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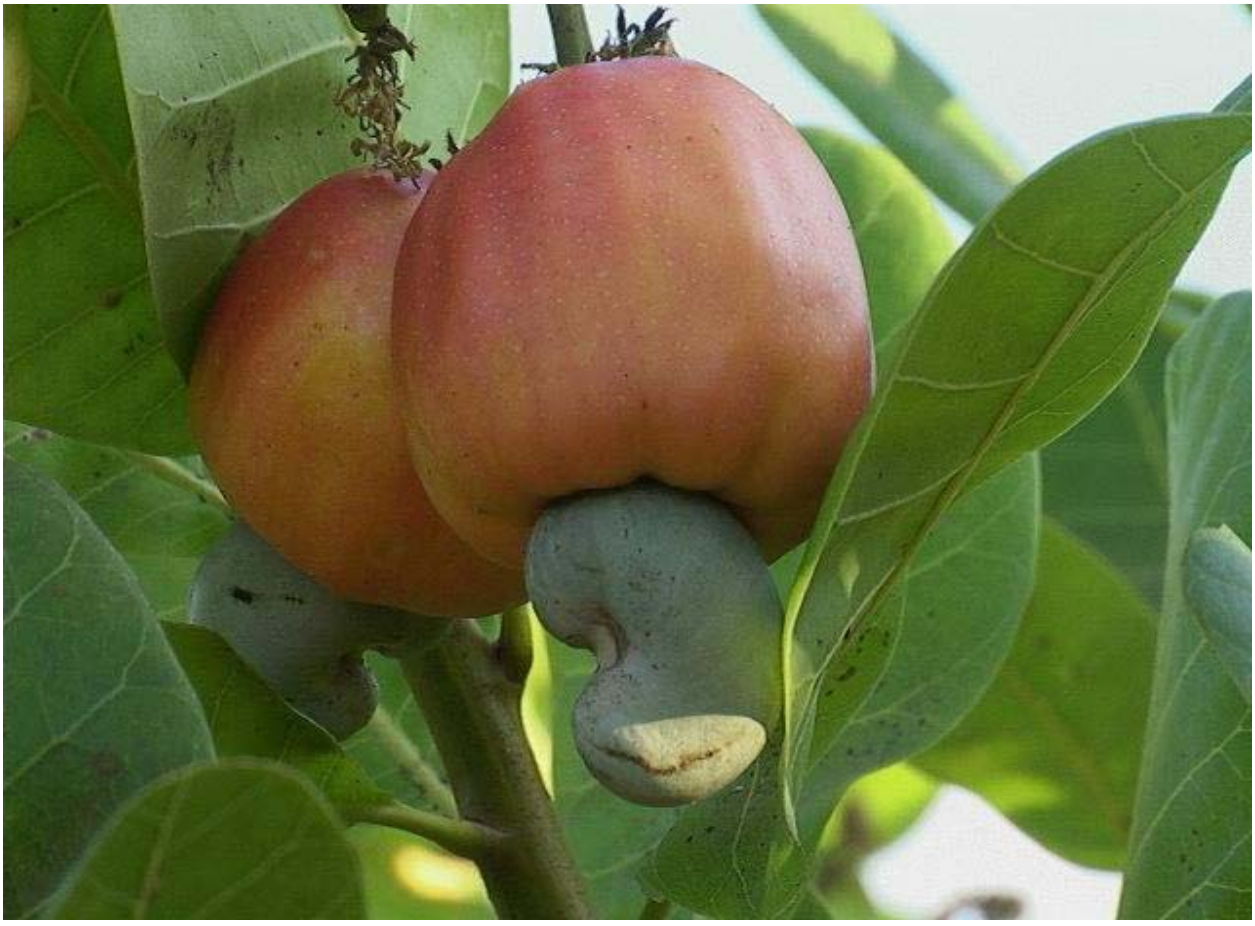

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COVER PHOTO

This is one of the 16 new cashew clones which were developed by the Naliendele Agricultural Research Institutes, Mtwara-Tanzania. The clones are high yielding and resitant to diseases such as Powderly mildew, Athracnose and Die back. The new clones produce yield as high as 70 kg per tree.

Photo Courtesy by Dr. Peter Masawe, Principal Research Officer, ARI Naliendele, Mtwara

The Tanzania Agricultural Research & Training Newsletter is published qauarterly by the Department of Research & Training, Ministry of Agriculture Food security & Cooperatives. The newsletter is a means of enhancing communication among Tanzania agricultural scientists, and disseminating scientific information especially recent research findings to relevant users. It is also used for publication-exchange programme with other scientific institutions within and outside Tanzania.

We invite contributions from the agricultural scientists and those of the allied sectors in Tanzania. Such contributions should be in form of short articles (800 - 3000 words), workshop/conference reports, illustration materials and news items that will help agricultural development in Tanzania. The articles should be original and authentic research findings or progress reports about on going projects.

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Message from the Director of Research and Training

Top of the agenda in 2005 was the merging of two Departments, the Department of Research and Development (DRD) and the Department of Training Institutes (DTI) to form the Department of Research and Training (DRT). The implementation of the new structure was effective in July 2005, where at the Ministerial level, I was appointed to be the first Director of the new department and my colleague Mr. Ramadhan S. Kapande was appointed the Assistant Director responsible for training.

The Implementation of the new structure at the Zonal level was worked out by a team of experts and recommendations on the modalities are being put into actions. It was under the same development spirit, a meeting of Zonal Directors for Research and Development and Principals of Training Institutes was held on 30th September 2005 at Kibaha Sugar Research Institute under the chairmanship of the Permanent Secretary, Wilfred Ngirwa. The meeting deliberated on among other things the implementation of the new structure at the Zonal level. In the new structure the zonal management team will include the Zonal Director Research and Training (ZDRT), Assistant Zonal Director Training (AZDT), Assistance Zonal Director Research (AZDR) and Technology Transfer Coordinator (TTC). These positions will soon be advertised and will be filled in on competitive basis with a specific salary structure and terms of service.

The good news for coffee growers this year was the official launching of 10 new varieties of Arabica coffee by the Tanzania Coffee Research Institute (TaCRI). That was a big break through for coffee research which started 50 years ago. The new varieties have potential to increase incomes of farmers by reducing costs that were previously spent on coffee diseases control. The major coffee diseases that the new varieties are resistant are Coffee Berry Disease (CBD) and Coffee Leaf Rust (CLR). Let me take this opportunity to comment TaCRI for their speedy release of the new varieties and their plans on the ground to ensure the varieties get quickly to farmers.

Another development worth mentioning is the improvement of government budget to finance research activities. As you may recall, this was the second year to operate without TARP II, where our research activities have operated entirely on government budget. Unlike in previous years this year the government budget going into research increased substantially. As a result after many years we could finance some of the personnel benefits such as paying leave allowance, which could not be provided in previous years.

The increasing GoT funds have given us more room to address issues that are of priority to our nation. Relatively substantial amount of funds were allocated to all research programs including the new thrust to research on traditional and non traditional crops. In addition to routine research activities, resources were also spent to support various training programmes in the country and abroad.

As you may have noted, the coordinating committee meetings which used to draw scientists together to discuss and share experiences stopped some few years ago and in return they were replaced by zonal committee, meetings namely the Internal Programme Review (IPR), Technical Review Committee (TRC) and Zonal Executive Committee (ZEC) meetings. Over the last two years the funding level could not support those meeting to take place. This has seriously denied our scientists a forum for exchanging ideas and experiences. This weakness has been observed and it has been agreed that after every two years there will be *a National Agricultural Scientific Conference* that will bring together scientists from different disciplines to present papers on a particular theme. The first scientific conference is planned to take place starting 2006/07 and I call upon all scientists to take this up seriously as this will be an opportunity and a gateway to get international exposure.

Dr. J.M.Haki

Information communication between the DRT Head office and research stations has continuously improved. Commendable achievements were recorded during TARP II where a number of zonal research centres were connected to the internet. It is interesting to mention that these efforts have continued in 2005, where four other research stations namely Mlingano, Ifakara, Dakawa and Makutopora were connected to the Internet. It is with this development, the DRT has almost all of its research stations connected to the Internet. This has not only facilitated the smooth flow of information with the head office, but has enabled scientists and trainers to communicate with each other and around the globe and access information almost instantly which has been an impetus in improving their research outputs. Efforts will continue in the coming years to improve communications in other research stations and training institutes.

Let me now underscore the importance of agricultural experts in improving agricultural productivity in the country. As we all know, the number of existing extension officers that are supposed to serve the farmers is very low. Worse still is the ongoing erosion of technical staff in the department due to retirement and other calamities. These are serious challenges which can only be solved by increasing the capacity of our training institutes to

enrol more students to cope with the demand. The current situation shows that in recent years there has been improvement in student enrolment especially after the government decision to start providing sponsorship. However the challenge now is the inadequate number of tutors to cope with the anticipated increase of students in the near future.

The sad news in 2005, involved the students' dormitory at the Ukiriguru Training Institutes which was completely gutted on fire accident that was caused by electricity faulty. In this incidence over 40 students lost their properties. I wish to convey my sympathy to all the effected students. The government has taken measures to restore the building to normal.

With the launching of the ASDP Basket Fund in year 2006/2007 and with renewed commitment from Government to increase the level of funding for the Department, we must now position ourselves to respond to the challenges ahead of us. The Zonal Agricultural Research and Development Funds to be established under the ASDP will provide additional resources to enable us respond to farmer needs.

I therefore look forward to a busy 2006/2007 whereby our contribution to agricultural growth will be required.

I thank you all for your continued cooperation, and wishing you all the best.

Jeremiah M. Haki, PhD
Director, DRT

Improved Arabica Coffee Varieties Provide New Hope to Coffee Farmers

Ten new varieties of Arabica coffee have been developed and released by the Tanzania Coffee Research Institute (TaCRI). These varieties are the product of research efforts which started 50 years ago by coffee research programme of the Department of Research of the Ministry of Agriculture, which was later taken over by TaCRI with the aim of revitalizing coffee production in the country.

The goals of the coffee research program have been to come up with solutions on problems facing coffee industry in Tanzania. Diseases such as Coffee Berry Disease (CBD), Coffee Leaf Rust (CLR) and Coffee Wilt for Robusta coffee prompted scientists to breed for resistant varieties. Parallel to diseases were the various insect pests that attack coffee which reduce coffee productivity and finally the income of the farmer.

More so aged coffee trees, non-use of modern production technologies, high costs of inputs, high interest rates of loans and low coffee prices are among many problems that are facing coffee industry in Tanzania. It is estimated that coffee diseases could reduce coffee yields from 30 to 60 per cent, whereas the costs of controlling the diseases in previous coffee varieties accounts by almost 50 per cent of the production cost.

The new coffee hybrids are superior in terms of possessing many good qualities. Those qualities include resistance to major coffee diseases namely Coffee Leaf Rust (CLR) and Coffee Berry Disease (CBD). The varieties produce large coffee beans in which a sack weighs between 65 – 70 Kg in comparison to 45 – 50 Kg obtained from previous coffee varieties that result into high profit margin of dried coffee. The varieties produce coffee of good taste and aroma thus attributing to their high marketing opportunities.

TaCRI's mission now is to produce planting materials of the new varieties in big numbers for distribution to coffee farmers. Some coffee farmers such as Mr. Elisalia Mosha is among the elite beneficiaries of the new coffee varieties. Commending on the varieties, Mr. Mosha said "the release of the new coffee varieties have made me return to coffee farming". He further said "coffee farming started to loose popularity because it was no longer profitable due to high costs of production resulting from chemicals one has to apply to control coffee diseases, apart from the low production potential of varieties we used before the new ones".

The launching of the new coffee varieties was done by Mr. Wilfred Ngirwa, Permanent Secretary of the Ministry of Agriculture and Food Security at the ceremony which was attended by stakeholders of coffee industry in Tanzania. Mr. Ngirwa congratulated scientists for their tireless efforts devoted towards developing the varieties. He also stressed on the need to protect the varieties under the Plant Breeders Rights Act of 2004 that would guarantees benefits to breeders and the country at large.

He extended appreciation to the farmers and other stakeholders in the coffee industry such as those in Business, the Coffee Board of Tanzania and donors particularly the European Union (EU) through STABEX program, for their support which contributed to the successful development of the new coffee varieties.

Performance of Cashew Hybrids Developed from Partial Dialed Crossing between Selected Clones in Tanzania[1]

P.A.L. Massawe, S. Mfume and Z. Mbunda

Abstract

Five cashew clones were selected as potentially high yielding, tolerant to powdery mildew and one as susceptible to the disease. All of them were crossed to produce 30 crosses including reciprocals and six self's. These progenies were planted and evaluated for their performance at Naliendele Agricultural Research Institute in the South eastern Tanzania. Yield, nut quality and vegetative data were recorded on a trees basis for a period of nine years. Results showed that 13 hybrids were the most outstanding in terms of yield and nut quality.

Introduction

Most cashew trees growing in farmers fields were derived from seeds of parents representing very narrow genetic base. However, the existing cashew population shows considerable phenotypic variations. Mass selection was carried out after several years of observations and superior genotypes were selected to enter a second stage of cashew improvement. The selection was based on yield performance and nut quality assessment. This was by far adequate because previously there were neither diseases nor insect-pests of economic importance for cashew in East Africa (Masawe 1994).

However, with the outbreak of cashew powdery mildew in East Africa and Anthracnose in Brazil and high incidences of insect pest attack in cashew, selection indices were reviewed to cope with the existing conditions and market demands. For that reason selection has now included more parameters and among them are diseases and insect pest tolerance, dwarfism, large nuts size and short duration of nut picking. In the existing populations, cashew trees possess one or few of those characters.

One way of obtaining improved materials from any genetic collection is by crossing between selected parents. Crossing combines the characters in such a way that a small proportion of the hybrids will perform better than both parents. Once this proportion of hybrids is identified it can then be multiplied vegetatively or forwarded for advanced trials to establish whether the performance of the identified individuals is genetically or environmentally controlled. Equally the trial will also identify hybrids, which are suitable to specific or several environments.

In Tanzania the first hybrids were developed in 1991. Observation of the hybrids at the early stages of the tree development indicated that growth of the hybrids was more vigorous than the clonally propagated parental clones. It was also found that tree heights were more heritable than canopy diameters (Masawe *et. al.*, 1998). However yield and yield components were not considered because the trees were still young. Now that such cashew trees have reached an optimum growth the data available can warrant evaluation of yield and yield components. This paper reports the performance of the hybrids planted in 1991 in the southern zone of Tanzania.

Materials and Methods

Five parents of promising cash clones were selected basing on yield results of over 15 years (Anonymous 1990). The clones were AC4, AC10, AC43, AZA2 and AZA17. In addition, ATA19 parent clone known to be susceptible to powdery mildew disease (Sijaona personal communication) was also selected. Clone AC4 was also used as control (Plate 1A, 1B and 1C). The six clones were crossed to provide 30 crosses including reciprocals and six selfs. Nuts from controlled hand pollination were raised in polythene bags and thereafter seedlings were planted in a design randomized complete block (RCB) design with four replicates, each with 18 trees per plot planted at a spacing of 6m triangle. There were 13 crosses and 5 selfs from 36 combinations. The six parents were randomized around the periphery of the trial plots and there were four cashew trees per plot. Data recorded were on yield, canopy diameter, nut and kernel weights. Data analysis was done using SAS statistical package.

Results and Discussions

Results shown that there were significant differences in yield and vegetative characters at p=0.01 between genotypes (Tables 1a & 1b). The interaction between of Rep x Genotypes was in significant except for yield data recorded in 1995 and also for canopy diameter which suggests that the genotypes were performing the same in each replicate.

The trial mean yield increased from yearly to 7.97 kg/tree in 1998 and in subsequent year there was no substantial increase probably due to overlapping of the tree canopies, which reduces production area of the canopy. The coefficient of variation (CV) for yields was very high. On the other hand the CVs for vegetative data canopy diameter and height nut weight and percentage kernel out-turns were low.

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A B C

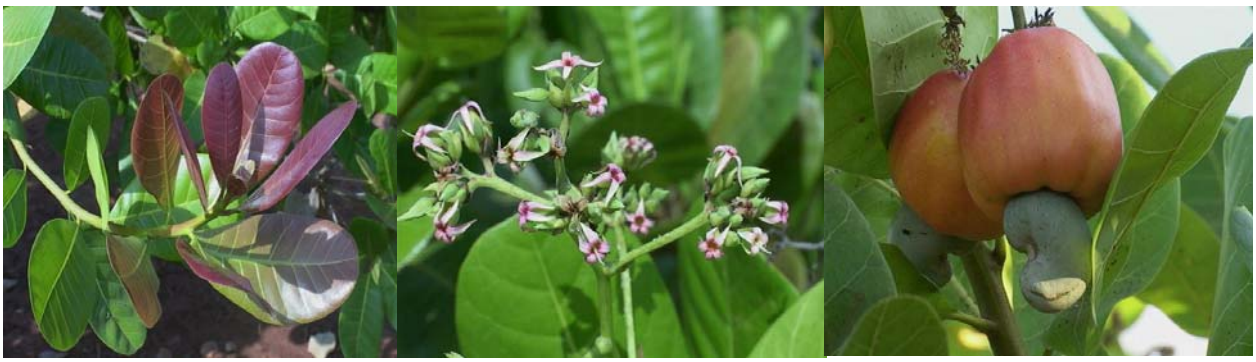

Plate 1 Clone AC4 (A) flush, (B) inflorescence and (C) apple and nuts

Table 1a. Analysis of Variance for Yield 1994-2000

Source	df	Mean Squares						
		Y1994	Y1995	Y1996	Y1997	Y1998	Y1999	Y2000
Rep	3	0.0958	8.2500**	47.3382**	7.7340	66.6328	20.7897	157.1422**
Genotype	23	0.4752**	2.9881**	9.7186**	21.8053**	86.7336**	34.2316**	95.5786**
Rep x Genotype	69	0.1646	1.8868*	4.7182	8.3637	23.0209	12.1751	35.9818
Error	135	0.2264	1.3354	4.7286	8.5085	28.7084	17.1140	41.2359
Mean		0.38	1.24	2.44	3.95	7.07	5.33	10.46
CV		124.90	93.07	89.03	73.83	75.71	77.51	61.36

Note:
* P=0.05
** P=0.01
Y = Yield (kg)

Table 1b. Analysis of variance for yield 2001, yield 2002, yield 2002/cgca, mean yield (1994-2002), nut weight, percentage kernel out-turn, canopy diameter and height

Source	df	Mean squares							
		Y2001	Y2002	Y2002/ cgca	MY94-02	NutWt	OT%	Canodiam	Height
Rep	3	106.1266	219.3395**	0.0139	18.3214	7.6989**	10.1750	39.6801**	39.6183**
Genotype	23	99.2899*	99.5045**	0.0142**	29.2186**	5.2213**	32.4599**	7.2722**	9.1804**
RepxGenotypes	69	51.6898	43.4614	0.0052	10.0086	2.1942	9.5825	3.7899*	1.7357
Error	135	60.6989	41.2212	0.0055	12.6997	1.7243	9.8261	2.6229	1.2728
Mean		10.52	10.22	0.1584	5.75	7.666	28.05	8.80	6.32
CV		74.00	62.82	47.12	61.90	17.12	11.17	18.40	17.84

* P=0.05 Y =Yield (kg) %OT= Percentage kernel out-turn
** P=0.01 Nutwt=nut weight (g) Y= Yield (kg)
MY94-02= Mean yield (kg) from 1994-2002 Canodiam=canopy diameter (m)

High CVs in cashew appears to be common in many countries. Eijnatten and Abubaker (1983) reported coefficient of variation of 48%. In India, Nair and Prabhakaran (1983) found CVs varying from 46.89% to 116.85%. Higher CVs in cashew yields were also reported by Neto (1992), Mead and Martin (1992), Masawe and Millanzi (1997). Nut set plays an important role in tree yields. However, nut set in cashew was found to be affected by lack of pollinating agents (Northwood, 1966; Heard *et al.* 1990) and to some extent this can cause variation in yield within genotypes, which contributed, to higher CVs. Low nut set on some cashew trees was reported in Mozambique (Masawe and Mapsangue, 2000), due to low temperatures, which delayed time of insect hatching. Other studies indicated that nut set can also be affected by limited nutrient resources (Subbaiah, 1983; Nawale *et al.* 1984, Ghosh, 1989).

Results of Duncan's multiple range tests on yields nut weight, kernel weight and percentage kernel out-turn showed that families of genotype AZA17xAC43 had the highest in yield. In contrast, families of genotype AC10xAC10 had the lowest yield and poor nut quality.

When yield and nut quality over the study period were analyzed six genotypes (AZA17xAC43 ATA19xAC10, AC4xAC4, ATA19xAC4, AZA17xATA19 and AC43xATA19) performed better than the control genotype AC4 which had lower mean yields ranging from 2.4 to 7.3. All genotypes had nut weight greater than 7g and percentage kernel ranging from 23-32%, which is above minimum accepted level of 20%.

It was also revealed that families of genotypes that performed better than the control genotype (AC4) had great variations within genotype in yield and nut quality. Since these are the most important characters for selection in cashew, a selection criterion was set to identify individual hybrids within genotypes that contributed to its good performance. The selection criterion was hybrids with mean yield equal or greater than 10 kg which was the average trial mean for period of three years the yield per unit area equal or greater than 0.20 kg/m^2, and the nut weight equal or greater than 7g. Based on those criterion 13 hybrids were most outstanding (Table 2). Although some hybrids had same parents they recorded different yield potential because cashew is highly heterozygous which confers with other results observed when studying fruit color segregation in cashew (Masawe, 1994). In that study hybrids from the same parents have different fruit colors such as red, orange and yellow.

Conclusion

The 13 selected hybrids are promising. However, a single tree represents each hybrid, which can be lost due to biotic or abiotic factors. For that reason they should be included in the cashew gene bank for conservation and also multiplied in scion garden for future use. Equally the hybrids should be tested at different agro ecological sites to find out if the environment influences the performance of the hybrids.

Table 2. Selected hybrid, proposed entry name in multilocational trial and its yield potential at the age of 12 years.

NN	Hybrid	Proposed entry name	Yield/tree at 12 years (kg)
1	56.24 (AC4XAC4)	Naliendele 91/1	21.64
2	22.11 (ATA19xAC10)	Naliendele 91/2	23.11
3	8.20 (9AZA17xATA19)	Naliendele 91/3	29.04
4	44.07 (ATA19xAC4)	Naliendele 91/4	15.75
5	54.09 (AC4xAC4)	Naliendele 91/5	27.11
6	52.28 (ATA19xAC10)	Naliendele 91/6	24.77
7	56.05 (AZA17xAC43)	Naliendele 91/7	25.36
8	22.09 (ACA4xAC4)	Naliendele 91/8	12.73
9	54.05 (AZA17xAC43)	Naliendele 91/9	29.81
10	22.05 (AZA17xATA19)	Naliendele 91/10	20.20
11	48.20 (AC43xATA19)	Naliendele 91/11	26.61
12	54.28 (ATA19xAC10)	Naliendele 91/12	22.07
13	52.18 (AZA17xAC43)	Naliendele 91/13	29.69

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Scientist working on cashew experiments at ARI Naliendele Mtwara, Tanzania

Evaluating the Impact of Improved Agricultural Technologies at Farm Level in Tanzania

D. Lwezaura[1]

Abstract

Assessment of the impact of improved technologies in farmers' fields was conducted during the last year of implementation of the Tanzania Agricultural Research Project (TARP). The study culminated after other studies which were conducted during the project lifetime which focused on randomly selected sample of farmers that participated in the whole process of the development, use and transfer of agricultural technologies. Using semi-structured questionnaire a total of 1995 farmers obtained through purposive and stratified sampling methods were interviewed. Generally the results showed that the project (TARP) intervention increased crop yields to farmers that adopted improved varieties and recommended agronomic practices.

Introduction

Monitoring and evaluation (M$E) system was institutionalized in the agricultural technology development and transfer prior to the implementation of the second phase of the Tanzania Agricultural Research Project (TARP II) in 1998. The main objective was to track down, on a yearly basis, the progress, effectiveness and impact of recommended agricultural technologies at farm level as a result on group research projects. TARP II started to be implemented in June 1998 and came to an end in June 2004. In order to be able to measure the impact of the project at farm level at the end of the project baseline, studies were undertaken in 1998. Time series information was generated through M&E studies conducted in the year 2000. The intention was to track changes in farming practices over a 5-year period focusing on the particular households. The data were collected repeatedly in the same farming systems where researchers had been interacting with respective farmers.

Study objectives

The assessment was to establish evidence of changes in farmers' practices that have taken place as a result of project intervention in agricultural technology development and transfer. The information generated will be a useful feedback for improving future research activities and make it more responsive in addressing to farmers needs. The information will also be used in research assessing the impact of investment. The evaluation has taken a keen interest in performance measurement basing on the analysis on rigorous performance indicators of the project. This study was also expected provided information to managers and donors about the contribution of the project in terms of successes and failures and spelling out lessons for future improvement.

Methodology

The survey covered seven research zones (Central, Eastern, Lake, Northern, Southern Highlands, Southern and Western). A total of 1995 farmers were selected for interview. Out of these, a total of 1246 were farmers who participated in on-farm research activities and 749 were non-participating farmers. The farmers were selected from five dominant farming systems in each zone. The sampled farmers were interviewed using a semi-structured questionnaire.

A multi-stage and purposive sampling process was used to select survey areas and farmers based on selection criteria such as the level of current on-farm research activities; past involvement in on-farm research and potential for initiating on-farm research (OFR) activities in the near future; agricultural potential; enterprise balance (crops and livestock); and other partners working in the area such as NGOs, development programmes and extension services.

Six villages from each of the five dominant farming system of each zone were selected based on logistics and/or proximity and level of on-farm research activities. Ten farmers from each village were selected, out of which 7 were collaborating and 3 were non-collaborating farmers. Selection also considered gender balance.

Data analysis

Descriptive statistics and test of functional relationships such as t-test, Chi^2, and analysis of variance (ANOVA) were used in the analysis. The analysis based on comparison between collaborating and non-collaborating farmers, farming system zones, adoption behavior disaggregated on such factors as gender, age, and education and farm characteristics.

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Results and Discussion

Household socio-economic characteristics

Results showed that 89% of households were male headed. The age structure showed that 39% of respondents were between 15 and 40 years, 47% between 41 and 60 years and 14% were above 60 years old. About 78% of the respondent farmers were primary school leavers 9% had no formal education and 13%) had college level education. The number of members per household ranged from 8 to10 with an average of nine.

Cultivation practices

The prominent tillage practices applied by farmers include minimum tillage, hand hoeing, tractor ploughing and draft animals. About 78% of the farmers indicated to be using a hand hoe followed by ox plough (34%), tractor (13% and zero tillage (12%). Terracing and tie-ridging were not common practices. Only 21% of farmers practice contouring, 12% tie-ridging and 6% used terracing.

Farm assets

Type of assets used (through ownership or hiring) is a reflection of the wealth and capacity of households to manage farm and off-farm business. The results show that about 97% of the respondent own and use hand hoe, out of them 63% were those collaborating with research institutions. This indicates that majority of farmers in Tanzania still rely on rudimentary farming tools. The reason could be that the peasant economy under which most farmers are operating is not enabling them to acquire and use modern farming tools. The results indicate that majority of farmers own and use the mentioned farm assets and that of collaborating farmers own and use more farm assets than non-collaborators. This probably implies that, farmers collaborating with research institutions are optimistic of the future outcomes and hence are self-pushed to acquire more assets.

Very few farmers' own tractor harrow or ox-plough. Hiring of farm assets was not a common practice. This could be due to either unavailability of such hiring initiatives or inability of the farmers to afford the costs involved.

Use of improved technologies

The findings show that about 96% of the total respondents were using improved cotton seeds, sunflower (58%), maize (55%), sorghum (42%), pigeon peas (42%), rice (39%), banana (29%), beans (28%) and millet (27%).Percentage of farmers using improved varieties of groundnuts, cassava and cowpeas was low(21%,20% and 15% respectively. The levels of use of improved varieties varied for each crop across zones. In case of maize, Northern zone with (85%)of the total respondents using improved varieties. This followed by Central zone with (62%), Western (53%), Lake (49%), Southern Highlands (49%), Easter (45%) and the lowest in the Southern zone (39%). Sixty one percent of farmers in the Northern zone used improved seeds of sorghum, that were followed by Western (53%) and Central zone (51%). Regarding rice production (63%) of respondents in the Eastern zone used improved seeds followed by Central zone (59%)

The proportions of use of improved seeds between collaborators and non-collaborators varied. In all major crops the proportion of collaborators who used improved varieties was higher than for non-collaborators. With the exception of cotton, rice and sorghum, in all other crops the differences that were observed were found to differ significantly at 5% level (Table 1). This implies that collaborators had benefited from contact with

Table 1: Percentage use of improved varieties

Crop	Overall Zones	Collaborators	Non-collaborators	Chi^2-test
Maize	55	62.0	46.1	S
Millet	27	13.0	11.5	NS
Sorghum	42	43.7	26.1	S
Rice	39	37.8	31.0	NS
Beans	28	34.7	20.0	S
Pigeon peas	42	36.1	14.6	S
Cowpeas	15	18.1	3.1	S
Groundnuts	21	19.4	14.7	S
Cassava	20	22.6	8.3	S
Banana	29	37.3	12.0	S
Cotton	96	92.9	86.8	NS
Sunflower	58	36.4	22.2	S

Table 2 indicates that there was a significant increase in the proportion of farmers using improved seeds for maize, rice, sorghum, wheat, coffee, cotton, and sunflower. The data also show that there was no increase in farmers adopting improved seeds for cassava, beans, groundnuts, banana and sweet potatoes. However, these findings should be taken with caution because of the differences in the sample sizes and number of farming systems used between the years.

Farm productivity

Table 3 shows 11 crops commonly grown in Tanzania. Productivity of almost all crops was very low reflecting the subsistence nature of Tanzanian agriculture. On average rice yield was 2040 kg/ha, cassava 1169 kg/ha, maize yield was 1508 kg/ha, and sunflower 1279 kg/ha, sorghum was 627kg/ha and beans 790 kg/ha. Productivity varied among different crops across zones. The results also indicated that overall Northern zone led was leading in crop yields for maize (2737kg/ha), while Southern Highlands produced the highest rice yield (3582 kg/ha).

Crop yields between collaborators and non-collaborators and between the farms own by men and women (see Table 3). The findings indicate that except for pigeon peas and cowpeas, crop yields of collaborators were higher than those of non-collaborators. However, in some of the crops the yield difference between collaborators and non-collaborators was not significant (p=5%). This implies that a significant number of non-collaborating farmers are active in adopting the new agricultural innovations either through parallel interventions or collaborating farmers.

Comparison of yields between men and women farmers showed significant variation. Male farmers had higher production levels for maize, rice, sorghum, cassava, cotton, pigeon peas and cowpeas. Female farmers had higher production levels for sunflower, beans, groundnuts and bananas. In all crops the observed mean yield differences between the groups was significant. There could be numerous factors to account for this trend including the economic status of the crop with males dominating commercially viable crops leading to differences in allocation of resources and time in management of the crop.

The yields recorded in previous surveys in 1998, 2000 and 2003 for various crops are presented in Table 4. There was an increase in yield for almost all crops except cassava, beans and sorghum. While the yield of cassava decreased in the annual average of about 13%, sorghum and beans decreased by 7% and 4% respectively. The increase in banana production was substantially significant compared to other crops (Table 4). This could be due to the introduction of improved agronomic technologies in the study area. The average increase of yield maize and rice was 3% and 6% respectively for the five year period

Farmers' participation in on-farm research activities

Technology development and dissemination (TDT)

The findings indicate that more than 56% of the total collaborators were involved at different stages of technology development and transfer. Table 5 shows the proportion of farmers who participated in site selection for the trials (74%), planning for on-farm and on-station research (46%), and problem identification (52%). There were variations across the zones in the application of research participatory methodologies. Women were not adequately represented in the TDT process.

Further analysis indicates that involvement of farmers in TDT increased from year 1998 at the start of TARP II to year 2003. For instance, about 19%, 35% and 52% of collaborators said to have been involved in problem identification in 1998, 2000 and 2003 respectively. In year 1998, 2000 and 2003 about 21%, 35% and 51% respectively participated in research planning. The number of collaborators who participated in planning for on-farm/on-station trials increased in the order of 26%, 34% and 45% in 1998, 2000 and 2003 respectively

Technology diffusion

The comparison made between collaborators and non-collaborators on the use of improved varieties and farm production and productivity shed lights on whether the non-collaborators did acquire technologies by way of diffusion. The transfer of technologies from collaborators to non-collaborators could be affected through sharing of research materials, informal meetings and farmer-to-farmer visits.

Table 2: Percent of respondents who used improved varieties by year

Crop	Year 1998	Year 2000	Year 2003	aver. Increase (%)
Maize	25	38	56	6
Cassava	17	8	17	0
Sorghum	15	15	39	5
Rice	20	12	35	3
Beans	35	24	30	(2)
Wheat	37	43	82	9
Groundnuts	25	13	18	(1)
Banana	39	40	31	(2)
Coffee	17	28	57	8
Cotton	50	43	90	8
Sunflowers	11	13	33	5
Sweet potato	33	28	22	(2)

Note: Figures in brackets denote negative number.

Table 3: Crop yield (kg/ha) by Collaboration and Gender

Crop	National	Research Collaboration			Gender		
	Average	Collaborators	Non Collaborators	T-test	Male	Female	T-test
Maize	1508.20	1635.63	1290.18	S	1554.75	1322.70	S
Rice	2039.78	2166.70	1861.53	NS	2117.23	1656.78	S
Sorghum	626.73	635.48	601.48	NS	684.63	433.70	S
Sunflower	1279.48	1348.73	1094.20	NS	1094.35	1757.88	NS
Beans	790.53	862.75	675.00	NS	759.70	930.33	NS
Cassava	1169.05	1326.85	858.00	S	1233.25	816.00	S
Ground nuts	726.78	775.43	625.43	S	698.48	817.40	NS
Bananas	8540.65	9242.03	6085.83	NS	7188.13	16317.70	NS
Cotton	715.25	811.85	453.05	S	770.30	379.85	S
Pigeon pea	933.20	872.63	1086.78	NS	971.38	758.43	NS
Cowpea	691.33	603.00	828.00	NS	705.23	510.43	NS

Note: N-Significant; NS-Non significant

Table 4: Comparison in yield of major crops by years (kg/ha)

Crop		Year		Annual Yield
	1998	2000	2003	Increase (%)
Maize	1400	1100	1508	3
Rice	1600	1500	2040	6
Cassava	2700	2200	1169	(13)
Beans	900	800	791	(4)
Sorghum	900	800	627	(7)
Sweet potato	2000	1900	2667	7
Wheat	1400	1381	1644	4
Banana	3000	2293	8541	50

Table 5: Percent of collaborators involvement in TDT process

Zone/Gender	Technology Development and Transfer Process			
	Problem Identification	Research Planning	Site selection for trials	Planning for on-farm/on station activities
Central	7(39)	10(58)	10(59)	6(36)
Eastern	3(39)	4(51)	5(63)	2(27)
Lake	7(52)	5(38)	11(81)	8(60)
Northern	10(60)	9(53)	12(73)	8(48)
Southern	9(59)	10(66)	10(66)	9(60)
S. Highlands	11(65)	9(54)	16(91)	10(55)
Western	5(45)	4(31)	11(88)	4(30)
Gender:				
Men	42(53)	41(51)	60(76)	38(48)
Women	10(51)	10(50)	14(71)	19(37)
All Zones	52	51	74	46

Note: Figures in brackets mean percentage of respondents within the zone/gender.

The findings show that about 82% of the collaborators shared results with non-participating farmers. About 74% of the total collaborators shared results with non-participating farmers by visiting their research plots/ animal, through seasonal evaluation (28%), through sharing of seeds/breeding bulls (29%), village meetings (27%) and about 76% shared through informal discussions.

There has been improvement for non participating farmers accessing technologies from participating farmers. For instance, the proportion of non participating farmers who visited research plots, shared improved seeds/breeds, attended village meetings and in informal discussion increased from year 1998 to 2003. In 1998 non collaborators who visited research plots were about 5% which increased to 31% in 2000 and 74% in 2003. There was also a significant increase for those participating in seasonal evaluation which increased from 4% in 1998, 8% in 2000 and to 28% in 2003. Those who shared improved seeds/breeds were about 8% in 1998, 14% in 2000 and 29% in 2003. Likewise, those who accessed technologies through village meetings increased from 10% in 1998, 14% in 2000 to 27% in 2003. The mechanisms that were mentioned by farmers as appropriate for technology up scaling were informal discussion among farmers and farmer-to-farmer visit. The results also show that men were highly exposed than women.

Constraints in technology development

Farmers were asked to explain the problems they are facing in the process of technology development and transfer. About 39% of the total collaborators said they had some problems with interacting with researchers in on-farm research. The responses varied from zone to zone and included irregular visits of researchers, poor timing of trials and untimely delivery of inputs that does not match with farming season. Other problems mentioned were undesirable results and lack of input and output market. The issue raised by farmers should, in future, be seriously taken into account by researchers.

Conclusion and recommendations

The core problem of agricultural production in Tanzania has been low yields of crops. Some of the direct cause being poor husbandry techniques, occurrence of insect pests and diseases, low genetic potential of crops, low plant nutrition, low soil productivity and adverse climatic conditions. Other problems are poor linkage between research – extension and farmers.

Out of these problems, the project (TARP II) developed researchable areas. The desired outcomes of the intervention at farm level were to see to it that insect pests and diseases incidents are minimized, appropriate materials of high genetic potential are developed and used by farmers, soil productivity is improved and technologies dissemination and communication is strengthened. Thus the main objective of increased farm productivity and income would be realized at farm households. This was in the assumption that the key stakeholders would participate effectively in the technology development, transfer and dissemination.

Ideally, it was expected that farmers who have been participating in TDT would have adopted and used more technologies than those who had no interaction with researchers. Their farm yield would be higher than non collaborating farmers. But that were not always the outcomes met by the project intervention. This could be due to some farmers identified as non collaborators might have been participating parallel with other development partners (run by NGOs and other private sector) while others could be progressive farmers who could easily interact and quickly access the different technologies and therefore attaining higher farm yields. These and other reasons make it unrealistic to draw conclusions for the project impact based on this comparison. Thus careful consideration needs to be made in selecting control group. This problem might be expected because it is sometimes difficulties to determine the control group for the project as the farmers can interact freely without restrictions.

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SARO 5-an emerging high yielding and profitable rice cultivar in Tanzania

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Introduction

Efforts to improve rice varieties in Tanzania started during the mid thirties when the rice breeding work started at Mwabagole Experimental Station on the shores of Lake Victoria *(Doggett, 1965*; *Monyo and Mwaruka*, 1974*; Monyo et al., 1973; Kanyeka, 2001*). Since then there has been several breeding programmes the current rice-breeding program is a continuation of the rice improvement program that started in 1965, whose objectives have been detailed in a number of working papers and reports (*Monyo et al 1973, Monyo and Mwaruka 1974; Monyo and Kanyeka 1978).*

Since when rice-breeding activities started, more than twelve exotic and local improved rice cultivars have been recommended and only two varieties were officially released to be grown in the country (Table1). However, the breeding efforts did not put emphasis on the improvement of grain characteristics that are preferable by farmers and consumers. As a result the adoption of the two recommended varieties has been low. Unacceptable. (*Kanyeka et al 1995, Kanyeka 2001*). About 62.5 % of the improved varieties such as all IR series, Afaa Mwanza selections, Selemwa and KATRIN were only grown by the large scale commercial rice farms which were managed by National Agriculture and Food Corporation (NAFCO) at Mbarali, Ruvu, Kapunga, and Dakawa. Small scale farmers could not adopt such cultivars because of poor grain qualities and the non preference of these improved rice varieties.

Rice improvement programme

In 1983 through Supa Improvement Project (SIP) a breeding program started at Dakawa Research Center. The program emphasis was to improve yield potential, and grain characteristics such as strong aroma, good milling, long translucent and palatable kernels. These grain characteristics traits are found in the widely cultivated and accepted local cultivar landrace known as Supa.

The traits for grain quality were incorporated in the new progenies through crosses between cultivar Supa and some selected cultivars. After several crossing, progenies were obtained. Aromatic progenies with short plant stature that were selected in F_2 populations from a cross number TXD 306 involving (Supa/P8) x (Subarimati/Supa).

Further evaluation and grouping of the lines on the basis of aroma and grain types resulted into three distinct series:

- SARO 1 Lines with strong scent and grain type of Supa
- SARO II Lines with intermediate scent and grain type of DAK 83 and NARO series were the non-aromatic lines with grain types of KATRIN.
- SARO 5 TXD 306-7-B-B1 was one of the few promising highly scented elite lines with short plant stature reselected and evaluated in SARO I series (Table 2).

Table 1. Some of Improved rice cultivars recommended or released up to 1990 in Tanzania

No	Cultivar	Origin	Year	Remarks
1	Gamti (Tunduru)	Land race	1972	Purified land races**
2	Faya Theresa	Land race	1972	Improved landrace**
3	Kihogo Red (Morogoro)	Landrace/Morogoro	1973	Heterogeneous landrace
4	Afaa Mwanza 1/159	Land race	1974	Improved local strain
5	Afaa Mwanza 0/706	Land race	1974	Improved local strain
6	Afaa Kilombero0/906	Land race	1976	Purified local strain
7	Kihogo Selection No 2	Morogoro	1973	Pure line selection**
8	Kihogo Selection No 7	„	1973	Pure line selection**
9	KihogoSelection No22	„	1973	Pure line selection
10	Katrin (IET 2397)	India	1985	Adopted cultivars
11-14	IR 5, 8, 20, 22	IRRI	1974	High Yielding
15	Selemwa	Local cross	1985	Local hybrid F8 No 37*
16	IR 64	IRRI	1988	High yielding introduction

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Evaluation for Yield Performance

SARO 5 was originally evaluated in the preliminary, replicated yield and in on-farmers' yield trials at different locations in the country.

In the preliminary and replicated yield trials, on average the line produced 3.56t/ha, out yielding both aromatic check varieties DAK 83 and Supa about 11% and 6% respectively (Table 3). In on-farm yield trials, the line had an overall performance of 3.7t/ha out yielding the parent DAK 83 and Supa by 33% and 6% respectively. SARO 5 also out yielded the parent Supa by 13.5% across locations (Table 4).

Agronomic characteristics

SARO 5 is semi-tall (85-110cm) lodging resistant cultivar with strong culms bearing erect leaves and short growth duration (110-125d) which is 2-3 weeks earlier than Supa (Table 5). The line has moderately exerted panicles of about 18.2 cm long with awn less slender long translucent grains (29.1g) (Table 4).

Farmers' assessment

Farmers' in four selected districts accepted the cultivar as a crop to grow or as to be used as food.Table 4). Farmers usually prefer tall to semi tall varieties with long and heavy panicles for easy of harvesting by planking single panicles.

Conclusion

SARO 5 is highly preferred by farmers because of its value added grain characteristics particularly its strong aroma, good milling quality and translucent kernels. The cultivar has emerged as the best choice for farmers and fetches competitive prices in many local markets.

Table 2. Some SARO I promising lines selected from the bulk populations at Dakawa Research Centre 1986.

SAROs	Progeny lines	No 1992	Remarks
Saro 1	TXD 211-5-1-2-4	6	Strong scent, non-shattering and long leaf pubescence
Saro 2	TXD 306-8-B-B	21	Long grain semi-aromatic. Tall plants
Saro 3	TXD 306-8-B-B	19	Slender grain, aroma, strong culms
Saro 4	TXD 306-5-B-4	17	Tall plants, scented, weak stems
Saro 5	**TXD 306-7-B-B1**	**20**	**Long grains, strong aroma, translucent Basmati type of grains**
Saro 6	TXD 306-9-B-B	22	Slender grain and aromatic

Table 3. Yield performance of SARO 5 in on-farm yield trials at different locations

Year	Location	Entries	Grain yields (T/Ha)					
			Yield range	SARO 5		DAK 83	Supa	
2000	Kitere-Mtwara	8	3.2—2.5	3.0		3.2	-	
2001	Kitere-Mtwara	8	3.5—2.8	2.8		2.8	-	
2002	Kinyope-Mtwara	8	3.4—2.5	3.2		2.4	3.2	
	Malinyi-Mahenge	8	4.8—3.1	4.8		-	4.4	
	Bahi-Dodoma	8	5.1—3.3	3.3	**4.04**	-	3.4	**3.56** (13.5%)
	Zombo-Kilosa	8	5.1—3.2	4.1		-	3.2	
	Mngeta-Kilombero	8	4.8—3.2	4.8		-	3.6	
Means				**3.71**		**2.80** (33%)	**3.56** (4%)	

(Percent in bracts are % the cultivar out yielded the check)

Table 4 Comparison of TXD 306 –7-B-B1 with parents and aromatic checks

Character	**SARO 5**	**Supa**	**Subarmati**	**DAK 83**
Aroma	Scented	Strong scent	-	Scented
Plant height (cm)	102.0	138.8	113.2	101.1
Tillers/hill	11.0	6.8	10.4	10.9
1000 grain weight (g)	29.1	32.9	28.1	28.4
Days to maturity	110-125	125-140	100-125	110-125

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Seed Industry Development in Tanzania

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Introduction

The government of Tanzania places great importance on the availability of quality seed of wide range of improved crop varieties as one of the most important factors in attaining food security in the country. For many years the government through the Ministry responsible for agriculture has taken several steps to initiate and strengthen a viable National Seed Programme in collaboration with various international partners. These initiatives included USAID Seed Project (1971-1982), HORTI Project (Netherlands Seed Project at HORTI-Tengeru 1984-1988), FAO/ UNDP Seed Project (1988-1995), CDC Joint Venture (TANSFED), ASPS/DANIDA (On-farm Seed Component 1998-2002 & 2002 - 2007) and others.

As a result of these measures a number of notable achievements have been made, which include:-

- Formation of a national seed company TANSEED in 1973
- Enactment of the Seeds Act 2003, which replaced the Regulation of Standards of 1973
- Enactment of the Protection of New Plant Varieties (Plant Breeders Rights) of 2002
- Preparation of Seed Regulations and Rules of 2005 which replaces Rules and Regulations of 1976
- Establishment of Foundation Seed Farms in the 1970s and early 1980s
- Establishment of quality control system through the Tanzania Official Seed Certification Institute (TOSCI) and its zonal seed testing laboratories
- Streamlining procedures for seed testing
- Establishment of variety release and registration procedures
- Institutionalization of a proper mechanism for the co-ordination, monitoring and overall direction/guidance of seed related activities through a National Seed Committee and its sub-committee of Variety release and Seed Certification and a Seed Unit at the Ministry's headquarters as the Secretariat
- Formulation and adoption of the National Seed Policy in 1994
- Approval of the National Seed Industry Development Programme (NSIDP) in 1989 and National Vegetable Seed Industry Development Programme (NVSIDP) in 1992. The NSIDP provides new guidelines aimed at creating a viable seed industry in a liberalized economy.

Despite all the efforts to improve the national seed industry, production and sale of certified seeds through formal seed sector, has not been very satisfactory. Currently it is estimated that the formal seed sector contributes between 4 - 5% of the national seed requirements while up to 95% of the seed used by farmers is from the informal seed sector (farm saved seed).

Variety development is another important component of the seed industry, where considerable achievements have been made by the public sector and in recent years by private sector. Unfortunately the improved crop varieties have not reached most farmers in Tanzania as it is the case in many developing countries. The story is worse for low value crops and open pollinated varieties where there are still few or no company which is involved in the production and distribution of seeds of these varieties. Recent development in the informal seed sector and government decision to promote the concept of on-

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farm seed production as a complement to the commercial seed sector is gradually changing the situation.

Components of the Seed Industry

Seed Policy

Effective regulations and clear policy are essential for development of a seed sector. As a result of government decision to liberalize its economy, the role of the Ministry of Agriculture and Food Security in relation to development of the seed sub-sector is being shifted from direct involvement in production of seeds to that of supporting research and development, stimulating, overseeing and regulating seed production. The National Seed Policy of 1994 seeks to ensure a collaborative effort of both government and private sectors to achieve national seed self-sufficiency. The policy document gives policy statements and implementation guidelines for each component of the seed chain. Among other issues it states that: -

- The government will ensure a continuous supply of improved varieties through a national research and plant improvement programme
- The government will observe plant breeders' rights through enactment of appropriate legislation
- The government will encourage and facilitate the establishment of formal and informal seed production conditions and marketing arrangements in the country
- The Tanzania Official Seed Certification Institute (TOSCI) shall continue to enforce the seed legislation in order to control seed quality to make sure that, farmers get seeds of the prescribed quality
- In line with the current policy of free market economy the government will adopt a liberal approach to seed prices charged at all levels.

Research and Plant Breeding

Government agricultural research stations are responsible for development of public varieties while private companies are responsible for development and maintenance of their own varieties. Currently there is no private seed company which is involved in development of new varieties through conducting actual breeding work in the country except that all bring in advanced lines/materials for evaluation. The rules which govern seed production in the country require that a variety has to be tested at different locations, released and registered before it is allowed to be used for seed production or marketing. Unfortunately this rule has not been applied to imported vegetable seeds.

Proposal for release of a variety, which has passed the Multilocational Trials and DUS (distinctness, uniformity and stability) test, is tabled for release consideration at the National Variety Release and Seed Certification Committee Meeting by the responsible breeder or institution. TOSCI conducts DUS test after a breeder has submitted variety description list and an authentic seed sample.

Plans are underway to establish a National Performance Trial (NPT) system whereby a neutral organ will be responsible for evaluating the varieties. The NPT system is expected to commence recently.

Protection of Plant Breeders Rights

In order to motivate breeders and encourage investment in the seed industry, Tanzania has recently enacted The Protection of New Plant Varieties (Plant Breeders Rights) Act of 2002 for the purpose of recognizing breeders of new plant varieties and for protecting their rights. The law was enacted in November 2002 and was declared to be operational from 1st February 2004. The Plant Breeders Rights Office (The PBR Registry) which is headed by a Registrar is based in Dar es Salaam at the headquarters of the Ministry of Agriculture and Food Security. The office has already received several applications for PBR grant.

Seed Production and Supply

Formal Seed Sector

(i) Public Seed Sector

As a result of the government policy to liberalize its economy, non-involvement in production of commercial seed and the collapse of TANSEED, very small amount of seed is produced and distributed by the public sector. Currently the government's Foundation Seed Farms are involved in the production and distribution of small quantities of commercial seeds of selected crops and varieties.

There are five state owned foundation seed farms, which are responsible for multiplication of basic seeds. The farms are located in different agro ecological zones and have a total land area of 8620 hectares of which 6400 hectares are arable. The distribution of land used for production of basic seeds of major field crops and pulses is as follows: Arusha Seed Farm located in Arusha (640 ha.), Msimba Seed Farm - Morogoro (3000 ha.), Mwele Seed Farm - Tanga (900 ha), Kilangali Seed Farm - Morogoro (3000 ha) and Dabaga Seed Farm in Iringa with 1080 hectares.

(ii) Private sector

Liberalization of the seed industry in 1989 has created good environment for the establishment of new seed companies in the country. Although some of them particularly Monsanto (T) Ltd which initially started by producing certified seeds locally, almost all of them with exception of Alpha Seed Co. Ltd are now importing seeds. Private seed companies and other institutions which are operating in the country include: - Monsanto (T) Ltd., East African Seeds Company, Kibo Seed Company, Alpha Seeds Co. Ltd, Pop Vriend, Sluis Brothers Ltd., Seed Project of the Diocese of Meru (formally INCOFIN Seed Project), Rotian Seeds Ltd., PANNAR SEEDS, PIONEER, INCOMET Project, Maungu Seeds Ltd., Zenobia Seeds Ltd, Krishna Seed Co. Ltd, Suba Agro Ltd., TANSEED International and Mbegu Technologies Co. There are also some seed companies which do not operate directly but use other companies as their distribution agents. Most private seed companies deal with crops that have high marginal returns such as maize, vegetables and sunflower.

(iii) Marketing and Distribution

Almost all private seed companies use stockiest and other agents such as Tanzania Farmers Association and cooperative societies to distribute seeds in the

country, although some of them own seed shops. In the past the co-operatives played a dominant role in seed distribution. However distribution and marketing of inputs, including seeds, is affected by several bottlenecks. Poor infrastructure especially roads, affect the input delivery system. Moreover, though input distribution centers are found in the regional capitals and in a few district townships there are almost none in the smaller towns or villages. Poor systems for forecasting the demand at the regional/ district level also pose problem to seed marketing.

(iv)Quality Declared Seed (QDS) Production

Quality Declared Seeds are produced on-farm by farmers whereby the seed quality is controlled by TOSCI. In this system small-scale farmers are required to declare the quality of their seeds and TOSCI verifies 10% of the declarations through field inspections and laboratory tests. The production of QDS under MAFS/DANIDA Programme is meant to improve the supply and dissemination of better seeds of superior varieties of major food crops and vegetables, which are adapted to the agro-ecological and social economic conditions. The system depends heavily on the understanding of seed producers and traders. It also relies on the efficiency of the extension services. In the pilot phase (1998-2002) the programme was implemented in 12 districts of Morogoro, Iringa and Dodoma regions. The second phase of the programme (2002 – 2007) intends to expand to more regions and districts. The second phase puts more emphasis on entrepreneurship in order to assure sustainability of the programme.

In 2001 the Ministry of Agriculture and Food Security approved rules and procedures to be followed by QDS producers all over the country. These rules are now included in the new seed regulations.

Informal Seed Sector

Informal seed sector is another form of seed supply used by most farmers in Tanzania. About 95% of the seeds sown by farmers in the fields are farmer saved seed or obtained through farmer-to-farmer exchange whose quality is questionable. In this form of seed production no formal quality control is practiced.

The other form of informal seed production is the one practiced by a number of non-governmental organizations (NGOs), church organizations and farmers groups. These include Christian Council of Tanzania (CCT), Diocese of Central Tanganyika (DCT) and Lay Volunteers International Association (LVIA). Others are HIMA Project (DANIDA supported programme, which has been merged with ASPS) and the Mara Farmers Initiative Project supported by IFAD.

Seed Quality Control

Seed quality control is the responsibility of the government and is undertaken by the Tanzania Official Seed Certification Institute (TOSCI). The Institute was established by the Act of Parliament (the Seed Act of 2003) to replace the Tanzania Official Seed Certification Agency (TOSCA). TOSCI is headed by Chief Seed Certification Officer and operates from the National Seed Testing Laboratory in Morogoro and has branches in Tengeru, Arusha and Njombe, Iringa. TOSCI has also trained a number of seed inspectors in the districts to represent it in areas where it's not easily reached by the institute. Operations of TOSCI are hampered by lack of physical resources which require immediate solution in order to have an effective regulator of seed quality

Challenges

The national seed programme is facing a number of challenges which need active participation of all stakeholders in seeking their solutions. The most important issues which need immediate attention include: -

- How to effect participation of private sector in local seed production
- How to enhance an effective quality control system, which meets national and international standards.
- How to forge an effective public and private partnership (PPP) in variety development, seed production quality control and promotion of improved varieties and seeds.
- How to effect quality control of imported seeds especially vegetable seeds
- How to increase investment in variety development and seed production using conducive policies and legislations such as the new Seed Act of 2003 and the Plant Breeders Rights Act of 2002.

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Smart Toolkit for Evaluating Information Products and Services Launched

Introduction

The Smart toolkit for Evaluating Information Products and services was launched during a workshop which took place from 28 November – 2 December 2006 in Dar es Salaam, Tanzania. Dr. Jeremiah Haki Director of Research and Training represented the Ministry of Agriculture in officiating the launching of the Smart Toolkit.

The workshop participants comprised of managers of information products and services, communication officers, and librarians from NGOs, the private and public sectors. A total of 65 Participants from 15 countries of Africa, Europe and the Caribbean attended the workshop where among others; they had an opportunity to develop expertise in evaluating information products and services. The participants also prepared action plans for implementations in their respective countries. Most importantly, participants came up with recommendations on how to further improve the toolkit.

The workshop was organised by the Technical Centre for Agricultural and Rural Cooperation (CTA) in collaboration with the International Institute for Communication and Development (IICD) and the Royal Tropical Institute (KIT).

Need for evaluation

Increasingly, multilateral and bilateral institutions, as well as national institutions are placing importance on the role of Monitoring and Evaluation (M&E) in development cooperation and management. It is also true that managers are expected to evaluate their own information products and services, often without a firm grounding in evaluation and come up with concrete decisions. The desire for integrating evaluation in the project cycles has been emphasied due to the following reasons: (i) Failure of various development models (via policies, programmes, projects, etc.) to have a significant impact on the achievement of development targets; (ii) The need for funding agencies as well as governments and executing agencies to be more accountable on the use of public funds; (iii) The need for greater transparency, higher levels of efficiency and effectiveness in development cooperation.

Consequently, in 2002, CTA, KIT and IICD formed a unique partnership and, together with a group of evaluation and information specialists drawn mainly from the ACP, the European Union (EU) and Canada, have developed the 'Smart Toolkit' to assist practitioners in improving the management and performance of their products and services.

What is the Toolkit?

The Toolkit is particularly aimed for use by those with little or no experience in evaluation. Its main purpose is to promote improved evaluation practices and to reinforce the evaluation culture within organisations. The Toolkit takes the matter different from the traditional approaches on M&E – where evaluation is seen more as an externally driven process. The toolkit approach has two main merits: (i) Instituting the discipline of internal evaluation as a means of self-reflection, self-analysis and as a continuous internal learning process; (ii) Evaluation as a means of capacity building and institutional development through an internally driven process. This should contribute to improved management and operations in the provision of information products and services.

Using the Toolkit

The Toolkit helps practitioners to 'self evaluate' their information products and services in the area of agricultural and rural development. It provides flexibility, easy accessibility and a step by step approach in its utilisation. It has a comprehensive scope in its usage, ranging from policy-makers and decision-makers to practitioners; and from trainers to students. It covers a range of theoretical and practical application of many techniques and tools through hands-on approaches. The Toolkit has been tested in several countries in Africa, Caribbean and Pacific (ACP) where encouraging reactions to its importance and need were provided. Tanzania which was represented by the DRT of the Ministry of Agriculture and Food Security had one of staff specialised in Databases participate in testing exercise of the toolkit.

Structure of the Toolkit

The Toolkit document as it was at its launching hathree main parts. Part one is the Handbook, which discusses various aspects of evaluation, the information on the project cycle; the application of evaluation techniques and methods to the area of agricultural information products and services. Part two covers nine products and services. Each of these is presented in a particular format with various types of information. Part three contains the process tools. The tools in this part are concerned with planning a project as well as planning the evaluation process helping to plan and evaluate project; and disseminate the findings for feedback.

Lessons learned

It was felt that before attempting any evaluation, some key terms need to be clearly understood. Participants noted possible confusion between terms such as evaluation, assessment, review and audit. Each term may lead to completely different procedure and end results of the evaluation. However, one may expect

that given certain information product or service, regardless of who is doing; the evaluation should result into similar results if the methodology and understanding of such procedures are correct.

Most participants noted as they explored various section of the toolkit that, one can not be an expert of evaluation overnight, but this develops overtime as experiences is gained by evaluating several products. Therefore participants came to such understanding as they were working in group where they had opportunity to exchange experiences, and got to learn more about the evaluation. As such most evaluations should be done in teamwork to bring on board synergies from people with different capabilities.

Some participants cautioned against the notion that may arise among users of the toolkit that; it is capable of getting answers of all evaluations. Rather, it is important to customize the toolkit according to the existing environment and set up an appropriate evaluation system. In this case the Toolkit is therefore an instrument in the process and should be treated as a guiding tool.

In designing the systems for the various scenarios, participants appreciated on the need for institutions to design a robust internal evaluation system that will be budgeted for and as part and parcel of institutional activities. This was raised in view that in many situations the evaluations of government programmes and projects are largely influenced by donors.

Lastly, there was a general feeling that an evaluation must be realistic. Consideration should not be biased on new technologies and theories but rather bringing on board old ideas and techniques to help reflect better on issues to facilitate learning. This is the best way to come up with conclusive judgments of any evaluation.

Conclusions

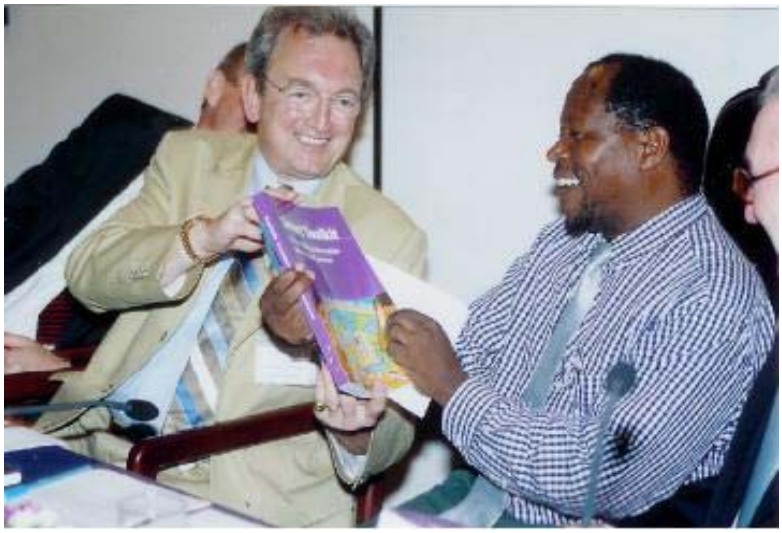
The Toolkit was widely received with enthusiasm and it was seen as a means of promoting evaluation practice, culture and provides exposure on a wide range of tools to a diverse audience. The language, style and presentation used make it easy to read. Furthermore, the Toolkit is a self contained product, making it handy to use, particularly at the grassroots level where there is often limited access to evaluation material.

To conduct an evaluation successfully, the top management of the organisation needs to be committed to the process and there should be involvement of many players in an organization.

The importance of providing feedback during the evaluation process not only to the key stakeholders, but also to those supplying the data in the field was emphasised so that they can get a sense of the value of information that they provide.

M&E is a means of checking the progress of a project based on good reasoning. M&E provides traceable reasoning (conclusions) that you can use to help guide you in the management of your project. M&E allows one to make explicit value judgments based on agreed upon judgment criteria; explicit comparisons and conclusions discussed amongst those concerned.

The DRT participation in the process of testing and launching the toolkit places it at a good position to use and market the toolkit to its scientists across the country. Some copies of the toolkit are available at the DRT library which is accessible to those interested in getting acquainted with evaluation techniques as expressed in the document. Additional copies may be obtained by contacting CTA through the normal procedures of ordering CTA documents.



Mr Jean-Claude Burguet of CTA and Dr. Jeremiah Haki from the Ministry of Agriculture admiring the Smart Toolkit document a moment after its launch.

Characterisation and diallel analysis of commercially planted cotton (*Gossypium hirsutum L.)* germplasm in Tanzania. *Lukonge, E.P. 2005. PhD Thesis. University of Free State, South Africa.*

Thirty cotton varieties were studied. Seven parents generated 21 F1 dialled progenies. The main objective was to evaluate genotypes through oil content, fatty acids, morphological and molecular characteristics. Statistical procedures were performed with Agrobase, NCSS and NTYSS computer programmes. Correlation, heterosis, heritability, G x E interaction and stability values were obtained. Stability across four environments was analysed by five stability measures, that of Shukla, Wricke, Lin and Binns, Eberhart and Russell land the AMMI analysis.

Significant differences were observed for oil and fatty acids content. Oil content results revealed an average of 20.23%. The ratio for polyunsaturated:saturated fatty acid was 2:1 and for unsaturated: saturated was 3:1. The predominant fatty acids were linoleic, palmitic, oleic, stearic, myristic, palmitoleic, arachidic and behenic. Palmitic fatty acid was high while oleic and stearic fatty acids were low for almost all varieties studied. Oil and fatty acid content were significantly influenced by the environment. CIM 70 and Cyto 12/74 can be selected as parents for increased oleic and stearic fatty acid and Stoneville 506 as a parent for reduced palmitic fatty acid, increased oleic, stearic and linolenic fatty acids in hybridisation.

ANOVA results indicated significant differences between varieties for all agronomical characteristics studies, where NTA 93-21 and NTA 93-15 were best performers almost for all characteristics. Genetic distances for morphological (qualitative characteristics) analysis ranged from 0.18 to 0.80. Two major groups, one including many varieties from Africa and the other including varieties from the USA, were revealed.

AFLP analysis showed high genetic similarities (0.85 to 0.98). Verieties were distinguished according to pedigree and origin. The increase genetic similarity observed indicates the need for the introduction of more diverse cotton material. Comparison of agronomical and AFLP markers for determining genetic diversity indicated that genetic similarities between varieties were low for agronomical compared to AFLP markers. The correlation coefficient between AFLP analysis and agronomical genetic similarities was insignificant.

Highly significant differences between genotypes over environments were observed and NTA 93-21 crosses outperformed the seven parents for almost all characteristics. The parent Super okra leaf performed poorly for many characteristics. Trial sites Ukiriguru followed by Kanziga were high yielding environments.

Combining ability analysis results indicate significant variation in GCA estimates among parents for different characteristics. Genotypes having high positive GCA estimates for yield components exhibited negative GCA estimates for fibre quality, excluding NTA 93-21. Some combinations indicated positive and significant SCA effects for seed cotton, boll weight, GOT and lint yield. The GCA/SCA ratios for most of the studied characteristics were larger than one.

Correlation among characteristics indicated highly significant positive and negative correlations. The observed high and significant GCA and SCA effects for those characteristics are promising for cotton population improvement. Positive heterosis for boll weight was observed for more than 90% of the combinations. Hybrids with high SCA values presented high values of heterosis. Heritability values for the studied characteristics were moderate to high.

The combined ANOVA over four environments indicated significant differences between genotypes and locations for all characteristics. The percentage contribution of location to total variation as high compared to genotype variation except for a few characteristics. Highly significant differences of G x E for lint yield and fibre strength were observed.

Three stability procedures (Wricke, Shukla and ASV) identified similar stable genotypes. Eberhart and Russell's procedure was in harmony with the above three methods but with some divergence. Cultivar superiority measure deviated from the other four measures. Therefore the procedures of Wricke, Shukla and AMMI can be applied for cotton stability studies.

Key worlds: Cotton (*Gossypium hirsutum L.*) Genetics diversity, oil, fatty acids, morphological, agronomical, AFLP, diallel, genotype x environment, stability

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Decision-Making Patterns By and Barriers to Women Small-Scale Agricultural Producers. *Maeda, E.J. 2005. PhD Thesis. University Of Arkansas, USA.*

This study sought to describe the role women play in the decision-making process and the barriers they face as women farmers on small-scale farms. Women engaged in agriculture are a diverse group who either farm with a spouse or are single farmers. The study found a great diversity in the way these farm women make decisions related to the economic and social well-being of their households.

The study explored the literature on decision-making and barriers facing farm women. The study was conducted using qualitative research methods, including in-depth interview, survey and participant direct observation among 12 farm women from two counties in Arkansas. Factors studied included the individual's role and position, the farm structure, household type, presence of preschool children and marital status, education and off-farm employment.

Differences in the patterns of decision-making were found in the study between farm women engaged as full-time versus part-time farm operators. Within joint male-female households, joint decision-making in major issuers was found to be especially prevalent among such households. For the female-only households, decision-making was based on her education and different sources of gathering information which aided in making final informed decisions. In the case where the female-only

household had preschool children, it was revealed that business and farm management decisions were made around the children's schedules.

Two of the most important changes influencing farm households included the significant extent to which farm households depend on external non-farm income and the importance of farm policy to household relationships. It was also revealed that these farm women faced some barriers including situational barriers such as equipment being too heavy, dispositional barriers such as lack of societal acceptance and understanding of farm women's experiences, and institutional barriers such as misconceptions and prejudices about their actual roles in agricultural production. These women felt discrimination from loan officers and company representatives. For the single farm operators the greatest barriers they faced was management of time in getting their tasks done on the farm while performing their roles as mother and caretaker of the house hold and, in some cases holding down, an off-farm job.

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Variation in rooting strategy and resource use efficiecy amongst spring wheat (*Triticum aestivum*). *Mansoor, H.A. 2005. PhD Thesis. University of Aberdeen. UK.*

An estimated 1.4 billion people live and work in the vast, diverse and risk-prone rain-fed areas in less developed countries (Miguel, 2002). In these regions, annual crops frequently complete their development using moisture stored in the soil. High variability in rainfall, together with high evaporative demand, creates severe constraints for crop growth and yields. Sustainable food security is needed for these regions. To achieve this, wheat research has to focus on sustaining the competitiveness of production in these environments. This goal can be achieved through a shift in the yield frontier to yield stability and enhanced input use efficiency in cereal species varieties such as those of wheat. In Tanzania traditional breeding is used to select cultivars that perform better under drought. Although this system had its successes, it does take long-time and it is costly. Establishment of a single drought resistant character, which will benefit yield under water-limited conditions, and then incorporating it into existing, breeding programmes, is an approach that would considerably increase the efficiency in breeding for drought tolerance. Rooting strategy has been proposed as an appropriate character. Optimal root architecture can mediate the adaptation of plant to soils in which water and nutrient availability is limited by increasing the total absorptive surface of the root system and the efficiency of water and nutrient use.

To this end, this study aimed at identification of genetic by environmental interaction variation between wheat cultivars in roots system architecture and how it relates to water and nutrients acquisition and drought tolerance/resistance. Specifically, it aimed to establish whether selection of the right rooting traits would help in improving WUE and the production of grain crops in dry semi-arid environments. Since it is well known in semi-arid regions that the two most limiting resources (water and nitrogen) have contrasting availability in the soil (water available in deep soil layers and nitrogen in the top soil), the study also intended to establish whether selection of root traits efficient for water utilization would compromise NUE. In addressing this, the research involved laboratory investigations, soil-bed and field studies. To assess variation in rooting strategies (architecture and extension rate) between spring wheat cultivars and within cultivar seed sizes, laboratory studies were conducted using Perspex growth chambers and agar for root growth, which was digitally recorded by Twain Pro Scanner, using WinRHIIZO. Clear differences in rooting strategies between UK and Tanzania cultivars and between different within-cultivar seed sized were revealed. Seed size was most influential in determining the rooting strategies of seedlings. The majority of cultivars that had longer total root length and longer seminal roots were those from Tanzania. There was also variation in rooting strategy amongst cultivars from Tanzania. This variation was used to investigate association between rooting strategies and resource acquisition efficiency amongst Tanzania cultivars.

^{13}C discrimination (Ä) and enriched ^{15}N were used as selection tools to determine cultivars with high yield potential, WUE (dry mater yield with respect to water made available to the crop through precipitation and/or irrigation) and NUE (the proportion of nitrogen taken up by a crop from that which was applied as fertilizer). Results provided clear evidence of association between rooting strategies and resource acquisition in the presence and absence of drought. The cultivars with different rooting strategies expressed two distinctive strategies, namely, enhanced resource acquisition and a conservative strategy, which contributed to differences in plant growth, yields WUE, NUE and drought tolerance/avoidance between cultivars. Cultivars with enhanced resource acquisition were able to acquire most of the water and nitrogen in both wet and dry moisture regimes and hence had fast growth, high yields, NUE and WUE. These results showed that WUE and NUE were both positively affected by selection of root traits for drought tolerance. Thus, there was no evidence of trade-off between WUE and NUE.

In conclusion, the results have successfully addressed the study objectives. By investigating variation in rooting strategies and using that variation to study association between rooting strategy, WUE and NUE, the study has shown the existence of variation in rooting strategies amongst spring wheat cultivars. It also showed how these different rooting strategies are associated with WUE, NUE and drought tolerance. Results showed little genetic by environment variation of the characters studies, which is much desired in breeding for wide adaptation. Most importantly, the study has shown how selection desirable rooting strategy for drought tolerance (high WUE) would also boost the NUE, disputing the suggestion of trade-off between WUE and NUE that has been raised by other studies. Selection of rooting strategies can thus complement traditional breeding in order to improve its efficiency.

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