CROP PROTECTION PROGRAMME

Improving farmers' access to and management of disease resistant cultivars in the Southern Highlands of Tanzania

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FINAL TECHNICAL REPORT

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Executive Summary

The project sought to develop and promote strategies to reduce the impact of pests and improve the quality and yield from high potential maize cropping systems for the benefit of poor people in the Southern Highlands of Tanzania. Activities were aimed to realize three main outputs: (1) Disease resistant maize varieties appropriate to farmers' needs and adapted to local conditions validated by farmers and other stakeholders; (2) Approaches for improving access to and management of quality seed by farmers validated and promoted; and (3) Sustainable pathways/systems for quality seed supply appropriate to local conditions and farmers' needs developed by farmers and other stakeholders.

Activities started with a baseline survey/situation analysis examining current access to and management of maize cultivars in target villages. Seminars to introduce the aim of the project to farmers followed, during which identification of training needs and formation of farmer groups were accomplished. Validation of new disease resistant maize cultivars was carried out by farmers and other stakeholders through village-based demonstrations in four target districts. In addressing quality seed production/supply-side issues and the current status of seed systems, a consultation survey of non-farmer stakeholders was carried out in the target districts, followed by a major workshop bringing together both farmer and other stakeholders.

These activities have achieved significant contributions towards the project's goals. The two most important yield-limiting maize diseases in the SH and the country as a whole (i.e. GLS and MSV) were addressed, using resistant cultivars identified during project activities as the main control strategy. This is the most feasible option for resource-poor farmers. On-farm demonstrations of these new maize cultivars in rural farming communities have created awareness of adapted, high-yielding, disease-resistant varieties for the benefit of farmers. Leaflets on agronomic recommendations for maize production, fertilizer use, general maize pathology plus one specifically on *Maize streak virus*, and on management of open-pollinated varieties were developed as training tools. Farmer-group exchange visits were also used to address the lack of knowledge among farmers on maize production and seed management. These training/learning tools, which were developed on a demand-driven approach, provide farmers and extension agents with current information and practices on maize production and seed management. In addressing the problem of quality seed supply, seed systems have been distinguished as certified seed, quality declared seed and farmer-saved/locally-traded seed. Opportunities to improve each of these inter-related systems have been identified by a range of stakeholders. The project facilitated the establishment of a public-private partnership between ARI-Uyole and private sector seed companies, so as to embark on certified seed production and distribution for the SH. This step should enable sustainable access for farmers to improved certified seed maize, starting with the cultivars they have already validated through this promotional effort. The above outcomes are likely to lead to increased maize productivity, contributing to poverty alleviation and sustainable livelihoods among farmers in the Southern Highlands of Tanzania.

Background

Maize is the most important food crop in Tanzania. This staple food accounts for 60% of dietary calories as well as up to 50% of utilisable protein for the majority of the Tanzanian rural population. It is the most widely cultivated crop in the country, covering about 45% of the area under annual crop cultivation in Tanzania. When it comes to national food security, maize is recognised as the most important crop in alleviating hunger nation-wide. Although maize is such a widely cultivated crop, the Southern Highlands of Tanzania (SH) (comprising Iringa, Ruvuma, Mbeya and Rukwa regions) provide the most favourable climatic conditions for the production of maize. Currently, the SH account for almost 50% of the total national maize production and up to 90% of the annual purchase of maize for the national strategic grain reserve is normally done in the SH.

Although maize plays such an essential role in the livelihoods of people in the SH (as well as consumers outside the zone), significant changes in context have been taking place with major implications for peoples' livelihoods. The relationship between peoples' assets, strategies and outcomes has been influenced/mediated by shocks (e.g. Grey Leaf Spot, *EL Nino*) and trends (e.g. increasing population density, declining soil fertility, persistent crop pests (e.g. stem borers), storage pests, diseases (e.g. *Maize Streak Virus* (MSV) - in 1994, 43% of sample farmers at an intermediate altitude in the SH identified MSV as a serious constraint on production) and weeds) and changing policies (e.g. structural adjustment programmes (SAPS)) and institutions (public sector research and private seed companies) – Moshi et al 1997..

The relationship between assets, strategies and outcomes is to some extent cyclical and an analysis can start at any point. For example, SAPS are generally associated with a removal of subsidies and an increase in input prices (e.g. seed and fertilizer), retrenchment in the public sector and an expanded role for the private sector. Seed, one of the key inputs/ assets, is particularly important to crop protection as it determines the genetic resistance of the crop to pests and diseases. The pre and post harvest protection of seed also determines a) whether it carries inocula of various pests and diseases and b) seedling vigour, essential for good establishment in the face of weeds and other adverse biotic and abiotic factors. However, with respect to seed of improved maize varieties there has been a significant increase in price and a subsequent decline in returns to the crop. Farmers appear to have adapted their livelihood strategies in response by e.g. growing a larger area of maize to compensate for a decline in fertilizer use, switching to other crops, reducing the amount of improved variety seed purchased and making greater use of re-cycled seed. The outcome has varied, but for many still dependent on maize, the returns from the crop/ profitability has declined with implications for people's capital assets (e.g. less money to purchase inputs, possibly unable to support children going to school). This situation is also associated with a lack of trust or confidence held by farmers in improved crop varieties from seed companies and many other institutions dealing with seed distribution.

Poor access to quality seed by farmers has also been a major constraint for a long time, not only after the collapse of the monopolistic national seed company, TANSEED, but even during its over 20 years of existence in certified seed production and marketing. During this period, inefficiency and poor management limited its ability to operate a seed system capable of sustaining farmers' requirements for good quality seed. Most of the certified seed, which was marketed through a limited distribution network, had been of questionable purity and in many cases it exhibited unacceptably low levels of germination. In response, farmers rejected this enterprise by gradually dis-adopting virtually all types of certified seed marketed by TANSEED, consequently leading to its collapse by the year 2002. This situation severely disrupted the certified seed system for locally developed varieties, giving way to unscrupulous traders who resorted to marketing of fake, or un-adapted seed, consequently plunging poor farmers into deeper trouble and even making them lose faith in the so-called improved seed. Under these circumstances, it was clear that there was a need to address this problem so as to ensure that a sustainable system of seed production and supply, which was responsive to the needs of poor farmers, was put in place.

This was the context, when a new, unknown and destructive foliar disease of maize was reported in Ruvuma region during the 1995/96 season. A crop loss assessment carried out in the major maize producing areas of this region during the 1996/97 season indicated that the disease, causing grain yield losses ranging from 15 to 40% had affected some 61,869 hectares of maize. This "new" disease was later identified and confirmed to be Grey Leaf Spot, (GLS) a serious foliar disease caused by the fungus *Cercospora zeae maydis* Tehon and Daniels. By mid-1998, the disease had spread to all four regions comprising the SH, and all local cultivars as well as most of the commercial maize varieties under cultivation across the zone during that season succumbed to the disease. During epidemics, MSV can also cause up to 80% loss in maize grain yield, however, instances even of complete crop loss are not uncommon in some parts of the SH (Marandu and Kabungo, 1987). This disease may be a serious problem in irrigated maize and MSV susceptibility has particularly hindered maize production in rural irrigation projects. In the intermediate altitude maize growing parts of the SH, up to 43% of sample farmers identified MSV as a serious constraint on maize production (Bisanda and Mwangi, 1998); promotion of some maize cultivars in some parts of the country has been unsuccessful on account of their susceptibility to this disease.

The occurrence of GLS and MSV diseases in the SH constitutes a significant threat to maize production in the country, since maize is the main staple food for the majority of the people of Tanzania. In addition maize is also a source of cash income for resource-poor peasants in rural areas. Since the disease had hit the most important and reliable zone for maize production in the country, national food security was also at stake. New maize varieties with better disease resistance were seen as the best option to assist particularly the small resource-poor maize farmers.

In response to this situation, the Maize Improvement Programme (MIP) at Uyole Agricultural Research Institute embarked on massive screening and evaluation of both local and exotic commercial and pre-commercial maize varieties and inbred lines. This task was commenced during the 1997/98 season at locations considered hot spot areas for GLS. Aided by the high GLS disease pressure which prevailed during the 1997/98 season, the MIP identified and quickly initiated seed increase of promising parental materials, in order to speed up the attainment of new stocks of foundation seeds, so as to facilitate the formation of new GLS-tolerant maize varieties. Evaluation of these new materials both on-station and on-farm confirmed the superiority of several potential new maize hybrids one of which was officially released during the 2000/2001 season under the name UH615. Given the urgency of this matter, seed production of this new variety was carried out concurrently with the last season of on-station and on-farm variety evaluation, at ARI-Uyole, through financial support from the World Bank in order to deliver these new improved seeds to the GLS-affected rural farming communities of the SH in the shortest time possible. Some 120 tons of UH615 were, therefore, readily available when the variety was officially released in November 2001.

However, less than 50% of the 120 tonnes of UH615 hybrid seed produced by ARI-Uyole were taken up by farmers. Smallholders' scepticism with regard to new technology may reflect the previous failure of TANSEED to provide good quality seed. Many farmers have lost confidence in the so-called new improved crop varieties from seed companies, or from many other institutions dealing with seed distribution.

What should be the way forward to promote disease resistant maize in the SH? A preliminary analysis suggested the following points need addressing:

1) High cost of seed - through e.g. increasing supply and/or reducing the cost of production
2) Increase in the use of farmer-saved/ re-cycled seed – through improving farmers' ability to manage seed both pre and post harvest.
3) Loss of confidence or trust- through trust-building activities between farmers and service providers and where appropriate amongst service providers.

In addition to UH615, stocks of a GLS resistant[1] version of the MSV-resistant TMV-2 (open-pollinated variety-OPV) were available at Dabaga, a foundation seed farm in Iringa region, SH. Other MSV-resistant (but not GLS-resistant) OPVs are also available e.g. Staha and TMV1. The ASPS Seed Unit and TOSCA have made significant progress in developing a protocol for

[1] The term resistance is broadly used in this project memorandum to include the term tolerance

'quality declared seed' i.e. seed produced by a registered seed producer which conforms to minimum standards and subject to quality control measures. There have been a number of community-based maize seed initiatives in e.g. Eastern and Northern Zones of Tanzania. Under project R7429, Ugandan farmers learnt about the principles of seed management and successfully multiplied seed of the MSV-resistant maize variety Longe 1 using a village-based system. Outputs from DFID, FAO and GTZ funded work on acceptable on-farm seed and grain pest management practices in East, West and Southern Africa will be utilised in the project (e.g. The retention and care of seeds by small-scale farmers, The quality of farmer saved seed in Ghana, Malawi and Tanzania, Development of IPM techniques for the control of Larger Grain Borer (LGB) and management of grain stocks (R7486), Assessment of coping strategies adopted by small-scale farmers in Tanzania & Kenya to counteract problems caused by storage pests (R6952), FAO LGB project - 1981-92 Minimizing damage caused by LGB using traditional materials as well as synthetic pesticides throughout Tanzania, GTZ Integrated Post Harvest Management project focusing on storage structure design and improvement).

Our proposed project builds on these previous initiatives which put people at the centre of the analysis and identifies sustainable access to and management of quality maize seed as a major issue which needs to be addressed for any breeding initiatives (e.g. GLS, MSV) to have impact, particularly on poorer people.

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Fig.1. A maize plot severely attacked by MSV (foreground) in comparison with unaffected plots on the left and in the background.

Fig. 2. A maize field severely attacked by GLS during the grain filling stage

Project Purpose

The project aimed to develop and promote strategies to reduce the impact of pests and improve quality and yield of maize in High Potential cropping systems for the benefit of poor people in the Southern Highlands of Tanzania. The unavailability, lack of confidence in and high price of improved, disease resistant seeds were perceived as constraints hindering small-scale farmers in these maize-based cropping systems. This project aimed to improve farmers' and other stakeholders' access to and pre and post harvest management of disease resistant maize cultivars and ultimately, people's livelihoods within the Southern Highlands and Tanzania as a whole.

Research Activities

Project activities began with an inception workshop to ensure all team members were acquainted with current knowledge in the project's domain and the project's aims and planned activities. The latter are divided into three main subdivisions. **Output 1** has 'Disease resistant maize varieties appropriate to farmers' needs and adapted to local conditions validated by farmers and other stakeholders' as its main aim. For this demonstration of already-developed technologies, a situation analysis was used to acquaint team members with the detailed circumstances of communities in which demonstration trials were to be planted. This provided an up to date analysis of how farmers are managing their maize and an entry point in each district for the development and co-operation of individual farmer groups. This led to planning demonstration trials of varieties expected by project members to be high yielding and disease resistant in the local circumstances. **Output 2** has 'Approaches for improving access to and management of quality seed by farmers validated and promoted' as its main aim. Training needs of farmers and extension had to a limited extent already been identified by the Situation Analysis (Output 1) but these needs were further examined by further activities culminating in a mini-workshop. Training tools including leaflets were then developed and validated by team members to address specific needs which had been identified. In addition to knowledge, farmers also need materials and **Output 3** has 'Sustainable pathways/systems for quality seed supply appropriate to local conditions and farmers' needs developed by farmers and other stakeholders' as its main aim. For this, a range of activities including a survey of the various stakeholders involved in access to seed and a workshop were held to identify means of improving seed systems to meet farmers' needs.

Output 1: Disease resistant maize varieties appropriate to farmers' needs and adapted to local conditions validated by farmers and other stakeholders.

Inception Workshop and **Situation Analysis**

An inception workshop on 25 and 26th November 2002 at ARI Uyole was used to introduce the project team (ARI-Uyole, NRI (UK), INADES-Formation-Tanzania) as well as other key project partners, inparticular 7 agricultural extension officers from the target districts of Mbozi, Iringa, Mbarali and Njombe. The Zonal Research Coordinator as well as the Director for Research and Development for the Southern Highlands (SH) zone also attended. the latter officially opened the workshop. Presentations were given on the status of maize in the SH in the target districts and of maize research at ARI-Uyole, particularly on GLS, and the potential of botanical pesticides and diatomaceous earths to control storage pests. The situation analysis survey was planned on the second day, prior to embarking on the actual analysis survey.

The **situation analysis** was the first major project activity. It aimed to provide the project team with a better understanding of the circumstances of the farmers in each target district, assist us in identifying exactly which farmers to work with and to provide an entry point to closer collaboration with farmer groups. Sites for the survey were selected based on several factors including the importance of maize in a given area and the diversity of agro-ecological zones within a given district. Three villages were chosen in each of the four districts, with the aim of gaining an insight into maize cultivars in current use and the diversity of maize seed management strategies practised. Three types of villages were picked, i.e., villages in remote areas, villages close to urban areas with accessibility to the services of agricultural input stockists, and villages growing maize under irrigation. Where applicable, villages where some farmers were participating in Quality Declared Seed production (QDS) (under the DANIDA-funded on-farm seed production project) were also selected. The selected villages are listed in Table 1. A detailed checklist and appropriate participatory rural appraisal (PRA) tools were developed to collect information on changes in the agricultural system, importance of maize, maize production practices, constraints and opportunities, non-seed inputs and technologies, maize varieties, maize marketing, storage issues, sources of seed, seed management, land (size, access and ownership), sources of income, wealth ranking and identification of other

institutions in the area. The PRA tools were used to guide discussions with separate groups of elders, men and women. The survey also sought current information and baseline data on maize production in each locality These informations were combined to provide an entry point for working in the districts.

Table 1. Villages selected for the Situation Analysis Survey in each of the four districts.

District	Village	Landform	Rainfall (mm)	Altitude (masl)
Mbozi	Mpito	Undulating with rift benches	800-1200	1600
	Ibembwa	-do-	800-1200	1500
	Mponela	-do-	600-800	1200
Mbarali	Majenje	Usangu lacustrine plains	800-900	1200
	Igomelo	Mostly rolling	600-700	1100
	Mahongole	Usangu Plains	600-700	1200
Njombe	Igagala	Njombe Plateau undulating	1000-1200	1800-2200
	Mhaji	-do-	-do-	1800-2200
	Igongolo	-do-	-do-	1600-1800
Iringa	Ihimbo	Undulating with inselbergs	900-1100	1500-1700
	Mangawe	Undulating with flats	500-700	1250-1300
	Luganga	Undulating with inselbergs	600-700	1500

Each district was visited by a team of four people consisting of three researchers representing different disciplines as well one member from agricultural extension. The information for each district was then immediately collated by the participating teams at ARI-Uyole for 5 days. Preliminary conclusions, implications and hypotheses were drawn up by each team.

Identification and Sensitization on Formation of Farmer Groups

Due to the late start of the project in relation to the planting season, demonstration trials were initially planted with individual farmers. Subsequently, seminars were held to form farmer groups. Three-day farmer seminars were organised in each of the four districts targeted by the project on the following dates:

- Mbozi: 3–5th March 2003
- Mbarali: 20–23rd March 2003
- Njombe: 27– 29th March 2003
- Iringa: 31st March to 2nd April 2003

It was arranged that, in each district, 6 farmers from each of four villages accompanied by their village extension offices and district crop officer attended. Gender balance was accomplished by ensuring that, in each village, at least two female farmers participated. Three facilitators assisted with the seminars in each district.

The objectives of these seminars were:

(i) to introduce farmers to the project and to seek their continued cooperation in carrying out the various project activities.
(ii) to train farmers on improved maize production recommendations (including maize varieties).
(iii) to harmonize data collection from the maize demonstrations.
(iv) to train farmers on issues related to group formation, gender and marketing.

The seminars began with an introduction to the project and its potential contribution to increased maize production in the target villages and beyond. This was followed by presentations from the district extension officers on status of the maize crop for the current season within their districts. This was followed by a feedback presentation by village extension workers on the status of the village-based maize demonstrations which farmers had fully participated in having them planted in December 2002. A participatory approach to learning

was adopted in all sessions, including group discussions, plenary presentations and discussion, as well as during questions and answers. Adequate time was allowed for farmers to provide their input through questions or otherwise, anytime during the course of the seminars. Where appropriate, field visits complemented the learning process. Farmers were provided with pens, pencils and notebooks. Flip charts and blackboards were used for illustrating and recording main points or issues. The following topics were covered:

- Maize Agronomy, Soil Fertility.
- Group formation, theory and practice.
- Gender and Development.
- Markets and Marketing of Agricultural produce, with reference to maize grain.
- Data Collection from the village-based maize demonstrations.

Status of maize demonstrations in the Districts

Before coming to the seminars, the Village Agricultural Extension Officers (VAEOs) and farmers from all districts had been instructed to prepare a brief report on the current situation of the maize demonstrations, giving details on crop performance, weather, achievements, problems and recommendations. These reports were presented in the seminar on the first day by the VAEO from each village, giving participants the opportunity to find out what was going on in other target districts.

Introduction and discussion on key stages within the maize agronomy cycle

Farmers, assisted by the facilitator developed the agronomic cycle beginning from field preparation to harvesting and storage. In each stage, important issues were discussed and in a very simple way, the scientific background to each operation was explained. All stages in the agronomic cycle including correct timing for each activity were fully explained, and examples were provided, where appropriate, by visiting actual maize plots for practical orientation. Within the various stages of the agronomic cycle, particular emphasis was placed on land preparation, time of planting, plant spacing and choice of the right variety for a given agro-ecological zone. Farmers were provided with a list of currently recommended maize varieties for their areas. Considerable time was also spent discussing the correct choice and use of fertilizer. Being an expensive input, it was necessary to ensure that participants were enlightened regarding aspects of correct and efficient use of fertilizers. Farmers were encouraged to use organic fertilizers, such as compost and green manure, as an alternative means of sustaining soil fertility and productivity. Timeliness with regard to weeding and insecticide application against insect damage has continued to cause farmers crop yield losses, particularly in the SH, and participants were reminded about these constraints, both theoretically as well as though field visits. However, the facilitators learnt something new from the farmers as well, after finding out that some of them were using, rather successfully, some botanical insecticides for insect control, both in the field and during storage. This session was ended by reminding farmers that they were faced with significant grain yield reduction at every stage of the maize agronomy cycle, if those key steps were not carried out according to current agronomic recommendations for maize production.

Data collection and record keeping

Farmers were introduced to the importance of data collection and record keeping in scientific investigations. Data is useful in the interpretation of information arising from the investigation, and must be collected and kept throughout the period under research. There are data within farmer's capability to collect, while other data are the responsibility of technical personnel. This topic was considered crucial in order to develop a uniform set of data from the demonstrations across sites and to instil a culture of record keeping.

In each of the four district seminars, farmer groups consisting of four members as well as an additional group consisting of village extension officers were formed. Each group was asked to do the following:

- To explain the importance of record keeping.
- To list down types of data they thought should be collected from the maize demonstrations, right from land preparation to harvesting.

There were 16 farmer groups plus 4 groups of VEOs from each district who were asked to do the same exercise, for a total of 20 groups. Results of the first presentations in the first district

were carried over to the next seminar, where after presentation by respective farmers and VEOs, a comparison was made at the end to find out differences and similarities of opinions on the data to be collected. On the last 4th district seminar, a final list of the data to be collected and kept was developed on a flip chart. This final version therefore, had a balance of opinions from the whole project area and was printed by the facilitator and each village was given a copy for reference. This means that the type of data to be collected by farmers was the same across the project area.

Formation and Sensitization of Groups

This session dealt with the importance of farmer groups, their formation as well as important features characterising such groups. It was repeatedly emphasised that groups must be formed by farmers and not for farmers, as the latter approach had often been found to threaten sustainability of such groups. In realisation of this, workshop participants discussed, with guidance from the facilitators, the importance of group formation and the need to work as groups in various economic ventures as well as in relation to the goals of the project. It was observed that such groups essentially had to consist of a voluntary collaboration of farmers having a similar vision towards challenges and opportunities facing them in their quest for better livelihoods. Such groups, therefore, would have the following positive attributes:

- They would allow room for exchange of experiences among farmers, thereby enhancing acquisition of knowledge and the speed of dissemination of such knowledge within a community.
- They would have a sense of ownership of the various group activities, thereby facilitating collective identification and solutions to problems.
- They would provide a good forum for efficiently utilising scarce resources in development efforts e.g. credit, grants, training opportunities, etc.

In addition to the above, participants were reminded of the importance of good group leadership, governed by regulations and by-laws, and that objectives of such groups had to be clearly worked out right from the beginning of group activities. Group structure was also emphasized, calling for as homogeneous a group as possible, noting that they should not be too different in terms of wealth or education, thereby avoiding putting together “big and small fish in the same pond.” Lastly, group size was also brought into the picture, noting that if the group became too large, it also become difficult to manage. Farmers under the project were recommended a maximum of 10 members as a reasonable number for a farmer-group, with a reasonable gender balance.

During discussion on formation of farmer-groups, farmers brought about the issue of constraints to marketing and identified major constraints to marketing. Farmers were given some tips to assist them on some aspects of marketing, such as:

Carrying out marketing research on:

- What crop product are needed.
- Buyers’ characteristics.
- Other producers as competitors.
- Size of the buyers or consumers (How many).
- What is the taste/preference or interest of potential buyers/consumers.
- What is time and quantity to produce.
- What is the payback period.

Careful pricing in order to:

- Cover all the production costs.
- Take into consideration the purchasing power of buyers or consumers.
- Take advantage of other producers’ prices.

Lastly, farmers were asked to take note of some additional marketing techniques to sustain competitiveness in agricultural production and marketing, such as:

- Improving the quality of the agricultural produce.
- Engaging in crop/livestock diversification
- Effecting, whenever possible, strategies which reduce costs of production.

Field Trips

Field trips to visit maize demonstrations in one village were organized on the second day of the seminar in each district. This gave the farmers an opportunity to see the performance of the demonstrations in other farmers' plots. They exchanged ideas and put forward suggestions for improvement of the demonstrations in terms of husbandry. Many questions relating to maize agronomy, breeding and soil fertility were asked by farmers; these were clarified by the agronomist and other resource persons during the field trip.

Farmer Groups Strengthening Seminars

Three day training seminars were organised in the four target districts of Mbozi, Mbarali, Njombe and Iringa with the main aim of training farmers in having purposeful, development-oriented and sustainable groups. From each district, 20 farmers, representing core members within village groups, participated. Facilitation was done by project team members from INADES-Formation and ARI-Uyole. Specific objectives of training were:

- To improve leadership skills
- To enhance effective communication within and between groups
- To set up by-laws (constitution) of the groups
- To impart skills on the management of groups' income arising from joint activities
- To improve skills on enterprise record keeping
- To establish a system for documentation and filling
- To develop group action plans for the year 2005 based on a jointly developed format

The training adopted a practical, participatory-oriented approach, where participants were involved in each stage of the development of the seminar outputs. The approach included:

- Group work on each subject
- Presentations and group discussion in the plenary
- Questions and Answers

It was observed that farmer group members lacked leadership, exposing them to internal conflicts, poor coherence and lack of sustainability. The following topics were discussed as a means imparting leadership and communication skills among group members:

- Different leadership styles: their strengths and weaknesses
- Leadership qualities
- Roles and responsibilities of leaders
- The top down *versus* bottom up types of communication

Practical examples were drawn from their own villages.

Constitution

At the beginning of the project, no group had a constitution. The idea and significance of each having a constitution was brought up during the first farmer seminars (March, 2003), during which farmers were given background material to assist them in developing a group draft constitution. They had been requested to come to this seminar with what they had put together as draft constitutions and time was spent to improve them.

It is commonly observed that farmers are not used to planning and writing down what they want to do during the whole year. To assist farmers and groups in acquiring skills on the development of an action plan, they were probed by a few questions such as: Why plan? For who?, What to Plan?, When to plan? In order to help them develop a planning tool**.**

Enterprise record keeping

Most participants were also found to be ignorant about enterprise record keeping. Similar to most other farmers across the zone, they did not have the habit of properly keeping records on inputs and costs incurred in carrying out various agricultural enterprises. Under such circumstances, therefore, farmers were not in a position to monitor their activities and to eventually determine the extent of profit or loss from their enterprises. In this seminar, it was strongly felt that farmers needed to be capacitated and encouraged to keep records of all costs incurred during the season, in order to be able eventually to carry out a simple profit/loss analysis.

To impart such skills on to them, participants were requested to sit as a group and to recall all costs that were incurred on the farmer-group farm. Then, they were asked to record the maize yield harvested and to convert the yield obtained into money using prevailing prices in their area and finally, to compare costs of production with income. The result was that 50% of the groups in the project area did not even manage to break even, despite the seemingly high grain yields realized. By these means, farmers were enabled to develop their own record keeping sheet.

Documentation and filing
Participants were also trained on how to write minutes or reports after group meetings and to safely keep records of the same in files. Similarly, important letters, field trials data and other educative documents needed to be filed for future reference. To this end, each group was provided with a box file, but the groups themselves provided a stapler and staple pins, a paper punch and a ream of paper. A demonstration was done on how to staple, punch and file. It was agreed that in those files be placed:

- Plans of action
- Field demonstration records
- Minutes of group meetings
- Workshop reports
- Enterprise records
- The constitution
- Correspondences

Village Based Demonstrations

i. Selection of sites and farmers
Within the 4 target districts (Mbozi, Mbarali, Njombe and Iringa), an initial choice of villages was made by the district extension personnel, followed by a final selection of four villages per district, based on information gathered from the Situation Analysis. From each of the 16 villages, five farmers, picked through the assistance of village extension officers in collaboration with the village government, each agreed to host one demonstration trial. These villages and farmers also coincided with the 16 farmer groups subsequently developed by the activities of Activity 1.3 above. The four villages per district and five demonstration plots per village amounted to 20 demonstration plots per district and a total of 80 village-based demonstration sites in the project's target area.

In addition to the five farmers formally participating in the demonstrations, an additional 4 to 6 farmers in the selected villages were provided with improved seed to plant in their own fields under their own management practices (no inputs were provided). During the second season of planting, each farmer group was provided with 5kgs of one of the new hybrids, which they planted on a plot belonging to the group. This was an effort to attain further promotion of the improved maize varieties.

ii. Materials and Methods
The number of entries included in the evaluation ranged from 4 to 5 during the 2002/03 season and from 5 to 8 during the 2003/04 season. Entries also differed slightly from one district to another, and sometimes, among villages within a district (Table 3). These differences came as a result of variations within the target area with regard to altitude, rainfall and adaptability. For a check entry, the most predominant local cultivar in a district was used. Entries were planted in 7-row plots measuring 7.50 x 5.25m at a spacing of 75m x 30cm between and within rows, respectively. Two seeds were planted per hill and later thinned to one plant. A Randomized Complete Block Design was used across all sites in evaluating the maize cultivars. In order to facilitate meaningful statistical analysis of data to be collected, entries were randomized within each plot and in addition, each farmer's plot was taken as a single replication within a village. Nitrogen fertilizer was applied at the rate of 120 kg N/ha, one third at planting, and the remainder top-dressed when plants were about one metre tall. Phosphorus fertilizer was applied at the rate of 20 to 30kg P/ha (the higher dose was for the Mbozi sites, where soil pH is lower i.e., 5.4 to 5.7 than in the rest of the sites). Stalk borer damage was controlled using readily available insecticides, such as Karate, Selecron or

Thionex, at the rate of 2.0 litres of the product per hectare, when maize plants were 25–30cm tall. Thinning to one maize plant/hill was done before insecticide application. Weeding was done manually twice or thrice, depending on the severity of weed infestation, so as to keep plots weed-free during vegetative growth.

Planting of the demonstrations was done jointly by researchers, farmers and the village extension worker. The farmers included those participating in the demonstrations plus other interested farmers (who voluntarily joined the group in order to learn), forming a team of up to 20 or more farmers at a site (see Activity 1.3). After setting up a demonstration, the whole group moved to the next farmer site, until all the five demonstrations in a village were completed. This approach was used in all the districts and all planting was done during the month of December for both seasons.

Table 2. Entries evaluated through the village-based demonstrations during two seasons.

District	Village	Entries evaluated during 2002/03	Entries evaluated during 2003/04
Mbozi	Mpito	UH615, UH6305, TMV-2, P84, Local	UH615, UH6303, UH6304, UH6305, UH6306, Local, H625, TMV-2
	Ibembwa	-do-	
	Igunda	-do-	The above entries were evaluated in all 4 villages in Mbozi district
	Mponela	UH615, TMV-2, P84, Staha, Local	
Mbarali	Majenje	Staha, TMV-2, P84, UH615, Local	UH615, TMV-2, Local, Staha-ST, Kilima-ST.
	Mahongole	-do-	
	Ihahi	-do-	The above entries were evaluated in all 4 villages in Mbarali district
	Igomelo	-do-	
Njombe	Igagala	UH615, UH6305, TMV-2, Local	UH615, UH6303, UH6304*, UH6305, UH6306*, Local, H625*, TMV-2
	Mtwango	-do-	
	Mhaji	-do-	
	Utalingoro	-do-	
Iringa	Ihimbo	Staha, UH615, TMV-2, P84, Local	UH615, UH6303**, UH6304, UH6305, UH6306**, Local, H625**, TMV-2
	Kitayawa	-do-	
	Wenda	-do-	
	Mangawe	-do-	

** Not evaluated at Mtwango & Mhaji, and in Kawogo's plot at Igagala*
*** Not evaluated in Mangawe village*

iii. Monitoring and Evaluation of the Demonstration trials Monitoring and evaluation of the maize demonstrations including data collection was effected through a participatory approach, involving farmers, the project team (researchers from ARI Uyole and NRI-UK) and District Extension personnel, at critical stages during crop growth. These were:

- immediately after crop emergence (ARI-Uyole researchers)
- during topdressing of nitrogen fertilizer (ARI-Uyole researchers)
- at flowering time (ARI-Uyole researchers)
- during grain filling (ARI-Uyole researchers, NRI, INADES-Formation, Extension personnel, farmers)
- at harvest (ARI-Uyole researchers, Extension personnel, farmers)

At harvest time, an effort was made to involve as many farmers as possible so as to gather enough information on overall variety preference assessment from the farming community.

Output 2: Approaches for improving access to and management of quality seed by farmers validated and promoted

Identification of groups/individual farmers and their training needs for improved management of good quality seed

The first part of this activity was accomplished through two different seminars carried out within output 1.

Various activities have been carried out to identify training needs among farmers over the life of the project. Activities which have significantly contributed to understanding farmers' and village extension staff training needs include the situation analysis survey, the on farm demonstrations, village and district based meetings, farmer seminars and field visits. A mini-workshop held at VETA-Mbeya from 26th- 30th July 2004 further deliberated on this agenda for two and a half days. The aims of the workshop with respect to training were: 1) Review progress of output 2 of the project, 2) Finalize the training tools / approaches and 3) agree a promotion strategy.

Development of training approaches/learning tools

Learning tools were developed based on the experience and knowledge of the project partners and drawing on experiences elsewhere, including other CPP projects. In addition existing tools were used where applicable. The development of the tools has been an iterative process. For example, initial versions of leaflets and booklets have been shared with farmers, extension officers and others. These have then undergone some modifications. The demonstrations themselves have also offered important opportunities for learning and over the life of the project these have evolved from being one purely researcher designed demonstration to three types of demonstrations/ trails. This included a farmer group plot which received seed, but no other inputs. This provided an opportunity for farmers and researchers to learn together under farmer conditions.

Training of farmers and Village Extension Workers on seed management

Two seminars on seed management were held. The first was for village and district extension officers (10-12th September 2003) and the second for farmers (6-7th April 2004). Although the content of the courses was similar in both, that for the village and district extension officers was more detailed since the latter had had formal training in agriculture. The seminars utilised three facilitators, one from the Tanzania Official Seed Certification Agency (TOSCA), and two from the Iringa-based ASPS-DANIDA QDS project. The project team at ARI Uyole (breeder and agronomist) also participated and contributed on some of the technical issues surrounding seed production and management.

Facilitators went through details of two stage seed selection (in local and improved composite varieties), procedures for production of quality declared seed (QDS) as well as composite varieties and reselection of seed from fields planted with OPVs. The two groups of participants were also given detailed differences between composite and hybrid varieties, regulations binding production of certified and QDS seed, the role of the official seed certification agency (TOSCA) and the Tanzania official variety release procedures. One of the requirements for official variety release in Tanzania is that a variety being proposed for release must have been tested for at least two seasons under farmers' field conditions and that farmers must fully participate in evaluating them. It was then clear to farmers that they had a critical role to play in the variety release process. The recently released new hybrid, UH 615 was given as an example where some farmers within the project participated in evaluating.

In one case, what was learnt in the seminar was supplemented with a field trip to observe and interact with other farmers involved in some on-farm seed production activities. Thus, 12 farmers from Mbarali district accompanied by their village extension officers were given an opportunity to visit Njombe District for 3 days, i.e from 13-15th April 2004. In Njombe, they visited farmers who were involved in on-farm seed production under the DANIDA-funded Quality Declared Seed (QDS) project. Discussion and exchange of experiences regarding this project took place right in the field where the visiting farmers were able to gain practical experience with regard to commercial on-farm seed production activities. Mbarali district was selected because it is a potential area for production of QDS seed under rain-fed and irrigated conditions.

Field inspection and backstopping visits

Field inspection and backstopping visits were carried out during the 2003/4 and 2004/5 seasons by officials of the Tanzania official Seed Certification Agency (TOSCA) and district extension staff in Mbarali district. These visits have been to provide technical backstopping to farmers engaged in QDS seed production as well as to ensure that the basics of seed production are adhered to in order to come out with the basic minimum standard seed (quality declared seed).

Planning/ monitoring and evaluation at beginning, mid and end of season.

This activity evolved into planning, monitoring and evaluation of the on-farm demonstrations/ trials in the four districts and for the project as a whole. Following the Inception meeting in October 2002, annual planning meetings took place in October 2003 and November 2004. Monitoring visits to demonstrations/ trials took place at various times during the season. .

Final preparation and dissemination of promotional materials

The final selection of learning tools for wider promotion was made at the mini-workshop held at the VETA Centre in July 2004. Under the project, three leaflets have been finalized, one leaflet has been prepared in English and a first draft in Kiswahili and a first draft of a booklet has been prepared. For wider dissemination of results arising from the various activities of the project, different communication strategies/ approaches have been planned to ensure that as many farmers as possible in the project's target area have access to and understanding of the validated improved seed production and management practices. . Preliminary maize promotion strategies for the four districts in which the project is working have been developed.

Output 3: Sustainable pathways/systems for quality seed supply appropriate to local conditions and farmers' needs developed by farmers and other stakeholders

In order to address the issue of quality seed supply, it was necessary to consult widely to better understand and document perceptions, interests, activities and the situation of stakeholders. These included farmers, seed companies, distributors, stockists, NGOs, public sector extensionists, public sector researchers, regulatory bodies and policy makers. This was carried out through the Situation Analysis (see output 1), a survey of stakeholders, a major stakeholder workshop and on-going communication with stakeholders throughout the life of the project. These activities identified opportunities for improving access to quality maize seed in the S. Highlands. Some of these recommendations were implemented within the influence of the project and others driven by wider interests. The original aim was to hold an end of project stakeholder workshop. However, as explained below, this was postponed following CPP's agreement to fund a second phase.

Stakeholders Consultation Survey

This survey was conducted in early July 2003. The aims of this activity were to better understand:

(i) stakeholders' aims, interests and activities in relation to maize seed
(ii) stakeholders' perceptions of the seed systems in the Southern Highlands together with current strengths, weaknesses, opportunities and threats to their improvement
(iii) broad trends in the commercial sector
(iv) How stakeholders would like to contribute to improving seed systems in the Southern Highlands.

A joint ARI Uyole, NRI and Sokoine University of Agriculture (SUA) team drew up an initial list of stakeholders (in June 2003) together with a checklist of questions to guide discussions. Thereafter a two-person team from NRI and SUA carried out the consultations in early July

2003. This team visited stakeholders mainly in the Southern Highlands, Dar-es-Salaam and Arusha. A total of 47 stakeholders were visited and 43 consultations took place. Particular emphasis was put on consulting private organizations because this is a relatively new sector with respect to maize production in Tanzania. The Table below summarises the stakeholders consulted:

Table 3. Classification of stakeholders consulted by sector, location and prime role with respect to maize seed in the S. Highlands

Sector	Prime role	Location	No. consulted
NGO	Not for profit Extension/ seed provision	S.Highlands	3
Private	Distributing/ retailing seed	Arusha	1
Private	Distributing/ retailing seed	S.Highlands	18
Private	Commercial seed supply to intermediaries	Arusha	7
Private	Commercial seed supply to intermediaries	S.Highlands	4
Public	Extension	S.Highlands	3
Public	Policy, regulation, funding	Dar es Salaam	2
Public	Policy, regulation, seed provision	S.Highlands	2
Public	Research	Arusha/Morogoro/ S.H	3

A working paper was prepared which presented the findings of the survey including: the range and characterization of stakeholders; stakeholders' aims, interests and activities; a brief description and trends in maize seed systems from stakeholders' perspectives, and how they would like to improve seed systems. This was followed by an overview of the findings and some implications to be considered for the improvement of maize seed systems. Issues and themes identified through this survey contributed to, and were further explored, in the Iringa stakeholders workshop aiming to improve seed systems to the needs of farmers in the SH.

Stakeholders' Workshop - Improving maize seed systems to meet farmers' needs in the S. Highlands of Tanzania

The stakeholder consultation survey results held in early July 2003 were utilized in planning a workshop was held in Iringa from 29th – 31st July 2003. The 71 participants included farmers, seed company representatives, distributors, stockists, NGO representatives, public sector extensionists, researchers, policy makers (e.g. Ministry of Agriculture (Seed Unit) and the Director of Research for Development), regulatory bodies (Tanzania Official Seed Certification Agency), donor representatives (e.g. ASPS DANIDA Seed Advisor) and other CPP project representatives (e.g. Farm Input Promotion Africa, Kenya and CABI ARC (Nairobi). In order to encourage interaction, most of the participants stayed at the workshop venue, the NBC Bankers' Academy hostel, Iringa. The key element in this workshop was to better understand perceptions, interests, activities and situation of stakeholders with an interest in maize seed in the SH. Specific aims were to:

(i) Share issues and experiences of different stakeholders about maize seed
(ii) Review existing roles and responsibilities of different stakeholders with respect to access and management of quality seed
(iii) Identify and make recommendations on ways of improving the involvement and linkages of different stakeholders in activities related to access and management of quality seed.

Workshop process: Following various introductions, participants were asked to record their expectations of the workshop. The workshop then proceeded as follows.

1. Presentations

To help set the scene a number of speakers were invited to make presentations (eight) and posters were presented on various aspects of maize seed systems. Presentations in English were simultaneously translated into Kiswahili. Presentations in Kiswahili were summarised in English.

2. Group work

In stakeholder groups -participants were assigned to one of seven stakeholder groups: farmers, stockists/distributors, NGOs, companies supplying seed, public sector extension, public sector research, public sector policy, regulation etc .

Task 1. Validating Stakeholder Analysis of Seed Systems
In Stakeholder groups participants were asked to:
Step 1: Look at strengths (S), weaknesses (W), opportunities (O), and threats (T) of maize seed systems already identified by those consulted in Stakeholder Survey. Allocate each S, W, O or T to one or more of the three seed systems (Certified Seed, Quality Declared Seed and Farmer Saved Seed) identified by the Stakeholder Survey.
Step 2: Review and add any further S, W, O & Ts for each seed system.
Step 3: For each S, W, O or T for each seed system, identify those for which there is broad agreement within the group.
Step 4: Put the group's S, W, O & Ts against those of others in each seed system (each seed system was located in a different corner of the room).
Final Outcome: Analysis of the three seed systems by each stakeholder group

Task 2: Identification of realistic opportunities, roles and contributions
Participants were asked to select which seed system group they wished to work in i.e. Certified Seed system; Quality Declared Seed system or Farmer Saved Seed system.

In seed system groups
Step 1: Participants reviewed the opportunities identified by all the stakeholder groups for their chosen seed system. They then selected the most realistic opportunities, taking into account strengths (S), weaknesses (W), opportunities (O), & threats (T). They clarified and redefined the opportunities where necessary.
Outcomes: List of realistic and clarified opportunities for each seed system.
Step 2: Roles were identified on the basis of identified opportunities and stated contributions by stakeholders.

3. In Plenary
Step 3: Participants reflected on opportunities and considered which were within whose areas of interest and/or responsibility.

Task 3: Participants evaluation of the workshop
Participants completed an evaluation sheet including details on how they would like to contribute in the future to improving seed systems.

The workshop is reported in three sections in a project working paper. Section 1 is an introduction and background to the workshop and the project. Section 2 includes the presentations, discussion and outcomes of the workshop. Section 3 is an attempt by a smaller team to interpret the outcomes and synthesise the ideas which came from stakeholders in order to provide a way forward.

The workshop brought together a wide range of stakeholders with an interest in improving maize seed systems in the SH. Participants signed up to roles and responsibilities to improve one or more of the seed systems of their choice. Activities, roles and responsibilities identified by participants have taken place at various levels (e.g. village, district, national), some within the influence of this project and others driven by wider interests.

Analysis of participants evaluations
At the end of the workshop participants were asked to complete a short questionnaire. Unfortunately, it was already late when they were distributed and only nineteen questionnaires were completed. However, the returned questionnaires represented a reasonable cross-section of the stakeholders and provided generally useful feedback. There were five main questions. The responses are summarised below:

1. Did the workshop live up to you expectations? If so, in what ways?
Out of 19 respondents, 18 replied 'Yes' to this question. The reasons may be grouped as follows:

- Learnt more about seed systems – farmer saved seed, QDS and certified seed; their strengths, weaknesses, opportunities and threats (7)
- Participatory nature of workshop – the workshop was organized and managed in such a way that encouraged participants to express opinions and listen to one another (3)
- Provided an introduction to other actors/ stakeholders with an interest in seed systems and what they were doing (4)
- Workshop process has produced specific outputs which can be taken forward by different stakeholders (5)

One respondent felt the workshop was not up to expectations because s/he was not sure that there was a strong enough plan to improve farmers' access and management of seed.

2. Have you become familiar and happy with the aims of the workshop?

All the 17 participants who responded to this question answered 'Yes'.
One participant suggested that this approach should be extended as a model for other crops.
One reservation was that there might be too much emphasis on research and not enough on directly increasing farmers' yields.

3. Were the arrangements of the workshop satisfactory and if not how could they have been improved?

14 out of 18 respondents felt that arrangements were satisfactory, but there were many comments both positive and negative:

Positive comments	*Negative comments*
• Range of stakeholders	• Lack of time to cover the issues resulted in late sessions
• Venue	• Lack of advance information/handouts prior to the workshop
• Transport arrangements	• Late evening meal
• Accommodation	• Presentations should all have been in Kiswahili
• People all staying together	• Transport arrangements- should have been more flexible, rather than travelling in groups

4. Have you come away with a strong commitment to follow-up activities? If not, what is your concern?

All the 18 participants who responded to this question answered 'Yes'.

5. What specific next steps would you personally or your organization wish to take to progress this initiative? (Relevant responses from question 3 above are included here)

There was a wide range of responses reflecting the diversity of stakeholders as to how participants would like to take this initiative forward. These may be grouped as follows:

i. Improved collaboration and communication
ii. Addressing fake seed
iii. Farmer training
iv. Workshop follow-up e.g. finalize workshop report and circulate
v. QDS seed – raise awareness and introduce to other areas
vi. Seed quality issues
vii. Seed packet size
viii. Funding – including ideas for future funding
ix. Increased emphasis on initiatives already planned by company for the SH
x. Promote village markets
xi. Germplasm collection
xii. Seed health issues investigated and clarified (e.g. through seed fairs, farmer seed experts)
xiii. Learning more about farmers seed management procedures through novel techniques e.g. animated video

Implementation of recommendations from the Iringa stakeholders' workshop

The Iringa workshop participants identified a range of opportunities for improved seed systems. The characteristics of the seed systems and opportunities for improvement are summarised below:

Certified Seed (CS) The amount of certified maize seed currently bought in Tanzania is low and declining. Reasons include high price of certified seed and other inputs, loss of confidence by farmers (due to fake and low quality seed) and poor access in rural areas. Low germination, high storage pest damage and the need for expertise in order to obtain high yields were weaknesses identified by farmers. The sector is going through a period of major transition with seed multiplication farms now operating at <10% of capacity and previous production levels. NGOs (e.g. ADB Mbozi) see it as their duty to provide farmers in rural areas with access to seed, including certified seed. Stockists seldom have seed as their main business, perceived low profitability and lack of access to credit gives them little incentive. At least six companies were promoting their seed and a minimum of 20 maize varieties (OPVs + hybrids) were on sale in the SH in the 2002/2003 season. Stakeholders agreed that good high yielding maize varieties with disease tolerance were available in the SH but that the low altitude areas were less well catered for than higher altitude areas. Promotion of these varieties is not very effective. There is a need to address soil fertility issues at the same time as promoting varieties. Despite the SH being the main maize production area, most of the seed companies were much more strongly represented in the Northern zone than the SH. Most certified seed is produced outside of the SH and most hybrid seed outside of Tanzania; the government wants more local production. Issues related to the ownership of varieties have been a constraint to plant breeding in the public sector. The government has recently agreed on Plant Breeders' Rights legislation. This move is expected to encourage plant breeders to put more effort towards the development of appropriate maize cultivars which meet farmers' quality seed needs in the various agro ecological zones of the Southern Highlands.

Opportunities to improve the certified seed system include broad issues such as:

- Packaging of seed for sale in smaller quantities
- Better national & international cooperation and communication
- Local entrepreneurs to benefit from new varieties produced by research
- Private sector to benefit from market liberalization
- Increased farmer awareness to help reduce sales/use of fake seed
- Maize seed production under irrigated systems to speed up production
- Higher profit margins for stockists
- Better promotion targeted at small-scale farmers, including less accessible areas

Quality Declared Seed (QDS) QDS maize seed production is way below requirements; however the system has government support to expand to cover whole country. QDS can supply only OPVs not hybrids. Seed quality control – TOSCA (which checks seed crops) is very deficient in terms of staff and logistics: in the SH, it possesses only one motorbike, one car and two staff. The QDS system may be vulnerable to local oversupply. There are a low percentage of women QDS producers, partly due to land ownership issues and the need for large isolation distances. As well as QDS, there ought to be quality 'traditional' seed. Farmers trust QDS because they individually have seen it being produced. In villages, farmers can barter for QDS seed. QDS seed is sold at about 500 TSh/kg while certified seed of the same variety is sold commercially at 1000 – 1200 TSh/kg. Opportunities identified to improve the quality declared seed system included:

- Strengthening marketing to ensure sustainability
- Expand range of varieties produced as QDS
- Expand production/ distribution area of QDS
- Better links with research

Farmer-Saved Seed (FSS) Farmer-saved seed is the key system for the SH, and current evidence points to this dominance increasing over the recent past and continuing to do so for the immediate future**.** During the consultations non-farmer stakeholders identified mainly weaknesses in farmer-saved seed systems. Although these weaknesses were mostly valid, stakeholders appeared to miss major key issues:

- About 95% of the maize crop in Tanzania is planted with farmer-saved locally traded seed.

- Farmers are continuing to grow local varieties and often mentioned eating quality characteristics as reasons.
- Farmers perceive the germination rates of farmer-saved seed as high (>90%), while germination rates of some certified seed as very low.
- Farmer-saved seed is available and affordable, and trusted by farmers.

Farmers therefore expressed the desire to co-operate with researchers in having farmer-saved seed improved for yield, disease tolerance and other desirable attributes. Opportunities identified to improve the farmer saved seed system included:

- Help with conserving the seed diversity
- Training for farmers to better select and save seed and to otherwise boost the image of farmer-saved seed

End of project stakeholders' workshop

It was planned that this workshop would take place in early 2005 just prior to the end of the project. However, following the agreement with CPP to move to a second phase of activities, this workshop has now been postponed (and funds retained) until November 2005. This provides opportunities for further developments and with the funding of a sister project (R8422) by the DFID Crop Post harvest Programme this workshop will now be hosted by both research programmes. In addition there will be a follow-up forum targeting policy makers.

OUTPUTS

OUTPUT 1: Disease resistant Maize varieties appropriate to farmers needs and adapted to local conditions validated by farmers and other stakeholders

Inception Workshop and **Situation Analysis**

The Inception Workshop and the Situation Analysis came up with the following main findings:

1. Change in the Agricultural Systems (past, present and future)

- Soil fertility has declined
- There had been a change from using maize landraces to improved maize hybrids and open pollinated, but still maintaining landraces
- Now farmers are buying very little improved seed instead they have gone back to landraces and recycling of hybrids

Reasons/Causes

- Selling of maize seed in wrong agro-ecosystems
- Removal of subsidies leading to increased costs of maize production
- Loss of confidence in seed from seed suppliers
- Low price of maize grain
- Availability of improved seed at farm level

Are these causes likely to change?

- Some of these causes are likely to change from the project intervention such as availability of quality seed at farmer's level.
- "Assuming most of the farmers continue to recycle seed" - the project should target for OPV & top cross hybrids or 3 way cross or double cross.

Rainfall pattern:

- There has been a dramatic change in rainfall pattern and reliability, hence risk of loss of seed investment
- There is a need to determine new planting dates
- There is a need for short maturity maize varieties
- Where moisture not enough to germinate the seed, seed priming may allow plants to catch up with the season

In irrigated areas. Justification for project to work there?

- Problem of MSV
- Government policy
- To ensure increased food production
- Mbarali represents a special agro-ecological climate which is likely to expand in the SH
- Farmers are growing maize for their own food security and selling green maize
- Why are farmers growing maize in irrigated areas instead of rice and vegetables?
- If the project works in irrigated areas, there may be competition with other projects e.g. using the same farmers and extension

2. Importance of maize

Conclusions:

- Maize is ranked number one food crop for all the villages visited in the districts
- As cash crop maize has variably ranked 1-4 from the 4 districts
  - Mbarali ranked maize in terms of importance as a cash crop: 2nd - 4th
  - Mbozi ranked it 2nd
  - Njombe ranked it 1st - 2nd

- Iringa ranked it 3rd to 4th

Hypothesis

Countries surrounding the SH remain maize food deficit; therefore maize will remain important as a cash crop

Implications

Increased food/ maize production would call for a more sustainable system of quality seed production and supply.

3. Maize production practices

Conclusion

- Hand hoe is a main tool for land preparation and weeding
- The use of ox-ploughs for land preparation are increasing
- Tractor use increased at one time but now is on the decline due to its high cost

Hypothesis

- Ox-plough reduces drudgery for both women and men
- Several methods are available to control stalkborers including many ITK practices
- Agronomic practices from the project areas are generally similar to the recommendations given by researchers/ extension.

Implications

1. For on-farm community seed production to promote TMV-2 and other open pollinated cultivars, all management practices such as isolation distance, recommended fertiliser rates, plant population and stem borer control should be adhered to in order to get marketable good quality seed. This is for all participating farmers
2. Demonstration/evaluation of disease resistant varieties: The advantages of the use of fertiliser in the SH are well understood by the farmers, but they are not using it to the level recommended by researchers or not using it at all due to high cost. Hence they opt for compost or FYM. This is farmers' normal practice, which the project has to take into account during demonstration/evaluation of the varieties.

4. Maize production constraints and opportunities and other inputs (non seed) technologies

Conclusion

- Low soil fertility is the major common constraint across the villages in the 4 districts.
- Poor access to improved (local & introduced) seed due to:
  - High price of seed and value of money
  - Physical availability
  - Cost of resultant packages
- Weather is unreliable
- Head smut is easy to control - project could contribute through appropriate learning tools
- Stalkborer is a major crop pest. Farmers are controlling it in different ways. The project could document and extend the effective methods of stalkborer control to other areas.
- Farmers' perceptions of pests and diseases need studying
- Farmer field school could be the most appropriate approach to address the problem of (pests/diseases) farmers' perceptions
- Ox-ploughing is increasing but we do not fully understand its effect on planting. Hence further information/study needed.
- Seed priming may have several advantages e.g. reduced seed rate, extended cropping season. The project needs to monitor farmers' activities on this.

5a. Maize varieties and attributes

Desirable characteristics included:

- flint,
- hybrids,
- large kernels,
- resistance to storage pests,
- early maturing
- drought tolerance
- 2 cobs per plant
- resistance to diseases

Issues include that a combination of large kernels and flint varieties may be difficult and >1 cob may not benefit yield despite a strong farmer perception that 2 cobs/ plant are better than 1. Most of the Uyole bred maize cultivars are flint, medium large kernels, have stay green character (H615), drought tolerant, medium maturity.

Hypothesis

Improved varieties are available that fit several of the defined attributes. Suggested varieties for the different districts:

Mbarali - is intermediate dry, and many areas practice irrigation

need: high yielding, early maturing, MSV resistant cvs with medium to large kernels resistant to storage pests.

recommended varieties: TMV-1 (has resistance to MSV); SC 627 - hybrid; Staha-ST; Kito-ST; P84

Mbozi - *need*: hybrid, flint cvs with MSV resistance

recommended varieties: UH 615; UH6305; TMV-2; P84

Njombe - *need:* large kernel, flint, 2 cobs/ plant, head smut resistance, ear rot resistance, MSV and GLS resistance.

recommended varieties: UH 615; UH6305; TMV-2; P84, (except for Igongolo where Staha will be added)

Iringa:

recommended varieties: UH 615; UH6305; TMV-2; P84 (also at Mangawe include Staha)

Trials: several recommended cultivars plus a local check, which will be constant to the 5 farmers in each village. Each farmer will also be given 100g of each of the recommended cultivars to grow simultaneously under their own management.

5b. Maize utilisation

- Home consumption
- Sale
- Making local brew
- Livestock feed

5c. Marketing

Market gets flooded at harvest leading to low prices. "There is a need for more effective marketing". Access to and ownership of harvest (ref. Mangawe village by Sangu tribe, where harvest belongs to men).

Implication to the project:

Women farmers should be included in the trials

6. Storage issues

- Use of several ITK practices against storage pests (ash, neem, mvanga etc.) and Actellic Super dust.
- Seed mainly kept separately from food; if shelled kept in bags, clay pots, buckets; if stored on cobs mainly under kitchen eaves or in kihenge.
- Some reports of germination problems - project could test the different methods of storage/and storage protection on germination, vigour, damage.

Constraints: larger grain borer (*Prostephanus truncatus*) and sale of fake Actellic Super dust

7. Sources of seed

Most farmers are mainly using recycled seed. There are a few farmers who exchange seed between themselves, buy from stockists e.g. TFA from nearby towns.

Constraints:

- High prices of improved seed
- Mixed varieties
- Unavailability of seed at village level
- Fake material presented as improved seed

Hypothesis

- Improving farmer management of recycled seed will increase productivity.
- Increasing the percentage of bought seed could have a worthwhile effect on maize productivity.

Implications

Current outputs of the project are appropriate.

8. Seed management

Seed selected: at harvest/after harvest at homestead. Seed selection criteria include: big cobs, big kernels, good husk cover, long cobs, not rotten or weeviled,
Seed stored: in bags, clay pots, hung in houses or kihenge, treated with Actellic Super dust.
Low seed germination occasionally reported. This suggests methods could be improved.

Implications

Project could test different methods for resultant percentage germination, vigour and damage.

9. Source of seed

Most farmers are mainly planting recycled seed.

Hypotheses

Improving accessibility to good quality seed among small farmers could benefit productivity.

Implications for the project

Current project outputs are appropriate.

Conclusions

Most farmers are selecting on the cob after harvesting at the house.
Few farmers are selecting at harvest in the field.
Some farmers test seed germination prior to harvest and some are practising seed priming (seed priming might spread head smut)
Farmers are selecting large undamaged grains from large cobs
The symptoms of GLS are present on the leaves of dried plants, the symptoms of MSV are not seen on dried plants.

Hypothesis

No farmers are selecting while the crop is green.

GLS implications

Farmers can select for GLS resistance at harvest but need to select while the plant is green for MSV resistance.
Farmers could be advised by the project on how to select while the crop is growing as well as at harvest/after harvest.

9a. Land (size, access, ownership)

Conclusions

- Land is generally owned by men
- Land access for women is generally through men either through the husband or father

- Land ownership is an aspect of wealth
- Within villages there were large differences in the amount of land owned, between the rich and the poor households.
- There was variation in land tenure e.g. renting

Hypothesis
Because of the size of our trials we are likely to be working with medium to rich farmers.

9b. Sources of income (other than agriculture and livestock)

Conclusions:
There were significantly different income sources between men and women and rich and poor.

Hypothesis:
Access to income affects maize inputs and methods of management

Implications for project
Project needs to clarify its target groups and consider the effect of its outputs on them and has to work with each.

9c. Wealth ranking

Conclusions:
Land, cattle, and type of house were always important wealth ranking criteria, but there were significant differences in the priorities of such criteria between villages and within districts.
Maize is an important food crop for all wealth categories.

Observation:
We do not know if maize is an important cash crop for all wealth categories

Implications:
What is the relationship between maize/ livelihood strategies and seed management for different wealth groups. Will working with different wealth groups involve different methods. This might influence how we choose the villages.
How do we make sure the project it is working with the appropriate sector of the household?

Conclusions
- Maize is the main food crop and is also an important cash crop in all the villages visited
- The hand hoe is the main implement used for cultivating maize in all villages. Tractor use has declined, however, the use of ox-ploughs has increased
- Slashing and burning are used for initial land preparation
- Herbicides are rarely used
- Use of agricultural inputs is relatively high in the SH compared to other parts of Tanzania. However, the high prices of these inputs (seeds, fertilizers, pesticides) have resulted in a decline in their use. This is a major maize production constraint.
- Decline in soil fertility is evident in many villages due to continuous planting of maize on the same land (with little or no rotation) and insufficient use of inorganic or organic fertilizers. Use of improved seed must go hand in hand with improved soil fertility
- Farmers mainly plant home-saved seed. This could be a local landrace, a recycled modern open pollinated or hybrid variety, or a mixture of all these. Farmers select seed from amongst harvested unshelled cobs, generally going for large, well-filled flint cobs.
- Both men and women are involved in seed management, women featuring more in home-saved seed and men in purchased seed.
- In addition to GLS, other diseases such as MSV and head smuts are threatening production of maize. In many villages, stem borers are prevalent; farmers control them using botanical insecticides or, sometimes, purchased insecticides.

- The maize weevil *(Sitophilus zea mays)*, the larger grain borer *(Prostephanus truncutus)* and rodents are the worst storage pests, causing significant damage to stored grain
- Maize is used for food, sale (as either milling maize, green cobs for roasting) and making local brew while the bran is used for livestock feed.
- Maize is stored as shelled grain in bags (after treatment with storage insecticides) or on the cob in a traditional crib *(kihenge).*

Further details are available in:
- Inception workshop report
- ARI Uyole/NRI/INADES Formation (2003). Situation analysis of maize growers in the Southern Highlands of Tanzania, with particular emphasis on access to and management of seed. Working paper for DFID Project R8220.

Identification and Sensitization on Formation of Farmers Groups

Three-day farmer seminars were held in each of the four districts targeted by the project on the following dates:
- Mbozi: 3–5th March 2003
- Mbarali: 20–23rd March 2003
- Njombe: 27– 29th March 2003
- Iringa: 31st March to 2nd April 2003

In each district, six farmers plus their village extension offices attended from each of four villages and a district crop officer attended, giving a total of 29 participants. Gender balance was accomplished: in each village, at least two female farmers participated. Farmers and extension officers received training on the following topics:
- Maize agronomy, soil fertility.
- Group formation, theory and practice.
- Gender and development.
- Markets and marketing of agricultural produce, with reference to maize grain.
- Data collection from the village-based maize demonstrations.

Discussions identified that collection of data on the following topics was important to the farmers and/or extensionists**:**

- Date of field preparation
- Area of the demo field
- Date of ploughing
- Date of harrowing
- Date of planting
- Row and plant spacing
- Variety/varieties sown
- Number of seeds per row/plot
- Type of fertilizer used
- Amount of fertilizer per plot
- Dates of fertilization
- Rainfall dates
- Days with no rainfall (drought)
- Dates when rainfall was adequate for crop growth
- Emergence dates for each variety
- Number of plants emerged (stand count)
- Date of stalk borer control
- Type of insecticide used
- Amount and type of insecticide applied in an area
- Date of insecticide application
- Dates of weeding (1st, 2nd, 3rd etc)
- Flowering date for each variety
- Maturity dates for each variety
- Harvesting date
- Yield for each variety
- Quality assessment of each variety
- Seminar/seminar dates and venue
- Researcher and other guests visit

Farmers identified that record keeping:
- allows forecasting of inputs e.g fertilisers, seeds, and estimates on potential yields
- enables farmers to select good performing seeds

- assists in determining proper timing for various agronomic activities e.g., planting, weeding, fertilization , etc
- provides information to facilitate planning for the following season

During discussion on formation of farmer-groups, farmers brought up the issue of constraints to marketing, noting that lack of reliable markets for agricultural produce had hindered their progress for a long time. Major constraints identified were:

- Buyers dictate prices (no negotiations)
- Prices are unstable and usually on a declining trend
- Government pull-out in controlling prices has left room for middlemen to harass them
- High costs of production as compared to returns
- Lack of marketing skills
- Low production of crops
- Lack or limited markets for their produce
- Poor transport network, particularly in remote villages
- Cheating by middlemen through use of non-standard measurements (e.g. sacks, plastic containers, tins), instead of kg, litre, tonne, metre

Formation of marketing groups at local level was appreciated as one option to minimize marketing problems, for instance, collectively sending their produce to markets. This effort would also minimize price dictation and cheating by middlemen.

Farmer Groups Strengthening Seminars

Workshops were held with farmer groups in 2004 aiming to make the groups more purposeful, less dependent and hence more sustainable.

Specific objectives:

The training workshops were part of group strengthening strategies and aimed mainly at:

- Improving leadership skills and enhancing effective communication within and between the groups.
- Setting out the groups' constitution.
- Sharing best ways to manage the Groups' joint activities (e.g. Shambas etc) and revolving funds.
- Improving skills in farm records.
- Setting a system of documenting the reports and filing.
- Developing the Groups' Plans of action for 2005 and adopting the jointly agreed format.

Participants:

Three day training seminars were carried out in the four target districts of Mbozi, Mbarali, Njombe and Iringa on the following dates and venues:

(i) Njombe: 1-3 July 2004; Lutheran Centre Hall, Njombe.
(ii) Iringa: 5-7 August 2004; Lutheran Centre Hall, Iringa
(iii) Mbarali: 23-25 August 2004; MATI Igurusi Hall, Igurusi
(iv) Mbozi: 2- 4 September 2004; ADP Ukwile Farmers Centre, Mbozi

From each district, 20 farmers, representing core members within village groups, participated.

The Process:

The workshop adopted participatory approaches where the following were discussed:

1. Group discussions and presentations on the preset by-laws
2. Plenary contributions from participants on communication and leadership skills.
3. Costs and expenditure analysis of the farm investments were done.
4. Report writing skills and filing.
5. Developing plans of action for each group.
6. Groups in relation to marketing.

At every stage, there were inputs from the facilitator.

Major findings:
Time was spent to explore the existing status and main findings or lessons, among others were:

- Over 95% of the groups had limited capital to invest in agricultural production.
- Collective responsibilities had its limitation especially for joint group activities.
- Dissemination of the project results to wider community is at a slow pace.
- The groups had no clear objective for being in a group; being part of the project mainly enforced their togetherness.
- Some of the groups worked on the suggestions made in the last training workshops, to increase the number of members to reach 8 – 10.

Workshop events:

Leadership and communication skills.
The discussions and inputs aimed at coming up or improving the existing leadership skills, as a means of avoiding internal conflicts and sustaining the groups. The areas discussed included:

- Different leadership styles – their strengths and shortfalls.
- Leadership qualities.
- Roles and responsibilities of leaders.
- The bottom - up against top – down types of communication.

a) Farm record keeping
Each group wrote down the investment they had made in the group field the previous season using the suggested format (Table 4). This analysis revealed to participants clearly that in many cases they are making significant loss on their projects. This is at least partially due to not recognizing or taking into consideration some of the costs incurred.

b) Development of groups' constitutions:
Each of the farmer groups had been requested to come to the seminar with draft constitutions for their groups. The constitutions were exchanged to allow inputs from the other participants. These were improved during the seminars so that, at the end of the seminars, each of the 16 farmer groups (4 in each district) had a near complete constitution. With help from the facilitators, two main elements were added to all constitutions: (a) a section on management of joint activities or projects and (b), management of the groups' revolving fund.

Table 4. An enterprise recordkeeping sheet for farmer groups in the target area

ENTERPRISE : (maize/beans/wheat/potatoes/vegetables)	
PRODUCTION COSTS	**SHILLINGS**
Land rent	
Land clearing	
Land preparation	
Cost of Seed	
Cost of fertilizers	
Cost of pesticides	
Labour for planting	
Cost of labour for fertilizer and pesticide applications	
Weeding costs (manual or herbicide)	
Harvesting costs (labour)	
Transport to the farm	
Shelling costs	
Storage chemicals	
Labour for treatment	
Cost of bags for storage	
REVENUE (INCOME)	
Yield of crop (bags, kilograms)	
Price of crop/bag or kilogram	
Income= No. of bags x Price of maize/bag	
PROFIT/ LOSS ANALYSIS	
REVENUE obtained in the sale of maize minus COST of Production. If the figure obtained is positive, it means profit If negative, it means a loss If the figure is zero, it means break even	

c) Establishing a year long plan of action:

Before the workshop, most of the activities under group or individual members were done in a "fire brigade style". It was observed that the groups needed skills that would enable them to plan ahead.

Basic discussions were on: why plan? for whom? what to plan? etc.

The following format was agreed:

PLAN OF ACTION FOR …… GROUP YEAR 2005

Objective	Activity	Responsible	Period	Resources required	Sources of resources	Budget

e) Report writing skills and filing of documents

In this theme, the issue was to make the participants familiar with necessary components of a report. At the end of discussion, it was resolved that the groups should have two different types of reports: 1) Reports based on plot demonstrations and 2) Reports based on their usual meetings or events. Each group was given a box file to inculcate the habit of having a

systematic mode of filling essential reports or documents. On their part, each group bought a stapler and pins, punch and a ream of paper. It was agreed that items to be filed should include: plan of action, demonstration records for all seasons, minutes of meetings, farm records for group joint activities, workshop reports, by laws and correspondences.

(v) Relationship between groups and marketing aspects

Participants were invited to reflect on 'groups' and 'marketing'. It emerged that there is a strong relationship between groups and marketing activities and that such groups could improve marketing opportunities. For example:

- Building COMMUNICATION on what to produce? What quality, amount to produce, period to produce and sale etc.
- To produce and transport enough to meet market demand.
- Being able to advocate for the prices of their products.
- Reducing costs within the marketing process (Production to selling).
- Being able to be registered (legal recognition) so as to facilitate direct marketing of their products in and outside the country.

Workshop outputs:

- Each group has a constitution in place.
- The groups have developed plans of action.
- Leadership skills have been introduced.
- Groups have been reshaped to have more of a developmental focus.
- Record keeping skills have been made available

How the training has changed the groups will be assessed during follow up missions.

Future challenges in supporting the groups:

- How best can we use the collaborating project groups and other existing groups to ensure wider dissemination of good outcomes of the project?
- How are we preparing to wean the groups as we are coming to the end of the project, while sustaining the good results achieved or observed?

Some recommendations:

Weaning strategy:

- Develop District or village pool of resource farmers.
- Promote farmer-to-farmer learning.

The team members should be highly supported in training of technical aspects on maize production (given special attention).

The team being well capacitated in facilitation skills.

Dissemination strategy:

- Carrying out the local exchanges (not only to groups under project), by involving other groups which have shown interest to grow maize – taking into considerations that these ones are buying their own inputs.
- Documenting the success stories of maize emerging from maize production.

Village Based Demonstrations

1. 2002/03 Season

Results on performance of the maize varieties under evaluation during the 2002/03 season are presented in Tables 5 through 11. The new improved maize varieties exhibited grain yield superiority over the local cultivars at most locations, and outstanding performance was exhibited on some farmers' plots across the districts. These results indicate that high maize grain yields are possible even under rural farmers' field conditions, as long as improved maize varieties are grown using standard management practices. On some demonstrations across the target area, maize grain yields as high as 11 tonnes/ha were recorded, and some of the hybrids yielded up to 147% higher than the local cultivars, as shown by a summary on

performance from the best four farmers across the target villages (Table 5). In two cases, however, the local check out-yielded the improved variety, and this was attributed to the good quality of the local check variety in that area, which was later found to have originated from several years of selection and reselection from improved open pollinated cultivars, including recycled hybrids.

Table 5. Summary of maize grain yield from top four farmers for each improved variety compared to local checks, during the 2002/03 season.

Variety	District	Village	Name of farmer	Yield of improved variety (tonnes/ha)	Yield of local cultivar (tonnes/ha)	% yield increase over local cultivar
UH6305	Mbozi	Mpito	Edward, M	11.22	7.06	58.9
	Mbozi	Igunda	Charles, N	10.39	5.18	100.1
	Mbozi	Mpito	Enock, K	10.21	4.14	146.6
	Njombe	Igagala	Germanus, M	10.17	7.13	42.6
Mean				10.50		
UH615	Mbozi	Mpito	Edward, M	10.80	7.06	52.9
	Njombe	Mtwango	Odillo, K	9.92	7.72	28.5
	Mbozi	Ibembwa	Christina, M	9.35	5.30	76.4
	Mbozi	Igunda	Charles, M	9.02	5.18	74.1
Mean				9.77		
TMV-2	Njombe	Igagala	Germanus, M	9.07	7.13	27.2
	Mbozi	Mpito	Edward, M	8.92	7.06	26.3
	Iringa	Ihimbo	Linus, K	8.83	6.19	42.6
	Mbozi	Mpito	Enock, K	8.35	4.14	101.7
Mean				8.79		
Staha	Mbarali	Mahongole	Juma, K	8.49	7.81	8.7
	Iringa	Wenda	Michael, C	7.89	5.88	34.2
	Iringa	Kitayawa	Venance, B	7.18	6.04	18.9
	Mbarali	Majenje	Absalom, M	7.00	9.66	(-28.6)
Mean				7.64		
P84	Iringa	Wenda	Michael, C	6.98	5.88	18.7
	Iringa	Kitayawa	Hezron, N	6.89	4.84	42.4
	Iringa	Kitayawa	Venance, B	6.72	6.04	11.3
	Mbozi	Mpito	Edward, M	6.56	7.06	(-7.1)**

**Note: Figures in parenthesis: The improved variety yielded less than the local cultivar

Details on performance of the varieties in the target area show grain yield at individual farmers' plots for each district (Tables 6 to 9), as well as mean performance of each variety across farmers within a village. Means across the varieties demonstrated at individual farmers' plots are also indicated.

The improved varieties, UH615 and UH6305 showed superior grain yield performance, notably in Mbozi district, where village means exceeded the local cultivar by at least 29%. Performance of the improved materials was less conspicuous in some parts of Njombe and Iringa, where participating farmers had allocated poor infertile land for the demonstrations, due to scepticism regarding ownership of the grain after harvest. Under these poor soil conditions, it became difficult to note clear differences between improved varieties and the local cultivars. Problems were also experienced at Mangawe and Ihahi villages in Iringa and Mbarali districts respectively, where all demonstrations had to be cancelled due to severe drought during the grain filling stage. At a number of locations, for example, Mhaji and Mtwango in Njombe district, unsatisfactory performance was attributed to either negligence or sickness of some participating farmers.

Nevertheless, results from the analysis of variance on grain yield (Table 10) showed highly significant differences among entries at the 5 per cent level of significance, particularly when improved maize varieties were compared to the local checks. UH 615 and UH 6305 did not differ significantly in yield performance, although the latter was superior and most preferred by farmers. The CVs computed were within the acceptable range for on-farm evaluation conditions at most locations (less than 20% at 11 out of 14 villages where the demonstrations were successfully carried out).

Overall means on grain yield performance across the four districts for the varieties evaluated during the 2002/03 season are presented in Fig. 3. Again UH6305 and UH 615 showed superiority to the local cultivar and the other entries evaluated during the season.

Special remarks

In the course of monitoring the demonstrations in Mbarali district, the project team observed that MSV was a problem in this district. The situation was most striking at Igomelo (one of the villages in this district) where infection pressure was so high that many of the currently available maize varieties (some of which are known to be tolerant), could not withstand this high level of MSV disease pressure. The relatively low grain yields at Igomelo village, therefore, were mostly attributed to attack by MSV disease, as infection ranged from 80 to 100 per cent in all five demonstration plots. Nevertheless, this village appeared to be a good site for screening of maize germplasm for resistance to MSV and a decision was quickly taken by the project team to initiate MSV resistance screening work at this site as soon as possible.

Table 6: Village mean grain yield of maize varieties evaluated in Mbozi district during the 2002/03 season.

Village	Gender	Name	Grain yield (tonnes/ha)						
			UH615	UH6305	Local	TMV-2	P84	Staha	Mean
Mpito	M	Edward Mbwana	10.80	11.22	7.06	8.92	6.56	-	8.92
	M	Enock Kibona	7.34	10.21	4.14	8.35	4.97	-	7.00
	F	Maria Mgalla	4.28	6.42	3.89	3.30	3.72	-	4.32
	F	Lina Mwamwezi	6.11	6.50	5.29	4.32	6.30	-	5.70
	M	Baridi Mwamwezi	4.88	6.03	2.20	3.62	3.13	-	3.97
		Mean	**6.68**	**8.08**	**4.52**	**5.70**	**4.94**	-	5.98
Ibembwa	M+F	Shule ya Msingi	7.31	8.68	5.70	6.13	6.18	-	6.80
	F	Joyce Ndidi	4.82	7.37	4.89	4.47	5.12	-	5.33
	M	Keneth Ndidi	8.57	7.64	5.86	5.59	3.90	-	6.31
	F	Christina Mgalla	9.35	8.39	5.30	7.77	6.50	-	7.46
	M	Augustine Mwakalobo	5.62	7.60	5.32	3.75	4.13	-	5.28
		Mean	**7.13**	**7.94**	**5.51**	**5.54**	**5.17**	-	6.24
Igunda	M	Paul Mwasenga	5.51	5.78	4.03	5.34	4.64	-	5.06
	M	Ambakisye Mayagae	6.23	7.33	4.28	5.14	4.30	-	5.46
	F	Veronika Nzoa	5.48	5.18	3.42	4.54	3.77	-	4.48
	M	Charles Nzoa	9.02	10.39	5.18	6.50	6.03	-	7.42
	F	Evelina Sanga	Eaten by cows	8.14	6.10	6.98	4.00	-	6.31
		Mean	**6.56**	**7.36**	**4.60**	**5.70**	**4.55**	-	5.75
Mponela	F	Tabia Msukwa	4.61	-	3.20	3.06	4.05	2.55	3.49
	M	Andendekisyse Fiyao	8.08	-	4.20	4.66	2.97	5.64	5.11
	M	Wilson Chisunga	5.81	-	4.04	2.74	4.83	3.89	4.26
	M	Jackson Mambwe	7.24	-	4.50	4.88	4.62	4.21	5.09
	F	Sofia Joseph	4.73	-	3.92	5.61	4.34	4.24	4.57
		Mean	**6.09**	**-**	**3.97**	**4.19**	**4.16**	**4.11**	4.50

Table 7: Village mean grain yield of maize varieties evaluated in Mbarali district during the 2002/03 season.

Village	Gender	Name	Grain yield (tonnes/ha)					Mean
			Staha	TMV-2	P84	UH615	Local	
Mahongole	M	Juma Kapalila	8.49	5.43	5.15	7.87	7.81	6.95
	F	Attu Mwinuka	4.96	2.82	0.86	2.99	4.13	3.12
	F	Noela Alphonce	4.65	2.59	1.44	4.23	4.32	3.45
	M	Zablon Mwakifuna	5.72	4.17	3.49	7.37	6.22	5.39
	M	Daniel Mwakibinga	Cancelled due to drought					-
		Mean	5.96	3.75	2.74	5.62	5.62	4.73
Majenje	M	Absalom Msetule	7.00	3.65	4.92	6.34	9.66	6.32
	M	Erasto Ng'ahara	6.05	4.03	6.02	5.47	6.55	5.62
	F	Amina Richard	5.01	4.73	4.64	6.09	6.59	5.41
	F	Esta Mhema	6.42	3.06	3.29	4.80	5.92	4.70
	M	F. Mahenge	-dropped due to poor management					-
		Mean	6.12	3.87	4.72	5.68	7.18	5.51
Igomelo	M	Daudi Mpanye	2.80	2.99	2.17	1.60	3.00	2.51
	F	Flora Omari	3.43	2.96	1.43	3.29	2.42	2.71
	M	Mridi Kidumba	4.11	3.55	2.17	3.34	2.93	3.22
	M	Patrick Fute	4.63	4.31	3.70	6.36	4.98	4.80
	M	Paulo Mwangela	1.63	4.15	3.84	4.72	3.48	3.56
		Mean	3.32	3.59	2.66	3.86	3.36	3.36

Table 8. Village mean grain yield of maize varieties evaluated in Njombe district during the 2002/03 season.

Village	Gender	Name	Grain yield t/ha, by Variety				Mean
			UH615	UH6305	TMV-2	Local	
Igagala	M	Germanus Msemwa	6.93	10.17	9.07	7.13	8.32
	M	Ignas Ngailo	8.49	7.40	6.29	7.68	7.47
	F	Bitia Msigwa	8.26	9.27	7.71	9.73	8.74
	F	Alatwanukila Mtokoma	8.48	8.06	7.26	6.16	7.49
	M	Dominicus Fwalo	5.64	6.94	6.87	7.38	6.71
		Mean	7.57	8.37	7.40	7.62	7.75
Mtwango	F	Jenifa Ng'eve	7.85	8.13	4.92	5.75	6.67
	M	Elias Wikedzi	7.04	5.74	5.78	4.97	5.88
	M	Odilo Kinyamagoha	9.92	7.70	5.84	7.72	7.80
	F	Lea Mbusya	7.59	8.17	6.62	7.49	7.47
	M	Frank Mgeni	-farmer sick for a long time, no care of the demo				
		Mean	8.10	7.45	5.79	6.48	6.96
Mhaji	F	Elen Mkane	7.87	6.79	6.54	6.30	6.88
	M	Yona Kilasi	5.71	4.08	4.80	4.15	4.69
	F	Emelia Wikunge	7.55	6.77	5.36	4.02	5.93
	M	Fed Nyamle	-farmer neglected the demo				
	M	Nickson Kilasi	-no data, very poor low soil fertility site				
		Mean	7.04	5.88	5.57	4.82	5.83
Utalingoro	M	Selvelius Myamba	3.38	3.07	3.34	3.44	3.31
	M	Elias Mpete	- no data , soil fertility problem				
	M	Protas Mlengule	-no data, soil fertility problem				
	F	Konostanzia Sanyigu	-no data soil fertility problem				
	F	Ostakia Mlengule	6.04	5.46	5.14	5.86	5.63
		Mean	4.71	4.27	4.24	4.65	4.47

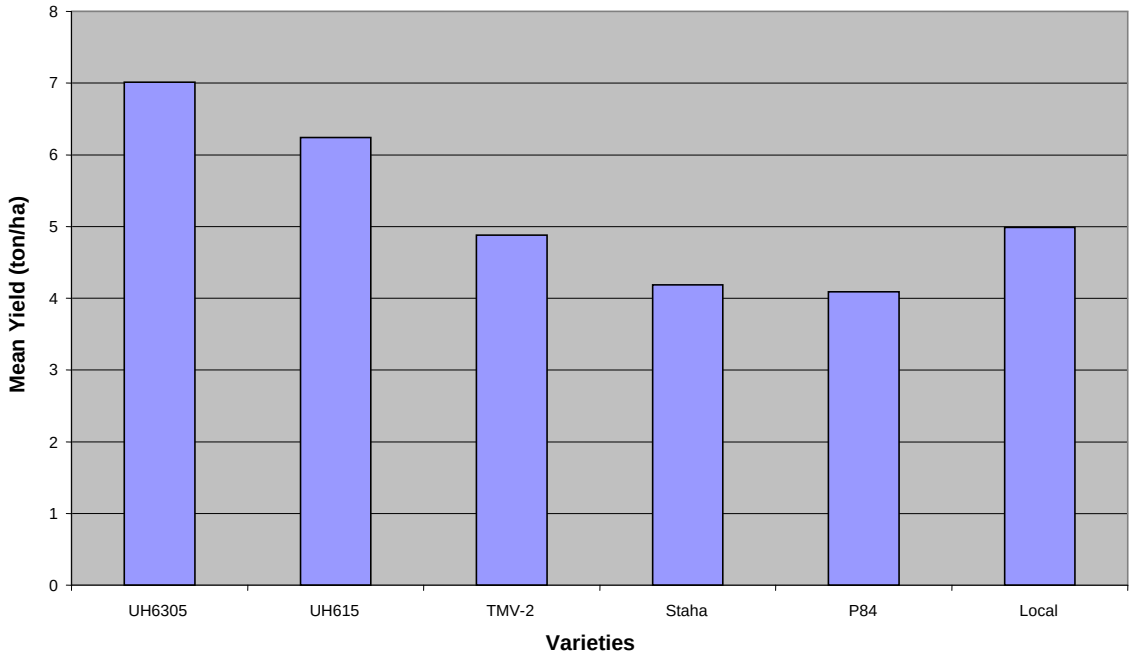
Table 9. Village mean grain yield of maize varieties evaluated in Iringa district during the 2002/03 season.

Village	Gender	Name	Yield, t/ha by Variety					Mean
			Staha	**UH615**	**P84**	**Local**	TMV2	
Ihimbo	M	Hassani Kiongosi	3.50	5.39	3.80	4.56	5.19	4.49
	F	Rukia Mgata	3.99	7.03	5.09	3.54	4.18	4.77
	F	Sauda Kifunge	2.75	3.66	2.36	2.31	1.89	2.59
	M	John Mkwalakwala	Eaten by cows	5.28	4.99	3.99	6.19	5.11
	M	Linus Kivamba	4.25	7.02	5.32	6.19	8.83	
		Mean	3.62	5.68	4.31	4.12	5.26	
Kitayawa	M	Venance Banga	7.18	9.24	6.72	6.04	6.43	7.12
	M	Longino Mpelembwa	4.36	8.42	5.04	6.50	6.96	6.26
	F	Emelita Nyinde	5.80	6.87	5.18	5.29	6.39	5.91
	F	Hezron Nyagawa	4.64	6.16	6.89	4.84	4.52	4.81
	M+F	Primary School	-no data, very poor soil fertility site					
		Mean	5.50	6.92	5.96	5.67	6.08	6.02
Wenda	M	John Kilendu	3.60	4.91	3.32	3.24	4.40	3.89
	F	Esterina Kutika	3.97	5.98	1.80	3.02	4.27	3.81
	F	Laura Christian	4.90	6.61	3.90	4.97	5.02	5.08
	M	Michael Chadenile	7.89	9.35	6.98	5.88	6.83	7.39
	M	Longino Koko	5.18	6.05	2.46	3.51	3.91	4.22
		Mean	5.11	6.58	3.69	4.12	4.89	4.88
Mangawe	M	Gaspar Mfikwa	-dried at mid grain filling stage due to severe drought					-
	M	Selestine Msemwa	-dried at mid grain filling stage due to severe drought					-
	F	Theodora Mkinja	-dried at mid grain filling stage due to severedrought					-
	M	Samweli Gwivaha	-dried at mid grain filling stage due to severe drought					-
	F	Matrida Nyegele	-dried at mid grain filling stage due to severe drought					-
		Mean	-	-	-	-	-	-

Table 10: Analysis of Variance on village mean grain yields during the 2002/03 season

District	Village	Mean grain yield (tonnes/ha)						LSD (0.05) T/ha	CV (%)
		UH615	UH6305	TMV-2	Staha	P84	Local		
Mbozi	Mpito	6.68	8.08	5.70	-	4.94	4.52	1.49	18.5
	Ibembwa	7.94	7.13	5.54	-	5.41	5.41	1.25	14.9
	Igunda	6.56	7.17	5.38	-	4.69	4.23	1.15	13.3
	Mponela	5.70	-	4.19	4.11	4.16	3.97	1.13	19.2
Mbarali	Mahongole	4.00	-	3.02	4.75	2.02	4.50	1.18	21.0
	Majenje	5.68	-	3.87	6.12	4.72	7.18	1.45	17.1
	Ihahi	-	-	-	-	-	-	-	-
	Igomelo	4.81	-	4.00	3.46	3.24	3.80	1.78	24.5
Njombe	Igagala	7.62	8.37	7.44	-	-	7.56	1.52	14.2
	Mtwango	8.10	7.44	5.79	-	-	6.48	1.39	12.5
	Mhaji	6.78	6.14	5.56	-	-	4.82	1.67	14.4
	Utalingoro	4.71	4.27	4.24	-	-	4.65	na	Na
Iringa	Ihimbo	5.36	-	3.75	3.41	3.75	3.47	1.41	18.9
	Kitayawa	7.86	-	6.08	5.50	5.02	5.67	1.16	12.5
	Wenda	6.58	-	4.89	5.11	3.69	4.13	0.80	12.2
	Mangawe	-	-	-	-	-	-	-	-

Fig. 3. Mean grain yield of maize varieties across all four districts (Mbozi, Mbarali, Njombe and Iringa) during the 2002/03 season



Farmers' assessment of the varieties (2002/03 season)
During the season, farmers had the opportunity of evaluating the varieties from emergence through vegetative and flowering stages and finally at harvesting. Their comments were compiled and because of similarities in their observations, they are presented by district (Table 11).

Table 11. Farmer evaluation of varieties evaluated during the 2002/03 season

District	Farmers' evaluation
Mbozi	**1.P84** -early, but susceptible to diseases. Early maturing - (for food security) -appears to bear small ears - **2. TMV-2** Long ears, high yield expected Susceptible to MSV **3. Staha** -small ears; not preferred -may be drought tolerant **4. Local (Ibandawe)** low yield susceptible to diseases (GLS, MSV) few grains on the cob **5. UH615** -high yielder -susceptible to MSV (some plants affected) -resistant to rust and GLS - white flint kernels -good stature(not too short, not too tall) **RANKING OF VARIETIES:** **1. H615, 2. Staha, 3. Local, 4. P84, 5. TMV_2**
Mbarali	**1. P84** -early maturing -susceptible to aphid attack -attacked by streak -thin small ears **2. TMV-2** attacked by maize streak virus late maturing compared to P84 and Staha good, well filled ears **3. Staha** -better than P84 in terms of cob size -late flowering compared to P84 -good yield **4. Local (name unknown)** medium yield too tall, susceptible to stalk lodging **5.UH615** -late flowering compared to the rest -long big cobs, therefore high yielder -some streak, but no other diseases **RANKING OF VARIETIES:** **1. Staha, 2. P84, 3. Local, 4. TMV_2, 5. UH615** *(their criteria were based on earliness rather than high yield)*
Njombe	**1. TMV_2** -presence of barren plants(not good) -earlier maturing compared to local -small ears(not good) -some said it looks similar to local, only shorter! -low yielder -susceptible to diseases (actually meant attacked by stalk borers) -variable maturity **2. UH6305** -no barren plants -good ear fill -similar to UH615 in many attributes

	-uniform ears -good plant height -matures earlier than the local variety -high yield expected, (seed requested) **3. Local (Mavalafu)** -lower yielder than Uh6305 or UH615 -many barren plants -susceptible to diseases(GLS, maize streak) -few grains on the cob -maintained in the absence of other good varieties, not good commercially **4. UH615** -earlier maturing than local variety -bears only a single ear (they prefer more than one), however, -high yielder -good stalk quality - no barren plants -medium stature -no symptoms of leaf diseases. **RANKING OF VARIETIES:** 1. H615 or UH6503 followed by TMV_2 and last Local
Iringa	**1. H615** -very good variety for milling -very good ear fill -no barren plants -no diseases -may be a good variety for roasting -good yield **2. Staha** good well filled ears early maturing susceptible to leaf blight good in general, however, too susceptible to various diseases 4. P84 **early maturing** good for food security **3. TMV-2** -can't differentiate it from local variety! -good ear fill -rudimentary ears plenty, not good **5. Local** -not as good as UH615 -early maturing -too many barren plants -susceptible to diseases (the local variety was known to have originated from a hybrid in 1985, now completely mixed) RANKING: (different among farmers) 1. UH615, 2. Staha, 3. TMV_2, 4. P84, 5. Local 1. UH615 2. TMV_2 3. Local 4. Staha 5. P84 1. UH615 2. TMV_2 3. Staha 4. Local 5. P84

Some observations during Monitoring and Evaluation Field Visits

During monitoring and evaluation of the demonstrations in the field, it was noted by researchers that many farmers were ignorant on some very basic knowledge such as:

- How to distinguish diseased plants from the normal senescence of leaves/plants, nutrient deficiencies and moisture stress.
- How to distinguish specific leaf diseases, in particular, GLS and MSV.
- How to thin without damaging the roots of the remaining plants.
- What are tassels and silks on the maize plant and the role they play in the reproductive process of the plant (young as well as elder farmers -over 50 years old- did not know at all the functions of these plant parts)
- Seed selection procedures

- Fertilizer types and soil fertility management in general.
- The role of the leaves above the maize ear *vis a vis* those below it as related to grain filling. (Farmers excessively defoliate maize plants for livestock feed)
- Saving of labour through multiple seed placement (2 to 3/hole) and adjusting the plant spacing accordingly, particularly in large scale manual planting.
- Maize row orientation to minimize soil erosion on sloping land

The above points were noted for inclusion in the training agenda for the 2003/04 season.

2. 2003/04 Season

1. Mbozi District. Out of the 20 farmer demonstrations planted, only one was discarded due to serious damage by a hailstorm at early grain filling stage (Mwambugi's plot). The new improved maize varieties exhibited grain yield superiority over the local check at many farmer sites, particularly at Mpito and Igunda villages, where UH615, UH6303, U6304 and UH6305 all exhibited high grain yield potential (Table 12). At Ibembwa and Mponela, mean grain yields were lower, largely due to shading, low soil fertility and termite damage. The lowest farmer site mean yields (below 4t/ha) were recorded at Ibembwa (3.35 t/ha: effect of tree shading combined with low soil fertility at Fausta's plot) and 3.98 t/ha (partial damage of the demonstrations by combined effects of hailstorm in March, resulting in heavy lodging). At Mponela, attack by termites and accidental feeding by livestock as well as torrential rains affected variety performance, hence the low means at that village.

Farmer Evaluation of the varieties: Farmer evaluation of the varieties was conducted at Mpito and Igunda (using matrix ranking technique at harvest), while at Mponela and Ibembwa, direct ranking was used. Farmers put forward what they would like to see in a new maize variety, and then scored the varieties using an agreed scale. Results of the matrix ranking are shown in Tables 13a and 13b. At Mpito village, UH6303 ranked first, while UH615, UH6304, UH6305 and UH6306 tallied for the 2nd choice. The local variety was ranked last. At Igunda, UH6303 was again their first choice, followed by UH6305 and UH615. The Kenyan Hybrid 625 came in last. At Mponela, UH6304 was ranked first mainly due to its earliness, while at Ibembwa, UH6305 was ranked 1st followed by UH6303.

2. Njombe District. Outstanding grain yield was obtained from some individual farmers' plots in Njombe district, particularly at Mtwango village, where UH6303, UH6305 and UH615 yielded over 9 tonnes/ha (Table 14). With the exception of Utalingoro village, where soils have been shown to be too acidic for profitable for maize production, two hybrids, UH6303 and UH6305 generally performed well across the other three villages. The local cultivar showed a surprisingly high yield at Joniphas Ng'eve's, it was revealed later that the local entry was in fact a recycled hybrid mixture between Kenyan and Tanzanian high altitude germplasm.

Farmer Direct Ranking:

The main criteria used in Njombe district was grain yield, kernel texture (e.g. flintiness) , cob length, ear height and drooping. The varieties were ranked by farmers across all villages in the district, according to the following order: (1) UH6303 (2) UH6305, (3) UH615 and (4) UH 6306. For UH6303, farmers requested for seed during the following season.

3. Iringa District. In Iringa, as noted in Mbozi and Njombe districts, the new improved hybrids consistently yielded high, with UH 6303, UH 6304, UH 6305 and UH6306 yielding above 10 t/ha on a number of farmers' fields (Table 15). However, very poor performance was noted at John Kilendu's plot at Wenda, where extreme soil variability, characterized by low soil fertility spots resulted in very poor performance for some of the entries. As a result of this, the yield values for such entries (shown in parentheses) were not included in the mean calculations nor in the Analysis of Variance. Mangawe village, which is on the drier part of Iringa district, had an outstanding performance, with yield of the improved varieties ranging from 5 to 6t/ha. This is in contrast to the 2002/03 season, during which severe drought necessitated cancelling of all the demonstrations at that village.

Farmers' Direct Ranking According to Mangawe farmers, they ranked the varieties in order of preference as follows: UH6304 (due to high yield and earliness), followed by UH 615, UH6305, TMV-2 and lastly, the local cultivar. For Wenda, Kitayawa and Ihimbo villages, preference ranking was as follows: UH 6304, UH6303, UH6305 and UH6306, using grain yield, flintiness, good cob size and disease resistance in that order, as their criteria for ranking them.

4. Mbarali District The most notable outcome from Mbarali district during the season was the high incidence of MSV, particularly at Igomelo village, where three out of the five entries evaluated there, i.e TMV-2, UH615 and the local check were completely wiped out by this disease (Table 16.) However, two entries, i.e. Staha-ST and Kilima-ST survived this pressure with village mean grain yields at 3.57 and 3.19 tonnes, respectively. Performance was much better at the other three villages, particularly at Majenje, where village means for each entry exceeded 5 tonnes/ha. At Mahongole and Ihahi, village means ranged from 3.30 to 5.01 tonnes/ha. The best individual performance was recorded at Erasto Ng'ahara's plot in Majenje, where UH615 recorded 8.19 tonnes/ha. While mean yields at Ihahi were comparatively low, due to moisture stress, it is worth noting that all demonstration at this location were cancelled due to drought during the previous season.

Farmers Direct Ranking According to Majenje farmers, they ranked the varieties in order of preference as follows: Local, Kilima-ST, Staha-ST, UH615, TMV-2, using grain yield, flintiness, good cob size and disease resistance as the main criteria. At Mahongole and Ihahi, the ranking was as follows: Local, Staha-ST, Kilima-ST, TMV-2 and lastly, UH615, using the criteria used at Majenje. At Igomelo, farmers did not have much of a choice, therefore, they picked Staha-ST and Kilima-ST which tolerated and survived the MSV epidemic at this village.

The analysis if variance based on district mean grain yields (Table 17) revealed significant differences between some of the improved varieties and the local cultivar at the 5% level of significance, except at Mponela and Utalingoro villages in Mbozi and Njombe districts, respectively, where no significant differences among entries under evaluation were detected. At Ihimbo in Iringa district, all improved cultivars significantly out-yielded the local cultivar. At Igagala and Mhaji (Njombe), Igunda (Mbozi) and Kitayawa (Iringa) three out of four improved cultivars significantly out-yielded the local cultivar at the 5% level of significance.

Overall means on grain yield performance across three districts (Mbarali excluded) for the varieties evaluated during the 2003/04 season are presented in Fig. 4, reflecting the superiority of UH 615 and UH6303 in the target area, when compared to the local cultivar and other entries evaluated during the season.

Table 12. . Village mean grain yield of maize varieties evaluated in Mbozi district during the 2003/04 season.

VILLAGE	M/F	FARMER	YIELD, TONNES/HA								
			UH 615	**UH 6303**	**UH 6304**	**UH 6305**	**UH 6306**	**TMV-2**	**H625**	**LOCAL**	**MEANS**
Mpito	M	Edward Mbwama	9.90	9.02	8.08	10.5	8.70	8.14	6.15	7.02	**8.44**
	M	Enock Kibona	7.34	6.31	6.15	5.86	5.94	6.06	5.28	5.71	**6.08**
	F	Maria Mgalla	7.25	9.30	8.85	8.62	8.54	7.08	6.87	7.07	**7.95**
	F	Lina Mwamwezi	4.61	4.94	8.22	6.13	7.99	4.65	6.54	4.67	**5.97**
	M	Baridi Mwamwezi	4.40	5.91	5.60	4.68	4.54	4.95	4.54	5.19	**4.98**
		Variety means	**6.70**	**7.10**	**7.38**	**7.16**	**7.14**	**6.18**	**5.88**	**5.93**	
Ibembwa	M+ F	Ibembwa Pr School	4.51	3.79	5.05	3.75	4.77	5.08	5.15	4.43	**4.57**
	M	Koria Pulumba	5.83	5.65	5.61	5.02	6.42	6.50	5.21	5.77	**5.50**
	M	Keneth Ndidi	6.07	4.49	4.40	4.27	3.56	5.35	3.15	5.45	**4.59**
	F	Christina Mgalla	6.18	3.49	5.71	4.79	5.17	5.48	3.26	4.53	**4.82**
	F	Fausta Mwasapania	4.34	3.05	2.49	3.30	2.47	4.58	3.04	3.52	**3.35**
		Variety **means**	**5.39**	**4.09**	**4.65**	**4.23**	**4.48**	**5.40**	**3.96**	**4.74**	
Igunda	M	Igunda Pr School	6.54	6.97	7.56	7.08	6.50	5.70	5.68	4.87	**6.36**
	M	Karola Tusamale	6.72	6.42	6.18	6.78	5.90	4.30	5.17	4.63	**5.76**
	F	Veronika Mwamlima	9.15	8.26	7.59	9.02	8.13	6.90	6.66	5.86	**7.70**
	M	Charles Nzoa	6.98	8.04	8.66	6.68	7.78	6.89	4.65	5.71	**6.93**
	F	Evelina Sanga	6.61	8.02	7.50	7.40	5.67	6.69	6.93	6.06	**6.86**
		Variety means	**7.20**	**7.54**	**7.50**	**7.39**	**6.80**	**6.10**	**5.82**	**5.43**	
Mponela	F	Tabia Msukwa	4.10	5.52	4.41	4.22	5.91	2.22	5.53	3.64	**4.44**
	M	Andendekisyse Fiyao	4.94	6.33	7.66	6.26	7.93	4.10	6.07	5.38	**6.08**
	M	Wesson Chisunga	4.47	5.90	5.09	6.04	5.17	3.85	5.71	4.75	**5.12**
	M	Jackson Mwambugi	Discarded, damaged by rain storm at early grain filling								**===**
	F	Sofia Joseph	2.65	4.94	5.59	2.23	6.53	2.27	4.77	2.86	**3.98**
		Variety means	**4.04**	**5.67**	**5.69**	**4.69**	**6.39**	**3.11**	**5.52**	**4.16**	

Table 13a. Matrix Ranking of maize varieties by farmers at Igunda village in Mbozi district.

No	Criteria	UH615	UH6303	UH6304	UH6305	UH6306	H625	TMV-2	Local	Total	Rank
1	Cob thickness	4	5	5	4	5	1	3	2	29	**7**
2	Cob length	4	5	4	5	5	2	2	2	29	**7**
3	Rows/cob	5	5	5	5	5	4	5	3	37	**1**
4	Disease Resistance	4	4	4	4	4	1	2	1	24	**9**
5	Lodging resistance	5	5	5	5	5	2	4	3	34	**3**
6	Maturity length	4	4	5	4	4	1	4	2	28	**8**
7	Kernel hardness/ Milling quality	5	5	5	5	5	2	5	2	34	**3**
8	Germination %	5	5	5	5	5	2	5	4	36	**2**
9	Market acceptability	5	5	4	5	4	3	4	3	33	**5**
10	Yield	5	5	4	5	4	3	4	3	33	**5**
	Total	**46**	**48**	**46**	**47**	**46**	**21**	**38**	**25**		
	Rank	**3**	**1**	**3**	**2**	**3**	**8**	**6**	**7**		

Scoring criteria :

a. Igunda village

- Criteria for assessment of the varieties were selected by farmers
- 22 farmers participated

Scoring : Criteria 1,2,4,5,7,8, 9 : 1 to 5, where 1 is poor, 5 is very good.

Criteria 3: 14+ rows/cob: 5; 12 rows/cob: 4; <12 rows/cob: 3

Criteria 10: 25-30 kg/plot field weight: 5 scores
20-24.9 kg/plot field weight: 4 scores
15-19.9 kg/plot field weight: 3 scores

Table 13b. Matrix ranking of maize varieties by farmers at Mpito village in Mbozi district.

No	CRITERIA	UH615	UH6303	UH6304	UH6305	UH6306	H625	TMV-2	Local	Total	Rank
1	Cob length	5	5	4	4	5	5	4	5	37	**2**
2	Disease Resistance	5	5	5	5	5	2	2	2	31	**5**
3	Lodging	4	4	4	4	5	1	4	3	29	**6**
4	Maturity length	3	4	5	3	3	1	1	1	21	**8**
5	Milling quality	5	4	3	3	3	1	5	3	27	**7**
6	Germin. %	5	5	5	5	5	3	5	5	38	**1**
7	Market	5	5	5	5	5	5	5	1	36	**3**
8	Yield	4	5	5	5	5	3	3	3	33	**4**
	Total	**36**	**37**	**36**	**34**	**36**	**21**	**29**	**23**		
	Rank	**2**	**1**	**2**	**5**	**2**	**8**	**6**	**7**		

b. Mpito village
Criteria for assessment of the varieties were selected by farmers
21 farmers participated

Scoring:
Criteria 1 to 7: 1 to 5, where 1 is poor, 5 is very good
Criteria 8: 30-35 kg/plot field weight: 5 scores
25-29.9 kg/plot field weight: 4 scores
20-24.9 kg/plot field weight: 3 scores

Table 14. Village mean grain yield of maize varieties evaluated in Njombe district during the 2003/04 season.

VILLAGE	M/F	FARMER	YIELD, T/HA								
			UH 615	UH 6303	UH 6304	UH 6305	UH 6306	TMV-2	H625	LOCAL	MEANS
Igagala	M	Dowadi Kawogo	7.16	8.13	===	6.58	===	6.85	===	6.31	**7.01**
	M	Ignas Ngailo	4.32	3.53	4.69	5.73	4.20	4.77	3.56	3.35	**4.27**
	F	Bitia Msigwa	5.42	6.02	4.77	6.87	6.41	4.13	4.77	5.19	**5.45**
	F	Alatwanukila Mtokoma	4.97	5.38	6.29	5.58	4.95	4.70	3.97	4.66	**5.06**
	M	Rosebeda Mgaya	6.10	5.88	4.38	6.38	4.31	5.43	5.10	6.31	**5.49**
		Variety means	**5.59**	**5.79**	**5.03**	**6.23**	**4.97**	**5.18**	**4.35**	**5.16**	
Mtwango	F	Joniphas Ng'eve	9.42	11.04	===	10.70	===	9.99	===	9.23	**10.08**
	M	Elias Wikedzi	6.10	7.67	===	9.74	===	7.09	===	5.22	**7.16**
	M	Odillo Kinyamagoha	7.56	7.71	===	6.32	===	5.55	===	6.10	**6.67**
	F	Lea Mbusya	8.80	9.85	===	7.92	===	7.61	===	6.76	**8.19**
	F	Anna Ng'eve	Discarded, farmer accidentally mixed up entries								
		Variety means	**7.97**	**9.07**	**===**	**8.67**	**===**	**7.56**	**===**	**6.83**	
Mhaji	F	Elen Mkane	7.22	7.78	===	7.85	===	6.27	===	5.52	**6.93**
	M	Nickson Kilasi	5.89	5.99	===	7.77	===	8.03	===	5.35	**6.61**
	F	Emelia Mgindo	3.94	6.98	===	6.05	===	5.15	===	3.41	**5.11**
	M	Michael Mng'ong'o	5.83	5.94	===	5.08	===	5.22	===	3.35	**5.08**
	F	Jane Mhame	4.81	4.22	===	8.28	===	4.93	===	4.64	**5.38**
		Variety means	**5.54**	**6.18**	**===**	**7.01**	**===**	**5.92**	**===**	**4.45**	
Utalingoro	M	Selvelius Myamba	3.87	3.85	2.70	3.36	3.21	2.25	2.68	3.11	**3.13**
	M	Elias Mpete	6.26	6.44	7.33	5.83	7.33	5.73	4.22	5.49	**6.08**
	M	Protas Mlengule	6.29	6.65	7.08	5.44	7.11	5.21	6.15	5.95	**6.24**
	F	Konostanzia Sanyigu	4.51	4.54	4.30	5.76	4.82	4.55	3.37	4.83	**4.59**
	F	Ostakia Mlengule	5.77	5.73	5.27	5.19	6.01	5.71	5.63	5.39	**5.59**
		Variety means	**5.34**	**5.44**	**5.33**	**5.12**	**5.70**	**4.69**	**4.41**	**4.95**	

Table 15. Village mean grain yield of maize varieties evaluated in Iringa district during the 2003/04 season.

VILLAGE	M/F	FARMER	YIELD, TONNES/HA								
			UH 615	UH 6303	UH 6304	UH 6305	UH 6306	H625	TMV-2	LOCAL	MEANS
Ihimbo	M	Hassani Kiongosi	6.54	6.52	7.85	6.57	5.40	5.57	5.28	4.59	**6.04**
	F	Rukia Mgata	6.32	5.03	5.35	5.50	5.19	5.40	5.77	4.18	**5.34**
	F	Sauda Kifuge	7.43	7.35	7.57	7.39	7.43	6.37	7.02	5.33	**6.97**
	M	Twaha Hassani	9.64	10.42	7.36	10.25	6.21	6.37	6.11	5.08	**7.68**
	M	Linus Kivamba	7.99	6.68	8.06	7.56	6.25	6.82	6.16	4.07	**6.70**
		Variety means	**7.58**	**7.20**	**7.24**	**7.45**	**6.10**	**6.11**	**6.07**	**4.65**	
Kitayawa	M	Venance Banga	7.41	7.81	10.99	9.13	7.33	6.46	6.49	6.27	**7.74**
	M	Longino Mpelembwa	8.40	9.57	6.27	7.70	6.38	4.74	7.51	6.60	**7.15**
	F	Emelita Nyinge	6.27	5.49	8.94	6.76	10.43	9.64	4.97	3.90	**7.05**
	F	Hezron Nganyagwa	4.33	4.90	8.51	7.75	7.52	7.23	3.84	5.09	**6.14**
	M+F	Kitayawa Pr School	5.66	6.22	5.01	4.29	4.62	3.92	4.77	3.67	**4.77**
		Variety means	**6.41**	**6.80**	**7.94**	**7.13**	**7.30**	**6.40**	**5.72**	**5.11**	
Wenda	F	Esterina Kutika	6.38	6.64	7.26	5.11	7.04	5.70	4.56	5.28	**6.00**
	F	Laura Christian	8.03	9.11	5.20	3.63	5.05	3.98	5.97	4.19	**5.65**
	M	Michael Chadenile	7.97	8.14	8.35	5.87	8.43	7.06	5.42	5.77	**6.23**
	M	Longino Koko	6.82	6.27	5.20	4.18	5.47	5.09	4.84	3.56	**5.18**
	M	*John Kilendu	(2.92)	(2.64)	4.21	(2.86)	6.94	6.36	(3.93)	(1.36)	**5.84**
		Variety means	**7.30**	**7.54**	**6.04**	**4.70**	**6.59**	**5.64**	**5.22**	**4.70**	
Mangawe	M	Gaspar Mfikwa	2.55	===	6.15	5.92	===	===	3.63	2.71	**4.19**
	M	Selestine Msemwa	6.00	===	6.05	6.13	===	===	5.70	5.79	**5.93**
	F	Theodora Lukinja	4.95	===	3.87	4.54	===	===	4.44	3.80	**4.32**
	M	Samweli Gwivaha	6.11	===	5.42	5.65	===	===	3.87	4.29	**5.07**
	F	Matrida Nyengela	5.20	===	5.24	5.70	===	===	4.63	4.99	**5.15**
		Variety means	**4.96**	**===**	**5.35**	**5.59**	**===**	**===**	**4.45**	**4.32**	

** Yields from the main demo are very low due to a soil fertility problem. thus figures in parenthesis are not included in the mean calculations.*

Table 16. Village mean grain yield of maize varieties evaluated in Mbarali district during the 2003/04 season.

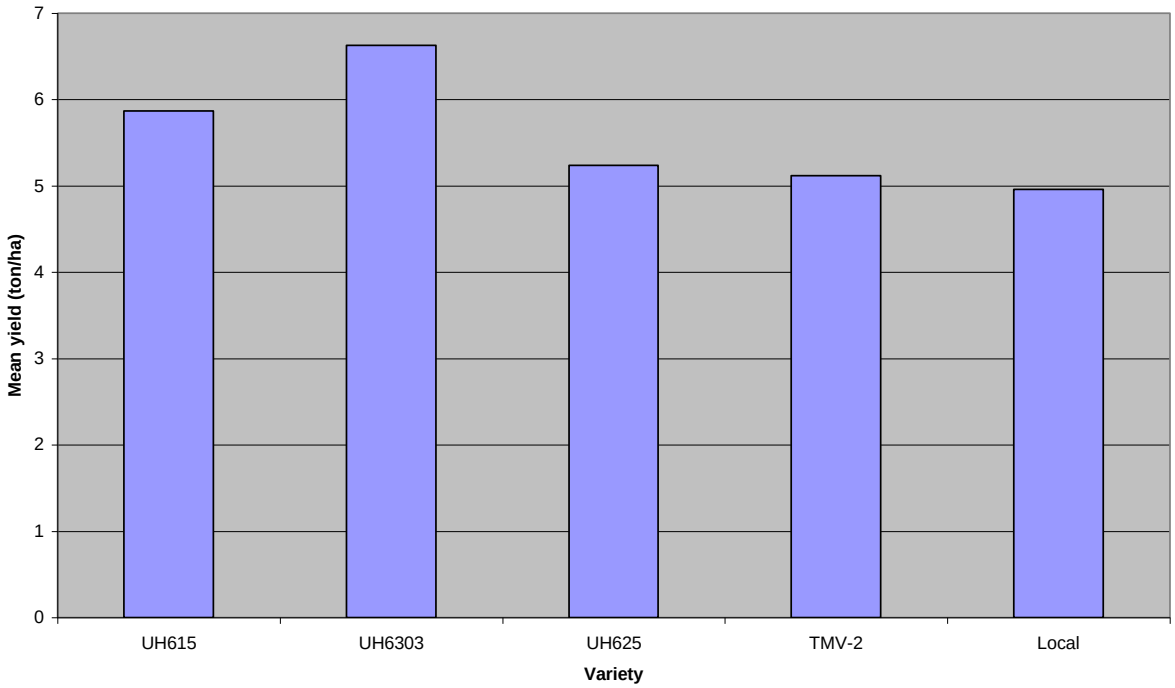
VILLAGE	M/F	FARMER	Grain yield (tonnes/ha)					
			LOCAL	TMV-2	STAHA-ST	UH615	KILIMA-ST	MEANS
Mahongole	M	Juma Kapalila	4.42	2.33	3.74	5.15	5.23	**4.17**
	F	Attu Mwinuka	4.25	2.59	3.90	5.41	3.51	**3.93**
	F	Noela Alphonce	3.28	2.93	4.08	4.19	3.70	**3.64**
	M	Zablon Mwakifuna	3.97	2.79	3.93	4.52	4.14	**3.87**
	M	Daniel Mwakibinga	6.21	4.51	5.01	5.77	6.15	**5.53**
		Variety means	**4.43**	**3.03**	**4.11**	**5.01**	**4.55**	
Majenje	M	Absalom Msetule	5.30	5.09	5.37	5.74	6.40	**5.58**
	M	Erasto Ng'ahara	6.43	7.18	7.73	8.19	7.82	**7.47**
	M	Richard Japhet	5.26	5.45	6.19	5.77	5.88	**5.71**
	F	Esta Mhema	4.99	4.69	5.24	6.59	5.85	**5.47**
	M	Firoz Mahenge	7.06	7.25	7.81	7.09	7.34	**7.31**
		Variety means	**5.81**	**5.93**	**6.47**	**6.68**	**6.66**	
Ihahi	F	Enea Sanga	3.51	3.49	3.81	2.68	2.65	**3.23**
	M	Festo Mgaya	4.49	4.30	3.25	2.68	3.19	**3.58**
	F	Joina Goliama	5.13	2.11	2.27	2.21	2.95	**2.93**
	M	Lufunyo Mwidete	Damaged by cattle					
	M	Tawi Mwilongo	2.86	3.29	4.41	4.70	5.55	**4.16**
		Variety means	**3.99**	**3.30**	**3.44**	**3.07**	**3.59**	
Igomelo	M	Mridi Kidumba	0.00	0.00	4.31	0.00	3.83	**4.07**
	F	Flora Omari	0.00	0.00	3.28	0.00	1.70	**2.49**
	M	Mary Mturi	0.00	0.00	3.30	0.00	2.85	**3.08**
	M	Patrick Fute	0.00	0.00	3.40	0.00	4.06	**3.73**
	M	Daudi Mpanye	0.00	0.00	3.54	0.00	3.52	**3.53**
		Variety means	**0.00**	**0.00**	**3.57**	**0.00**	**3.19**	

Table 17. Analysis of variance for grain yield based on district means during the 2003/04 season.

DISTRICT	VILLAGE	Mean grain yield (tones/ha)							LSD 0.05 (t/ha)	CV (%)
		UH615	UH6303	UH6305	TMV-2	STAHA-ST	KILIMA-ST	LOCAL		
Mbozi	Mpito	6.70	7.10	7.16	6.18	====	====	5.93	1.09	12.3
	Ibembwa	5.39	4.09	4.23	5.40	====	====	4.74	0.56	8.75
	Igunda	7.20	7.54	7.39	6.10	====	====	5.43	0.77	8.59
	Mponela	4.04	5.67	4.69	3.11	====	====	4.16	NS	30.5
Mbarali	Mahongole	5.01	====	====	3.03	4.11	4.55	4.43	0.75	13.4
	Majenje	6.68	====	====	5.93	6.47	6.66	5.81	0.56	6.57
	Ihahi	3.59	====	====	3.70	5.55	3.59	2.93	1.83	42.1
	Igomelo	Statistical analysis not done, 'zero' yields due to maize streak virus							====	====
Njombe	Igagala	5.59	5.79	6.23	5.18	====	====	4.76	0.88	11.8
	Mtwango	7.97	9.07	8.67	7.56	====	====	6.83	1.46	11.8
	Mhaji	5.54	6.18	7.01	5.92	====	====	4.45	1.35	17.3
	Utalingoro	5.34	5.44	5.12	4.69	====	====	4.95	NS	8.9
Iringa	Ihimbo	7.58	7.20	7.45	6.07	====	====	4.65	1.21	13.7
	Kitayawa	6.41	6.80	7.13	5.52	====	====	5.11	1.25	15.1
	Wenda	6.43	6.56	4.99	4.33	====	====	4.01	1.34	18.9
	Mangawe	4.96	5.35	5.59	4.45	====	====	4.32	1.13	17.0

Key: ===:variety not demonstrated at that location

Fig. 4. Mean grain yield of maize varieties across three districts (Mbozi, Njombe and Iringa) during the 2003/04 season



Post-harvest study on storage quality of new maize hybrids

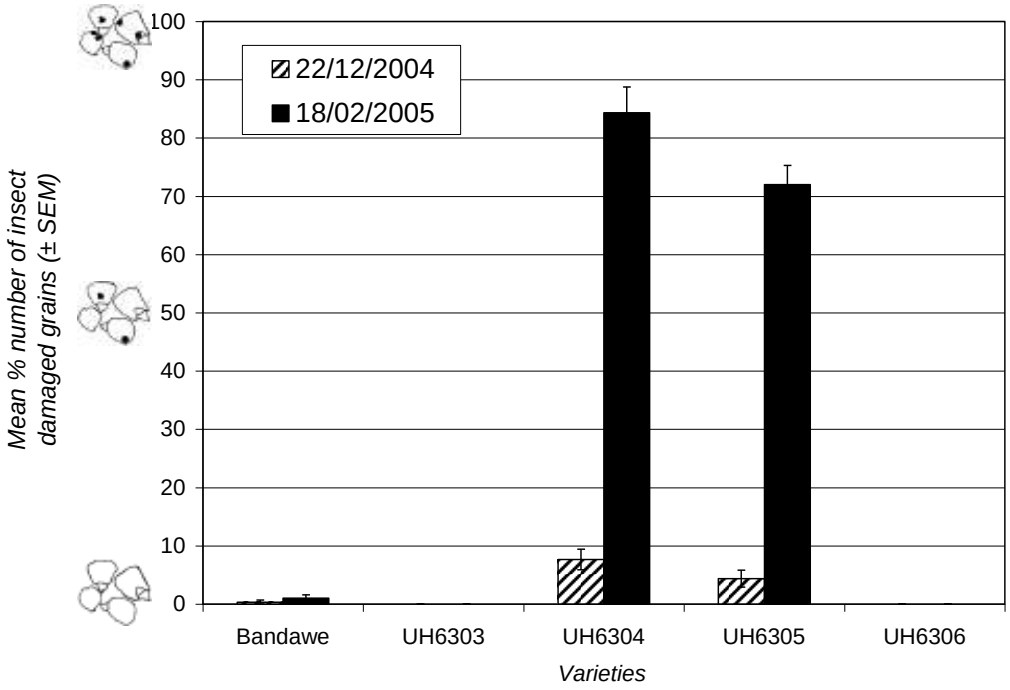
When asked to describe a popular commonly grown maize variety, most farmers mention not only its yield and pest/disease or drought tolerance characteristics but also several post-harvest characteristics such as its likelihood to be damaged by insect pests during storage, its taste, the percentage flour obtained during milling etc. However, despite this, most variety evaluation trials only capture the information about the field characteristics of varieties including their yield.

A small study was designed to learn about the post-harvest characteristics of the varieties included in the village demonstration plots. This study did not happen during the first year due to farmers not being aware that the study of the demonstration varieties would continue after harvest, and in the second year despite detailed advanced planning of the exercise, it again only happened at a very limited scale compared to that which had been planned. These occurrences reflect the way agricultural research and breeding work in particular often overlook the important post-harvest aspects of crops which are so integral to farmers' livelihoods.

A histogram was been developed to show the percentage number of grains damaged by storage insects at different periods during a storage trial using limited information collected from grain of five varieties stored untreated by three farmers (who acted as replicates) in Igunda village, Mbozi district (Fig. 5). The storage trial was set up on 29/9/04 and is still continuing. There are clearly significant differences between the insect damage to the different varieties when they are stored without treatment grain protectants. Little damage (≤ 1%) was suffered by the local variety Ibandawe and the hybrids UH 6303 and UH6306, in comparison to the hybrids UH6304 and UH6305 which suffered more than 70% damage by mid February following 20 weeks of on-farm storage. Further studies are needed to confirm these interesting preliminary results, and must include open pollinated varieties as well as

local and hybrid varieties as per the original plan. These further studies will be set up following the harvest of the third season's demonstration plots, and much greater effort will be put into alerting farmers about this post-harvest work so that grain from the different varieties is not mixed immediately after harvest.

Figure 5. Maize grain storage trial of five varieties by farmers in Igunda village, Mbozi district



Output 2: Approaches for improving access to and management of quality seed by farmers validated and promoted

Identification of groups/individual farmers and their training needs for improved management of good quality seed.

The training needs of farmers were identified through an iterative process using information gathered during the situation analysis, stakeholder workshop, other workshops/ seminars, interactions with members of farmer groups in the projects focus area and written submissions with farmer group members. At the mini-workshop held at the VETA centre, Mbeya in July 2004 the participants worked in 3 groups (representing the districts, Mbozi, Mbarali and Njombe, unfortunately the Iringa DCO could not join the workshop till the 3rd day) to identify the training needs for the different stages of the crop cycle (see Figure below), using their own experience, the information learnt during the projects earlier activities and notes made by A. Temu following an evaluation by farmers of two draft training leaflets he had designed on i) fertiliser use and ii) 8 steps to maize production.

Fig. 6. Crop cycle, soil fertility management cycle, and seed selection cycle: training needs, training tools and approaches

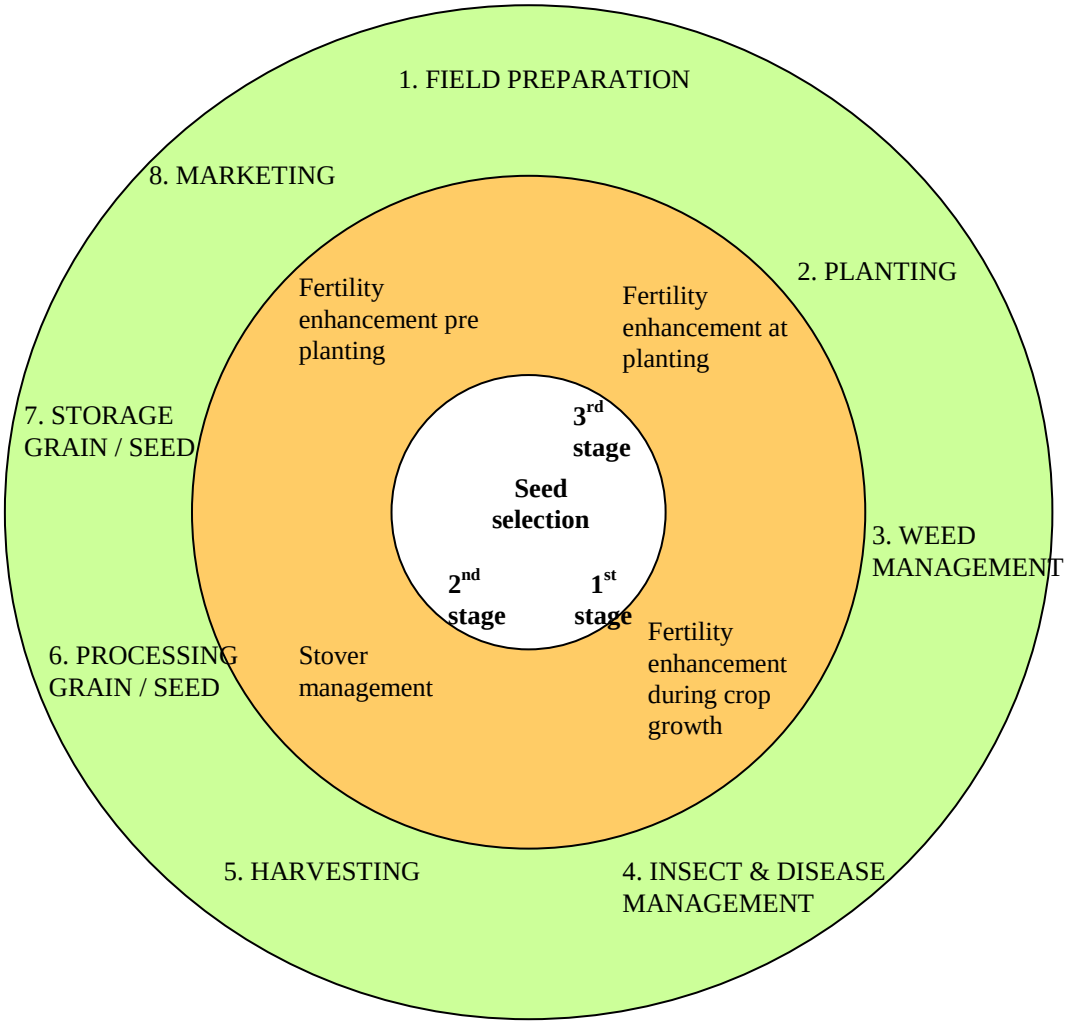


Table 18. Training needs identified for the different villages

Stage in crop cycle and associated activities	Village	Training Needs
1. Field preparation	Majenje	• How to get good weather forecast
	MSc Thesis	• Use of ox ploughs
2. Planting	Majenje	• Information on different maize varieties • Indication of germination % on seed packets • Benefits of early planting, proper spacing and improved seed
	Mahongole	• Information on use of oxen for planting
	Mponela	• Proper spacing and optimal plant population
	Ibembwa	• Exposure to different varieties • Appropriate varieties for areas
	Mtwango	• Informationon composites • How & where to obtain GLS resistant varieties
	MSc Thesis	• Differences between hybrid, OPV and landraces • How to address frequent re-planting
3. Weed management	Majenje	• How to use herbicides • Optimisation of weed management
	Mponela	• Optimum weeding time in a given situation
4. Top dressing		•
5. Insect and disease management	Majenje	• Information on different insect pests and their control
	Mahongole	• Symptoms of diseases and their control
	Mponela & Ibembwa	• Proper use of insecticides including botanicals and other control measures
	Mtwango	• How to cultivate species for use as botanicals • Occurrence and distribution of botanicals in the wild
	MSc Thesis	• How to use pesticides
6. Harvest	Mahongole	• Information on optimal harvesting and drying practices
7. Processing		•
8. Storage *(women do the storage)*	Mtwango	• How to use botanicals in storage
	Igagala	• botanicals and industrial pesticides for grain storage
	MSc Thesis	• Better understanding on following instructions on pesticide packages
9. Marketing	MSc Thesis	• Improved marketing strategies
10. Soil fertility management	Majenje	• How much fertiliser to use in fertile soils • Appropriate source of N just before flowering • How to use DAP • Usefulness of mixing N & P fertilisers • Advantages and disadvantages of inorganic fertilisers • Usefulness of crotalaria • Quality of fertiliser
	Mahongole	• How different fertilisers work • How to use Farm Yard Manure (FYM) • Information on different plant nutrient deficiency symptoms

	Mponela	• Application and importance of different fertiliser • Don't know how Minjingo fertiliser works and how to apply it • How much fertiliser to mix during planting
	Ibembwa	• Use of SA on different soils – planting and top dressing • Recommended types of fertilisers at planting & top dressing stages and mixing of fertiliser
	Mtwango	• Calibrating, use and fertility management of inorganics • How to identify nutrient deficiency symptoms
	Igagala	• Nutrient content in different fertilisers • Uses and effects of chemical fertilisers on soil fertility
	MSc thesis	• How to stop synthetic fertilisers burning crops
	General comments	• Knowledge on how to do composting • Understanding of differences between the different fertilisers sold • Knowledge on use of animal (differences between cattle, pig and chicken manure) and plant fertilisers
11. Other	Majenje, Ibembwa, Mtwango	• How to know altitude of village
12. Seed	Mponela	• How to produce seed to reduce costs
	Majenje/ Mahongole	• Suitability of varieties in different areas of Mbarali
	MSc Thesis	• Training on seed management including fake seed

Note: MSc thesis research covered Mponela village –Mbozi, Ibembwa village –Mbozi, Mangawe village – Iringa, Ihimbo village – Kitolo.

Training needs have been identified with farmers and other stakeholders across the four target districts, during which farmers expressed demand for information/training at all stages of the crop cycle. With regard to seed management, demand related to modern (e.g. information on new varieties) and local varieties (e.g. understanding differences between hybrids, OPVs and landraces, and how to improve farmers' own seed). Insect and disease management training needs included diagnosis and management information using both industrial pesticides and botanicals. Soil management featured significantly and there was a high demand for information on both inorganic and organic methods of enhancing soil fertility. Appropriate training/learning tools in the form of leaflets were developed in order to address those needs.

Development of training approaches/learning tools

Based on the training needs identified in Activity 2, training approaches and learning tools in appropriate media and languages for different groups of farmers were developed and field tested. So far the following leaflets have been developed in order to address farmers training needs: 1. Agronomic recommendations for maize production. 2. Fertilizer use practices for maize production. 3. *Maize Streak Virus* disease information sheet. 4. Be your own maize doctor: A guide towards identification of nutrient deficiency and foliar disease symptoms in maize production. 5. Open Pollinated Maize Varieties: Hints on some management and variety maintenance aspects for the small farmer.

The first three have already been produced and distributed to farmers (Fig. 7). Efforts are being made to mass-produce these tools, in response to demand expressed within and outside the project's target area. The fourth and fifth items have already been translated into Swahili and are undergoing further pre-testing by farmers before being mass-produced. Other training tools (in Swahili) under development are: 1. Storage pests and their control and 2. A zonal maize cultivar recommendation chart, clearly matching maize varieties with the appropriate altitude, rainfall and soil suitability, for the entire SH of Tanzania.

Figure 7. Three leaflets on (a) Maize Varieties (b) Fertilizer use and (c) *Maize streak Virus*

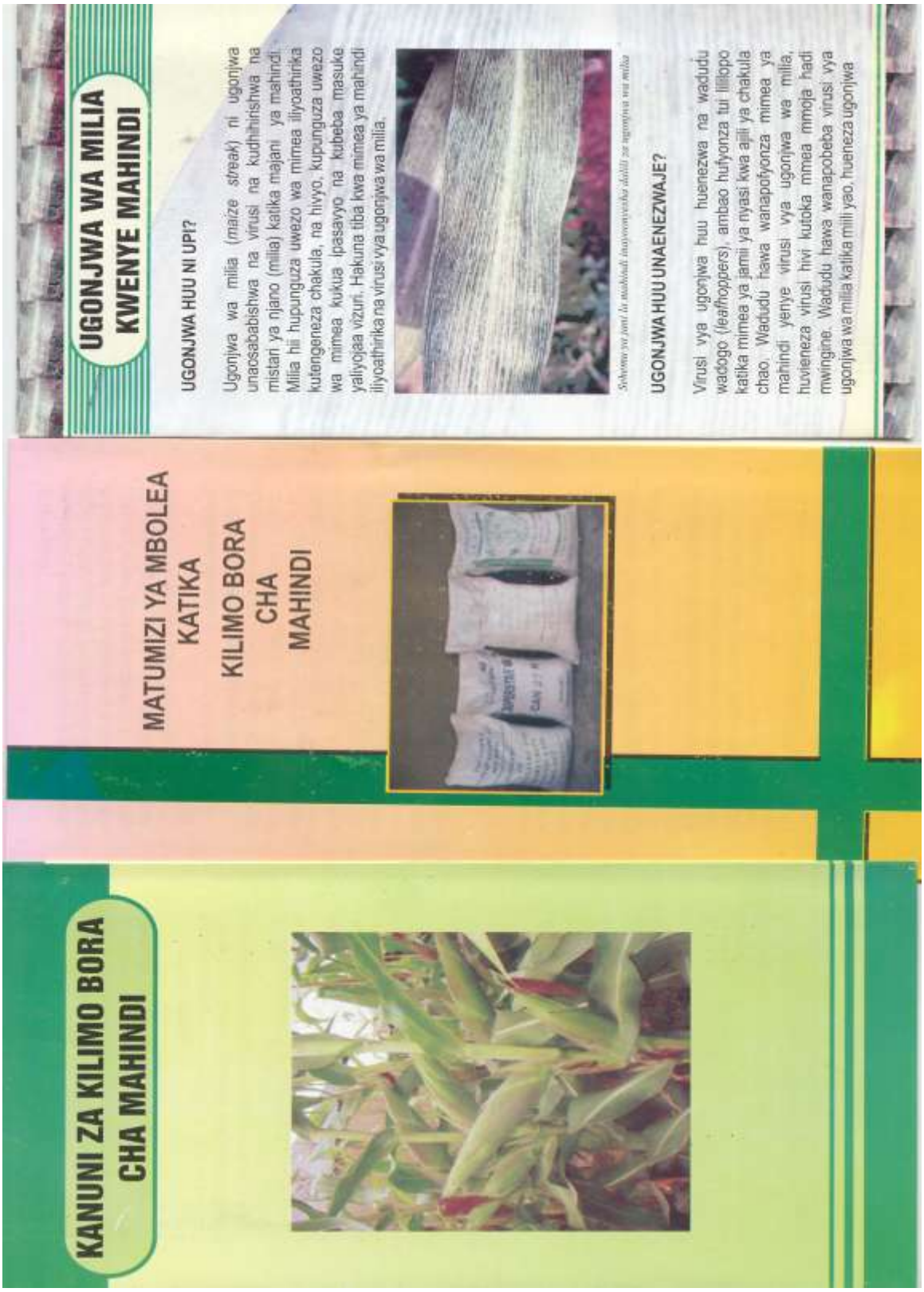


Table 19. Tools and approaches used to improve farmers' maize management

Type	Title / Subject area	Source
Leaflet	Matumizi ya mbolea katika kilimo bora cha mahindi (Use of fertiliser for better maize production)	Project
Leaflet	Kanuni nane za kilimo bora cha mahindi (Cultural practices for better maize production)	Project
Leaflet	Ugonjwa wa milia katika kilimo cha mahindi (*Maize streak virus*)	Project
Booklet	INADES booklets on farmer group strengthening (~10 booklets in this set)	INADES
Demonstrations/ trials	Variety demonstration trials at the different villages	Project
Course	Correspondence courses that project farmers have registered on include agriculture and livestock, management	INADES
Exchange visit	Exchange visits for the QDS farmers	Project
Seminar	After each seminar farmers within each group visit each other, but also could help organise village to village exchange visits	Project
Seminar	Seminars at district level (2 this year, 4 last year)	Project
Booklet	Seed management handouts for farmers and VEOs (in both English & Kiswahili) and used the TOSCA notes too .Open pollinated maize varieties: hints on seed management and variety maintenance for small farmers.	Project
Leaflet / Poster	Kuwa daktari ya mahindi (A modified version of 'Be your Own Maize Doctor' translated into Kiswahili).	Project
Poster	GLS poster from CABI	CABI CPP project

Training of farmers and Village Extension Workers in seed management

Two seminars on seed management were held, the first one for village and district extension officers (10-12th September 2003) and the second one for farmers (6-7th April 2004). Facilitators went through details of two stage seed selection (in local and improved composite varieties), procedures for production of quality declared seed (QDS) as well as composite varieties and reselection of seed from fields planted with OPVs. The two groups of participants were also given detailed differences between composite and hybrid varieties, regulations binding production of certified and QDS seed, the role of the official seed certification agency (TOSCA) and the Tanzania official variety release procedures. One of the requirements for official variety release in Tanzania is that a variety being proposed for release must have been tested for at least two seasons under farmers' field conditions and that farmers must fully participate in evaluating them. It was then clear to farmers that they had a critical role to play in the variety release process. The recently released new hybrid, UH 615 was given as an example where some farmers within the project participated in evaluating.

In one case, what was learnt in the seminar was supplemented with a field trip to observe and interact with other farmers involved in some on-farm seed production activities. Thus, 12 farmers from Mbarali district accompanied by their village extension officers were given an opportunity to visit Njombe District for 3 days, i.e from 13-15th April 2004. In Njombe, they visited farmers who were involved in on-farm seed production under the DANIDA-funded Quality Declared Seed (QDS) project. Discussion and exchange of experiences regarding this project took place right in the field where the visiting farmers were able to gain practical experience with regard to commercial on-farm seed production activities. Mbarali district was

selected because it is a potential area for production of QDS seed under rain-fed and irrigated conditions.

Farmers, particularly those from Mbarali district are now conversant with the principles and practice of Quality Declared Seed (QDS) production and should fit in very well with plans of the DANIDA-funded on-farm seed production project, when it extends its activities to Mbeya region probably during the 2005/06 season. The QDS system has good potential as a means of improving access to good quality seed, particularly in areas, such as Mbarali district, where open pollinated maize varieties are still very popular.

Final preparation and dissemination of promotional materials

For wider dissemination of results arising from the various activities of the project, different communication strategies/ approaches have been planned to ensure that as many farmers as possible in the project's target area have access to and understanding of the validated improved seed production and management practices. Approaches developed by the project collaborators are listed under activity 2 above. Preliminary maize promotion strategies for the four districts in which the project is working are shown in the following tables 20a to d.

Tables 20. Preliminary maize promotion strategies for the different districts

a) Iringa district

What	Who is being targeted?	What approach could be used?	What tools should be used?	Who does it?	When is it done?	Where?	Inputs	Contributors/ collaborators		Comments
								CPP	Other sources	
Seed mgmt	Farmers in projects' farmers gps & others interested	Farmer field days	Learning plot	VAEO/ DCO	Tassling (Feb/ March)	4 project villages	1. Leaflets – 400 2. Diesel – 200 lts 3. Sodas & bites – 20 crates & 400 sambusa	Fuel & refreshments	Dist council (transport & staff); Uyole (Leaflets)	400 farmers
		Farmer exchange visits	Learning plot in other villages Dr Lyimos handout	DCO/ VAEO Uyole	Apr/ May Oct/Nov/ Dec 04	4 project villages	1. Fuel – 300 lts 2. Lunch for 5 extn staff 3. Lunch for 60 farmers	Fuel & Lunch	Dist council (transport & staff)	60 farmers
		District seminar	Practical learning plot (irrigation area) FFS plot	DCO/ Uyole/ TOSCA	Oct/ Nov 04	Ilula	1. Bus for 48 2. Fuel – 150 lts 3. Leaflets – 96 4. DSA farmers – 48 5. DSA – 4 + driver	DSA & Busfare	Dist council (transport & staff & fuel); Uyole (handouts)	48 farmers
General seed mgmt	VAEOs	District seminar	Dr Lyimos handout TOSCA handout	DCO/ Uyole/ TOSCA	Oct/ Nov 04	Ilula	1. Bus for 80 2. Fuel – 12 lts 3. Handout – 4. DSA – (5 + 4 VAEO + driver	DSA & Busfare	Dist council (transport, staff, fuel, stationery & fuel); Uyole (handouts)	4 VAEO
Soil fertility mgmt (agenda of farmers themselves)	Farmer group members & others interested	FFS approach	Matumizi ya mbolea leaflet Be your own Maize doctor Organic fertiliser	SMS crops	Oct/ Nov 04	4 project villages	1. Fuel – 200 lts 2. Lunch allow. – 3 SMS & Driver 3. Leaflets – 144 4. Refreshments for 53 members	Fuel & refreshments	District council (transport, staff, lunch allowances); Uyole (leaflets)	48 farmers

What	Who is being targeted?	What approach could be used?	What tools should be used?	Who does it?	When is it done?	Where?	Inputs	Contributors/ collaborators		Comments
	VAEOs	TOT seminar	As above	DSMS Crops/ DCO/ Uyole	Oct/ Nov 04	Iluri/ Nzihi	1. Bus for 4 2. Fuel – 80 lts 3. Handouts/ leaflets–12 4. DSA (3 resource + 4 VAEO)	DSA & Busfare	District council (Transport; Staff); Uyole (leaflets)	4
Knowledge of inorganic fertilisation	Stockists	Seminar	Fertiliser composition & use & handling	DCO/ Uyole/ TFC	Sept/ Oct 04	Iringa	1. Bus - 11 2. Fuel – 30 lts 3. Handouts/ leaflets–11 4. Refreshment 5. DSA (Uyole + TFC + stockist)	DSA	District council (refreshments for stockist, fuel) Uyole - handout	23 (11 + 12)
Crop Mgmt (maize)	Farmers/ Farmer gps in the 4 project villages/ other villages	Field days FFS Exchange visit	Leaflets on: maize husbandry, fertilisers; diseases; diagnosis of deficiencies; insects (field – storage)	DCO/ Uyole/ researchers of various disciplines	Oct/ Nov	In the 4 project villages	1. Fuel – 300 lts 2. Farmer lunch allowances - 600 3. Handout/ leaflets–1200 4. Refreshments – 600 farmers 5. DSA (Uyole + district fms)	Fuel DSA Refreshments	District council (transport, staff) Uyole (handouts/ leaflets)	600 farmers
	VAEO	Seminar	As above	DCO/ Uyole researchers	Sept/ Oct	Ilula FTC	1. Fuel – 80 lts 2. DSA for VAEO 3. Bus fare for VAEO-8 4. DSA for Uyole & DCO	DSA & Busfare	District council (Transport; Fuel); Uyole (handouts/ leaflets)	8 VAEO

N.B. Still need to be refined by a team at district level/ office, especially as regards: 1) numbers of leaflets required; 2) development activities related to maize promotion in the district; 3) looking for other collaborators/ supporters to the programme in the district

b) Mbarali district preliminary maize promotion strategy

What	Training need	Who is being targeted?	What approach could be used?	What tools should be used?	Who does it?	When is it done?	Where?	Contributors		Remarks
								CPP	District council/ farmers	
Seed management	Indication of germination % on seed packets	Farmers Extensionists Commercial seed producers	Farmer Field days Exchange visits District seminar TOSCA to enforce existing seed labelling laws Inspection	Demo plots Handouts Letter from TOSCA to seed company	DALDO office TOSCA Project team	Sept - May	Project Villages District HQ	DSA = 5 extn; 2 researchers; 10 kg of maize seed, 4 flip charts, 4 masking tape, 4 boxes of marker pens, 45 notebooks & pens, refreshments for 47 members; Fuel	District Council = vehicles; Farmers = sisal twines & pegs	40 farmers
Crop management	How to get weather forecast	All farmers Extensionists Ward to district level leaders	Group meetings (abide to their timetables) Village/ public meetings Individual radio/ newspaper access	Radios Newspapers Posters	Met dept. DALDOs office	Oct-Nov	DALDOs office	DSA for extensionists 1 box marker pens 25 manila sheets Fuel – 40 lts	Transport (vehicles, motor cycles)	11 wards
	Benefits of early planting, proper spacing and improved seeds	All farmers	Gp meetings Field days at demo plots	Leaflets Demo plots	Project team DALDOS	Oct- May	In villages	DSA for 5 extn, 2 researchers, 4 flipcharst, 5 bags of fertiliser, 3 masking tapes, 5 tape measure	Pegs & sisal twine = farmers District council = Vehicle & motorcycle; sign boards	1 tape measure for 1 extn
	2. Information on different varieties and use of oxen planters	All farmers (project villages) Extensionists (district HQ, project ward) Stockists (15 whole district) Seed producer farmers (project villages)	Field days at demo plots Farmer gp meetings Distribution of leaflets and maps to stockists, extensionists	1. Leaflets (100 pcs) (Kanuni 8) 2. Map showing varieties suited to the different areas of SH (30) 3. Demo plots of diff varieties	1. Project team (using feedback from farmers) 2. Project team 3. Farmers & DALDOs office & project	By October	DALDOs office In project villages	DSA = 5 extn; 2 researcher; Fuel = 180 lts; 20 kg of seeds; 5 bags of fertiliser; 2 lts of i'cide; 4 flip charts; 4 boxes of market pens; Fuel	District Council = Vehicle & motorcycle; Farmers = Sign boards, sisal twines	1 plot per project village (=4 plots)

What	Training need	Who is being targeted?	What approach could be used?	What tools should be used?	Who does it?	When is it done?	Where?	Contributors		Remarks
								CPP	District council/ farmers	
	Use of different herbicides & optimisation weed mgmt	Project farmers Extensionists	Group meeting Conduct demonstrations	Leaflets Demo plots	Project team DALDO	Nov – Feb	Project villages	DSA = 5 extn, 2 researchers; Fuel = 180 lts; 20 kg of seeds; 5 bags of fertilisers; 2 lts of I'cide; 4 lts of herbicide; refreshments; 4 boxes of marker pens; 4 flip charts; 45 notebooks & pens	District council = Vehicle & motorcycle Farmers = Sisal twines & pegs	40 farmers, 1 demo plot per village
	5. Insect pests and disease control and identification	Project farmers Extensionists	Gp meetings at farmers field Gp meetings Demo plots Field days at demo plots	Leaflets Farmers fields Demo plots	Project team (using feedback from farmers) DALDOs	Dec – May	Project villages			
	6. Advantages of timely harvest	All farmers	Visit different fields at diff grain ripening stages Gp discussion	Farmers fields	DALDO	Apr – June	Project villages	Fuel = 120 lts; DSA = 5 extn; refreshments for 45 members; 4 flip charts; 2 boxes marker pens	District council = vehicle & motorcylce	40 farmers, 1 demo plot per village
Soil fertility management	7. Plant nutrient deficiency symptoms, sources of plant nutrients, & fertiliser application (OM& inorganic fertilisers)	Farmers Extensionists	Gp meetings Visit fields to see deficiency symptoms & diff fertiliser performances	Leaflets showing diff deficiency symptoms Leaflets on fertiliser use Farmers fields Bwana shamba soil testing kit	Project team* DALDO	Dec - June	Project villages	DSA = 5 extn & 2 researcher ; Fuel = 120 lts; 4 flipcharts; 4 boxes of marker pens; 4 masking tape; refreshments	District council = vehicle	40 farmers

c) Mbozi district preliminary maize promotion strategy

What	Who is being targeted?	What approach could be used?	What tools should be used?	Who does it?	When is it done?	Where?	Budget
1. Seed mgmt	Farmers (from 18-60 yrs, men & women)	FFS Field days	Learning plots Leaflets Agricultural shows	Farmers Village extension officers District extension officers Local village govt	Oct/ Nov – Jun/ July	At the 4 project villages	a) Learning plots – Materials: 100kg of TSP (4 villages); 200 kg of CAN (4 villages); 10 kg of seeds (diff vars); 1 lt of insecticide; fuel – 400 lts; DSA for DCO, VEOs & Researchers. b) Leaflets – Kanuni 8 (100); Matumizi ya mbolea (100); Uzalishaji na utuuzaji bora wa mbegu (50); Ugonjwa ya milia (100); Utumiaji bora wa mbolea za miamba/ minjingu (100) c) Field days – Transport Fuel 400 lts; DSA for DCO, VEOs, Researchers; Refreshments – farmers & invited guests =60 people; materials 1 box marker pens; 20 manila sheets; 4 masking tapes; 8 sign boards; 4 flip charts
2. Soil fertility	Farmer gps Vill extension officers, ward & districts	Gp meetings FFS Field days	Demo plots Leaflets Poster	Researchers Farmers Public extension (district/ village/ NGOs)	The whole year	At the villages	a) Demo plots – Treatments = top dressing only CAN, minjingu + CAN, TSP + CAN. Minjingu 100kg. Materials; TSP 100 kg; CAN 200 kg; Seed 10 kg (UH615), field materials. b) Transport cost - DCO, VEOs & Researchers. Soil analysis , Fuel 400 lits
3. Crop Mgmt	Farmers Public extn NGOs	FFS Field days	Demo plots Leaflets Posters Agric shows	Farmers Researchers Public extension (district/ village) Village local govt	Dec - June	ADP Ukwile At the 4 villages	Posters – Be your own maize doctor (50) Follow up to village groups Transport costs – Fuel 400 lts; Upkeep (DSA) DCO, VEO & Researchers

d) Njombe district preliminary maize promotion strategy

What	Who is being targeted?	How/ What approach could be used?	What tools should be used?	Who does it?	When is it done? (season)	Where?	Requirements	Contributors	
								CPP	Other sources & district council
Seed & seed mgmt	Individual farmers						To be developed further in a district council strategy		District council
	Farmer gps	gp meeting	leaflets	District extn, farmers	2004/5	Village	Soda 2 crates, 40 pens, 40 notebooks, 2 flipcharts, 4 masking tape, 2 boxes marker pens, 1 ream, p/copy services, 40 * 5 leaflets = 200, 50 lts diesel * 3 trips * 4 villages, 3 facilitators (lunch)	Refreshments, leaflets, fuel, lunch	Stationeries (D/C)
	Public extn (village)	gp meeting	Leaflets	District extn, farmers, ARI Uyole	2004/5	District	1) DSA 4 staff for 2 days 2) Meal allowances for 2 days (TOSCA, DCO, DALDO, DEO) 3) Stationeries (flipchart 2, masking tape 2, p/copy paper 1 ream, 1 box pens, 1 box markers 4) DSA (researcher * 2 days) 5) 10 leaflets * 5 types 6) Bus fare (4 staff) 7) Hall charges	DSA, meals, leaflets, busfares	Stationeries (D/C) Hall charges
	Stockists/ Distributors	Market place, field days	Leaflets, agric shows	District extn, farmers, ARI Uyole	2004/5	Town/ ward	1) 30 stockist @ 2 leaflets 2) Stationeries 3) DSA (researcher) 4) Bus fare (stockist) 5) Meal (DCO stockist & TOSCA)	DSA Busfares Meals Leaflets	Stationeries Hall charges
Soil fertility mgmt	Individual farmers						To be developed further in a district council strategy		District council
	Farmer gps	Exch visits	Leaflets	District extn, farmers, ARI Uyole	2004/5	Village	1) Fuel 150 lts 2) 40 leaflets (matumizi ya mbolea) 3) 2 crates of soda	Fuel Leaflets Refreshments	

	Public extn	Field visit	Demo & learning plots	DEO, DALDO, Uyole		Village	1) Fuel 50 lts * 2 trips * 4 villages; 2) Lunch (6 staff * 2 * 4 villages +driver) 3) DSA (researcher) * 2 trips * 4 days	Fuel Leaflets Refreshments	
	Stockists/ Distributors	Training	Leaflets	District extn, Uyole	2004/5	District	1) 30 stockist @ 1 leaflet 2) Stationeries 3) DSA (researchers) 4) Meal allowance (DCO) 5) Bus fare (stockist)	Leaflets Busfares DSA Meals	Hall charges Stationeries
Crop Mgmt	Farmer gps	Field days	Demo plots	District extn, farmers, ARI Uyole	2004/5	Village	1) Fuel 50 lts * 4 villages 2) Refreshments (8 crates) 3) Meal allowance (DCO, DALDO, VAEO & Driver) 4) Stationery 5) DSA (Researcher)	Fuel DSA Refreshment Meals	Stationery
	Public extn	Field visit	Demo & learning plots	District extn, farmers, ARI Uyole	2004/5	Village	1) Fuel 50 lts * 2 trips * 4 villages 2) Lunch (6 staff & driver * 4 villages) 3) DSA (Researcher) * 2 trips * 4 days	Fuel DSA Meals	
	Stockists		Leaflets			Town	To be developed further in a district council strategy		District council
	Marketing & coop officers	Farmer marketing officers meetings, gp meetings, market places	Leaflets, loudspeaker	District extn, farmers, ARI Uyole	2004/5	Town/ ward/ village	To be developed further in a district council strategy		

NB. The whole strategy needs to be refined at district level

Output 3: Sustainable pathways/systems for quality seed supply appropriate to local conditions and farmers' needs developed by farmers and other stakeholders

In order to address the issue of quality seed supply, it was necessary to consult widely to better understand and document perceptions, interests, activities and the situation of stakeholders. These included farmers, seed companies, distributors, stockists, NGOs, public sector extensionists, public sector researchers, regulatory bodies and policy makers. This was carried out through the Situation Analysis (see output 1), a survey of stakeholders, a major stakeholder workshop and on-going communication with stakeholders throughout the life of the project. These activities identified opportunities for improving access to quality maize seed in the S. Highlands. Some of these recommendations were implemented within the influence of the project and others driven by wider interests. The original aim was to hold an end of project stakeholder workshop. However, as explained below, this was postponed following CPP's agreement to fund a second phase.

Stakeholder consultation survey: Overview of main findings and implications

(i) Introduction Stakeholders (other than farmers) with an interest in maize seed in the SH were consulted as part of an initiative seeking to empower farmers through improving their access to, and pre- and post-harvest management of, disease-resistant maize seed/ cultivars. The specific aims of the survey were to understand better:
1) Stakeholders' aims, interests and activities in relation to maize seed.
2) Stakeholders' perceptions of the seed systems in the SH, together with current strengths and weaknesses, and opportunities and threats to their improvement.
3) Broad trends in the commercial seed sector.
4) How stakeholders would like to contribute to improving seed systems in the SH.
A total of 43 consultations took place mainly in the SH, but also in Dar es Salaam and Arusha in June/ July 2003.

(ii) Stakeholders aims, interests and activities The following broad stakeholder (non-farmer) groups were identified:

- Distributors/ stockists
- Not-for-profit non- government organizations
- Seed supply companies and main agents
- Public sector extension (DALDOs offices)
- Public sector research (Division of Research and Development, MAFS)
- Public sector policy, regulation, provision and funding (MAFS Ministry of Agriculture and Food Security)

The Private Sector
The main stakeholders from the private sector are stockists, distributors and seed supply companies.

Distributors/ stockists have the common aim of operating a successful commercial enterprise through the provision of agricultural inputs to farmers and/ or intermediaries. Stockists' main role with respect to maize seed supply is selling seed directly to farmers. Distributors are buying from other companies and selling to stockists. Most stockists buy seed on a cash basis, unless they have been able to build-up a position of trust with their distributors. In most cases, these enterprises are selling a range of products including agro-chemicals, fertilizers, equipment and veterinary products, as well as seed and these businesses are also providing advice to their customers. Distributors and stockists are mainly based in urban centres.

Private sector commercial seed suppliers refers to companies where seed is a significant part of their business. Many are also selling other agro-inputs and seed may not be their main line of business. This is a diverse group and, although all are selling maize seed to their
Figure 8. A typical seed stockist operating in a small market town in the SH

customers (from farmers to relief agencies), not all are involved in seed production and few are involved in varietal development. OPVs (nine reported) which have been developed and maintained by the public sector are being produced by seed companies within the country (mainly in the N. Zone). Hybrids (14 reported) are generally being developed and seed produced outside Tanzania. Within Tanzania, these companies are primarily based in Arusha.

The focus of these private sector organizations is on the provision of a product (ie seed and other inputs) on a commercial basis, although to varying extents other services (e.g. advice, other information) are provided by some organizations.

Not-for-profit non-government sector
Not-for-profit non- governmental organizations (NGOs) are typically aiming, usually with donor funding support, to facilitate rural communities to achieve development through improvement in agriculture and other sectors e.g. health and education. They are contributing towards improving farmers' access to seed, including training farmers to produce and manage their own seed (modern and local varieties). The NGOs consulted are tending to work on a relatively small geographic scale within the SH. Their focus is on people, with seed being seen as a means of making a contribution towards development.

Public sector
Public sector extension (DALDOs' offices) has been reduced and substantially decentralized, and at district level is now under the direction of District Councils. Current policies include: use of participatory approaches, strengthening of farmer groups and initiatives for credit, input supply and output marketing, new approaches to quality of services and encouraging a greater role for the private sector. They have a general aim of improving access to improved seeds through: identifying and promoting maize varieties with suitable characteristics; making

seed available during emergencies or food shortages; promoting Quality Declared Seed (QDS) currently in Iringa and Njombe districts and becoming more involved in seed regulation.

Public sector research (Division of Research and Development, MAFS) is nationally organized into seven zones, including the S. Highlands (ARI Uyole) and is guided by a client-oriented approach (COR) to research. A key aim is to make improved seed available to the farming community. Activities include germplasm improvement; developing varieties; variety maintenance and production of breeder seed. The aim is to develop adapted high yielding varieties, with pest and disease resistance and responding to market needs e.g. flint type, early maturity. ARI Uyole farm is currently producing UH615 hybrid seed.

Public sector policy, regulation, provision and funding (MAFS Seed Unit, TOSCA and Seed farms) includes a range of individuals and organizations work within MAFS with a wide range of responsibilities relating to seed. Their overall aim is to ensure improved seed is available to farmers. The Agricultural Sector Programme Support (ASPS) project (DANIDA funded) is making a major contribution to supporting the MAFS's seed programme.

The public sector organizations are focusing on the product ie seed as well as the provision of a wide range of other services in response to perceived needs of farmers and other stakeholders.

Table 21 Maize varieties, number of stockists reporting, location, source of seed, buying arrangement, seed pack size and selling price (mean and range) for 2002/2003 season in survey area

Variety	No. of respondents	Location	Source of seed	Buying arrangement	Pack size (kg)	Mean sale price Tsh/kg (Min & max)
Hybrids						
CG4141	6	Mbeya Mbozi Tunduma Iringa	Monsanto Starchem	Cash Credit	2	1642 (1500-1850)
H511	1	Makambako	Kibo	NA	2	1500
H513	3	Mbeya Makambako Tunduma	Kibo Starchem	Cash	2	1600 (1500-1800)
H614	10	Mbeya Mbozi Njombe Makambako Iringa Tunduma	Kibo Starchem	Cash Cash+1month Credit	2	1510 (1500-1600)
H625	4	Mbozi Njombe Makambako Iringa	Kibo	Cash + 1 month Credit	2	1500
H614/ H625/ H513	3	Iringa Njombe Mbeya	Kibo TFA Njombe	Cash, Credit	2	1467 (1400-1500)
H627	1	Njombe	Tanseed Int	NR	5 & 10	1200
H628	2	Njombe Makambako	Kibo	Cash+1month	2	1500
H6302	1	Njombe	Tanseed Int	NR	10	1200
H6549	1	Mbozi	Pannar	NR	2	1500
HDH02	1	Makambako	Kibo	NA	2	1500
PHB3253	5	Iringa Mbeya Mbozi	ByTrade/ Pioneer	Credit Cash	2	2138 (2100-2150)
SC627	2	Mbeya Makambako	SATEC SeedCo	Credit	2	1500
UH615	8	Tunduma Mbeya Mbozi Njombe Iringa	Uyole One private stockist	Credit Cash	1, 2.5, 5, 10	1201 (1080-1300)
OPVs						
Katumani	4	Iringa Rujewa Makambako	Mukpar SATEC	Cash Credit	2	967 (800 1100)
Kilima	7	Iringa Mbeya Rujewa Makambako	E.African Seeds SATEC	Cash Credit	2	1100(900 1500)
Staha	3	Rujewa Makambako	SATEC	Credit	2	1033 (1000-1100)
Taxapeno	2	Njombe Makambako	E.African Seeds SATEC	NR	NR	1000
TMV1	3	Rujewa Makambako	SATEC Uyole	Cash	NR	1033 (1000-1100)
TMV2	1	Rujewa	NR	NR	NR	NR
UCA	6	MbeyaNjombe Mbozi Iringa Tunduma	E.African Seeds SATEC	Cash	2	1020 (900-1200)
UCA/Staha/ Kilima	1	Mbeya	SATEC	Credit	2	1250

Information provided by 19 respondents; NR = Not recorded

Table 22. Seed companies and major agents consulted in 2003

Company	Location of company	Maize varieties Hybrids	OPVs	Location of seed production	Comments
By-Trade	Arusha Dar Iringa	PHB3253	None	Zimbabwe, S. Africa	By-Trade are agents for Pioneer Seed.
E. African Seeds	Arusha	Pannar 691	Katumani TMV1 TMV2 Staha Tuxpeno UCA	N. Zone Imported	Agents for Pannar
FICA	Arusha	Longe 2H	Longe4	Imported from Uganda	Hope to release in 2003
Kibo (Kenya Seed Co.)	Arsuha Makambako	H614 H625 H628 H513 H511 HDH02	None	Kenya	
Monsanto	Arusha	CG4141 DK8051* DK8071	None	Imported from S. Africa, Malawi, Uganda	Previously seed was produced by Cargill in Tz, but problems with infrastructure and rainfall
SATEC	Arusha Makambako	SC627	Katumani Staha TMV 1& 2 Kilima Tuxpeno	N. Zone Imported	Agents for SEEDCO
Tanseed International	Njombe	H6302	Kilima Katumani TMV2	S.Highlands	
Zonobia	Arusha	None	Kilima Katumani Kito TMV1	N.Zone	Not currently marketing in S.Highlands

**Starting 2003/2004*

(iii) What are the maize seed systems and what are the trends?

(a) What are the maize seed systems?

Seed systems are typically characterised as comprising formal and informal or modern and traditional sectors. Through consultations with stakeholders in Tanzania, it emerged that it may be more useful to think in terms of three linked components of maize seed systems: Certified seed, Quality Declared Seed (QDS) and Farmer saved/ locally traded seed. Table 21 summarises the type of seed involved and those stakeholders which appear to currently have a particular interest.

Table 23. Seed systems in the Southern Highlands: Types of seed and the main current interests of stakeholders

Seed system	Type of seed	Stakeholder groups						
		Farmers	Distributors/ stockists	NGOs	Seed Companies	Public Extension	Public Research	Public Policy etc
Certified seed	Hybrids OPVs	✓	✓	✓	✓	✓	✓	✓
Quality Declared Seed (QDS)	OPVs	✓				✓		✓
Farmer saved/ locally traded seed	Landraces, OPVs Hybrids (recycled)	✓		✓				

✓= stakeholder interest

Certified Seed

This refers to seed which has been produced through the formal seed sector. It involves the production of a registered variety which, within Tanzania, is through a process involving breeders' seed, foundation seed (registered seed) and finally certified seed. Certified seed is either produced through the above system within Tanzania or is imported. This process is regulated by TOSCA. The seed involved may be either hybrid or OPV. Until the late 1980s, certified maize seed was produced and marketed by a monopoly parastatal organization Tanzania Seed Company (TANSEED). However, following the government's liberalization policies, private companies have entered the market. TANSEED has been unable to respond sufficiently to the competition and officially ceased to exist in 2002. Currently, most hybrid seed is imported and most OPV seed is produced domestically (see below).

Table 24. Maize seed availability (Tonnes) in 1999/2000

	Imported	Local	Total
Hybrid	4134	1053	5187
OPVs	-	2623	2623
Total	4134	3676	7810

Source: Statistics Unit, URT (2002)[2]

Quality Declared Seed (QDS)

The essential idea behind QDS is to provide a system of quality control during seed production which is cheaper than seed certification. The development of the QDS approach has been facilitated by FAO and originates from the 1980s. QDS refers to 'seed produced by a registered producer which conforms to the minimum standards for the crop species concerned and which has been subjected to the quality control measures outlined in the Guidelines[3]'. Under the QDS system in Tanzania, seed is produced by farmers for the local market using good quality parental seed of improved varieties and under government regulation. Under the scheme, only released OPVs may be grown by producers who must be registered with TOSCA. TOSCA is expected to inspect a minimum of 10% of seed crop and 10% of seed offered for sale. The introduction of the QDS system to Tanzania has been facilitated by the ASPS. Under Phase 1 QDS has been developed in pilot areas, including Iringa region.

Farmer Saved/ locally traded Seed

[2] URT (2002) Tanzania mainland: Basic Data Agricultural Sector 1994/95 -2000/2001. Statistics Unit, MAFS, PO Box 9192, Dar es Salaam, Tanzania.

[3] URT (2001) Rules, regulations and procedures for quality declared seed production in Tanzania. MAFS, Tanzania.

This refers to a system where farmers manage variety selection, seed production and storage under local conditions. The seed type may be landrace (local variety), OPV or recycled hybrid. A very high proportion of seed grown by farmers in the SH emanates from this system. An important point, however, is that this germplasm originates from many sources including the formal seed sector.

Trends in seed systems. Table 25 summarises the main trends with respect to each of the three main seed systems. Utilization of certified seed from the formal seed sector has declined substantially from its peak in the 1980s when TANSEED was the monopoly supplier of subsidised seed. The current market (in terms of seed actually purchased) for certified seed in Tanzania is much smaller than in the past. Estimates of the current national market compared to the peak in the 1980s given by three informants from the seed industry ranged from: 5-10% to 25% to 38%. One informant suggested that the market for certified maize seed in the SH has declined from 3,000 tonnes to 600 tonnes. An increasing number of companies are competing for shares in what has been a declining market.

The QDS system is still new and evolving. It has been operating in different parts of the country including Iringa region for the last 3-5 years. Under the original QDS system, foundation seed was needed to produce quality declared seed, but this in now changing and although foundation seed is needed to produce so-called QDS1, QDS1 can be used to produce QDS2. There are plans to expand to Mbeya, Rukwa and Ruvuma regions in the near future. The government anticipates that the QDS approach will be a transient system as a stepping stone towards increased future use of certified seed by farmers.

As sales of certified seed (and chemical fertilizer[4]) have declined, national maize production appears to have increased. Ley et al (2002)[5] note that no long term data are available, but these increases in production 'are typically associated with population growth and expansion of cultivated land'. Whatever the explanation, utilization of farmer saved or traded seed appears to have increased, but details are not clear.

Table 25 Trends in maize seed systems

Seed system	Type of seed	Trends
Certified seed	Hybrids OPVs	Purchase and utilization by farmers has declined following liberalization of input market in the 1980s. Current market estimated at anything between 5% –38% of peak demand.
Quality Declared Seed (QDS)	OPVs	Operating in Iringa region in last 3-5 years Plans to expand to Mbeya, Rukwa and Ruvuma region
Farmer saved/ locally traded seed	Landraces, OPVs Hybrids (recycled)	Utilization has increased, but details are not clear.

What is the explanation for these trends? Bisanda et al (1998[6]) identified a number of reasons for farmers dis-adopting H614 and H6302 hybrids between 1988 and 1994 in the SH including: low yield, susceptibility to pests and diseases (store and field), high price and late maturity. A recent Situation Analysis (2002) in four districts of the S. Highlands suggests the

[4] Fertilizer consumption/ hectare (kg/ha) of arable land: 1961-1; 1970-7; 1980-16; 1990-17; 1995-7– FAOSTAT data in Scoones and Toumlin (1999) Policies for soil fertility management in Africa: A report prepared for the Department for International Development, IIED Edinburgh, IDS Brighton

[5] Ley G, Baltissen G, Veldkamp W, Nyaki A, Schrader T (2002) Towards Integrated Soil Fertility Management in Tanzania: Developing farmers' options and responsive policies in the context of prevailing agro-ecological, socio-economic and institutional conditions. URT MAFS DRD CORP. KIT Publishers Amsterdam Netherlands.

[6] Bisanda S, Mwangi W, Verkuiji H, Moshi A, Anandajayasekeram P (1998) Adoption of maize technologies on the Southern Highlands of Tanzania. Mexico, D.F.: International Maize and Wheat Improvement Centre (CIMMYT), the United Republic of Tanzania and the Southern Africa Centre for Cooperation in Agricultural research (SACCAR).

following reasons. The removal of input subsidies and liberalization of the exchange rate (under SAPs) has increased the costs of external inputs for maize production, particularly certified seed and chemical fertilizers, making many modern varieties less attractive. At the same time, the real price of maize grain is reported to be relatively low making maize a less attractive cash crop. There appears to be a loss of confidence in seed from seed suppliers at least partially due to the selling of maize seed in inappropriate agro-ecosystems, in some cases the desired varieties are not available and 'fake' seed is on the market.

(iv) Stakeholders' perceptions of the maize seed systems: strengths and weaknesses, and opportunities and threats to their improvement

There is a wide range of stakeholders with differing interests in maize seed. Many of these stakeholders are making links or working with others in either their own or different sectors. The different and overlapping interests, perception and values of these players present both challenges and opportunities for the improvement of maize seed systems. In general, most stakeholders interpreted 'seed' to be certified, or to a lesser extent QDS, seed rather than farmer saved/ traded seed.

Although there is a general consensus that there are many weaknesses/ problems, there was less agreement about the causes and even fewer about the opportunities to improve seed systems. The common and differing views of the nature of the seed systems and their SWOTs are summarised in the Tables below.

Table 26 Stakeholders' perceptions of strengths, weaknesses, opportunities and threats in relation to seed systems in the S. Highlands

(a) STRENGTHS	Distributors/ Stockists	NGOs	Seed Supply Companies	Public Extension	Public Research	Public policy, regulation etc
Availability & appropriate-ness of seed/ varieties	✓	✓	✓	✓	✓	✓
Farmers' perceptions knowledge and practices	✓	✓	✓		✓	✓
Agro-ecological factors	✓		✓		✓	✓
Capacity of seed producers and processors	✓	✓			✓	✓
Capacity of public research	✓	✓			✓	✓
Marketing & Price of grain	✓		✓			✓
Capacity/availability of stockists		✓				
Demand for maize seed			✓			
Government policy support			✓			✓
Infrastructure						✓
Seed quality					✓	
Seed quality regulation				✓		

b) WEAKNESSES	Distributors & Stockists	NGOs	Seed Supply Companies	Public Extension	Public Research	Public policy, regulation etc
Farmers' perceptions, knowledge and practices	✓	✓	✓	✓	✓	✓
Agro-ecological factors	✓	✓	✓		✓	✓
Cost/ price of other inputs	✓		✓	✓	✓	✓
Distributors/ distribution	✓	✓	✓	✓		✓
Price and marketing of grain	✓		✓	✓	✓	✓
Roles and responsibilities	✓	✓	✓		✓	✓
Seed quality	✓	✓	✓	✓	✓	
Capacity of seed producers &processors	✓	✓			✓	✓
Cost/ price of seed	✓	✓	✓			✓
Government policy & support	✓		✓		✓	✓
Infrastructure & distances		✓	✓	✓		✓
Availability/ appropriateness of seed/ varieties	✓		✓	✓		
Availability and Timeliness of seed delivery	✓	✓		✓		
Capacity of stockists	✓	✓	✓			
Communication / cooperation			✓	✓		✓
Farmers wealth/ income/ poverty			✓	✓		✓
Pests and diseases			✓	✓		✓
Seed quality regulation			✓		✓	✓
Demand for seed			✓			✓
Seed marketing					✓	✓
Capacity of extension			✓			

(c) OPPORTUNITIES	Distributors & Stockists	NGOs	Seed Supply Companies	Public Extension	Public Research	Public policy, regulation etc
Agro-ecological factors	✓	✓	✓	✓		✓
Capacity of seed producers and processors	✓		✓	✓	✓	✓
Farmers' perceptions knowledge and practices	✓	✓	✓	✓		✓
Government policy and support	✓		✓	✓	✓	✓
Capacity of public research	✓				✓	✓
Cost/ price of seed	✓		✓			✓
Infrastructure			✓	✓		✓
Availability/ appropriateness of seed/ varieties	✓		✓			
Capacity of extensionists				✓		✓
Capacity of stockists	✓			✓		
Communication and cooperation			✓			✓
Cost/ price of other inputs	✓					
Distributors	✓		✓			
Price and marketing of grain			✓	✓		
Roles and responsibilities			✓		✓	✓
Seed quality	✓		✓			
Seed quality regulation	✓					✓
Availability and timeliness of seed delivery		✓				
Demand for seed			✓			
Farmers' wealth/ income				✓		
Germplasm collections						✓
Property rights			✓			

(d) THREATS/ CONSTRAINTS	Distributors & Stockists	NGOs	Seed Supply Companies	Public Extension	Public Research	Public policy, Regulation etc
Government policy and support	✓		✓	✓	✓	✓
Regulation of seed quality	✓		✓	✓	✓	✓
Capacity of seed producers & processors	✓		✓		✓	✓
Cost/ price of other inputs	✓	✓	✓			✓
Farmers' perceptions, knowledge practices	✓		✓	✓		✓
Infrastructure	✓		✓	✓		✓
Agro-ecological factors	✓		✓	✓		✓
Availability& appropriateness of seed/ varieties		✓	✓			✓
Cost/ price of seed	✓	✓		✓		
Seed quality	✓	✓			✓	
Farmers wealth/ income	✓	✓				
Pests and diseases			✓	✓		
Price and marketing of grain	✓		✓			
Roles and responsibilities	✓		✓			
Capacity of extensionists	✓					✓
Availability of other inputs	✓					
Communication & cooperation						✓
Demand for seed			✓			
Property rights			✓			
Seed marketing						✓

In the following section stakeholders' views are grouped into some larger themes/ issues and an attempt is made to draw out implications with respect to the overall aim of improving maize seed systems to meet the needs of farmers in the S. Highlands.

(a) Farmers' situation

Farmers' wealth/poverty

There was broad consensus from a range of stakeholders that poverty limited most farmers' ability to buy seed and other inputs. Most farmers don't have access to capital for farming.

Farmers' perceptions knowledge and practices

There was some agreement that many farmers in the SH have used certified seed and other inputs in the past and were familiar with their advantages. The value of local knowledge and practices regarding local seed systems was raised by an NGO.

Stakeholders agreed that farmers were generally using farmer-saved seed (landraces and modern varieties, including recycled hybrids), but the reasons and implications offered varied between stakeholders. Distributors, stockists and seed companies typically perceived this as a weakness and attributed it to a lack of awareness of benefits of modern varieties or perceived high price of inputs by farmers. A number of public sector informants tended to see the explanation for using farmer-saved seed more in terms of farmers losing confidence in certified seed and therefore depending on their own or locally sourced seed. At least one of the NGOs saw farmer saved or local seed systems not as a weakness per se, but identified lack of skills by farmers to manage their systems better as the problem.

One distributor suggested that if farmers are given the opportunity to experiment by making seed affordable, they will realize the value of using quality seeds. An NGO also commented that farmers need the seed, but at a low price. A public extension informant suggested comparing the varieties farmers are using with released varieties and 'see what comes out'. Public policy informants made the point that farmers need more knowledge about seed.

A very small proportion of farmers currently use certified seed. Although stakeholders may have different aims, all have an interest in understanding what farmers are doing and why. What are the opportunities for farmers to voice their views e.g. through MVIWATA[7] or district councils? What are the opportunities for sharing information about different farmers' situation and needs between stakeholders so their needs can be better addressed?

(b)Maize Seed

Appropriateness of seed/ varieties available

At least 13 hybrid varieties and seven OPVs were being sold by organizations in the SH in 2003. Although some stakeholders felt that there were many varieties available, others had concerns. Stockists and public sector extension commented on: the limited availability of varieties for some agro-climatic areas; the susceptibility of some varieties to diseases (e.g. MSV, GLS); the susceptibility of hybrids to insects in field and store; and the relatively high input requirements of hybrids. An NGO raised the issue of the extent to which the varieties available met the needs of the market.

Some distributors/ stockists commented positively on the availability of quality seed from Uyole, as well as the availability of different varieties and supply companies to serve the local market. Some also expressed a preference for seed which is produced in Tanzania rather than from outside the country. Seed company informants commented on the availability of disease tolerant varieties and some companies reported that they have long term plans to develop varieties for the SH. One of the companies promoting OPVs commented on the preference of the grain millers for OPVs and their relatively low input requirements compared to hybrids.

Genetically modified (GM) maize seed was identified as a threat by both seed company and NGO informants. Related to this, one NGO commented on the threat of farmers losing traditional seed which is adapted to their environment (physical and social). Dependency on

[7] MVIWATA Muungano wa Vikundi vya Wakulima Tanzania (Network of farmer groups in Tanzania)

hybrids was also perceived as a threat by one NGO because of a greater need for associated inputs (particularly fertilizer) and that they segregate if recycled.

Availability and Timeliness of seed delivery
Stakeholders with more direct contact with farmers had concerns about the timeliness of seed delivery with seed not available at the right time at the beginning of the season. This was attributed at least partially to the long supply chain for seed e.g. Kenya – Arusha – Makambako – Mbeya.

Seed quality
Issues around poor seed quality were mentioned by informants in all groups except the public sector policy, regulation etc group. However, perceptions of who was responsible for the problem varied. Some attributed the problem to petty traders buying grain, treating it and selling as seed at a lower price. Some traders are reported to have duplicated logos etc to produce fake seed and this is considered quite widespread with small stockists. Others perceived the problem to be the seed supply companies, with quality of seed varying between companies. A distributor commented that seed is not always treated against pests (e.g. weevils) and packaging is sometimes poor. A seed company commented that there was no ownership or control over seed contract growers. It was suggested by a public extensionist that seed cheating is mainly in villages, but rare in towns. One public sector researcher attributed fake seed to the open market and weak control. NGOs also commented on the lack of reliable seed sources and farmers planting seed without knowing the quality.

Regulation of seed quality
Seed quality regulation was a concern in both public and private sectors. Some seed company informants felt that 'TOSCA is sleeping'; there were unethical practices in the seed business, the law needed to be enforced at different levels and there is no organization which monitors seed marketing. Some public sector researchers also commented on the weak policing by TOSCA. One public sector policy informant pointed out, however, the very limited resources of TOSCA[8] and the fact it still can't retain funds and therefore it is difficult to regulate seed production. However, in future it is planned that TOSCA will have a revolving fund under ASPS phase 2 and inspectors have been trained in districts. There were mixed views from distributors/ stockists with some suggesting that there was good quality control offered by TOSCA and extension services. Others suggested that there was poor control and monitoring of marketed seed (referring at least partially to seed entering the country from neighbouring countries). A public sector extensionist also commented on maize (seed) coming from across the border, but attributed this to the suitability of short duration varieties for irrigation. A public sector researcher was concerned that a delay in filling the gap left by TANSEED poses a danger of having 'Tanzania as dumping place for seed from all sources'.

Cost/ price of seed
There was concern from both the public and private sectors about the high price of (certified) seed. Seed companies suggested one way of reducing prices would be through producing higher quantities and through economies of scale reducing costs. This of course is dependent on having a sufficient market. One public policy informant commented on attempts to reduce the price of foundation seed, which would also contribute to cheaper certified seed.

Seed distribution
There is a perceived problem with distribution of certified seed. Certified seed usually only reaches stockists who are generally based in urban centres.

Demand for seed and Seed marketing
The national market for certified maize seed is very small and has declined, with estimates ranging from 5-38% of what it was at its peak. There were few comments about seed marketing. This may reflect limited marketing expertise among some of the staff of private seed companies, many of whom are ex-civil servants with limited commercial experience.

[8] During the consultations we visited a TOSCA office and the phone had been cut because of an unpaid bill.

Market research and feedback
The private and public sectors appear to have similar approaches to market research and feedback. Varieties are promoted and then assessed through feedback by farmers and in some cases other stakeholders. The main difference is that varietal development in the public sector is essentially within Tanzania, whereas in the private sector it is mainly outside the country. There appears to be very little systematic research to identify markets for seed with different farmers in different areas of the SH.

Germplasm collections
Public policy informants commented on germplasm collections (e.g. ARI Uyole and the PGRC Genebank, Arusha) as providing potential opportunities for improving seed systems

Quality Declared Seed-QDS
QDS forms a major part of government policy addressing the high price and limited access to maize seed. There are many different views about QDS. Many stockists were not previously aware of QDS before they were asked during the survey. However, some saw it as an opportunity and would even like to stock the seed. Private companies cannot produce QDS, however, if it were possible, some would be interested in producing it. One company informant supported the government argument that in the short run companies are in competition with QDS, but in the long run it is creating awareness and so eventually improves the market. Another seed company clearly saw QDS as a threat to sales of certified seed. There were concerns from public extension about the sustainability of QDS. In phase 1 the programme targeted resource poor farmers, but in phase 2 it will target 'capable farmers' who will be expected to pay TOSCA.
There may be opportunities for the Ministry Seed Unit to promote greater awareness of QDS more widely. However, this is likely to require greater resources being made available to TOSCA if the current system of regulation is to be implemented.

Farmer Saved/ Locally traded seed
The value of local knowledge and practices regarding local seed systems was raised by an NGO. At least one of the NGOs saw farmer saved or local seed systems not as a weakness per se, but identified lacks of skills by farmers to manage these systems better as the problem.
One distributor suggested that if farmers are given the opportunity to experiment by making seed affordable, they will realise the value of using quality seeds. A public extension informant suggested comparing the varieties farmers are using with released varieties and 'see what comes out'. Public policy informants made the point that farmers need knowledge about seed.
Improvement of farmer saved seed is a relatively neglected area, which appears to offer opportunities which could meet farmers' needs. Currently, however, there appears to be little interest or incentive for non-farmer stakeholders (other than NGOs) to address this issue.

(c) Agro-ecological environment

Agro-ecological factors
Rainfall is generally perceived favourable for maize production in the SH. However, there is low rainfall and distribution in areas such as Mbarali and dry weather in some years such as the 2002/ 2003 season. There is a perception that rainfall is becoming less reliable. Where low rainfall is a problem, private sector and public extension informants commented on the availability of water for irrigation and the possibility of producing maize or seed maize under irrigation.
Low and/ or declining soil fertility was considered an important issue affecting seed utilization in the SH. One seed company, noting the limitations of blanket fertilizer recommendations, suggested districts could have a simple test to help farmers determine the type and amount of fertilizer to apply.

Pests and diseases
Pests (stemborers) and diseases (e.g. GLS, MSV) were considered a problem in their own right, but also because some varieties are not tolerant and even susceptible.

(d) Economic environment

Cost/ price of other inputs
There was wide spread consensus that the cost of other inputs, particularly chemical fertilizer, was affecting seed utilization. Low productivity of maize was attributed to lack of access to appropriate inputs and use of agro-chemicals without proper knowledge.

There may be opportunities for more efficient use of inputs through training. Only blanket recommendations are available for the use of chemical fertilizer; farmers may or not be aware of them; they may or may not be applicable in a particular context; the appropriate fertilizer may or may not be available; farmers may or may not be aware of the composition or effects of particular types of fertilizer. As suggested by one company informant, if it was possible for farmers to better determine the fertility status of their own soil and if there was better knowledge of options for enhancing soil fertility, then farmers could build on their current expertise and make more efficient use of expensive external inputs. This may ultimately increase the demand for quality seed. An NGO in Kenya (FIPS-Africa) has developed learning tools to help farmers and other stakeholders diagnose specific soil fertility conditions. In partnership with companies, FIPS-Africa has also made fertilizer and seed available in small packs to allow farmers to afford to experiment.

Availability of other inputs
Distributors/ stockists commented on the lack of availability of other inputs such as fertilizers

Marketing & Price of grain
Grain marketing and prices were considered key problems limiting use of certified seed in the opinion of many informants across stakeholder groups. The possibility of marketing beyond national borders has been seen by many as an important opportunity. The demand for large immature maize cobs (green maize) for roasting, particularly in urban areas, offers an alternative market (e.g. for hybrid seed). The main opportunity identified by seed companies and some in the public sector was government buying for the Strategic Grain Reserve (SGR). NGOs commented that farmers use the income from the sale of maize to meet their various needs and hence no money available for inputs such as expensive seed. Some referred to the lack of grain buyers following liberalization and the need to strengthen village primary societies.

Property rights
During consultations the government was in the process of passing legislation to establish breeders' rights. This is anticipated to provide incentives for breeders to increase their output of new varieties and make them available through a financial contract for others in the private sector to produce and distribute seed. One seed company agreed that breeders' rights provide an opportunity to make money and produce results. However, the informant went on to say that access to foundation material without exclusivity is a limitation (and a general problem with publicly bred materials) as marketing of a variety involves a lot of money. In order to meet farmers' needs, such partnerships will of course be expected to improve the choice, quality and price of seed available.

(e) Infrastructure

Infrastructure & distance
Most of the seed companies are based in Arusha and freight costs are high. Within the SH, roads between major centres are good, but feeder roads are very variable and are an important constraint to access and use of certified seed. A number of stakeholders noted the opportunities for growing irrigated maize in the SH and the opportunities this offered for increasing the demand for seed as well as seed production.

(f) *Government policy and support*

It was widely felt across private and public sectors that government policy was insufficiently supportive of the seed sector. Reference was made to the removal of price subsidies; insufficient support to breeders, TOSCA and seed promotion and lack of a strong marketing policy. Some in the private sector saw opportunities with respect to government policy and support. Examples that were provided included the announcement in the 2003 budget of subsidies on transport of seed and fertilizer to the SH and the apparent removal of obstacles to market liberalization. In the public sector there were differing views regarding liberalization of the seed market, with some arguing it had created opportunities and others seeing the need for the government to form an agency (such as TANROAD) to fill the gap left by TANSEED.

From public and private sectors there was concern about future government policies and support, particularly in relation to credit provision, maize marketing (general concern about restrictions on movement of grain and some feeling that the government should be more active in seeking external markets), subsidies (concern from private sector that government is under external pressure not to provide subsidies), QDS (seen as a threat by some in the private sector and unsustainable by some in the public sector) and possible conflict of interests between central (emphasis on national food security based on self-sufficiency) and local government (looking for income earning opportunities) policies. A number in the private sector noted that the results of government spending were not very visible and were concerned that the budget was donor dependent (e.g. Agricultural Sector Development Plan as source of funds dependent on meeting donor criteria). Some companies producing hybrids were also concerned that the government is promoting mainly OPVs. There is still a very wary relationship between the public and private sectors and as expressed by one seed company informant, there is a 'perception that the private sector is for exploitation'.

(g) Non-farmer stakeholders, their roles and responsibilities

Stockists

There were very few positive perceptions about the role and capacity of stockists. However, one NGO pointed out that they link producers and users of seed and because they can make a profit they are motivated and (potentially) sustainable. Informants from the private sector commented on the low capital available to most stockists and limited storage facilities for maintaining seed quality.

Would building the capacity of stockists/ distributors improve farmers' access to quality seed? Stockist expressed many ideas about how they might contribute towards improving seed systems and a number of stockists expressed an interest in being trained (e.g. in agronomic practices). This could be explored further as a possible role for public sector agencies in support of the private sector.

Public sector research

There were at least some informants from the private (although not seed companies), NGO and public sectors that viewed the capacity of public sector research (e.g. at ARI Uyole) as a strength and a future opportunity.

Researchers see a future role for themselves in variety development and evaluation, promotion and encouraging public-private partnerships. ARI Uyole is the only organization actually based in the SH working on variety development. With sufficient resources, this should provide a substantial advantage in the development of varieties which meet the needs of farmers in the zone. What should be the balance between public sector investment in hybrids and OPVs? A recent review of the QDS system commented on the need for a constant stream of new OPVs if QDS producers are to be sustainable. Hybrids which are consistent with farmers needs are more likely to be adopted. Making these varieties available must involve partnerships with other organizations which will satisfy all parties. The establishment of breeders' rights may contribute towards the development of effective partnerships. In addition, there may also be a much greater role for researchers in identifying ways of improving farmer saved seed.

Public sector extension services
Some seed company and distributors/ stockists informants considered weak public extension services to be responsible for many farmers not having knowledge of farming and hence a low demand for seed. One public policy informant supported the view that lack of information flow from extension to farmers is a problem, but attributed this at least partially to financial constraints. Public extension informants felt that there were some capable extension staff, but of course, resources are limited.

The decentralization of agricultural extension services has brought a mixed reaction, but many extension staff appear to appreciate the opportunities it provides. Those consulted saw a role in QDS activities, facilitation of the private sector and at least exploring opportunities to improve local seed systems. Facilitation of the private sector will need to be consistent with their new seed regulatory activities and the provision of relief seed following droughts etc. The public sector should have an important role in at least facilitating service provision in a country which is very heavily dependent on agriculture. Key factors are the capabilities of personnel, the incentives to respond effectively and the resources available. The priorities of district councils will be a major determinant.

NGOs
There were very few direct references to NGOs, although informants from other NGOs, seed companies, public extension and public research organizations reported that they were linking with these organizations. At least one seed company clearly saw the views of some NGOs as a threat.

NGOs reported an interest in improving input supply, improving local seed systems and training in seed management for quality seed (all types). NGOs appear to be the only non-farmer stakeholders with a direct interest in improving farmer saved seed. What are the opportunities for NGOs to link with other partners to address this issue?

Seed producers and processors
Some informants from the private, NGO and public sectors felt that at least some private companies have the capacity to produce good seed with attributes such as high yield, pest and disease resistance, genetic purity, high germination rate. Some distributors commented on the ability of the public sector to produce good seed for the SH (e.g. Uyole producing UH615 seed). Some in the public sector felt that good foundation seed farms exist and that Dabaga seed farm is in the SH Zone.
After the demise of TANSEED, the seed industry in Tanzania is going through a period of major transition towards what should be freely competitive systems. There are differing views as to whether the change is for the better or worse. Some distributors/ stockists commented on it still being a growing industry and having a lack of confidence in supply sources. There were concerns expressed about the financial state of some producers and processors. Seed farms still can't retain revenue and therefore have difficulty producing foundation seed.
There are differing views about the importance of who produces the seed. At least some in the public sector are concerned about private seed company priorities. Some argue the need for local entrepreneurs to take advantage of new products from public sector research and viewed non-local entrepreneurs producing locally developed varieties as a threat. Some seed companies see the entry of multi-national companies as a threat. Conversely, one large company saw increased competition from local companies as a threat

Roles and responsibilities
There was quite widespread concern about roles and responsibilities with respect to seed following liberalization/ deregulation. As one company put it 'everybody is producing seed since the decline of Tanseed'. There was concern particularly from the private (seed companies), but also public, sector that ARI Uyole was producing hybrid seed (UH615) and was in effect in competition with seed companies. One seed company informant expressed the view that ultimately breeding is more effective in the private sector. Another from the private sector commented on unethical practices in the private sector. From public research there was some concern about in-bred lines passing from public sector breeders to private seed companies. However, there was consensus that public sector research cannot breed,

multiply and produce certified seeds. Is there sufficient involvement of farmers in identifying varieties?

Seed companies already appear to be linking with a wide range of stakeholders, but may explore opportunities to work more closely with a wide range of farmers and other stakeholders to better identify market opportunities. There may also be opportunities to work with others to directly or indirectly facilitate farmers to better diagnose their farming constraints.

Communication / cooperation between stakeholders
Informants from the private and public sectors felt insufficient communication/ cooperation between stakeholders was a concern. Examples were given of issues between seed companies and public extension officers; between stockist and public extension; between researchers in Northern and Southern Highlands research Zones. Public policy also commented on a lack of information e.g. availability of grain prices.

At the national level, the Seed Unit has a key role in trying to facilitate and resolve the above issues. Identifying means of improving communication on different aspects of seed would appear to offer a lot of scope for improving seed systems to meet the needs of farmers. For seed companies, TASTA now provides a voice. The annual seed coordination meeting provides an opportunity for all stakeholders to contribute. At the zonal level, ARI Uyole and district councils are key public sector players.

(v) How would stakeholders like to contribute towards improving seed systems?

Stakeholders are clearly interested in making a contribution and providing ideas on how to improve maize seed systems in the SH. Areas identified include: Variety development; Seed production and distribution; Improving local seed systems. Non-seed input supply; Promotion of seed; Financial issues, including credit provision; Marketing of grain; Training farmers or other stakeholders; Partnerships and communication; Advising/ lobbying government; Capacity building in the private sector; Seed regulation; Funding.

These ideas were combined with the Situation Analysis findings and explored further with representative farmers and other stakeholders in a workshop held in Iringa in July 2003. In that workshop, participants were asked in stakeholder groups to consider SWOTs for each of certified seed, QDS seed and farmer saved components of the maize seed systems in the SH. They were then asked in mixed groups to refine realistic opportunities to improve each of the components. The results are summarised below.

Certified Seed
- ***Use of existing capacity to conduct research*** **-** maize breeding capacity is generally perceived to be strong and should be given continued support to ensure that researchers are able to work closely with farmers, extensionists, TOSCA and others in order to produce varieties that are appropriate to farmers needs in different agroecolgical zones. There needs to be stronger links between breeders, foundation farms and other stakeholders so that varieties validated by farmers can then be bulked and distributed efficiently. Irrigated areas in the SH offer breeders the opportunity of two growing seasons per year, potentially speeding release of new varieties.
- ***More national & international cooperation and communication*** - opportunities for stronger international and national cooperation exist e.g. to obtain disease resistant materials, and to prevent duplication of efforts. Improved communication between the different players provides an important way of this being achieved.
- ***Local entrepreneurs can take advantage of new varieties from research*** **-**information about recently developed varieties is often not given a high enough profile, and exhibitions, field days, demonstrations, newspaper articles should be integrated more into the variety development process. Greater effort should be taken to ensure that new varieties reach smallholder farmers in rural areas and not just urban dwellers.
- ***Private sector to take advantage of market liberalization*** to produce and distribute quality seeds.

- ***Increase farmer awareness to help reduce sales/use of fake seed*** **-** need to help farmers realise and act on their rights to complain about being sold fake or low quality seed. Raising awareness about the need to keep packaging and receipts and about where and who they complain to, would help improve the reputation of certified seed quality.
- ***Maize seed production under irrigated systems to speed up production*** **-** assessment of the schemes for maize seed production should be carried out.
- ***Packaging of seed for sale in smaller quantities*** - selling seed in small quantities (e.g. 250g or 500g) would enable farmers to purchase their seed requirements at the rate they acquired funds prior to the planting season and would also provide an opportunity to try different varieties under their own management systems. Research on quantities affordable by farmers (market) and promotion of packed seeds would be useful.
- ***Offer stockists a higher commission or margin for selling their products*** - stockists are reported to receive a relatively small proportion of the profit received by the seed companies, and increasing this margin could act as an important incentive for stockists. This would help to ensure farmers receive more information about different varieties available and perhaps improve access to the different varieties through sale points in villages etc.
- ***Invest more in promotion (demonstrations, posters) that will actually reach small settlements***
- ***Improvement of extension services and seed regulation agencies*** -it was recognised that extension services and TOSCA were seriously under resourced and that research and private companies could help to improve their skills and capacity.

Quality Declared Seed (QDS) Seed

- ***Existing capacity to conduct research*** **-** widen choice of varieties available to farmers including disease resistant OPVs and preferred local varieties. Closer links with ARI-Uyole researchers to provide more vitality through a two way learning process. Collect, characterise and improve traditional varieties. Identify farmer preferences in their varieties and improved varieties and the characteristics that need to be improved. Demonstrate/ trial on-farm.
- ***Strengthen marketing to ensure sustainability*** **-** link farmers to markets, establish information service centre.
- ***Improve communication infrastructure*** **-** improvement and construction of roads and bridge.
- ***Need to work as a team with extension staff to know what farmers need*****.**
- ***More collaboration between the North and Southern Regions (Regional level)***
- ***More inspectors trained at district level***
- ***Collection of germplasm e.g. Uyole and Gene-Bank Arusha*** **- c**ollect and evaluate germplasm. Develop suitable materials for use by farmers
- ***Expands QDS production to irrigated areas*** **-** make farmers in irrigated areas aware of QDS production. Improve irrigation infrastructure in irrigated areas (Traditional + Non-traditional)
- ***Capable farmers to work in groups for production and marketing –*** facilitate group formation. Strengthen existing and new farmer groups. Provide credit to farmer groups.
- ***Enlarge production/distribution of QDS product through links with NGOs –*** make NGOs aware of QDS production. NGOs should support farmers and extension workers involved in QDS production
- ***Encourage household approach to QDS production (gender roles/ consideration) –*** raise awareness of gender in QDS production.

Farmer Saved/Traded Seed

During the consultations non-farmer stakeholders identified mainly weaknesses in farmer saved systems. Although these weaknesses were mostly valid, stakeholders appeared to miss major key issues.

- **Source of genetic material –** the diversity available in farmer-saved seed is in itself valuable and there is a need to maintain local germplasm as there are threats associated with natural disasters (e.g., widespread drought), mass importation of foreign maize e.g., as disaster relief and genetic erosion. There are some moves to do this through germplasm collections at the Plant Genetic Resource Centre, Arusha and ARI Uyole but there is a need to document this diversity thoroughly. It should be available for use not just by breeders but can be re-released back to farmers if seed stocks of landraces are lost. Farmers need

researchers' help especially when external disasters (e.g., new diseases) strike. Need to collect, conserve, characterise germplasm and document genetic potential. Germplasm utilisation, breeding & improvement. Make germplasm available.

- **Opportunity for increased maize production through technical training –** there is potential to develop training programmes for farmers and other stakeholders. Curriculum development/revision for e.g. seed selection; diagnosis of plant symptoms such as disease, nutrient deficiency, aspects of seed technology; farmer empowerment through purposeful groups. Training tools and approaches need to be developed.
- **Farmers are capable of producing good seed and storage** - farmer-saved seed builds on indigenous knowledge and focusing on it boosts the image of the farmers. Develop, document, promote, disseminate farmers' knowledge. Study FSS System including utilisation, sources, seed health status, diversity etc. Farmers need training in a wide range of aspects of how to produce better seed. This ranges from training in how to recognise various pests and diseases, how to select the right cob or plant from which to keep the seed and post-harvest storage of seed.
- **Existence of irrigation schemes in the SH** - rehabilitation/improvement of irrigation schemes
- **Existence of large farmers' markets in SH for promotion of seed varieties -** exploit market (*Magulio*) to introduce new varieties, seed fairs.

(vi) Concluding points

Production of maize appears to be increasing in Tanzania but this is apparently due to increasing human population and area of planting, with productivity reportedly declining. Although there are different interests in the components of the maize seed systems, a better/common understanding of their composition and interactions should be of benefit to all stakeholders. It is important to recognise that there is scope to improve certified, QDS and farmer saved/ traded seed. Clarifying roles and responsibilities and allocating resources to improve these systems needs to be done through active participation and improved communication between stakeholders. There is a case that given the dominance of farmer saved seed and the relative lack of research and development related to it, there are potentially high returns to investment in this area. Overall, the SH maize crop is very important regionally, nationally and for the SH, which should provide the political and economic incentive to attract commitment and resources to improve the SH maize seed systems as a whole.

Stakeholders' Workshop – Improving maize seed systems to meet farmers needs in the S. Highlands of Tanzania

Maize is the most important food crop in Tanzania and the Southern Highlands (SH) account for about 40% of maize production. Seed is a key component yet the use of certified maize seed has now fallen to <5% of seed sown. The Iringa workshop was held to explore seed-associated issues with a broad range of participants which included farmers, seed company representatives, stockists, NGO representatives, public sector extensionists, researchers and policy makers. It began with a series of 'position' papers describing different perspectives on maize seed systems. There are three main seed systems in Tanzania (certified seed, quality declared seed and farmer saved seed) and the position papers were followed by group work in which initially the strengths, weaknesses, opportunities and threats to each were explored. Afterwards, the opportunities were stressed and a list of realistic and clarified opportunities was identified for each seed system. Following the workshop a small team from Uyole ARI, NRI, Ilonga and CABI attempted to interpret the collated outcomes from both the presentations and the group work exercises.

i) Points from the workshop presentations especially relevant to project activities

All three seed systems

- Production of maize is increasing in Tanzania but this is due to increasing area as productivity is declining

Certified Seed (CS)

- However examined (% area planted with certified seed planted, % of apparent demand, % previous maximum certified seed use), the amount of certified maize seed currently bought in Tanzania is low and declining
- <5% of maize in Tanzania is planted with certified seed, reasons including high price of certified seed and poor access in rural areas: Government is concerned.
- Following reforms, seed multiplication farms are now operating at <10% of capacity and previous production levels
- A Friis-Hansen (1999 report) showed that, in the SH, <2% of land was planted with CS
- NGOs (e.g., ADB Mbozi) see it as their duty to provide farmers in rural areas with access to seed, including CS
- Stockists seldom have seed as the main content of their stock or business – there is evidence that the prices at which seed companies supply stockists and allow them to sell do not allow stockists much profit from seed, severely constraining their enthusiasm for selling maize seed. Also, stockists usually have to pay cash for their stock
- Stockists act as advisers to farmers for many of their products
- Small packeting can enable farmers to achieve access to, and to try out, new varieties and fertiliser; **selling** small packets can be a very good promotion strategy and enable farmers to learn through experience – although some seed companies seem to see small packets as meaning less profit rather than looking at them as a long-term strategy for increasing sales
- 15 maize seed companies selling only 18 maize varieties (OPVs + hybrids)
- Most certified seed is produced outside of the SH and most hybrid seed outside of Tanzania; Government wants more local production
- Before Independence, research stations focused on cotton, sisal, coffee, tobacco etc, not maize
- Private sector seed companies are nearly all based in Arusha
- Ownership of varieties issues are a constraint to plant breeding in the public sector; Government has recently agreed Plant Breeders Rights legislation which will be enforced from July 2003
- Need to address soil fertility issues at the same time as promoting superior varieties

Quality Declared Seed (QDS) Seed

- QDS maize seed production is way below requirements; system has government support to expand to cover whole country
- QDS can supply only OPVs not hybrids
- Seed quality control – TOSCA (which check seed crops) is very deficient in terms of staff and logistics: in SH, it possesses only 1 motorbike, 1 car and 2 staff
- QDS system may be vulnerable to local oversupply
- Low percentage of women QDS producers, partly due to land ownership issues and need for large isolation distances
- As well as QDS, there ought to be quality **traditional** seed
- Farmers trust QDS because they individually have seen it being produced
- In villages, farmers can barter for QDS seed
- QDS seed is sold at about 500TS/kg while CS seed of the same variety is sold commercially at 1000 – 1200TS/kg

Farmer-saved Seed (FSS)

- About 95% of maize crop in Tanzania is planted with FSS.
- CS sales have declined to 10 – 20% of what it was at its peak in 1970s/80s, with FSS increasing by a corresponding degree to replace it
- Farmers are continuing to grow local varieties and often mentioned eating quality characters as reasons
- Farmers perceive the germination rates of FSS as high (>90%), while germination rates of some certified seed is very low

ii) Synopsis of each seed system group discussion

Certified Seed System

The most realistic opportunities identified from the Certified Seed System SWOT completed by each stakeholder group are listed in the first table above.

In general it was felt that the maize breeding capacity within Tanzania was strong and should be given continued support to ensure that researchers were able to work closely with farmers, extensionists and TOSCA in order to produce maize varieties that were appropriate to the farmers in the different agro-ecological zones. It was felt that there needed to be stronger links between breeders and the foundation seed farms, so that once research materials were validated as appropriate and acceptable by farmers they could then be bulked and distributed efficiently. Irrigated areas in the Southern Highlands offered breeders the opportunity of two growing seasons per year, potentially doubling their productivity and the speed of release of new varieties. It was recognised that extension services and TOSCA were seriously under resourced and that research and private companies could help to improve their skills and capacity. It was felt that opportunities for stronger international and national cooperation existed especially in the effort to obtain disease resistant materials, and to prevent duplication of efforts, and that improved communication between the different players was the only way this could be achieved. Information about recently developed varieties was often not given a high enough profile, and that exhibitions, field days, demonstrations, newspaper articles must be integrated more into the variety development process to ensure that maximum impact is achieved with effort being taken to ensure they reach small-holder farmers in rural areas and not just urban dwellers.

The need to help farmers realise and act on their rights to complain about being sold fake or low quality seed, to raise awareness about them needing to keep packaging and receipts and about where and who they complain to, would help improve the reputation of certified seed quality. The opportunity of selling seed in small quantities (e.g. 250g or 500g) to enable farmers to purchase their seed requirements bit by bit at the rate they acquired funds prior to the planting season was also explored. With this approach, it was noted that by planting time farmers would have collected sizeable quantities of seed in the form of several small packages (smaller packaging was also recognised as providing an opportunity for farmers to try a number of different varieties under their own management systems). Unfortunately, some seed company representatives failed to see the market potential of smaller packages questioning whether anyone who bought seed in such small quantities could be called a farmer. This point highlighted the huge gap in understanding between some private seed company staff and their clients (several million small-holder farmers), and emphasised the lack of marketing expertise among some of the staff of private seed companies, many of whom are ex-civil servants with limited commercial experience. However, the majority of the group felt that smaller packaging of seed for sale would be worth investigating. Considerable success has been recorded in Zimbabwe, for example, where marketing of seed maize in 500g packs enabled SEEDCO, the largest private seed company in Zimbabwe, to sell large quantities of seed maize in rural farming communities. It is important to realize that a considerable proportion of the farmers who initially go for the small seed packs end up purchasing the larger seed packs after several seasons, particularly if they eventually discover that they may realize some profit from cultivating such maize varieties.

It was felt that stockists currently only received a very small proportion of the profit received by the seed companies, and that increasing this margin could act as an important incentive for stockists helping to ensure farmers received more information about different varieties available and perhaps improving access to the different varieties through sale points in villages etc.

- **Quality Declared Seed System**

Discussion of the strengths of QDS seed highlighted what a good choice of seed it is for farmers because it can be produced in the locality and is therefore more likely to be available on time in sufficient quantity. It is relatively cheap compared to certified seed and therefore more affordable for small farmers. Since QDS seed can be recycled upon good selection from

the field for 2 to 3 seasons, this seed system offers a good option for sustainability in the farming systems of the SH. The basic seed for QDS production can be provided by public seed farms (e.g. Dabaga Foundation Farms) and public research institutions (e.g. ARI Uyole) all of which exist within the zone. TOSCA, the official seed certification agency, assisted by trained staff in the District Agricultural Office (village extension officers) are in place to ensure that seed quality is maintained.

However the production of QDS seed demands that those farmers involved have fields which can offer the minimum isolation distance required. This is perceived as a potential weakness since most farmers in all localities grow maize as a staple food crop. This can force QDS farmers to look for seed production fields in the marginal less fertile areas of the village which then negatively affects seed production. The QDS system also demands that funds are available to support farmers to buy basic inputs (fertilizers, pesticides, basic seed) before they start to generate their own funds through seed sales. This dependency on government support through donor support raises questions of sustainability. The marketing channel for the QDS seed is not yet well defined and other farmers can be reluctant to buy the seed preferring to stick to their own local varieties, the limited choice of seed for the system (only OPVs can be produced) also came up as a potential weaknesses. The undeveloped market creates a risk to farmers in terms of unnecessary carry over stocks. Since seed farms cannot retain funds arising from the sale of foundation seeds, and maintenance of basic seed by research for production of QDS foundation seed is expensive, without government financial support the system is likely to be negatively affected.

Looking ahead the production of QDS seed could be increased through linkage with local NGOs (to assist farmers at the grass root level) as well as extending its production into irrigated areas. Currently the QDS seed system works with a few OPVs, however, the research system could widen the choice by providing a wider range of preferred composite varieties. On costs associated with initiation of the QDS production, farmers could start to solicit loans from financing institutions such as CRDB through groups or their primary societies. In the shorter term, ASPS and other projects with similar aspirations could be requested to increase support in terms of inputs and technical assistance to the producer groups as well as extending it to other areas in the SH.

Farmer Saved Seed System

Farmer-saved seed is available and affordable to, and trusted by farmers. Farmers have major problems in accessing certified seed locally. What they can buy often isn't what it is supposed to be with low germination or vigour. It is difficult for farmers to obtain redress

The diversity available in farmer-saved seed is in itself valuable and there is a need to maintain local germplasm as there are threats associated with natural disasters (e.g., widespread drought), mass importation of foreign maize e.g. as disaster relief and genetic erosion. There are some moves to do this through the germplasm collection at Arusha but there is a need to document this diversity thoroughly so it is available for use not just by breeders but can be re-released back to farmers if seed stocks of landraces are lost.

Most of the SWOTs identified by the consultation were weak, presumably because farmers were not involved. Although those drawn out by the consultation were mostly valid, they missed major key issues.

Farmer-saved seed builds on indigenous knowledge and focusing on it boosts the image of the farmers.

SH maize crop is very important regionally, nationally and for the SH. It therefore has political and economic weight to back up its importance. This should be "exploited" as a means of getting resources to address the problem. Farmers need researchers' help especially when external disasters (e.g. new diseases) strike. Farmers need training in a wide range of aspects of how to produce better seed. This ranges from training in how to recognize various pests and diseases, how to select the right cob or plant from which to keep the seed and post-harvest storage of seed.

Cross cutting themes

The only cutting theme identified from the certified seed system opportunities was that of the improvement of the extension services which could have positive affects on all three seed systems.

iii) Interpretation of the outcomes and synthesis of stakeholders' ideas to provide a way forward.

Certified Seed System

- Stakeholders agreed that good high yielding maize varieties with disease tolerance were available in the SH, but that the low altitude areas were less well catered for than higher altitude areas.
- Promotion of these varieties was not very effective, stockists were often not as well versed in the characteristics of the different varieties as they were in the effects of different livestock medicines for example.
- Despite the SH being the main maize production area (>47%) of Tanzania, most of the private seed companies were much more strongly represented in the Northern zone than the SH. National and international collaboration could be strengthened to help speed up access to appropriate materials and reduce duplication of efforts.
- Low germination, high storage pest damage and the need for expert skills in order to obtain high yields were weaknesses identified by farmers, exemplified by the continuous recycling (sometimes for 20+ years) of hybrid seed by farmers.
- The cost of seed together with inputs such as fertilisers is very high for most farmers, and the sale of these goods in large sized packets doesn't help those who obtain money in small chunks and are often unable to save enough to purchase a large 2kg packet of seed before other demands are put on the funds. Purchasing of seed supplies bit by bit in small quantities appears to be a missed marketing opportunity, although small scale packaging may not initially appear profitable it has huge potential as a promotion tool to facilitate farmers familiarity with and use of certified seed.
- Seed distribution is currently very poor, with farmers having to make long and expensive journeys to town centres in order to purchase these and other inputs.
- The presence of fake and low quality seed is destroying the market for all companies, and awareness about this issue needs to be raised, and strong penalties for those convicted of it need to be publicised. All stakeholders need to realise the role they can play in preventing this problem.
- The Plant breeders rights act might serve as a further disincentive for the development of new and appropriate OPVs.
- Less than 2% of the total maize crop in Tanzania is planted with purchased certified improved seed of modern varieties.

Quality Declared Seed System

- QDS seed is cheaper and more locally available than certified seed in villages with QDS trained farmers. However, at the moment the QDS system exists only in relatively few locations and although MAFS hopes to encourage the development of QDS elsewhere, there are both financial and human resource implications particularly regarding the capacity of TOSCA which is already stretched.
- QDS has the potential to be successfully recycled for several years as the seed varieties used are OPV, it therefore potentially undermines the sustainability of the QDS producing farmer unless new varieties regularly come through the system. To date experience in Tanzania reveals that QDS farmers are not varying the seed variety they are producing, highlighting the need for more incentives for those involved in variety development to increase the rate and range of new maize OPVs that are being developed.
- There are issues around the ability of QDS producers, to manage their crop, seed and finances successfully, suggesting a need for increasing the capacity building aspects of the QDS training system. There is still a dependency on external funding.
- Increasing awareness of the QDS system to farmers and other stakeholders needs to be done by the MAFS.

Farmer Saved Seed System

- The farmer-saved seed system is the key system for the SH, and current evidence points to this dominance increasing over the recent past and continuing to do so for the immediate future. Therefore, it must not be overlooked by the project. It has had little research attention and therefore there is a wide range of aspects that need to be addressed both pre- and post-harvest.
- The most important aspect is to provide farmers with the knowledge they require to select and maintain seed better. Farmers are keen to be involved and such training could potentially have a massive effect. Farmers also have knowledge and this should be documented so it can be built upon - despite occasionally being based on false premises. A farmer field school approach was high-lighted as a probable way forward.
- Local landrace seed represents a valuable germplasm collection. It is an important asset for Tanzanian breeders, from which they can develop better varieties for farmers. However, the germplasm should also be documented and arranged such that farmers themselves can also access their varieties directly.

There was also considerable discussion about other issues such as rehabilitating irrigation schemes and improving roads. However, it was eventually decided that such targets were completely unrealistic and should be excluded

The way forward

This workshop brought together a wide range of stakeholders with an interest in improving maize seed systems in the Southern Highlands. Participants signed up to roles and responsibilities to improve one or more of the seed systems of their choice. It was anticipated that the activities, roles and responsibilities identified by participants will take place at various levels (e.g village, district national), some within the influence of this project and others driven by wider interests. In the next section, activities which followed the Iringa workshop are presented.

Implementation of recommendations from the Iringa stakeholder workshop

This section presents some of the outcomes which followed the Iringa workshop. The opportunities that were identified in the workshop are used to guide this section. However, attribution to this workshop and the project is not always entirely clear. These are, therefore, a mixture of activities and achievements some derived from this project's funds, others at least partially originating from the Iringa workshop and yet others apparently not connected.

Certified Seed

A viable link with the private sector has been established following the effort of the project to promote public-private partnerships in quality seed production and supply for the benefit of farmers in the Southern Highlands of the country and beyond. Two private sector seed companies (Mbegu Technologies Inc. and Highland Seed Growers Ltd) have shown a keen interest in undertaking this endeavour and have gone even further by signing a memorandum of understanding with the Tanzanian Ministry of Agriculture and Food Security to jointly participate in research and development for mutual benefit between the two parties. The project has also linked with the Kenya-based FIPS project (R8219) so as to share experiences in the supply of agricultural inputs (seed and fertilizer) through mini-packs to resource-poor farmers. To begin, two hundred gram mini packs of improved seed (UH615, UH6303, Kilima and Staha) were distributed this season in the project villages and beyond (30-40 mini packs/village).

Table 27. Certified seed system

REFINED OPPORTUNITIES	WHAT COULD BE DONE	WHAT HAS HAPPENED
1) Use of existing capacity to conduct research	Continue research (on farm to station) in order to produce varieties appropriate to farmers in different AEZ	See Output 1 of project

	Released varieties to stockists then farmers or direct to farmers Varieties from research should be forwarded to foundation farms for bulking Seed multiplication by stakeholders & distribution	
2) More national & international cooperation	Enhance communication between both national & international bodies/ networking for sharing of experience & introduction of new materials	Private public partnership between ARI Uyole (DRD), Highland Seed (Tanzania) and Fica Seed (Uganda) who want to release UH615 and UH6303 in Uganda
3) Local entrepreneurs to take advantage of new varieties from research	Exhibition, field days, demonstrations, posters, newspapers, articles, advertisement, TV and mass media.	Promotion has mainly been through demonstrations. In Phase 2 and under the CPHP project posters, leaflets and radio programmes are planned.
4) Private sector to take advantage of market linberalization	To produce and distribute quality seeds	Stakeholder consultation survey. Public –private partnership has support from Director Highland Seed and Tanseed Internatioanl (both based in the SH) have now acquired rights to ARI Uyole seed and are bulking up.
5) Increase farmer awareness to help reduce sales/use of fake seed	Farmer training Seed quality aspects and rights Identification of fake seeds	Only limited developments under the project. Under output 2 primariliy with farmer groups working with the the project: Informing farmers of seed policy. Linking farmers and stockists
6) Maize seed production under irrigated systems to speed up production	Assessment of the schemes for maize seed production	UH6303 foundation seed being produced under irrigation in 2005
7) Packaging of seed for sale in smaller quantities	Make a study/research on quantities affordable by farmers (market) Promotion of packed seeds	Initial follow-up with some companies has been made WHO? Further follow-up with companies, stockists etc needed as soon as possible and prior to planting season. Sample packs (250 g) of UH615 to be promoted with other promotion materials (ZRELO) Monitoring of sample packs etc (ZRELO) Sample packs (250 g) of Staha to be followed up with Suba by Mbarali extension Good links have been established with the not for profit company FIPS which is now operating in northern Tanzania. This initiative is supported by DFID Tanzania Under the linked CPHP project a study is to be made of small packs being sold formally or informally by stockists in the 4 main districts in which the project is operating.
8) Offer stockists a higher commission or margin for selling their products in order to motivate stockists to sell seed.		
9) Invest more in promotion (demonstrations posters) that will actually reach small settlements		District promotional strategies have been developed. Promotion activities to be expaeded in 2005, including demonstrations in Ileje and Rungwa districts. In Phase 2 and under the CPHP project posters, leaflets and radio programmes are planned

Quality Declared Seed

District and village extension staff from four Districts were trained in the principles and practice of Open Pollinated Seed production. Farmers in Mbarali district received training (including a field visit to Njombe district) in QDS production.

Table 28. QDS seed system

REFINED OPPORTUNITIES	WHAT TO BE DONE	What has happened

1.Existing capacity to conduct research Widen choice of seed varieties (incl. resistant varieties) available to farmers Include preferred local varieties in QDS system Closer linkage with ARI-Uyole researchers to provide more vitality through two way learning process	Collect, characterise and improve traditional varieties. Identify farmer preferences in their varieties and improved varieties and what characteristics that need to be improved Demonstrate/ trial on farms	No new OPV varieties have become available.
2. Strengthen marketing to ensure sustainability	Link farmers to markets, establish information service centre	The IFAD Agri. Marketing systems Programme is active in parts of the SH CPHP project plans exchange visits for farmers groups working with this project to groups working with the AMSP. Radio programmes of marketing success stories to be made
3. Improve communication infrastructure	Improvement and construction of roads and bridge	Private companies are expanding mobile phone networks. Mobile phone ownership growing in rural areas.
4. Need to work as a team with extension staff to know what farmers need.		Project has strengthened partnership between ARI Uyole and 4 participating districts.
5. More collaboration between the North and Southern Regions (Regional level)		
6. More inspectors will be trained at district level	Train more seed inspectors at district level	
7. Collection of germplasm e.g. Uyole and Gene-Bank Arusha	Collect and evaluate germplasm Development of suitable materials for use by farmers	
8. Expands QDS production to irrigated areas	Sensitise farmers for QDS production in irrigated areas Improve irrigation infrastructure in irrigated areas (Traditional + Non-traditional)	Training of farmers and extension staff from Mbarali district in seed production and exchange visit to Mjombe where QDS is already operating.
9. Capable farmers to work in groups for production and marketing	Mobilise/sensitise group formation Strengthen existing + new farmer groups Provide credit to farmer groups	16 farmer groups have been established using expertise from the NGO INADES Formation.
10. Enlarge production /distribution of QDS product through links with NGO's.	Sensitise NGOs on QDS production NGOs to support extn. workers & farmers involved in QDS production	Potetially through partnership developing with Ileje Development Trust Fund in Ileje district.
11. Encourage household approach for QDS production (gender roles/ consideration)	Awareness/ sensitisation of gender in QDS production	

Farmer Saved seed

The Iringa stakeholder workshop helped to raise the profile of farmer saved seed in the SH with a range of stakeholders, including policy makers. Results from two seasons of demonstration indicate that some farmer saved seed can perform well. For example, in Majenje village in Mbarali district, farmer saved Staha seed out yielded certified Staha seed. The project is finalising production of a training booklet on how to produce OPV seed which provides advice on how to select seed which is applicable to farmers selecting seed from their own crop, as well as QDS producers.

Table 29. Farmer saved seed system

REFINED OPPORTUNITIES	WHAT COULD BE DONE	WHAT HAS HAPPENED
1)Source of genetic material Farmers, QDS farms Gene banks & Breeders	1a) Collect, conserve and characterise germplasm, document genetic potential 1b) Germplasm utilisation, breeding & improvement	Initial collection exists at Uyole. Uyole seeking funds to continue Characterizing and documenting for wider utilization

	1c) Make germplasm available	
2)Opportunity for increased maize production through technical training	2) **Technical training programmes for farmers and extension officers** Curriculum development/ revision for • Seed production • Aspect of seed technology • Soil conservation • Farmer empowerment through purposeful groups • Training manuals	Training materials have been prepared and various training activities carried out Refer to output 2 of project. Booklet on farmer seed management (first draft)
3) Farmers are capable of producing good seed and storage	3a) Develop, document, promote, disseminate farmers knowledge 3b) Study FSS System •Utilisation, sources •Seed health status •Diversity etc.	Situation analysis MSc thesis (N.Peter) Links have been established e.g. through workshop participation with FAO LINKS project –Mrs M. Mkuchu. ToTs workshop (Kibaha). Planned Tof Ts. booklet on farmer seed management
4) Existence of large farmers' markets in SH for promotion of seed varieties	5) Exploit market (Magulio) •to introduce new varieties •seed fairs	CPHP project planning to monitor seed fair in Ileje in May 2005

CONTRIBUTION OF OUTPUTS TO DEVELOPMENTAL IMPACT

Contibution towards DFID's and the GOT's developmental goals

DFID is generally working towards the millennium development goals, including halving the proportion of people in extreme poverty and suffering hunger between 1990 and 2015. In many sub-Saharan African (SSA) countries poverty is growing, agricultural production and food security are worsening. Labour productivity is declining, with HIV/ AIDS a major contributory factor. There is a widespread consensus that high rates of economic growth are a prerequisite for poverty reduction. Agriculture is a key sector in most SSA countries and therefore increasing agricultural productivity is regaining prominence as a strategy for stimulating growth and hence poverty reduction. Appropriate agricultural development can be a key element of pro-poor growth. Food crop production/ capita is generally declining, although specific reasons varying with location. The underlying forces include population change (generally increasing, but influence of HIV/AIDS), policies and markets (generally a trend towards liberalization), institutions & organizations and social context. URT's Poverty Reduction strategy Paper (PRSP) considers agriculture to be critical to Tanzania's economic and social and development goals. The national Agricultural Sector Development Programme - which arose in response to the PRSP – that has the overall aim of creating an enabling environment for improving agricultural productivity and profitability, improving farm incomes, reducing rural poverty and ensuring household food security. The ASDP has identified strengthening of the institutional framework, public and private sector roles in improving support services and strengthening marketing efficiency for inputs and outputs as three of the five key strategic issues that need to be addressed. The project's outputs are consistent with the above as further explained below.

The project outputs have targeted the most important cereal crop and the zone with the highest potential for maize production in Tanzania, with a view to safeguarding not only the food security of farmers in the SH, but that of the entire nation as a whole. It is from this zone that Tanzania derives up to 50% of its total national maize production.

Promotion through demonstrations in rural communities (including areas which have very limited access to new maize production technology in any form for the last 20 years), has created awareness about the existence of high yielding, disease resistant varieties capable of contributing towards improvement of farmers' livelihoods, most of whom depend on maize as a source of food and cash income.

As part of the promotion activities, over two full seasons a range of maize cultivars were evaluated in 16 villages on 80 farmers' fields and Uyole-bred maize hybrids showed high levels of tolerance to Grey Leaf Spot (GLS) as well as a high grain yield potential. These materials were also generally ranked relatively highly by farmers, under high input regimes, in Mbozi, Njombe and Iringa districts. This has resulted in the release of a further maize hybrid UH6303. In lower-lying Mbarali district, however, open pollinated varieties showed better adaptability. In addition, none of the varieties evaluated in Mbarali appeared to possess the level of resistance required to withstand the MSV pressure experienced in some parts of the district.
In the course of demonstration and promotion of new disease resistant maize cultivars, an MSV "hotspot" was identified at one of the target villages in Mbarali district and this has significantly facilitated the assessment of our cultivars for resistance to this disease. As a result, we have been able to identify new cultivars which are highly resistant to MSV, one of which it is anticipated will be presented for release as a new GLS/MSV resistant hybrid over the next 12 months.

Training needs have been identified with farmers and other stakeholders across the four districts. Farmers expressed demand for information/ training at all stages of the crop cycle. With regard to seed management, demand related to modern (e.g., information on new varieties) and local varieties (e.g. understanding differences between hybrids, OPVs and landraces; how to improve farmers' own seed). Insect and disease management training

needs included diagnosis and management information using both industrial pesticides and botanicals. Soil management featured highly and there was a high demand for information on both inorganic and organic methods of enhancing fertility. Training tools have been developed to address diagnosis of soil deficiency and disease symptoms, MSV information, soil fertility management and seed management.

The Iringa stakeholder workshop (held in July 2003) identified opportunities to improve certified, Quality Declared Seed (QDS) and farmer-saved seed systems
Certified seed system - the project has facilitated the establishment of a public/private partnership between the Tanzanian Ministry of Agriculture and private sector seed companies in order to initiate a seed production and delivery system for the benefit of farmers in the Southern Highlands. This step will ensure a sustainable access by farmers to the new disease resistant maize cultivars already validated by them. To signal the establishment of this partnership, a Memorandum of Understanding was signed between the Ministry of Agriculture and two private sector seed companies in April 2004, in an effort to build up a mutually beneficial partnership, while serving the farmers' needs for quality seed. It is worth noting that the country has been without an organized system for local certified seed production and distribution since the year 2000, when the national seed company, TANSEED, collapsed due to mismanagement. This situation had severely limited access to locally bred certified seed by farmers, particularly in rural areas. The two private seed companies (i.e. Mbegu Technologies Inc. and Highland Seed Growers Limited) have already embarked on certified seed production during the 2004/05 season, starting off with UH615, one of the hybrids which was validated by farmers during the promotional exercise. In order to ensure accessibility of seed among poor farming communities, both private seed companies have also agreed to start distributing seed in small packs (500gm to 1 kg bags) starting with the newly released (and already farmer-validated) hybrid, UH6303. Commitment of these two seed companies in sustainable quality seed production and distribution is further evidenced by their decision to absorb costs involved in further screening of maize germplasm for disease tolerance at ARI-Uyole, as from the 2004/05 season, in order to speed up the attainment of more and better maize cultivars for farmers in both the Southern Highlands and other parts of the country.
QDS seed system - District and village extension staff from four Districts were trained in the principles and practice of Open Pollinated Seed production. Farmers in Mbarali district received training (including a field visit to Njombe district) in QDS production.
Farmer saved and locally traded seed system - the Iringa stakeholder workshop helped to raise the profile of farmer saved seed in the SH with a range of stakeholders, including policy makers. Results from two seasons of demonstration indicate that some farmer saved seed can perform well. For example, in Majenje village in Mbarali district, farmer saved Staha seed out yielded certified Staha seed. The project is finalising production of a training booklet on how to produce OPV seed which provides advice on how to select seed which is applicable to farmers selecting seed from their own crop, as well as QDS producers.

Promotion pathways to target institutions and beneficiaries.

The project has identified the following institutions which are expected to play key roles in the uptake and promotion of the realised outputs.

1. The District Councils through their Agricultural Extension Departments in Mbozi, Mbarali, Njombe and Iringa will participate in the uptake and promotion of the outputs. Farmer Field Schools which are now being piloted in the districts will serve as one of the strategies for this promotion. The district level extension workers and the division/village-based extension officers will be key players in the dissemination of the outputs through farmer training forums, on-farm/demonstration activities including the various training and learning tools developed by this project. These have been planned through district promotion strategies which are to be initiated under phase 2 of the project.

2. Non-governmental organizations operating in the SH. Specifically targeted are:

- INADES – Formation Tanzania (Institut Africain pour le Development Economique et Social). Their philosophy is centred on empowering rural communities to bring about self advancement,

using a gender sensitive Action-Research-Training approach. Currently, this NGO is supporting over 80 farmer groups in Mbeya, with the main aim of improving their livelihoods through increased food production and profitable marketing of surplus farm produce.

- The ADP-Mbozi Trust Fund, an agricultural NGO operating in Mbozi District since 1986. Its mission is to support the efforts of resource-constrained rural communities in the district by improving agriculture, rural infrastructure, education as well as primary health care. With regard to agriculture, one of the strategies is to improve food and cash crop production, thereby increasing nutritional levels and household income in rural communities.
- The Isangati Development Programme. With a mission similar to ADP-Mbozi, this NGO is working in Mbeya Rural District.
- The Ileje Rural Development Trust Fund, working with poor rural communities in Ileje district. One of its strategies is to increase food self sufficiency at household level.
- CARITAS: This is a Catholic NGO with extensive experience in working with rural communities in an effort to improve livelihoods among poor people.
- VECO (Vredeseilanden Office). This NGO seeks to empower resource-poor communities to manage their own food security situations by promoting sustainable agriculture and economic processes. Currently, it is working in 5 districts within Mbeya region.

3. The Agricultural Sector Programme Support Programme (ASPS) – Seed Unit under the Ministry of Agriculture and Food Security. The ASPS-DANIDA-funded on-farm seed production activities are due to be expanded in order to cover Mbeya and Ruvuma regions as from the 2004/2005 season. Farmers who have received training on Quality Declared Seed Production and management under the current project will be absorbed into the ASPS on-farm seed production project so that they may participate in village-based seed production activities, consequently improving seed availability, particularly for open pollinated maize varieties in those rural areas of the SH which are poorly served by the commercial seed sector.

4. Private Seed Companies. These seed companies will produce and distribute new maize cultivars validated by farmers under this project. Already, two local seed companies, (i.e. Mbegu Technologies Inc. and Highland Seed Growers Limited) have shown a keen interest in producing and distributing improved seed maize cultivars to rural farming communities in the Southern Highlands of Tanzania.

5. Training Institutes under the Ministry of Agriculture and Food Security. These are the institutes which train and upgrade extension service personnel across the country. There is a big demand for new and updated information regarding new maize cultivars as well as improved husbandry practices from Agricultural Training Institutes. They will therefore benefit from the training tools generated under R8220.

Disseminations

International refereed journals

R.W. Gibson, N. G. Lyimo, A.E.M. Temu, T.E. Stathers, W.W. Page, L.T.H. Nsemwa, G. Acola, R.I. Lamboll. 2005. Maize seed selection by East African smallholder farmers and resistance to *Maize streak virus*. Annals of Applied Biology (accepted)

Internal Reports:

1. Situation analysis of maize growers in the Southern Highlands of Tanzania with particular emphasis on access to and management of seed.
2. Improving Maize Seed Systems to meet Farmers' Needs in the Southern Highlands of Tanzania: Report of a Stakeholders Workshop on 29th – 31st July, 2003 in Iringa, Tanzania.
3. Improving Farmers' Access to and Management of Maize Seed in the Southern Highlands of Tanzania (2003) Consultation with Stakeholders.

4. Improving Farmers' Access to and Management of Maize Seed in the Southern Highlands of Tanzania (2003) Identification of groups and individual farmers and their training needs for improved management of good quality seed.
5. Improving Farmers' Access to and Management of Maize Seed in the Southern Highlands of Tanzania (2003) Follow up report on status of farmer groups.
6. Village-based demonstrations: Annual Maize Variety Evaluation Report for the 2002/2003 season.
7. Village-based demonstrations: Annual Maize Variety Evaluation Report for the 2003/2004 season.
8. ARI Uyole (2003) Open pollinated maize varieties; hints on seed management and variety maintenance for small farmers. Notes presented at the Training Seminar on Seed Management VETA Centre, Mbeya 10th – 12th July 2003.
9. Improving Farmers' Access to and Management of Maize Cultivars in the Southern Highlands of Tanzania (2004) Training Seminar Report on Organization and Management for Farmer Group Strengthening.
10. Peter, N.E. (2005) Assessment of farmers' access to quality maize seed in improving rural livelihoods: A case study of the Southern Highlands of Tanzania. MSc. Thesis submitted in partial fulfilment of the requirements for a Master of Science degree in Agricultural Economics at Sokoine University of Agriculture, Morogoro, Tanzania.

Farmer leaflets

1. Agronomic recommendations for maize production.
2. Maize Streak Virus Disease Information Sheet.
3. Fertilizer use Practices for Maize Production.
4. Be your own maize doctor: A guide towards identification of nutrient deficiency and foliar disease symptoms in maize production.

FOLLOW-UP INDICATED/PLANNED:

There is a need to achieve wider promotion of the outputs realised by the project in other parts of the SH, with particular attention to areas where GLS and/or MSV continue to hinder farmers' effort in attaining increased productivity from their maize-based farming systems. Training tools need to be utilized more intensively and made accessible through a wider range of partners both in the SH (zonal and district strategies have been developed with project partners) and eventually elsewhere across Tanzania. These will be achieved initially through a number of activities including project R8406, which is a 10-month extension to the current project and project R8422 which is a sister project also led by ARI Uyole and funded by the DFID Crop Post harvest Programme . Increased links with the private sector, government extension and NGOs working with farmers will be employed in an effort to achieve wider promotion of the realised outputs. This initiative will facilitate lesson learning, while the opportunity to engage with local and national policy makers may provide further opportunities for improving farmers' and other stakeholders' access to quality products, information and training.

Biometricians Signature

I confirm that the biometric issues have been adequately addressed in the Final Technical Report.

Signature: 

Name (typed):
Barnabas Anthony
Kiula.

Position: Senior
Agricultural Research
Officer.

Date: 08.05.2005