination:**
   In collaboration with TTD, existing technologies will continue to be unlocked, perfected, packaged and disseminated.

Case Study 3: "Know your farm": Campaign to sensitise farmers on the importance of analytical services

Determination of pH (left), organic carbon (middle) and available basic nutrients (right)

Most smallholders coffee growers apply fertilisers and/or manure as routine or sometimes in response to specific manifested symptoms of nutrient deficiency. In either case, at best the efficiency of fertiliser use on the crop in any given season is not maximised and at worst an economic loss is incurred in situations where such fertiliser use was not necessary at all.

The campaign "Know your farm" was launched in May 2006 with the aim of sensitising the coffee farming community on the need to make scientifically-based decisions. To date, 80 farmers in 6 farmer groups at Arumeru have received this package as a component of on-farm nutrition seminars, and a group of 35 farmers and District Coffee Subject Matter Specialists who visited Lyamungu from Kibondo district were also trained. The sensitisation is on-going.

The "Know your farm" message emphasises to farmers who want to use fertilszers (especially industrial fertilisers), that they should get to know their farms properly first, by soil fertility analysis. The campaign encourages farmers to prepare and send soil and leaf samples to the soil laboratory at Lyamungu for soil analysis at least once a year, on the back of which sensible decisions can be made as to the type fertiliser needed, the optimal rate per tree and hectare, and the best time for such interventions. The advise is supported with a leaflet and a poster, which provide a hands-on guide for farmers who would like to take samples themselves. This includes explaining that farmers should carry out composite sampling (0-30 and 30-60 cm depths) from at least 5 pits dug in selected sites representative of the field, that samples should be mixed well, labelled properly and submitted promptly.

The analytical information of value to farmers that can be established by soil analysis in the laboratory, includes the following:-

- Soil reaction (pH): This has a significant influence on the chemistry of the soil, and availability of mineral nutrients. The suitable pH range for coffee is 4.5-6.5, which shows the crop to be slightly acid dophilic. Higher or lower values progressively reduce yield. To moderate extremes of soil pH farmers are advised to:
- Use CAN as an N-based fertilizer if the pH is below 4.5. This adds Ca2+ to the soil exchange sites, thus moderating soil pH.
- Use NPK 20:10:10 if the pH lies between 4.5 and 6.5 or urea 46%N in situations of moderate slope and rainfall.
- Use SA if the pH is above 6.5. This hydrolyses to ammonia and sulphuric acid, thus lowering the pH.

- Organic carbon (OC): This is a measure of soil organic matter, which takes time to decompose, thus releasing nutrients slowly. It gives a clue to the levels of reserve nutrients that will be released later in the season, or even several years later.
- Available nutrients (Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur and micronutrients): This gives a picture of the levels of nutrients that can be readily taken up by plant roots.

A 60cm deep soil pit, for taking soil samples

Knowing the specific requirements of the crop, the farmer can work out how much of each nutrient to add to the soil, by observing the difference between crop demand and soil supply.

To simplify the task of data interpretation and ultimately fertiliser recommendation to stakeholders, TaCRI is working in collaboration with a scientific consultant from PUM, the Netherlands, to develop a software model for automatic computation of optimal fertiliser rates for different soil conditions. A draft model called SAFERNAC is currently being fine-tuned and perfected. Details of this model will be presented in the 2007 annual report.

While the soil laboratory at Lyamungu is undergoing major rehabilitation, farmers are being advised to seek analytical services of other laboratories such as Mlingano and Selian, or even those outside the country if necessary.

TaCRI's new Soils Laboratory is expected to be operational by mid-2007. The laboratory will be able to process 40-50 samples daily and will provide a fast, efficient and cost-effective service to farmers around the country. With this new-found knowledge farmers will be able to tackle their soil challenges with renewed vigour and understanding; this will improve yields and quality, and reduce the cost base for farmers.

Collecting top soil samples for analysis

Mixing soil depth before sub-sampling

Case Study 4: OTA Management Highlights

Good pulping management, the right fermentation structure and proper raised beds all help in keeping OTA at bay

Food safety and public health are major policy issues and involve authorities at national, regional and international levels as well as in the food sector. Amongst the many subjects affecting food safety are contaminants caused by mould formation. Some moulds produce mycotoxins that can be harmful to human health. One of the toxins is Ochratoxin A (OTA), produced by two fungal species, *Aspergillus* and *Penicillium*. For their survival and growth, these moulds require foodstuffs that have been subjected to high levels of moisture. Coffee is one such foodstuff and no single producing country in the world is entirely free from the dangers of OTA contamination. Where it does occur, OTA leads to contamination of the green coffee bean, producing unpalatable flavours, and rendering the beans unsuitable for roasting. In addition, if it is consumed the toxin is nephrotoxic and carcinogenic to humans.

While initial contamination may occur at farm level, the actual OTA formation can happen anywhere along the chain, at every stage of transportation, storage and production. As such, a comprehensive range of preventive measures that have impact across the coffee chain from tree to cup are required to prevent mould formation and thus enhance coffee quality. In the absence of these measures, authorities in consuming countries may feel obliged to introduce maximum limits for OTA and other mycotoxins, which would create major problems for the coffee sector (cumbersome procedures for sampling and analysis, disruption of the logistical flow of coffee, the creation of a secondary ("black") market of rejected shipments, difficulties over contractual obligations and insurance, and so on). The European Union has already set standards requiring OTA in roasted coffee not to exceed 5 ppb; a ruling which came into effect in April 2005.

The results of a study conducted by The Tanzania Industrial Research & Development Organisation (TIRDO) in 2005, did not find evidence of OTA in Tanzanian coffee; very good news indeed!

The following are recommended measures to minimise the formation of OTA in coffee:

Growing

Healthy coffee plants produce healthy fruits. The tissue layer of healthy fruits protects the moist, nutritious interior of the cherry from contact with mould. Nevertheless, contact with any obvious sources of fungal contamination (soil, dirty water and other mouldy fruits) should be minimised.

Harvesting

The soil under each tree should be covered with a clean sheet of plastic during picking to prevent cherries from becoming contaminated by dirt, or mixed up with mouldy cherries from previous harvests. Cherries that have fallen to the ground should be discarded and fresh cherries should be processed as soon as possible. Storage of cherries, especially ripe and over-ripe ones should be avoided completely. Where cherries are dried, trays or tarpaulins should be used rather than drying on bare soil, and the layer of drying cherries should be not more than 4 cm thick. Drying cherries must be regularly raked (5-10 times per day) and protected from rain and night dew during the drying process.

Processing in general

The processing plant should be located in a dry area, away from low lying ground that could attract puddles and water. The pulp from wet processing should be disposed of away from clean dry coffee; it must be well composted before being used as mulch in the field. Equipment and facilities should be kept clean and coffee should be cleaned carefully from all husk materials (more than 90% of mould comes from husks in sun dried cherries). Defects such as husks, un-hulled cherries or mouldy beans should be removed as soon as possible and clean bags used for storing and transporting cleaned dried beans. Keep dried beans and

discarded materials separately and avoid recontamination by preventing clean green beans from coming into contact with dust, husks and dirty bags. Cleaned, dry green coffee should not be stored near rejects and husks and processing should achieve a uniform green bean moisture content that is as low as feasible, but certainly not higher than 12.5%.

Wet processing

For wet processing it is recommended that pulping takes place on the same day as harvesting. Floaters should be separated off and the quality of water controlled carefully throughout the process. Equipment should be sanitised and parchment must be completely free from pulp. During drying, where possible, excess water should be removed rapidly through forced drying but drying should be done slowly to avoid cracking by excessive heat. Parchments should be dried to a maximum of 12% moisture content. The layer thickness during drying needs to be controlled and turned regularly. Farmers should avoid re-wetting, by covering dried coffee at night whilst ensuring adequate ventilation.Mats or drying tables are ideal for holding the drying coffee to avoid soil contact. Mats or tables should be kept clean and sanitized.

Dry processing:

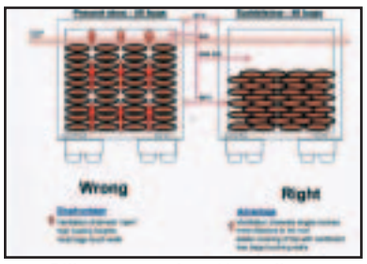
As with wet processing, drying should start on the day of harvesting and the coffee should not be heaped but spread out evenly, and mats and tables must be clean and sanitised. Again, layer thickness needs controlling and the coffee should be turned regularly and ideally kept on mats or drying tables to avoid soil contact. Once dry the coffee should be covered and well-ventilated to avoid rewetting. The water content of the cherries should be maintained at a maximum of 12%.

Hulling:

Beans, parchment and husks should be kept completely separate.

Transport and storage

Ensure that the bags are properly covered during transport and storage to prevent rewetting. Two staking scenarios, an improper and a proper one, are given in the chart on the right. Trucks should be loaded and unloaded in dry weather only or under cover. Damaged containers should not be used in order to prevent water leaks, and pallets or the wooden floors of trucks and containers must be kept dry.



Different ways of stacking coffee in a truck

Coffee should be stored in well-ventilated and leak-proof warehouses away from the walls, and the bags (or loose beans in a container) should be covered with a water proof or water-absorbent cover to prevent rewetting of the top layer of coffee by condensation. Good quality control tests (including cupping) should be provided and adhered to, especially to check for moisture and defects.

The above recommendations, at farm level, reflect what are called the "Ten Commandments" of good coffee processing. Through TaCRI's extensive backstopping missions, most farmers are already well acquainted with these rules. In addition to this emphasis on proper primary processing, all the other participants in the marketing chain (transportation, warehousing and shipment) should be sensitised on measures that will prevent rewetting and mould formation in coffee.

Highlights on the problem and recommended measures to prevent it can be found in many web-based documents, but the most comprehensive link is the FAO project called "Reducing ochratoxin A in coffee" which can be found at http://www.coffee-ota.org.

Reference: European Coffee Cooperation, 2002. Code of Practice: Enhancement of coffee quality through prevention of mould formation

Case Study 5: Antestia Bug - a threat to Arabica coffee production in Tanzania

The antestia bug (*Antestiopsis lineaticollis*) is a pest which has a devastating effect on Arabica coffee. The pest uses a sucking technique to feed on immature cherries, leaves, young shoots and developing flowers. This results in rotting and shedding of the affected cherries (due to infestation by the fungus *Nematospora coryli*), general stunting due to impeded photosynthesis, and flower discolouration which results in drying up. Most of the affected berries become floaters.

The female bug lays batches of about 12 eggs on the under-leaf surface and the eggs hatch into nymphs which look like a dwarf version of the adult. The lifecyle is about 8 weeks in hot weather and up to 4 months in the cooler seasons with 5 nymphal stages, the last one giving rise to the adult bug. Green cherries are essential to the Antestia's diet for normal growth and reproduction, and consequently Antestia populations tend to increase considerably at the time of cherry development; i.e. from flowering to the long rains.

Chemical solutions to controlling the Antestia bug

To control the insect, farmers are advised to prune coffee trees as often as advised, preferably twice per season. They are also encouraged to ensure proper management of shade including training and pruning of shade trees. It is also necessary to impose control measures whenever 2-3 bugs are found on a single tree. Action includes the use of chemical measures which include spraying with either Fenitrothion 50 EC 25ml per 15 litres of water or Selecron 720 EC 25ml per 15 litres of water. Farm sanitation is also a crucial aspect to controlling the pest. Where infestation has occurred, it is advisable to have the neighbouring fields treated at the same time.

Technology Transfer & Training


Mr Twahir Nzallawahe, Head of Department

During 2006 the Technology Transfer and Training Department (TTD) continued with its mission to support the rejuvenation of the coffee industry in Tanzania. This includes the promotion and dissemination of appropriate and financially viable technologies to farmers and associated agencies, and the facilitation of two-way linkages between researchers, district extension staff and farmers, by encouraging participatory techniques.

This department continued not only to support the multiplication of new nurseries for the replanting programme, but also developed and delivered training courses to coffee farmers, extension staffs and other partners within the coffee industry.

Achievements and Milestones 2005 - 2006

Multiplication and distribution of clonal seedlings


The national mother garden at Lyamungu has 20,000 mother trees of 10 improved varieties. It has been the source of all mother gardens in Tanzania

The department continued with the important task of multiplying clonal materials and delivering them to farmers in coffee growing areas. A total of 300,000 mother trees were distributed to farmers for on-going multiplication of seedlings. Since then, farmer groups and estates have produced and planted about 31,500 clonal seedlings in their fields. The department also provided backstopping services to a total of 104 secondary and tertiary clonal nurseries managed by farmer groups, NGOs, and estates.

Promotion of research outputs through the media

TTD continued to promote and disseminate technologies to stakeholders through the media, including newspapers, radio and television. More than 150 articles were published in different national newspapers and a number of news items were aired on national and community radio stations, as well as television stations.

Preparation of technologies in appropriate formats and their dissemination to stakeholders

During the year under review, in collaboration with TaCRI's research departments, TTD successfully produced 16 leaflets and one brochure on farmer groups, as well as two posters on the eight commandments of increasing productivity and the ten commandments of processing quality coffee. Leaflets were also produced covering a range of topics. These are listed in Appendix II in this report.

TaCRI Open Day and Farmers Fairs

TaCRI continued to attract many visitors to Lyamungu and its sub-stations. In the year 2006, the Institute received and hosted 3,000 visitors, which brings the cumulative visitors' figure to 11,200 since the Institute opened its doors in 2001. The Institute continued to participate at zonal and national agricultural shows. Nine hundred visitors visited TaCRI booths in Mbeya at zonal level and in Arusha at national level, where this year's Nane Nane show was held.

Prof James Teri receiving a certificate of recognition for TaCRI's good Nane Nane display, from Amani Karume, President of Zanzibar

Mrs Sheila Mdemu, a TaCRI staff member, demonstrates multiplication of clonal seedlings to Deputy Permanent Secretary, Ministry of Agriculture and Food Security, Mr Mohamed Muya, and Arusha Regional Commissioner Rt. Col. Samwel Ndomba

Lushoto Stakeholders' Needs Assessment
TTD conducted a very successful stakeholders' needs assessment in Lushoto which resulted in the development and implementation of an operational strategy designed to rejuvenate coffee in the district. A total of 23 stakeholders (10 farmers, 8 extension officers and 5 other resource people) participated. About 3,000 clonal seedlings were distributed to start clonal multiplication. In addition, TTD continued creating linkages in Kigoma, Kibondo, Lushoto, Kasulu and Same.

Structured Visits
Several structured visits were made to Karatu Coffee Estates, Ngorongoro Coffee Estates, Blackburn Estate, Manyata, and Finca, Levy Farm, Finagro Plantations, Eldeweisse Estates, Burka Estates, Tanzania Episcopal of Conference (TEC), and APK.

Research Extension Linkages
Some 219 village extension workers including 36 district extension officers from all 12 major coffee growing districts were trained on research extension linkages. The department continued to expand linkages into Lushoto, Mwanga, Same, Kasulu and Kigoma which are new districts in addition to the initial 12 major districts that have been covered.

Priorities for 2006-2007

1. Continue to work with research departments to unlock on-shelf technologies on pest diseases and soil fertility management, coffee processing and general coffee husbandry practices
2. Continue packaging of research recommendations e.g. IPM, Pest and Diseases, Primary Processing, Pruning, Intercropping and Fertility Management
3. Prepare and run field days hosted by stakeholders in all 12 major coffee districts
4. Set up farmer demonstration plots to demonstrate banana coffee intercropping, fertiliser application and pruning patterns (at least 50 demonstration plot to be set with farmer groups)
5. Strengthen links with 15 District Coffee Subject Matter Specialists
6. Undertake training of the 250 district coffee extension staff working with TaCRI
7. Conduct training of at least 1,500 farmers at all TaCRI Training Centers.
8. Initiate and support Village Based Training with all 104 groups working with TaCRI
9. Establish clonal mother gardens in 8 districts.
10. Train at least 206 nurseries and clonal garden supervisors from groups working with TaCRI
11. Continue backstopping of clonal nurseries managed by farmer groups, districts, Estates, NGOs.
12. Conduct coffee processing for quality campaigns in all 12 major districts and the additional districts (Lushoto, Same, Kasulu, Kibondo and Kigoma)
13. Organise and facilitate farmers in Mbinga, Mbozi, Arumeru, Moshi and Hai to process quality coffee in central pulperies
14. Participate and contribute to efforts to promote local coffee consumption

Lyamungu Sub-Station

The Lyamungu sub-station is located in Hai district at Lyamungu on the slopes of Mt. Kilimanjaro around 23 km from Moshi town. It serves the four regions of Kilimanjaro, Arusha, Manyara and Tanga and a total of ten coffee growing districts. Lyamungu's catchment has 180,000 coffee farmers with an average of 0.5 ha per farmer. The area under cultivation is 89,420 ha with an average production of 12,920 tons of parchment per year. Potential production is 59,000 tons (at an average of 500g per tree).

Mr Msanjo Temu, Extension Agronomist, Lyamungu

The Lyamungu catchment has a long history in growing Arabica coffee, with an excellent reputation for Kilimanjaro coffee, especially in the Japanese and German markets. Farmers continue to regard coffee as a reliable cash crop for improving their livelihoods and there are opportunities for them to increase productivity and coffee quality by careful adherence to the eight and ten commandments for improving coffee productivity, processing and quality.

However, there are some major challenges for rejuvenating the coffee industry in the region; for example the majority of coffee trees are more than 60 years old; general husbandry practices are poor which lowers productivity and quality; and there is no individual reward for quality coffee, especially in cooperatives. In addition, great competition of land resources in the region and inadequate availability of clean water for quality wet processing continues to threaten the coffee industry in the northern zone.

The functions of the station in the coffee rejuvenation process are to help to address these challenges, and to support the development of the industry in Kilimanjaro, Arusha, Manyara, Tanga and Mara regions by disseminating proven technologies to district extension staff, farmers and estates through training courses and extension messages. The priority now is to accelerate multiplication of new varieties and rehabilitate old trees through stumping, including the re-alignment of bananas within the existing coffee-banana intercropping system.

The climax of TaCRI's farmer-hosted open days was an event held by Mrimbo Ouwo, where Mr Mohamed Babu, Regional Commissioner of Arusha was guest of honour

Achievements and Milestones 2005 - 2006

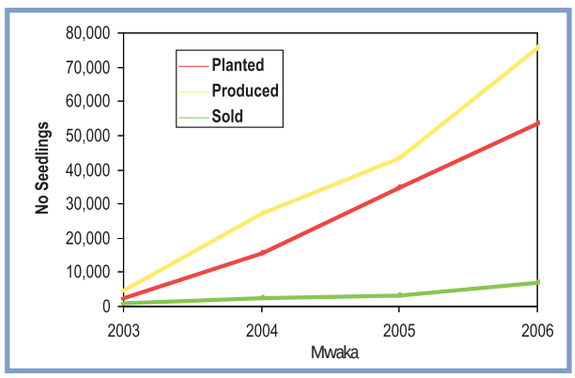
In line with the TaCRI strategic action plan, the following have been achieved during the period

Farmer Group-Hosted Open Days

The first open days organised and hosted jointly by farmer groups and TaCRI were successfully conducted by the following groups:- Wabokasha (Shari) in Hai district, Tumaini (Kirua Vunjo), Mrimbo Ouwo (Mwika) in Moshi (R), and Kiuka in Rombo, where an estimated 2,500 people participated.

The flagship event was hosted by Mrimbo Ouwo where Mr. Mohamed Babu, the Regional Commissioner for Arusha was the guest of honour.

Fig 4: Status of Seedling Multiplication



Production of c

During this finar
sub-station continued to empower farmer groups to produce their own clonal


A lorry ferries clonal seedlings to Rombo district stakeholders

seedlings. Through a participatory approach, the sub-station successfully strengthened and empowered 41 voluntary farmer groups, which have now produced 43,500 seedlings. Of these, 35,115 seedlings were planted by group members and a total of 3,300 were sold at 500/= per seedling (Fig. 4).

Training at Lyamungu

The sub-station trained 112 people during the reporting year, of whom 76 were farmer group representatives and 36 VEWs from 40 farmer groups. Vegetative propagation methods, participatory extension, rehabilitation methods and general coffee husbandry practices were covered during the training sessions.

Village Based Training (VBT)

52 farmers in Same District (12 women & 40 men) benefited from VBT, as well as 40 (7 women & 33 men) in Arumeru, 24 (6 women & 18 men) in Mwanga , 27 (9 women & 18 men) in Rombo.

Research extension linkages strengthened

The Lyamungu substation conducted 8 workshops to strengthen research extension linkages to 83 extension officers (27 DEOs & 56 VEWs). The central focus of the training was the role of extension workers, and participatory extension. Others included husbandry practices, processing, farmer group formation, and management.

Improved coffee and banana practices

The substation successfully trained 111 farmers on improved coffee and banana intercropping practices; a total of 52 farmers in Mrimbo Ouwo, 23 in Lekura, 20 in Shari, 8 in Mkomongo, 5 in Koboko, and 3 in Rombo have adopted the technology on their farms. Adoption of the practice is now picking up due to the good rains this season (Fig. 5).

Distribution of clonal mother trees

Lyamungu sub-station continued to accelerate multiplication of seedlings. A total of 21,000 mother trees were distributed to 29 new farmer groups. Mother trees have the ability of producing between 2.5-3.5 million seedlings per year equivalent to 70 - 100 seedlings per tree.

Farmer group exchange visits

During the year under review, a very successful training visit to Mbinga was organised and supported for 29 growers and extension staff. The experiences gained on quality coffee processing, farmer groups' management and networking are being practiced by farmers in their respective farmer groups.

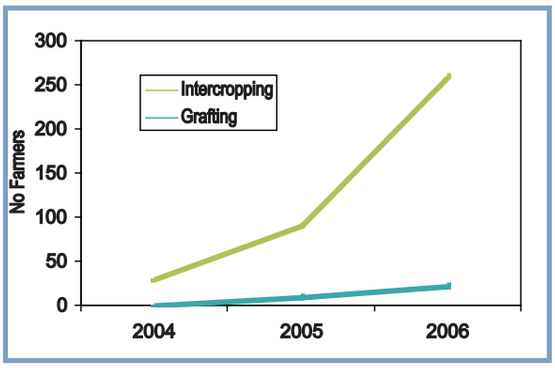
Establishment of promotional farmer demonstration plots

Lyamungu substation has successfully established 15 impressive demonstration plots in five districts namely Hai 4, Moshi (R) 8, Rombo 1, Mwanga 1 and Same 1. These plots have created awareness,and farmers have started adopting these technologies, such as improving coffee and banana (intercropping), improved spacing, rehabilitation of old farms, stumping and grafting.

Parallel-accelerated seedlings multiplication

In a bid to accelerate clonal seedlings multiplication, bare rooted cuttings were distributed to farmer groups as follows: 27,000 bare rooted cuttings to 26 farmer groups of which 13 were in Hai, 7 in Moshi (R) and 6 in Rombo districts. The farmers in turn will use the shoots from their trees to produce their own seedlings.

Fig 5: Spreading coffee technologies in Northern Tanzania



Priorities for 2006-07

1. Scale up and conduct VBT to at least 20 farmer groups as follows; 4 Hai, 4 Moshi (R), 2 Rombo, 4 Arumeru, 3 Same, 2 in Lushoto and 1 Mwanga
2. Continue with structured visits and promote extension messages on multiplication of clonal seedlings, rehabilitation of old farms and production of quality coffee
3. Proactively strengthen link with DCSMS in 10 districts
4. Prepare and participate in Nane Nane - Arusha
5. Establish technology promotional demonstration plots in 7 Districts, 1 Mamsera (Rombo), 1 Mshewa (Same), 2 Singisi & Ngyani (Arumeru), 1 Tloma (Karatu), and 1 Lambo- Mwanga and Monduli
6. Continue with supporting accelerated multiplication to establish at least 63,000 mother trees with a target to produce 11 million seedlings annually by the end of June 2008
7. Strengthen 20 farmer groups by supporting their registration, and organise them to process their coffee centrally to improve qualityright through to auction. This will include at least 4 farmer groups exchange visits of Wabokasha - Shari and Mrimbo Ouwo.
8. Prepare and conduct second farmer-organised Field Days in Same (Mshewa), Arumeru (Singisi), Monduli and Ledea
9. A total of 114 training of trainers (ToT) 38 DEOs and 78 VEWs will be trained on quality coffee processing, marketing, networking between farmer groups for profitable sales, VBT, and grafting

Case Study 6: Farmer to Farmer Agricultural Extension - Participatory Approach & Spill-Over Effects

TaCRI is practicing a participatory approach (PA) with coffee farmer groups, which aims to encourage farmers to meet regularly on different farms to learn about new technologies and share recommendations and knowledge for improving their routine coffee husbandry practices.

The PA approach has been both useful and successful to TaCRI and farmer groups, particularly by facilitating technology transfer from research to farmers.

The PA is specifically useful with well-established and organised farmer groups where it can enhance the transfer of knowledge between groups and provide easy access for TaCRI researchers to inject different technologies directly to farmers.

Farmer to Farmer Approach - the Case of Mrimbo Ouwo

Mrimbo Ouwo is a farmer business group with 100 members. With offices in Mwika, Moshi Rural District, Kilimanjaro region. Its major objective is to process coffee centrally and sell directly to the Moshi coffee auction where the group normally enjoys better prices than those who sell individually at farm gate.

In the year 2004 TaCRI worked with Mrimbo Ouwo for the multiplication of clonal seedlings of improved varieties.

The group was trained on clonal multiplication and immediately established a clonal mother garden for harvesting shoots to produce cuttings. The Mrimbo Ouwo Group successfully produced 7,700 seedlings by the end of 2005. Of these, each member received and planted 75 seedlings, and a further 250 clonal seedlings were sold to other farmers.

Case Study 6: Continued

The most important milestone this group has scored so far is that it was approached by other fellow farmer groups to help them start up their own clonal multiplication programmes. Mrimbo Ouwo is therefore important because it provides backstopping services to five other groups namely; Mrimbo Ouwo B, Mrimbo Ouwo C, Maarifa, Jipemoyo and Kilimani, which are also now producing their own clonal seedlings. This is an excellent example of spill-over of knowledge.

The Case of Tumaini Group, Kirua Vunjo: The Tumaini group at Sumi, Kirua Vunjo is another group which has an accelerated clonal multiplication programme with TaCRI. Their journey to this end started with a visit to TaCRI Lyamungu by the group Chairman Mr. Sebastian Sinato Ombella and the Secretary Mr. Benedict Alfonce, back in 2004. On their motorcycle, these retired former government employees cruised about 80 kms to and from Sumi and TaCRI Lyamungu.
Unknowingly, this was the start of a beautiful success story in which a group of mostly retired people, interested in clonal multiplication, was established. The group was the first to share the first clonal seedlings produced by itself amongst its members. In return, TaCRI extension agronomists have visited the group to help strengthen the programme. The group has succeeded so well because of the individual members' vitality, enthusiasm and desire to achieve speedy and effective results.

But more interestingly, the group has hatched three more satellite groups (Mero, Kilewo and Kapero) which they have successfully backstopped in all aspects of clonal multiplication.

This multiplier effect, whereby one group creates satellites, each of which then creates its own satellites is what TaCRI has been aiming to achieve in the accelerated clonal multiplication of new varieties. As news spreads, groups are being created and spreading like wildfire across the country, from Shari in Hai district to Kyamukorere in Tarime where the Nyarero men's group is back-stopping a group of Nyarero women, to Mbinga where the Myangayanga group now has 11 satellites - an excellent example of farmer -to-farmer or group-to-group extension.

Through the success of this multiplier effect, TaCRI now works with a total of 360 farmer groups across the country. If each of these just backstops three further groups, this would increase the total that are benefiting directly from accelerated multiplication programme to more than 1,000, and so encourage yet more exponential growth.

Maruku Sub-Station

The TaCRI Maruku sub-station is situated near Bukoba town in Kagera Region. It undertakes research and development activities in its mandate area, namely the three districts of Muleba, Karagwe and Bukoba where coffee (mainly Robusta) and banana-based farming systems are found.


Mr Nyabisi Ng'homa,
Extension Agronomist, Maruku

There was a concern about the continued viability of Robusta coffee production in the Lake Zone due to the low prices, and the threat imposed by coffee wilt disease (CWD), low soil fertility, and farmer demoralisation caused by a variety of reasons.

Maruku Sub-station is addressing these concerns and supporting the development of the Robusta coffee industry in Kagera Region by disseminating proven technologies to district extension staff and farmers through the provision of training courses, by promoting extension messages, and also by supporting TaCRI's central research programme by facilitating on-farm and on-station research.

In Kagera, the area under coffee cultivation is 51,416 ha with a potential to expand by a further 20,774 ha. Annual average production is 21,000 tons or 320g of clean coffee per tree with the potential for 1kg per tree.

Achievements and Milestones 2005 - 2006

Distribution of Robusta Clones
Successfully distributed 78,900 Robusta clones to farmers in Bukoba and Muleba districts in collaboration with district councils and the Kagera Cooperative Union (KCU).

Participatory Learning for Farmer Groups
A total of 23 farmer groups were effectively used for field based training through the Participatory Learning Approach and 564 farmers were trained on different best crop husbandry practices with an emphasis on rehabilitation of old coffee farms by stumping, pruning, timely weeding, manure and fertilisers application and harvesting.

Farmer Field Schools
In the Farmer Field Schools (FFS) programme, 690 farmers and 15 extension staff were fully involved. More than 15,333 farmers were trained on CWD and appropriate management techniques through different forums. During the reporting period, 630 farmers and 15 extension workers participated in 21 FFSs and 690 farmers participated in 23 extension farmer groups.

Symptoms Identification Training
A total of 287 extension staff from Bukoba, Muleba and Karagwe districts as well as other coffee growing areas in Tanzania were trained on symptoms' identification and management strategies for coffee wilt disease. FFSs' were run to collect CWD data and sensitise local leaders on the importance of participating and being supportive of the CWD eradication programme.

CWD Management
We continued with training of CWD management during which 2000 farmers and 48 extension staff were trained.

Direct Auction Sales
TaCRI Maruku helped three farmer groups to sell their coffee direct to the auction in Moshi (2 from Muleba, and 1 from Karagwe district); these groups enjoyed higher prices as a result, achieving an average price of Tshs 1,186 per kg clean coffee as compared to the Tshs 925 and Tsh 650 per kg achieved by KCU and KDCU respectively.

A total of 1,480 copies of extension materials were distributed to farmers at Izigo ward in Muleba District. In addition, total of 10 farmer groups in Karagwe district received 300 copies of leaflets promoting coffee wilt disease management.

Monitoring of Coffee Wilt Disease

Coffee Wilt Disease continues to threaten Robusta coffee production in Kagera region to different degrees. The disease incidence is very significantly higher in Bukoba district than in either Karagwe or Muleba districts (Fig 6). During the reporting period, a total of 35,246 Robusta coffee trees were reported to be affected by CWD, of which 38.13 percent were uprooted. Uprooting significantly reduced disease incidences and its spread; for instance at Omukagando village in Karagwe, disease incidence has been reduced from 4% to 1.3%. At Nyakatuntu village coffee trees infested by CWD reduced from more than 65 coffee trees in 2003 to just 13 coffee trees in 2006 (Table 5).

Installation of Washed Robusta Pulpery Machine

More than 90% of the installation work for the pulpery machine was completed during the period. Evaluation of the quality of coffee processed by using the machine was done in December 2005 and the cupping results indicated that washed Robusta coffee had a much better cup quality compared to sun dried coffee. More than 200 farmers who participated during the open day event held at Bwizanduru village in Maruku ward were encouraged to process their coffee using the washed Robusta machine, depending on the market situation.

Promotion of Arabica coffee in Kagera region

An on-station Arabica clonal garden with 194 mother trees was successfully established. The first cuttings from this garden were harvested and placed in the rooting boxes for expansion of the mother tree garden.

Research Extension Farmer Linkages

In Kagera region TaCRI continued to work with other stakeholders including district councils, coffee buyers, processors, the Tanzania Coffee Board, unions, the Ministry of Agriculture and Food Security, Ministry of Industry and Marketing amongst others to promote improved coffee husbandry.

Open Days

The sub-station continued to make an impact during open days. In 2006, Maruku conducted open days in six villages in collaboration with farmer groups in Bukoba, Muleba and Karagwe districts, during which 4,658 people participated. Working with CABI, TaCRI also conducted open days on CWD management in Bushasha, Bushumba, Bwizandulu, Kiilima, Ibosa, Omukagando, Nyakatuntu, Nyabishenge, Minziro, Rubya and Rukuraijo villages where 3,300 farmers participated. The emphasis was on coffee productivity and quality improvement through appropriate coffee husbandry practices, and coffee wilt management strategies.

Robusta Coffee Research Programme

Successfully identified 24 Robusta cultivars which have proven to be high yielding with large and bold bean sizes. In addition, on-station trials were initiated for the best-identified 24 Robusta cultivars,

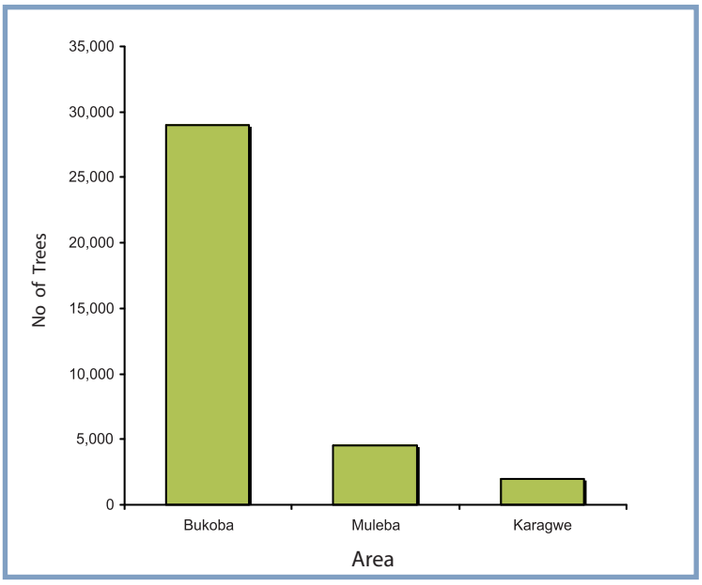
Table 5: CWD incidence in eight farms in Karagwe District 2000 to 2006

Village	Name of farmer	Number of coffee 1996	Coffee trees destroyed by CWD (cumulative data)	
Rutunguru	Edward	463	70	363*
Nyabishenge	Christian Lutegereha	634	1	314*
Nyabishenge	David Karugendo	810	1	599*
Nyabishenge	Patrick Burengero	900	1	299*
Businde	Isa Rutenge	600	20	33**
Omukagando	Christian Songamble	1500	40	80**
Omukagando	Valentine Babireba	600	50	71**
Nyakatuntu	Paulo Peter	2000	65	78**

KEY: *Coffee trees infected with CWD and not uprooted. ** Coffee trees infected with CWD and immediately uprooted and burnt.

which have proven to be high yielding with large and bold sizes. 273 individual Robusta trees showing resistance to CWD were screened and identified. A total of 216 accessions of Robusta germplasm were successfully maintained at Maruku.

Fig 6: Number coffee trees affected by CWD in Kagera Region



Priorities for 2006-2007

1. A total of 150,000 Robusta planting materials will be multiplied at Biirabo, Ibwera and Maruku (at least 50,000 from each site)
2. Field based and on-station training programmes will be conducted in Kagera region. The main focus will be on improved crop husbandry (stumping, manure application, harvesting and processing)
3. Multiplication and dissemination of extension materials to farmers and other stakeholders
4. Implementing of on-farm demonstration plots in collaboration with farmers and village extension staff
5. Evaluation of the performance of the coffee, banana and vanilla demonstration plot at Maruku.
6. Continue the monitoring and evaluation of the performance of agro- forestry trial at Byamutemba village
7. Evaluate the profitability of intercropping coffee with bananas under different planting patterns
8. Mobilise farmers and other stakeholders to improve Robusta coffee processing by utilising the new pulper machine and determining market demand
9. Finalise the installation of the pulper at Maruku
10. Evaluate the performance of the coffee huller and pulper
11. Conduct field days in Bukoba, Muleba and Karagwe districts.
12. Continue with the maintenance and collection of data from germplasm and on-station trials
13. Continue monitoring the CWD trials in Bukoba and Karagwe districts in collaboration with CID and CABI
14. Select the best Robusta lines with resistance to CWD in collaboration with CID
15. Maintain a mother garden for Robusta lines which are resistant to CWD
16. Screen Robusta coffee against CWD in collaboration with CID
17. Establish a screen house and pathology laboratory at Maruku
18. Maintain and evaluate the best 24 Robusta cultivars in terms of yielding ability, cup quality, bean sizes and other agronomic parameters.

Case Study 7: The rehabilitation of Robusta coffee farms to raise coffee production and quality in Kagera Region

Two growers from Kabuhora Farmer Group show off their high yielding rehabilitated Robusta coffee in Karagwe

Robusta coffee is the principle cash crop in Kagera Region, an area accounting for 25% of coffee produced in Tanzania. It is estimated that about 80% of the residents in Kagera Region depend on coffee as source of income for improving their livelihoods.

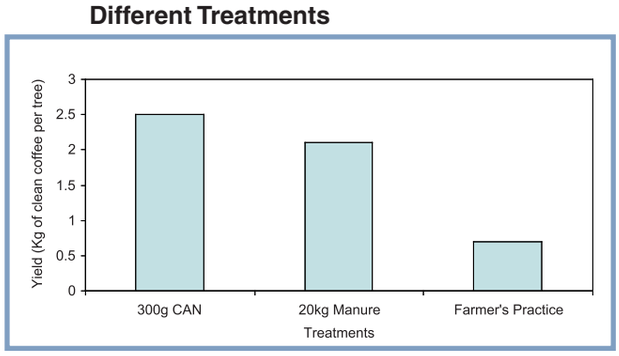
During 2005/2006, TaCRI worked with farmers to develop a training programme using discovery learning and a Farmer Field Schools Approach which was implemented in Chabuhora, Rwambaizi, Chanika (in Karagwe), Rubya, Bushumba and Itongo (in Muleba), Kiilima and Bwizanduru (in Bukoba). At the same time, these villages conducted a study to identify the major factors which impinge on the productivity and quality of Robusta coffee in the area.

The purpose of the study was to improve coffee productivity and quality through the use of appropriate technologies, especially the rehabilitation of existing farms by stumping, pruning, fertiliser applications, mulching, weeding and, making ditches.

Methodology

Trial plots of 160 coffee trees were superimposed in farmers' fields. The coffee fields were divided into two plots, one focusing on farmers' existing techniques and the other emphasising improved technologies. The plots for improved technologies were further divided into two equal plots, each having 40 coffee trees. The coffee trees in the first plot had 300 g of CAN fertiliser applied at three stages annually (at the start of short rains, and at the start and end of the long rains). The coffee trees in the second improved varieties plot had 40kg of manure applied (two full buckets of manure per tree) after every two years. The improved plots were thoroughly weeded using hand hoes, hands or herbicides depending on the types of weeds. After weeding all non-bearing coffee trees were stumped using saws, to produce new suckers. Thereafter, improved plots were mulched using up to 15cm of thick grass mulch. Waterways and ditches were dug to conserve moisture or to control erosion caused by runoff.

Fig 7: Comparison of Yields using Different Treatments



Results and Discussions

The results from eight farms showed that using CAN and application of manure significantly increased coffee productivity by more than 182%. The results indicated that productivity can be increased from the current average production of 0.3 kilogramme of clean coffee per tree to an average of 2 kilogrammes per tree through improved crop husbandry practices such as stumping old coffee trees, removing suckers, applying two buckets of manure or compost per tree after every two years, controlling erosion by digging water ditches, timely weeding and mulching (Fig. 7).

The Way Forward & Conclusions

TaCRI is using this experience to improve yields and quality across the region. The Institute intends to mobilise various stakeholders including government to supply pruning saws, secateurs and hulling machines to farmers; all of these are pre-requisite tools in the overall process of coffee production and quality improvement.

It was found that the use of appropriate husbandry practices and manure and fertiliser will increase Robusta coffee productivity and help the aim of increasing the current average production of 21,000 tons to more than 68,000 tons annually in Kagera region.

Mbimba Sub-Station

The Mbimba Sub-station is located in Mbozi District, Mbeya Region at an altitude of 1,525m. Rainfall patterns are unimodal starting from mid-October to the end of April, with average rainfall of between 1300 and 1800mm annually. This is an important and expanding coffee growing region with 246,000 progressive farmers and six estates.

Mr Isaac Mushi, Extension Agronomist, Mbimba

The region has massive untapped potential for Arabica coffee production. For example, from a total of 196,000 ha of suitable land, only 59,950 ha is currently under coffee cultivation. Similarly, 16,500 tonnes of parchment are produced currently but there is potential to produce over 50,000 tonnes per year. The average production per tree is currently estimated to be 250-300 gm and 280-300 kg per ha which could very easily be doubled by applying available technologies.

However, there are challenges facing the Southern Highland Zone coffee growers, in particular, inadequate water supply for irrigation and processing, limited agricultural inputs and poor rural roads, all of which impact on the region's ability to improve productivity. The function of the station is to address these challenges and to help farmers in the region fulfill their potential and improve quality and productivity.

Achievements and Milestones 2005 - 2006

Hiari ya Moyo Farmer group giving instructions on establishing VPU to a group from Ludewa

Dissemination of proven technologies
Mbimba continued to make efforts in meeting the high demand for information by coffee stakeholders in the region by disseminating proven technologies and by producing hybrid seedlings through the expansion of the on-station clonal garden to 10,000 mother plants from 5,749 in 2005.

Cuttings distributed & hardened
A total of 11,000 bare-rooted cuttings from Lyamungu were hardened; 7,352 of these were distributed to small-scale growers and a further 2,000 to SHIWANDA Estate. By March 2006, 8,000 seedlings had been hardened at the station VPU, ready for distribution to farmers. This was an important milestone, being the first output from the Mbimba Vegetative Propagation Unit (VPU).

Farmer Group VPU training
Six farmer groups were trained and helped by TaCRI to construct their own VPU using locally available materials, with each group constructing four propagation boxes. About 6,000 bare rooted cuttings from Lyamungu were distributed to these groups for hardening off. A total of 55% survived and these have already been distributed among group members for planting in their respective fields.

Training of Extension Workers
Twenty-five extension workers, six of whom were women, received training and practical skills in a number of areas including the production of hybrid seedlings through vegetative propagation methods, pruning, weeding, pest control and fertiliser application, as well as techniques for primary processing to improve quality. They also received training on group formation and management. In addition, 450 farmers from 18 groups as well as 90 farmer group leaders were also trained in the same subjects.

On-station expanded mother garden at Mbimba from 5,749 to 10,000 mother trees

Field officer, Mr Charles Mwingira, holding training session on producing hybrid seedlings through vegetative propogation methods

Charles Mwingira demonstrates how to establish a mother garden, to visitors at the TaCRI pavilion at the Mbeya agricultural show

Research-Extension Linkage Workshops
Three workshops, one at Mbozi and two at Rungwe were conducted, primarily to establish how best TaCRI and the existing extension system can work together to disseminate new technologies to farmers more effectively and efficiently.

Farmer Field Days
Field days were successfully conducted at Isansa and Vwawa wards involving a total of 13 villages (Isansa, Itumbi, Igamba, Ibembo, Msia and Itepula Mbimba, Ilembo, Hasamba, Ilolo, Masangula, Nyimbili, and Ndolezi) and 750 growers. During the Nane Nane agricultural show, Mbimba participated at zonal level in Mbeya where 250 visitors visited the TaCRI booth.

Priorities for 2006-2007

1. To expand the on-station clonal garden to 20,000 mother plants by 2008
2. To expand the on-station VPU to 100 propagation boxes from 50, thereby increasing the rooting and hardening capacity to 100,000 cuttings and 42,000 potted plants
3. To undertake temporary repairs to the present VPU shade by replacing some wooden poles and bamboo lattice damaged by termites while waiting to reconstruct the VPU by using metal poles.
4. To install an irrigation system (pipes and sprinklers)
5. To continue with routine management of the on-station clonal garden by weeding, irrigation, fertiliser and insecticide application, and light pruning.
6. To facilitate and provide further training to 26 individual growers and 2 estates who have planted hybrid coffee, to help them to produce seedlings from hybrid shoots from their plantations by June 2007.
7. To continue developing training courses for extension workers, farmer groups,individual medium growers, and estates
8. To increase the number of farmer groups from the present 18 to a total of 32 groups consisting of around 800 growers
9. To double the number of farmer groups processing their coffee together, from 6 to 12, by constructing central pulping units.
10. To facilitate farmer groups to organise and conduct field days in their respective villages by the end of May 2007

Case Study 8: Pruning by Women; It can be done! The story of women committed to coffee farming in Msia Village Mbozi District

Pruning is one of the most important management practices that can be used to produce high yielding, high quality coffee. When it is not carried out properly, coffee yield and quality drop dramatically, but when effective, good pruning management systems certainly create good returns.

Many coffee growers neglect pruning completely; others do prune but without sufficient knowledge to really understand how to be effective.

For many years, pruning has been very much a male domain, with women expected to support their farm's coffee production in other husbandry practices. Rose Katwila is a great example of how norms can be broken, and broken successfully. Rose is a 64 year-old widow and a coffee farmer in Msia village, Mbozi District, where many years ago she and her late husband established a 3.5ha coffee farm. During her husband's lifetime pruning was his task and yield per tree was around 0.25kg.

Mrs Rose Katwila, a role model for women in the industry

After her husband's death in 2004, Rose began to follow TaCRI's pruning regime rigourously, in combination with other coffee management practices promoted by the Institute. Having worked through the practices herself, she quickly maintained the stand of coffee trees and raised the yield from 0.25kg to 0.5kg per tree.

Based on Rose Katwila's success, TaCRI is starting a concerted effort to target women, using Rose as a model for good practice. With effective training and empowerment, TaCRI believes that women can play a very important role in helping to improve livelihoods for themselves, their respective families and the nation as a whole through more effective coffee farming.

Ugano Sub-Station

Ugano is situated 13 km from Mbinga, about two hours drive from Songea, and 1,500 km (two days by road) from Lyamungu. The station is well located in the heart of the important coffee growing district of Mbinga. There is strong demand for training at both district and regional level, and good support from local government, NGOs, and farmers to contribute to the rejuvenation of the region's coffee industry.

Mr Felician Swai, Extension Agronomist, Ugano

Currently only 52,000 ha are under Arabica coffee cultivation in the region, out of a potential for 128,000ha, and Ugano is working hard to help bring land under coffee cultivation up to this potential. At the sub-station, TaCRI has so far established contact and worked with 70 farmers groups from a total pool of 206 groups, so there are still great strides to be gained from knowledge dissemination to many more farmers. In terms of production, the region's potential is estimated to be 52,000 tonnes with current annual production of between 8,000-13,000 tonnes. Production per tree is between 200g and 300g per hectare.

Achievements and Milestones 2005 - 2006

Mother Garden Expansion
Successfully expanded the on-station mother garden by more than 100% from 5,000 plants in 2005 to 10,140 plants in 2006. Land was cleared for further expansion to reach 20,000 plants.

Coffee Husbandry Training
Continued with training to 36 farmer groups and 134 farmers on general coffee husbandry practices designed to improve quality and productivity and, and trained 2 farmers on grafting, with 120 old trees grafted with new improved varieties.

Quality Successes
Collected 162 coffee samples from farmer groups for liquoring which were sent to the Tanzania Coffee Board in Moshi. In the results, quality had improved from Grade 9 to Grade 7. This is a remarkable achievement for smallholder farmers in Mbinga who should be congratulated on this success.

Capacity Building
Capacity building continued to farmers as well as farmer groups and a total of 64 farmer groups were provided with market information.

Workshops strengthen linkages
Continued strengthening effective two-way linkages with different stakeholders. As a result, two workshops were successfully organised, one focused on the establishment, management and supervision of nurseries, and the other on how best TaCRI can link with Mbinga District on the multiplication and distribution of new coffee seedlings for distribution to farmers.

Central pulping technology training
Successfully organised 64 farmer groups to utilise central pulping technology. About 800 tonnes of super grades (class 5-7) from 64 farmer groups were processed and sold direct to the Moshi Auction.

Higher prices achieved
A notable increase in prices achieved for coffee sales has been recorded since TaCRI started working at Mbinga. In 2002, average price per kilo was Tshs 300 with TaCRI-trained groups at the time selling at Tshs 635 per kg. However, analysis of data from 2005/2006 showed the average price per kg for the period to be Tshs 2,346 for farmers working with TaCRI, with the price for other farmers being Tshs 1,100-1,600 per kg. This

is a very important result and a categorical indication of how combining forces, and adhering to good practices can have a visible and significant impact on farmer livelihoods (Fig. 8).

Farmer Field Days

During the year under review, field days were successfully coordinated in Mbinga's seven wards (Mbangamao, Mpepai, Mbuji, Nyoni, Myangayanga, Mkumbi, and Mahuka). An estimated 8,300 farmers participated during the field days.

Secondary Mother Gardens set up

The sub-station successfully supplied 13,000 seedlings to farmers in Mbinga and Songea for establishing their own mother gardens. A total of 9,600 bare rooted cuttings from Lyamungu were hardened at Ugano and distributed to farmers. A total of 2,300 shoots were supplied to farmers for planting in their own Vegetative Propagation Units (VPUs).

Farmers continued to multiply seedlings from their own mother gardens, and as a result a total of 7,600 seedlings were produced and planted in farmers' fields.

On-station mother garden expanded from 5,000 to 10,140 trees

Training of farmer groups at Ugano

The central pulping machine owned by the Jiendeleze Pilikano Farmer Group in Mbinga

Priorities for 2006-2007

1. Continue the mobilisation and formation of new farmer groups
2. Provide market information to farmers in six districts in Mbinga, Songea (R), (Ruvuma region) and Ludewa, Njombe, Mufindi, and Kilolo in Iringa region.
3. Link more farmer groups to the auction
4. Provide training on general coffee husbandry practices, including the establishment of mother gardens, and their management to at least 8,000 farmers
5. Continue with exchange visits
6. Conduct field days in at least in five wards in Mbinga, as well as one each in Ludewa and Songea districts
7. Graft at least 2,500 trees and encourage more farmers to stump old coffee trees.
8. Continue with Village Based Training (VBT) in six districts in Mbinga, Songea (R), Ludewa, Njombe, Mufindi, and Kilolo.
9. Train extension staff from Mbinga, Songea, Ludewa, Njombe, Mufindi, and Kilolo Districts.
10. Establish six demonstration plots with new coffee varieties in six districts including Mbinga, Songea, Ludewa, Njombe, Mufindi, and Kilolo.
11. Distribute at least 300,000 seedlings to farmers in the same districts
12. Expand the on-station mother garden from the 10,140 plants to 20,000 plants by June 2007.

Case Study 9: How Coffee is improving people's livelihoods in Mbinga

Alfereda & Christandus Chacha Ndunguru

TaCRI's work in Mbinga and neighbouring districts has significantly increased productivity and quality, reduced costs of production caused by diseases and old coffee trees, and improved growers livelihoods.

Mr. Christandus Chacha and his wife Alfereda Komba are amongst the progressive farmers who have received quality advice and proper extension on coffee husbandry practices to help improve yield and quality.

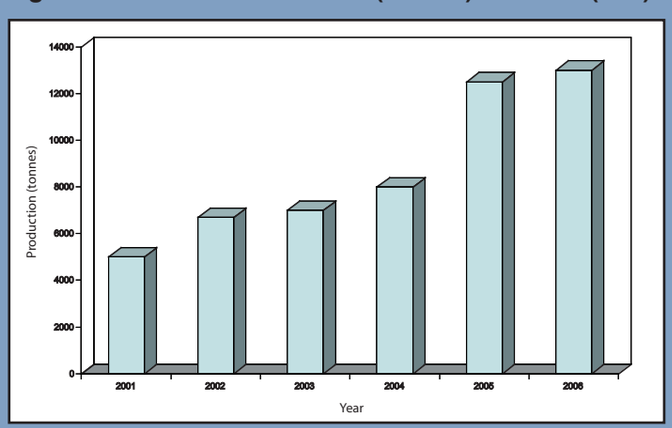
Before TaCRI's presence in Mbinga, Mr Chacha and his wife harvested just five bags of 50 kg parchment coffee from their old coffee trees. However, since training they have succeeded in harvesting 40 bags of parchment over this last period. They are expecting to harvest 60 bags in the 2007 season.

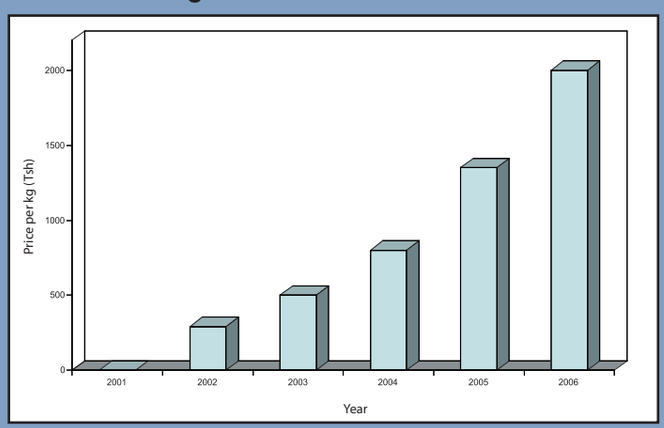
Mr Chacha says, "We continue to enjoy potentialities of the new varieties and in 2006 we have harvested three bags of parchment from our 75 coffee trees. The coffee was graded Class 4 and sold at 2,000/= per kg. The extra income has significantly helped us to pay school fees for our son who is in form VI in Mbeya".

In addition, Mr & Mrs Chacha have produced 400 seedlings from their own mother garden and they are now ready to plant out to replace their old coffee. They are proactive in teaching their fellow farmers on best coffee practices and multiplication of clonal seedlings and are proud to be involved in this important national effort.

Since TaCRI's inception in Mbinga, coffee production, price, quality and incomes have all increased year on year, bringing new hope to many coffee growers. These results are presented in the graphs below.

Fig 8: Increase in Production (tonnes) & Prices (Tsh) for Coffee in Mbinga 2001-2006





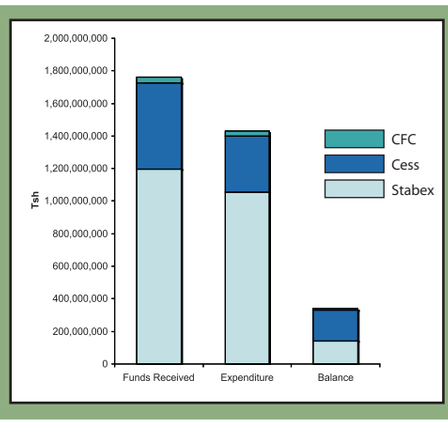
Finances


Mr Hubert Lema, Accountant

The activities of the Tanzania Coffee Research Institute (TaCRI) continued to be financed through various sources during the period under review, with specific commitments in the areas detailed in Table 6.

Table 6: Source & Disbursement of Funds

Sno.	Source of funds	Cost items	Amount (Tsh)	Financial year
01.	Cess/Stakeholders Contributions and TaCRIs' own funds	Staff remunerations Office costs Administrative Overheads	528,347,432	October/September
02.	STABEX funds	Coffee research & technology support programme-CRTSP	1,197,587,513	July/June
03.	Common Fund for Commodities-CFC	Coffee Wilt Disease programmes in robusta coffee	35,223,162	January/December



Efforts are underway to ensure reporting uniformity, especially after taking account of the fixed investments, as well as harmonising the accounting methods of TaCRI's various financing sources in line with the International Financial Reporting Standards (IFRS) and International Standards on Auditing (ISA) as adopted by the United Republic of Tanzania.

To give a glimpse of the financing at TaCRI during the year under review, the graph above highlights the position of cash flows as extracted from the different audited statements and reports.

Human Resources


Dr Omar Kizango,
Personnel & Administration Manager

During the period under review, the TaCRI team was strengthened with the employment of key technical people in the areas of Crop Improvement, Nursery Management, and Communications. Efforts were still being pursued to recruit experts in agricultural economics.

Staff members continued to be exposed to various capacity building activities including but not limited to:

- Team building events
- Participation in regional and international conferences
- Participation in work and professional related workshops and short courses
- Training in MSc. Degree course programmes by 3 staff members
- Consultations with external experts in research and management activities
- Collaborations with research and scientific bodies including CIFC, CIRAD, and the regional research institutions of Uganda and Kenya

The overall working atmosphere during the year was excellent which is attributable to the improved and motivating working environment, following substantial progress to modernise the Institute's facilities, equipment and management systems.

Obituary

The Chairman , Board of Directors, regrets to record the untimely demise of Clement Thomas Mwinuka, 40, who died at KCMC Hospital, Moshi on 4th November 2005. Clement joined TaCRI in December 2003 as a Nursery Coordinator and quickly distinguished himself as one of the rising stars in TaCRI. He was promoted to be the Head of the Department of Crop Productivity & Quality Improvement in March 2005, a position he held until his death.

Appendix I: List of Acronyms

CABI	Centre for Agriculture and Bio-Sciences International
CBD	Coffee Berry Disease
CIFC	Centro de Investigacao das Ferrugens do Cafeeiro
CIRAD	Centre de Coopération Internationale en Recherché Agronomique pour le Developpement
CLR	Coffee Leaf Rust
DEO	District Extension Officer
EAFCA	Eastern African Fine Coffee Association
IPM	Integrated Pest Management
PUM	Netherlands Senior Experts Programme
SUA	Sokoine University of Agriculture
VEW	Village Extension Worker

Appendix II: Distribution of Leaflets & Posters

Description	Lyamungu	Ugano	Mbimba	Maruku	Kigoma
Coffee Berry Borer (CBB)	4,000	400	400	0	200
White Stem Borer (WSB)	4,000	400	500	0	200
Trapping of CBB	1,936	400	500	0	200
Mealburg	1,936	400	500	5,000	200
Antestia	1,936	400	500	5,000	200
Identification of CWD	2,786	400	500	15,000	0
Know CWD	2,786	400	500	15,000	0
Coffee Leaf Rust (CLR)	1,256	400	500	5,000	200
Coffee Berry Disease	1,936	400	500	5,000	200
Use of Organic Fertilisers	4,000	400	500	0	200
Use of Minjungu Phosphate	4,000	400	500	0	200
Establishing mother garden	2,700	600	100	-	400
Multiplication of Clonal seedlings	2,700	600	100	-	400
Grafting	1,586	600	200	-	200
Processing	5,000	1000	500	-	200
Establishing & Managing Farmer Groups	400	120	100	-	50
Eight commandments (productivity)	500	80	50	-	80
Ten commandments (quality)	810	120	20	-	50

Appendix III: TaCRI Partners 2005-6

S/N	Partner	Collaboration
1.	Apex Engineering Co. Ltd Consulting Engineers and Planners Plot No. 438, Old Bagamoyo Road P.O.Box 4111Dar Es Salaam, Tanzania	Design & supervision of rehabilitation works
2.	African Coffee Research Network/Interafrican Coffee Association (ACRN/IACO) B.PV 210 ABIDJAN, COTE D'IVOIRE	Research and development
3.	Centre de Coopération Internationale en Recherché Agronomique pour le developpement cirad (CIRAD) TA 80/PS3, Boulevard de ra Lironde 34398 MONTPELLIER CEDEX 5, France	Establishment and operationalisation of research coffee tissue culture laboratory at Lyamungu
4.	Centro de Investigacao das Ferrugens do Cafeeiro (CIFIC) Rua da Junqueira, 86 - 1º 1300-344 Lisboa, Portugal	Breeding for durable resistance varieties to coffee leaf rust and coffee berry disease
5.	Centre for Agriculture and Bio-sciences International (CABI) P.o.Box 633-00621, Nairobi, Kenya	Management of CWD
6.	Coffee Research Network for Eastern Africa (CORNET) CAB International - Africa Regional Centre P. O. Box 633-00621, Nairobi, Kenya	Research & development
7.	East African Fine Coffee Association (EAFCA) Plot 958 Muyenga Hill, Galukande Close P.O.Box 27405, Kampala, Uganda	Promoting speciality coffee
8.	Mikocheni Agriculture Research Institute (MARI) P O Box 6226, Dar Es Salaam	Genetic finger printing for new varieties
9.	Netherlands Senior Experts Programme (PUM) P.O. Box 93078, 2509 AB The Hague The Netherlands	Support for Dutch senior experts in research management, crop improvement and soil fertility management
10.	Selian Agricultural Research Institute (SARI) P O Box 2064, Arusha	Farmers' assessment of new coffee varieties
11.	Sokoine University of Agriculture (SUA)/ Ohio State University Department of Crop Science and Production P.O.Box 3000, Morogoro, Tanzania	Coffee IPM

Appendix IV: TaCRI Officers & Staff

Board of Directors

Mr. Edwin Mtei - Chairman (Tanganyika Coffee Growers' Association)
Dr. Jeremiah Haki - Vice Chairman, Ministry of Agriculture & Food Security, Dar es Salaam
Mr. Leslie Omari - Tanzania Coffee Board, Moshi
Mr. Bill Harris - Tanzania Coffee Association, Moshi
Mr. Vedastus Ngaiza - Kagera Cooperative Union, Bukoba
Mr. Tobias Masaki - Kilimanjaro Native Cooperative Union, Moshi
Mr. Godfrey Makonganya - Isayula Cooperative Union, Mbozi
Mr. Ernest Komba - Kimuli Primary Society, Mbinga
Prof. James M. Teri - Secretary

Technical Advisory Panel

Prof. Martin Kyomo - Chairman
Prof. Bruno ndunguru - Vice Chairman
Mr. Simon Muro
Dr. Alli Mbwana
Dr. Hussein Mongi
Prof. James M. Teri - Secretary

Administration

1	Prof. James M. Teri	Chief Executive Director
2	Dr. Omar. S. K. Kizango	Personnel and Administrative Manager
3	Mr. Hubert N. lema	Accountant
4	Mr. Geoffrey N. Mtei	Estates Works Manager
5	Ms. Salama A. Kozi	Secretary
6	Ms. Amelda P. Kimaro	Librarian Assistant
7	Ms. Restituta A. Mallya	Typist
8	Mr. Haruna S. Msangi	Store Keeper
9	Mr. Hassan O. Kimath	Electrical Technician
10	Mr. Ismail S. Msuya	Estate Attendant
11	Mr. Abbas A. Mushi	Office Attendant
12	Mr. Joseph D. Kweka	Head Security Guard
13	Mr. Bertini C. Kweka	Security Guard
14	Ms. Isdora C. Mankya	Security Guard
15	Mr. Ludovick B. Kweka	Security Guard
16	Mr. Nuru J. Ilala	Driver
17	Mr. Robson Mushi	Driver

Crop Improvement Department

1	Dr. Linus I. Masumbuko	Head of Department
2	Mr. Deusdedit L. Kilambo	Senior Research Officer
3	Mr. Damian J. Mtenga	Research Officer
4	Mr. Faustin L. Mtuy	Field Officer
5	Mr. Josephine M. Urassa	Field Officer
6	Ms. Elianasoe E. Mosha	Field Officer
7	Ms. Grace K. Monyo	Field Officer
8	Mr. William N. Kimaro	Field Officer

Appendix IV: TaCRI Officers & Staff continued

Crop Productivity and Quality Improvement Department

1.	Mr. Godsteven P. Maro	Head of Department
2.	Clement Mwinuka	Head of Department (Deceased)
3.	Mr. Fredrick L. Magina	Research Officer
4.	Ms. Sophia E. Malinga	Field Officer
5.	Mr. Emanuel O. Nkya	Field Officer
6.	Mr. Harrison E. Monyo	Field Officer
7.	Mr. Focas M. Ritte	Field Attendant
8.	Mr. Hassan H. Kisere	Field Attendant
9.	Ms. Paulina P. Salla	Field Attendant
10.	Mr. Leonard N. Mushi	Field Officer
11.	Ms. Donatha F. Mbowe	Field Officer

Technology Transfer & Training Department & Lyamunugu Sub-station

1	Mr. Twahir S. Nzallawahe	Head of Department
2	Mr. Msanjo H. Temu	Extension Agronomist
3	Ms. Sheilla Y.S. Mdemu	Training Officer
4	Mr. Sixbelt K. Mourice	Assistant Nursery Coordinator
5	Mr. Aminieli Aligaesha	Assistant Communication Specialist
6	Mr. Mohammed A. Munisi	Field Attendant
7	Ms. Catherine B. Ritte	Field Attendant
8	Ms. Lydia S. Lema	Typist
9	Mr. Melkior B. Ngowi	Cook
10	Ms. Aisha K. Lalu	Typist

Maruku Sub-station

1	Mr. Nyabisi N.Maliyatabu	Extension Agronomist
2	Mr. Laurean P. Kaiza	Field Officer

Ugano Sub-station

1	Mr. Felician B. Swai	Extension Agronomist
2	Mr. Victor C. Akulumuka	Field Officer

Mbimba Sub-station

1	Mr. Isaac K. Mushi	Extension Agronomist
2	Mr. Charles J. Mwingira	Field Officer

Appendix V: Publications & Technical Reports

1. **Kilambo, D. L; Ng'homa, N. M; Mtenga, D. J; Teri, J.M; Nzallawahe, T; Mike, R & Masumbuko, L. (2006)** Progress Towards Searching for Durable Resistance to Coffee Wilt Disease in Tanzania. Poster presented at 21st ASIC Conference, Montpellier, France, 11 to 15 September 2006

2. **Magina, F. L; Mbowe, D. F; Chipungahelo, G. S & Teri, J. M. (2006).** Evaluation of Different Alcohols in Trapping Adult Coffee Berry Borer (Hypothenemus Hampei Ferrari). Poster presented at 21st ASIC Conference, Montpellier, France, 11 to 15 September 2006

3. **Maro, G. P; Monyo, H; Nkya E; & Teri, J. M (2006).** Soil fertility status of coffee growing areas in Tanzania. Poster presented at 21st ASIC Conference, Montpellier, France, 11 to 15 September 2006

4. **Mtenga, D. J; Kilambo, D. L; Teri, J.M; & Masumbuko, L. (2006**) Progress in Coffee Berry Disease (Colletotrichum kahawae) Resistant Compact Hybrid Varieties (Coffea Arabica) in Tanzania. Poster presented at 21st ASIC Conference, Montpellier, France, 11 to 15 September 2006

5. **Ng'homa, N; Kilambo, D. L; Masumbuko, L; Teri, J.M; Nzalawahe, S & Kaiza, M.P.L (2006).** Strategies for Coffee Wilt Disease Management in Kagera Region, Tanzania. Poster presented at 21st ASIC Conference, Montpellier, France, 11 to 15 September 2006

6. **Temu, M.H; Nzalawahe T. S, & Teri, J.M (2006)** The Potential of Participatory Extension Approaches in Coffee Rejuvenation: An Experience of Northern Tanzania. Paper presented at 21st ASIC Conference, Montpellier, France,11 to 15 September 2006

7. **Swai, F & Mushi, I (2006)** Development of Smallholder Coffee Growers in Southern Highlands of Tanzania. Paper presented at the Farmers Dialogue Conference, Buhuri, Tanga, 5-10 November 2006

Major Coffee Growing Areas of Tanzania and TaCRI Substations

Tanzania Coffee Research Institute

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