Grain Storage Stakeholder Workshop

Report of a Workshop organised by the Plant Protection Services (IPM Project), Western/Lake Zone, the Natural Resources Institute (UK) and the University of Zimbabwe, on the 8th November 2002, at the IPM Project Compound, Shinyanga, Tanzania

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Cover photograph: *Sampling maize in Mwamakaranga village, Shinyanga Rural District.*

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Acronyms and Abbreviations

AIC	Africa Inland Church
AKIS	Agricultural Knowledge and Information System
ASD	Actellic Super Dust
CARITAS	Catholic Development Organisation
CBO	Community-based organisation
CDAP	Catholic Diocese of Shinyanga Agricultural Programme
CDTF	Community Development Trust Fund
CPHP	Crop Post-Harvest Programme
CRS	Catholic Relief Services
DALDO	District Agriculture and Livestock Development Officer
DAO	District Agricultural Officer
DAS	District Administrative Secretary
DC	District Commissioner
DED	District Executive Director
DEO	District Extension Officer
DEs	Diatomaceous earths
DFID	Department for International Development (UK)
Dryacide®	Commercially produced diatomaceous earth
godown	Village or communal warehouse
HASHI	Hifadhi Ardhi Shinyanga
HH	Household
IPM	Integrated Pest Management
KIHACHA	Kikundi cha wakiki na chakula
kihenge	Locally made storage basket
LGB	Large grain borer
MAFS	Ministry of Agriculture and Food Security
MAO	Municipal Agricultural Officer
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania
MVIWASHI	Mtandao wa Vikundi vya Wakulima Shinyanga
NGO	Non governmental organisation
NRI	Natural Resources Institute
Output/s	That which the project is contracted to produce
PHMS	Post-Harvest Management Services
PHS	Plant Health Services
PIDP	Participatory Irrigation Development Project
Protect-It®	Commercially produced diatomaceous earth
RAA	Regional Agricultural Adviser
RAS	Regional Administrative Secretary
SGR	Strategic Grain Reserve
SHIRECU	Shinyanga Regional Cooperative Union
TAHEA	Tanzanian Home Economics Association
TAWLAE	Tanzania Association of Women Leaders in Agriculture and Environment
TFNC	Tanzanian Food and Nutrition Centre
TPRI	Tropical Pesticides Institute
UDSM	University of Dar es Salaam
UZ	University of Zimbabwe
vihenge	Locally made storage baskets - plural of ‘kihenge’
WEGCC	Women’s Economic Group Cordinating Council
WVT	World Vision Tanzania
YADEC	Youth Advisory and Development Council

I. Introduction: rationale and workshop design

The '**Small-scale farmer utilisation of diatomaceous earths during storage**' project, which builds on work already undertaken in Zimbabwe, is being carried out at locations in three regions of Tanzania, namely Dodoma, Shinyanga and Manyara (formerly under Arusha). The **purpose** of the project is to contribute to the development of strategies that will improve the food security of poor households. To do this the project is developing storage technologies using diatomaceous earths (DEs), which it is anticipated will increase the availability and quality of foods used by small-scale farmers.

The project is being funded by the Crop Post-Harvest Programme (CPHP) of the UK Department for International Development (DFID). As originally conceived the project was designed to be undertaken during the three year period, April 2002 to March 2005. The contract was only however issued in June 2002 and for an initial period of one year, with future activities to be determined by an internal programme review scheduled after this period. During the three year timeframe, the project team anticipate delivering the following six **outputs**:

1. Optimal methods for the protection of grain against damage by LGB and other storage insects, using commercially available diatomaceous earths (DEs), based on on-farm field trials over two seasons in 3 regions.

2. Tanzanian and Zimbabwean deposits of DEs evaluated against storage insect pests and assessed for their potential use as grain protectants.

3. Evaluation of user/farmer acceptability of DE treated stored grain, in terms of efficacy, cost, application method, taste, cooking and brewing characteristics.

4. Extension materials describing DEs and their role, and recommendations for use as a grain storage option by small-scale farmers, developed for the different information systems used by different groups of producers.

5. New knowledge about DE storage technologies disseminated and promoted through multiple channels to inform relevant stakeholders at national and regional (i.e. SADC) levels.

6. Project procedures evaluated throughout the project cycle, using participatory processes to capture different stakeholders' perspectives.

The core project team comprises staff from Plant Health Services with support from Post Harvest Management Services, in the Crop Development and Food Security Divisions of the Ministry of Agriculture and Food Security (MAFS) respectively, together with colleagues from the University of Zimbabwe (UZ) and the Natural Resources Institute (NRI), UK. The project has also sought - and continues to seek - the active collaboration of organisations with an interest in storage and/or food security issues, operating in the respective trial site districts, and is of course reliant on farmers in the different locations playing an increasingly central role.

Following programme related delays, the work commenced in July 2002 at the beginning of the storage season. Project team members, including the NRI project leader, headquarters, zonal and/or district staff from MAFS, met with district-level stakeholders and with members of the village communities at five locations, to introduce the project and set up the initial storage trials, which in the first year are being undertaken by researchers.

The first season's trials are designed to test and compare the effectiveness of a number of different treatments, including diatomaceous earths, in protecting different grains against insect damage (particularly that caused by the larger grain borer *Prostephanus truncatus*, which isn't present in Zimbabwe) during storage (see Appendix I). The research procedure requires that the stored grains are sampled, and the amount and cause of damage are analysed, at 8-weekly intervals.

A visit to project locations and sites[1] by core team members - Tanya Stathers (project leader and post-harvest entomologist, NRI), William Riwa (Tanzanian project coordinator, MAFS), Brighton Mvumi (post-harvest entomologist, UZ), and Mike Morris (a social and institutional development specialist, NRI) - was planned to coincide with the third grain sampling[2]. However, while their visit to Shinyanga necessarily involved working with local team members in the sampling and analysis, it was also intended as an opportunity for other aspects of the project to be developed. At the first meeting on the

[1] The term 'location' is used here to refer to destinations within the operational areas (e.g. districts) of project stakeholders, whereas the term 'site' refers to the specific villages where the project trials are being carried out.
[2] Mr Riwa's busy schedule and wider responsibilities meant that the initial plans, which included all core team members visiting Babati, Shinyanga and Kongwa districts, had to be changed. While he visited Kongwa with Tanya Stathers and Rachel Mosha earlier in October, he was unable to accompany other team members, when they visited Babati and Shinyanga in late October, early November, 2002.

Monday of the week-long visit (Sunday 3rd to Saturday 9th November), the idea of a grain storage stakeholder workshop was proposed and developed.

This report is a record of the half-day, grain storage stakeholder workshop, organised by staff of the Plant Health Services / IPM Project, Shinyanga, from the Natural Resources Institute (UK) and the University of Zimbabwe, on Friday 8th November 2002, at the IPM Project Compound, Shinyanga, Tanzania.

Workshop design

Design Team Meeting

Project outputs, as already indicated, include the dissemination and promotion of new knowledge relating to the use of DEs, and more specifically, the development of extension materials tailored to the information systems used by farmers as potential end-users of the DE technologies, and by those intermediary organisations who provide for farmers' needs in this area (e.g. government, NGOs or Church extension agencies, private sector suppliers). To deliver such outputs the project must develop a framework to better contextualise intermediary stakeholders in the post-harvest/storage arena - a stakeholder analysis - and develop understanding of the post-harvest/storage information systems used by these intermediaries and by different groups of farmers. This challenge, which formed part of the terms of reference for the team's social scientist, Mike Morris, was a prime motivation for the workshop.

Participants in the initial meeting at which the workshop was proposed and developed - the design team - included:

Mr Martin Katua, IPM Zonal Coordinator
Mr Lazaro Kitandu, IPM Technology Development & Liaison Officer
Mr Henry Kolowa, IPM Monitoring and Evaluation Officer
Mr Pius Karega, District Plant Protection Officer
Ms Tanya Stathers, NRI (Project Leader)
Dr Brighton Mvumi, UZ
Mr Mike Morris, NRI

Initial discussion between team members involved a general sharing and revisiting of information relevant to the project and Shinyanga[3] and feedback on the visitors' experiences of the project in Arusha and Babati. The possibility of arranging a workshop for Shinyanga-based organisations with interests in grain storage issues pertaining to small-scale farmers, within the visitors' timeframe and trial samplings and sample analysis, was then discussed[4]. Once it was agreed that a workshop might realistically be held within the week, the discussion went on to clarify the objectives. Various issues and considerations were whittled down to two overarching **workshop objectives**:

- To update and share information on the '**Small-scale Farmer utilisation of Diatomaceous Earths during storage**' project (amongst post-harvest/storage stakeholders).
- To share and utilise participants' knowledge, skills and experience for the development of future project activities.

Additional preparatory work included identifying potential participants, including both those who had been involved in the project design workshop in August 2001 and others, firming up potential workshop outputs, devising a programme (including group exercises) to optimise realisation of the objectives and outputs, planning the reporting of all activities, preparing a press release (based on the attached project flyer, see Appendix I), and generally arranging the implementation of the plan within an agreed budget.

[3] These included: prevalence of complaints amongst farmers about fake Actellic Super dust (ASD); introduction of new ASD packaging and batch numbers; RAS appointed retail outlets; enforcement of plant protection Act; engaging with the private sector; contact with the Lake Zone Communications Officer in Mwanza and role of local, zonal and national radio; organic cotton farming project in Meatu District; farmers' field days at 4 IPM villages; continued enforcement of colonial ban on intercropping cotton (with sunflower, maize which has been found to be an effective IPM practice); role of MPs in promoting registration of DEs, etc.

[4] The visit priority was to ensure that the science was rigorous, so that data generated would be of sufficient quality to determine whether DEs could be effective in different regions in Tanzania, and additionally to expedite the registration process (i.e. minimise any grounds for objections, facilitate the earliest interest of the private sector). The priority of local team members during the period of the visit was also to advance the field trials (i.e. Output 1), and specifically to undertake the sampling and sample analysis planned for the period. It was inevitable that quality time to work with the team and other project stakeholders on wider project issues was (as known beforehand) in limited supply.

It was relatively easy to identify themes in line with the first workshop objective, i.e. that could be usefully presented to update and share information with organisational stakeholders in Shinyanga. These included progress reports on the work in Zimbabwe, from the other locations in Tanzania, and from the trial sites in Shinyanga, which few if any of the participants (outside of the IPM staff) would have visited. These individual presentations could be contextualised using an initial project background report.

The design team identified and discussed a number of additional issues and challenges that related to future project activities as identified in the project memorandum. The nature of the second workshop objective suggested that a more participatory approach would be required to benefit from the participants' experiences. The following ideas were discussed with a view to identifying potential **workshop outputs**:

Stakeholder identification and analysis: to more systematically advance the identification of project (or storage/post-harvest) stakeholders, and develop a framework for their analysis. This would contribute to a more inclusive and pluralistic (e.g. state & civil society, NGOs and private sector, influential and powerless) project approach, which in turn should improve operational processes and realisation of project outputs.

The terms *stakeholders* and *stakeholder analysis*, liberally used in the development literature (including project and CPHP documents), are not always defined or explained. *Stakeholders* in a given initiative include all those who affect and/or are affected by the associated processes. In this case key stakeholders include those actively engaged in the research (i.e. project partners); differentiated individuals and/or households who stand to benefit directly from the research findings (i.e. end-users); and state and civil society agencies who might make use of the research findings, either directly as information to be extended to end-users, or as a basis for developing additional products or processes (e.g. policies) to benefit end-users (i.e. intermediate users). *Stakeholder analysis* recognises that stakeholders may have different interests, and provides a means to identify and resolve trade-offs and conflicts of interest. In Arusha for example, the project team had been intrigued by the views expressed by staff at the Tropical Pesticides Research Institute (TPRI), the regulatory authority, which highlighted various complexities and competing interests that might be expected before local DE deposits could be exploited and registered. The registration process, it seemed, could well throw up stakeholders whose interests in DEs might be in conflict with the aims, or the timetable, of the project.

Local **information networks**: to develop a better understanding of the communication context as experienced by local organisations with an interest in storage issues. It was anticipated that the workshop participants on this occasion would be organisational or service sector stakeholders rather than the primary stakeholders or intended end-users of the research findings, farmers. Who or what were their major sources of information, and their major outlets? What types of information did they share? What factors favourably influenced or impeded the flow of information? Answers to these questions would have bearing on the development of extension materials to be used with extension staff (Output 4) and to the wider promotion of new knowledge relating to DEs (Output 5).

Social differentiation issues: to learn from local organisation working with communities on post-harvest issues, if, how and why they differentiated rural households. An understanding of the diversity of farmers and households is needed to inform the selection of participants for the farmer validation trials in the second year (Output 3), to signal potential differences between farmer types as to how and where they obtain information, both ultimately to optimise the dissemination of the technology amongst farmers most suited to benefit.

Earlier work by the IPM programme, for example had used participatory wealth ranking to explore household differences in villages in Shinyanga, Kahama and Bariadi districts[5]. It also revealed the village IPM groups comprised in the main, farmers from middle wealth groups, with little or no representation from the small number of wealthiest households, and excluding many or all of the poorest households. IPM groups comprised: no members from the 15% of households deemed to constitute the poorest group of 5 in the Shinyanga village; 33% of the 51% of HHs in the poorest of 4 groups in Kahama; and, 55% of the 81% of HHs in the poorest of 3 groups in the Bariadi village. The current thinking of IPM Project / Plant Health Services staff is not to take account of differentiation within rural communities, but rather to view the community as if it were homogeneous or to leave it to influential players within the community to determine the fit (access and availability) between products and/or services and different households.

[5] Humann-Bellin, J and C Mmbaga (1995), Economic assessment of crops, cropping patterns and farming households in Shinyanga Region with special emphasis on the monitoring of the economical impact of IPM concepts: A field study using participatory rapid appraisal methods for IPM Project, Shinyanga. July 1995, 49 pp.

Participatory evaluation: how currently do organisational stakeholders monitor and evaluate their own activities with farmers? Are there lessons to be learnt from their experience which could guide the project in establishing participatory evaluation of its own processes (Output 6).

It was agreed that Mike Morris would further reflect on the above issues, creating a short list of ideas that would dove-tail with a presentation by him on the post-harvest communication context. Group work activities throwing light on the short-listed issues were to be devised to fit into the 70 minutes provisionally allocated on the timetable. Three pieces of group work were subsequently identified with specified **outputs** to be realised by the participants:

- A list of ways in which the participants and/or their organisations perceive or treat farming households (HHs) as differentiated entities (e.g. female-headed HHs, cash vs food crop households, progressive vs traditional);
- A scoping exercise to identify the different grain storage stakeholders, indicating their relative relationship to the farming households.
- An exploration of the information linkages between the participants, based on the direction of information flows, their frequency and quality.

These ideas were further shared and elaborated with individual members of the design team.

Delegated activities

Development and implementation of the workshop plan were smoothly assumed by the IPM/PHS staff, with additional support from the visitors.

Further development of the agenda and distribution of the invitation letter, together with the programme and project flyer (see Appendix I), were managed by the IPM zonal coordinator, Mr Katua and support staff (Happy, Flora and Ramadhani). Organisations to be invited and the potential representatives are reproduced below.

Responsibilities for the catering arrangements were assumed by Mr Mkumbwa.

Additional resources were secured and budgetary aspects addressed by the Project Leader, Tanya Stathers.

Table 1. Proposed invite list

Organisations and representatives	Organisation and representatives
1. Municipal Plant Protection Office, Municipal Council - Mrs Levira. 2. District Plant Protection Officer, Kilimo - Mr Pius Karega. 3. Regional Administration - Mrs Mashaka, Regional Agricultural Advisor. 4. Zonal Information Office - Mr Rweikiza 5. World Vision - Mr Kuhanda. 6. Oxfam - Mr Wawa, Manager. 7. District Extension Office, Shinyanga Rural District Council - Mr Lugendo. 8. District Extension Office, Shinyanga Municipal District Council - Mr Chuwa.	9. Private Stockists - Mr Mfanga & Mr Dickson. 10. Community Development Trust Fund (CDTF) - Mr Omari Ngalawa. 11. Municipal Council Nutritionists - Mrs Bairu & Mrs Maganga. 12. Shinyanga Strategic Grain Reserve - Manager. 13. Agricultural Programme - Mrs Kamaya. 14. YADEC - Mrs Magreth Koyi. 15. Africa Inland Church - Coordinator. Plus the seven design team members.

II. Grain Storage Stakeholder Workshop: Planned Programme

Friday 8th November 8.30 - 1.00, IPM Project Compound

Time	Activity/Topic	Responsible
	Workshop Moderation	Mr Kitandu (IPM Technical Development Officer)
8.30 - 9.00	Registration - and completion of 'expectations' card	All participants
9.00 - 9.30	Welcoming Self introductions Introduction to workshop objectives and agenda	Mr Katua (IPM Co-ordinator, Western Zone
9.30 - 9.40	Project background	Ms Tanya Stathers, Project Leader (NRI)
9.40 - 10.25	Progress to date	
	- Zimbabwe	Dr Brighton Mvumi (UZ)
	- Arusha & Dodoma	Ms Tanya Stathers
	- Shinyanga	Mr Kitandu
10.25 - 10.45	Post Harvest communication context: Agricultural knowledge and information systems (AKIS)	Mr Mike Morris (NRI)
10.45 - 10.55	Questions and Answers	All participants
10.55 - 11.00	Introduction to group work	Mr Mike Morris
11.05 - 11.20	Break – refreshments	
11.20 - 11.55	Group work I - identifying stakeholders	Groups A,B & C
11.55 -12.30	Group work II - information linkages	Groups A,B & C
12.30 - 12.55	Feedback session	
12.55 - 1.00	Closing remarks	Mr Katua

III. Workshop inception

A full list of participants and their contact details is given in Appendix II.

Participants' expectations

On arrival the workshop participants were invited to write their expectations of the workshop on cards which were subsequently displayed. These sets of expectations would be grouped in the evaluation session, and tested as to their realisation. The list of expectations, as expressed is recorded below:

- Gain knowledge on grain storage.
- Exchange views with others.
- Reduce loss of storage crops.
- Increase food security.
- Added ideas about food security.
- To share experience on post-harvest grain storage pest control.
- To get more knowledge concerning grain storage.
- To learn more about food storage techniques to enhance food security.
- To exchange experiences on crop storage problems.
- To know the problems the project has faced to date.
- To learn more on DEs.
- Get more information on DEs.
- To learn more about DEs.
- To exchange experiences with others.
- Get information about progress on DEs.
- Hear about farmers' reactions.
- To hear more how DEs can control insects.
- To know more on DEs and their merits.
- To get a way forward for DE use.
- Gain experience on grain storage from NGOs.
- To identify methods in engaging various stakeholders in storage pest management.
- An understanding of institutional linkages in Shinyanga and their awareness of the DE project.
- Realisation of workshop objectives.
- Meeting new friends.

IV. Welcoming, introductions and workshop objectives

As moderator for the workshop, Mr Kitandu introduced the chairperson for the workshop, Mr Katua, to the participants.

Mr Kitandu warmly welcomed the participants to the IPM compound, and invited them to stand up in turn and introduce themselves to the assembly, which was done.

Mr Kitandu reflected on the Integrated Pest Management (IPM) approach and its role to date in post-harvest issues. Introducing the '**Small-scale farmer utilisation of diatomaceous earths during storage**' project, he reminded the participants that many of them had been involved with staff from the IPM Project / Plant Health Services and NRI, at an earlier workshop in August 2001, when the DE project proposal was developed. He welcomed the on-going interest and involvement of the participants in the continued unfolding of the project.

Participants were then introduced to the **workshop objectives**, that the design team had planned to realise through the workshop activities. These were:

- **To update and share information on the 'Small-scale Farmer utilisation of Diatomaceous Earths during storage' project.**
- **To share and utilise participants' knowledge, skills and experience for the development of future project activities.**

Mr Katua drew attention to the workshop agenda, and spoke briefly to the different activities planned to help realise the workshop objectives. He hoped that everyone would participate freely and enjoy a rewarding day.

V. Project background presentation

'Small-scale farmer utilisation of diatomaceous earths during storage' – Ms Tanya Stathers, Project Leader (NRI)

In August 2001 we held a grain storage workshop to develop the *Small-scale farmer utilisation of diatomaceous earths during storage* project proposal, here at the IPM compound in Shinyanga which many of you attended. This presentation aims to explain to those of you who were not with us last August how the above project developed.

Farmers in Tanzania perceive storage pest damage to be a serious constraint to both household food security and control over the timing and scale of their grain sales. The main message from the Larger Grain Borer (LGB) coping strategies workshop held in Dar es Salaam in 1999 was that farmers wanted alternative strategies and treatment methods for grain protection to that of organophosphate use. Conventional insecticides are often unavailable when needed, adulterated, of poor quality, expensive and many farmers are afraid to use synthetic chemicals on their stored food because they are inherently poisonous. Following the workshop, Mr Riwa of the Ministry of Agriculture and Food Security, contacted NRI to discuss the potential for the use of diatomaceous earths (DEs) as grain protectants and the trials that we were conducting in Zimbabwe in collaboration with the University of Zimbabwe and the Institute of Agricultural Engineering. These trials had found that DEs were effective in controlling post-harvest insect pests in maize, sorghum and cowpeas stored for >8 months under small-scale farmer conditions in Zimbabwe and offered an acceptable alternative to the locally recommended insecticide, Actellic Super Dust (ASD). Mr Riwa, Dr Golob and I concluded that given the existing evidence there might be potential for DEs to be used in Tanzania to provide an alternative option for farmers in the battle against LGB. We submitted an outline proposal to the DFID Crop Post Harvest Programme (CPHP) in April 2000. The CPHP Project Advisory Committee were very keen to fund the work, however they were at that time short of funds, but in July 2001, they decided to release some funds to enable the project proposal to be collaboratively developed during a workshop in Shinyanga.

At the Shinyanga grain storage workshop in August 2001, participants related how farmers constantly mentioned the threat posed by storage pest damage, to NGO staff and other field workers and that the adulteration of Actellic Super Dust had reached such a serious scale in Tanzania (one farmer in Shinyanga region actually managed to breed storage insects in what had been sold to him as pesticide). The scale of damage caused by LGB and the widespread adulteration of pesticides had made stored product pest damage a political issue and parliamentary members had been asking the Ministry of Agriculture what they were doing about this problem. The project proposal was completed and submitted to the CPHP in Sept 2001 and finally in June 2002 we heard that the proposal had been successful, leaving very little time to set up the planned storage trials for that season in three regions of Tanzania, Dodoma, Manyara (formerly in Arusha) and Shinyanga.

Some of you may not be familiar with diatomaceous earths and may be wondering what they are. Diatomaceous earths (DE) are formed from the fossils of microscopic planktons called diatoms, that are found in fresh and salt water. When diatoms die, they sink to the bottom of oceans or freshwater lakes and accumulate into a sedimentary layer, which over the centuries builds up and becomes compressed and fossilised into a soft chalky rock called diatomaceous earth. DE is a porous material and is used: in filters to help clarify fruit juices, beers, wine, pharmaceuticals, swimming pool waste; dry cleaning solvents; as food additives; in baby powders; to remove oil from concrete floors and as an insecticide. The sample being passed around will enable you to see that DE looks similar to talcum powder, however if you were to put your finger into the DE you would find it makes your fingers feel quite dry. DEs exert their effect on insects through physical means. When insects come into contact with the DE particles, waxes are absorbed from the cuticle (or outside skin) of the insect resulting in water loss, dehydration, and death. However, insect species differ in their sensitivity to the various DEs and laboratory trials at NRI have found that LGB (*Prostephanus truncatus*) is less susceptible to DEs than some of the other storage insect pests such as *Sitophilus* spp. As a result a range of application rates of DEs and a mixture of DE with the pyrethroid permethrin have been included along with traditional farmer grain protection practices such as grain admixture with ash, in the Tanzanian field trials to determine how DEs can best be used to reduce damage caused by LGB.

The use of diatomaceous earths in pest control is not new. Observations of birds and mammals taking dust baths to rid themselves of mites and parasites is believed to have led the Chinese to start using diatomaceous earths in pest control more than 4000 years ago.

DEs have extremely low toxicity to mammals (e.g. DE rat oral LD50, >5000 mg/kg), and are considered 'Generally Regarded As Safe' by the USA Environmental Protection Authority. The US Food and Drug Agency has exempted DE from requirements of fixed residue levels when added to stored grain. The only possible negative health effect comes from long-term chronic exposure to quantities of inhaled dust, and safety precautions such as the wearing of masks need to be taken by workers during DE application. Many DE dusts are now commercially available, and are registered for use as grain protectants in Australia, Brazil, Canada, Croatia, China, Germany, Indonesia, Japan, Philippines, Saudi Arabia, United Arab Emirates and USA. DEs can be used for managing stored product insects and mites, improving fumigation and aeration efficiency, and structural treatments. DEs are approved for organic processing.

The '**Small scale farmer utilisation of diatomaceous earths during storage**' project has six main outputs that it plans to achieve, in summary these are:

Output 1 Field trials in three agro-ecological zones in Tanzania to test DEs against LGB

Output 2 Evaluation of local African deposits of DEs against storage insect pests

Output 3 Study of the user acceptability of DEs and the registration of DEs for use as grain protectants in both Zimbabwe and Tanzania

Output 4 Development of extension materials describing DEs for use as grain protectants

Output 5 Dissemination of new knowledge generated about DEs

Output 6 Evaluation of the project procedures

VI. Presentations on progress to date

Experiences from Zimbabwe - Dr Brighton Mvumi, University of Zimbabwe

In several participatory surveys conducted in Zimbabwe between 1996 and 2000, farmers ranked insects as a major constraint threatening postharvest food security at household level. Although synthetic insecticides are widely used by more than 75% of smallholder farmers, there are numerous problems associated with their use, and farmers' concerns include the following:

- High cost (could be associated with foreign exchange rate as active ingredients have to be imported).
- The pesticides are not available in some areas.
- Loss of efficacy (could be either due to misuse of the pesticides or possibly an indication of resistance development).
- Concern for safety of consumers.

One possible alternative to the synthetic insecticides, is the use of diatomaceous earths (DEs). The application techniques of DEs are very similar to those of the pesticides currently being used by smallholder farmers, which are dust formulations. Two imported DEs were therefore field-tested in Zimbabwe for two consecutive storage seasons (1998/99 and 1999/00) in three agroecological zones covering the typical semi-arid to sub-humid conditions. The DEs tested were Protect-It® and Dryacide® and they were tested on maize and sorghum (two seasons) and cowpeas (one season). The treatments were Protect-It® at 0.1% and 0.2%; Dryacide® at 0.1% and 0.2%, Actellic Super dust (combination of pirimiphos-methyl 1.6% and permethrin 0.03%) (all on w/w basis) and Untreated grain which served as the control. During the second season, the 0.2% rate of the DEs was replaced with 0.05%. The trials were researcher-managed and farmers only had a chance to evaluate the treatments at the end of the storage period.

The DEs were found effective at ≥ 0.1% but on sorghum, the lesser grain borer (*Rhyzopertha dominica*) was only effectively controlled at 0.2%. Protect-It® 0.1% performed slightly better than Dryacide® 0.1%. In the participatory evaluation of the treatments, farmers were impressed by the efficacy of DEs.

Information on farmer perception of the DEs under farmer-managed grain storage systems was also obtained through farmers' evaluation of Protect-It® 0.1% admixed with sorghum or maize in their own stores for 7 months. This was compared with the typical grain protection methods in the area (which included no treatment, admixed with botanicals or admixed synthetic insecticides). Using parameters

identified by the farmers as important to them, DEs scored better than the conventional farmer practices.

Farmers, having seen and experienced the efficacy of DEs, were eager to buy the products; raising the issue of sourcing and distribution of the DEs in the country. One agrochemical company in Zimbabwe has consequently initiated the registration of DEs, based on the field trial data, so that the company can import, distribute and market Protect-It®. Further tests will be done to determine whether DEs have an effect on taste, cooking and processing properties. This can only be done following temporary registration of the DEs, in accordance with Zimbabwean legislation.

Some local deposits have already been identified in the Northern part of the country near Chirundu. Samples collected from the site and submitted to Canada for preliminary screening showed that the Zimbabwean DE has potential as grain protectants. There are plans to collect samples from other sites and test them. It is hoped that the tapping of local DE deposits will help to stabilise prices of grain protectants and hence more farmers will have access to safer and sustainable grain protection methods.

Progress in the Kongwa and Babati district trials – Ms Tanya Stathers

The grain protection trials in Kongwa and Babati districts were set up in July 2002.

At **Mlali village in Kongwa district**, farmers typically store their **maize** in sacks in a storage room in their home. Shelled maize grain was purchased from farmers in the village, and then treated in the village godown (Figure 1.). Two commercially available diatomaceous earths, Protect-It and Dryacide were included in the trial. The treatments used were:

- Protect-It at 100g/100kg of maize (0.1% w/w) and 250g/ 100kg of maize (0.25% w/w);
- Dryacide at 0.1% w/w;
- Actellic Super dust at the recommended application rate for Tanzania of 100g/90kg of maize;
- Protect-It at 0.1%w/w plus permethrin at 2mg/kg;
- a typical traditional grain protection practice - unwinnowed grain and animal dung ash at 1.5kg/ 100kg if maize (as described by Mlali villagers);
- and an untreated control.

Four households were selected by the village executive office and each household stored one replicate of each of the seven treatments on a raised wooden platform structure in their store room.

At **Arri village in Babati district**, farmers typically store their **maize** in a kihenge[6] (woven basket plastered with animal dung on the inside) inside one of the buildings at their homestead. For the storage trials mini vihenge with enough capacity to hold 100kg maize were constructed by villagers (Figure 2). Shelled maize grain was purchased from farmers in the village, and then treated in the village godown[7]. The treatments used were as for Mlali village (described above) with the exception of the traditional grain protectant practice where unwinnowed grain was treated with a 1:1 mixture of cowdung ash and giri giri mo (pounded and dried plant leaves) by volume; 18 matchboxes of this mixture were admixed with 100kg of maize. A central godown was identified and all four replicates of each of the seven treatments have been stored inside it in a randomised block design. Unfortunately as the vihenge were not completed on time the treated grain was stored in sacks in the godown for the first six months.

At **Singe village in Babati district**, the trial was set up using **beans** that were purchased from local farmers (Figure 3). The treatments used were:

- Protect-It at 2g/10kg of beans (0.02% w/w), 5g/10kg of beans (0.05% w/w) and 10g/10kg of beans (0.1% w/w);
- Dryacide at 0.1% w/w;
- Actellic Super dust at the recommended application rate for Tanzania of 100g/90kg of beans;
- and an untreated control.

The Protect-It application rates were lower than those used on maize, as the main insect pests of beans are know to be very susceptible to DEs. Dryacide was applied at the recommended label rate of 0.1% w/w. A central godown was identified and all four replicates of each of the six treatments were stored inside it in mini jute sacks (10kg capacity) in a completely randomised design.

[6] The Swahili word for (storage) basket, 'kihenge', becomes 'vihenge' in the plural.
[7] Village warehouse.

Figure 1. Admixing maize grain with DEs in Mlali village godown

Figure 2. Inspecting mini vihenge in Arri village

Figure 3. Admixing beans with protectants in Singe village

Grain sampling occurs every eight weeks, samples of 1 kg of maize and 500g of beans are taken from each replicate of each treatment using sampling spears. The villagers are involved during the sampling and the samples are placed into clear polythene bags enabling easy study of grain damage and insect presence. The samples are then taken back to the lab for detailed analysis of the percentage of grains damaged by insects and the numbers of each insect species present, this data is then represented graphically (Figures 4-7).

Data collected during the first 16 weeks of the storage trial, indicates that insect damage in the untreated control is increasing more rapidly than in the protectant treatments. Insect damage is also higher in the traditional protectant treatments used on maize grain in Mlali and Arri villages than in the DE and Actellic Super dust treatments. These early results are encouraging and it is likely that as the storage season continues the differences between the treatments will increase. Visual photo noticeboards about the trials in English and Kiswahili are on display in the villages and district extension offices, Kisukuma versions for the Shinyanga sites are being prepared.

Although the DEs, Protect-It and Dryacide come from America, DE deposits can also be found in East and Southern Africa. During the first year of the project we are planning to test DE samples from Kagera, Dodoma and Singida regions in Tanzania, and from Northern Zimbabwe for efficacy against storage insect pests. If local diatomaceous earth samples look promising they will be included in the community managed grain protection trials during the second storage season. The presence of locally available DEs could have important economic implications for DE use in the region.

As well as the field trials the project is also studying the flow of post-harvest information amongst different stakeholders in order to facilitate the effective promotion and dissemination of grain storage information. These aspects of the work are discussed in Mike Morris' presentation on the communication context.

Figure 4. Maize grain protection trials, Mlali village, Kongwa district

Jaribio la hifadhi ya mahindi kijiji cha Mlali (2002/2003)

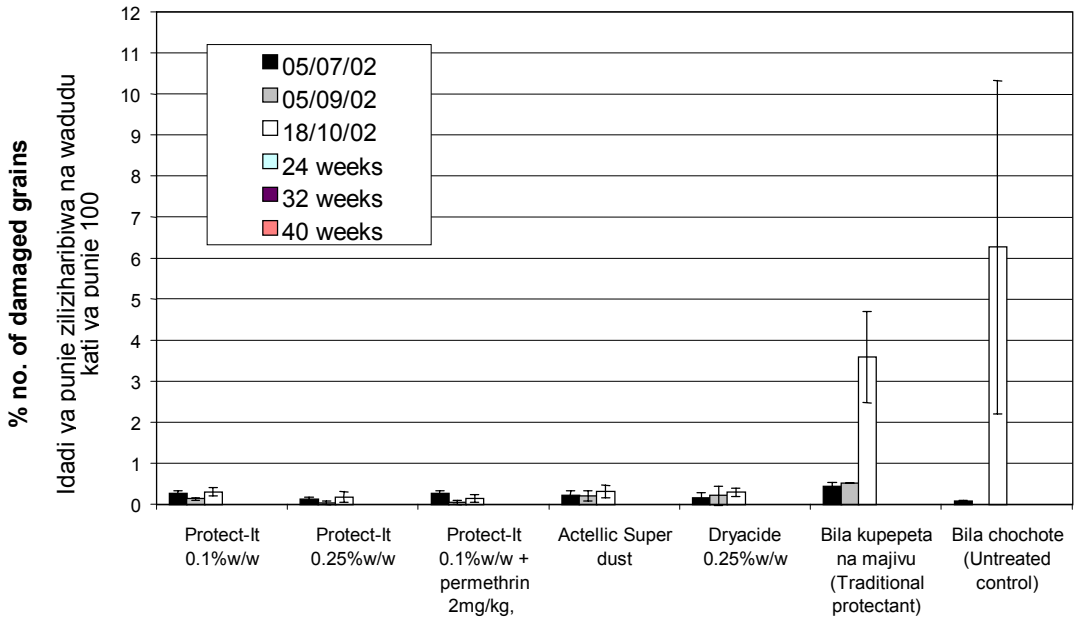


Figure 5. Maize grain protection trials, Arri village, Babati district

Jaribio la hifadhi ya mahindi kijiji cha Arri (2002/2003)

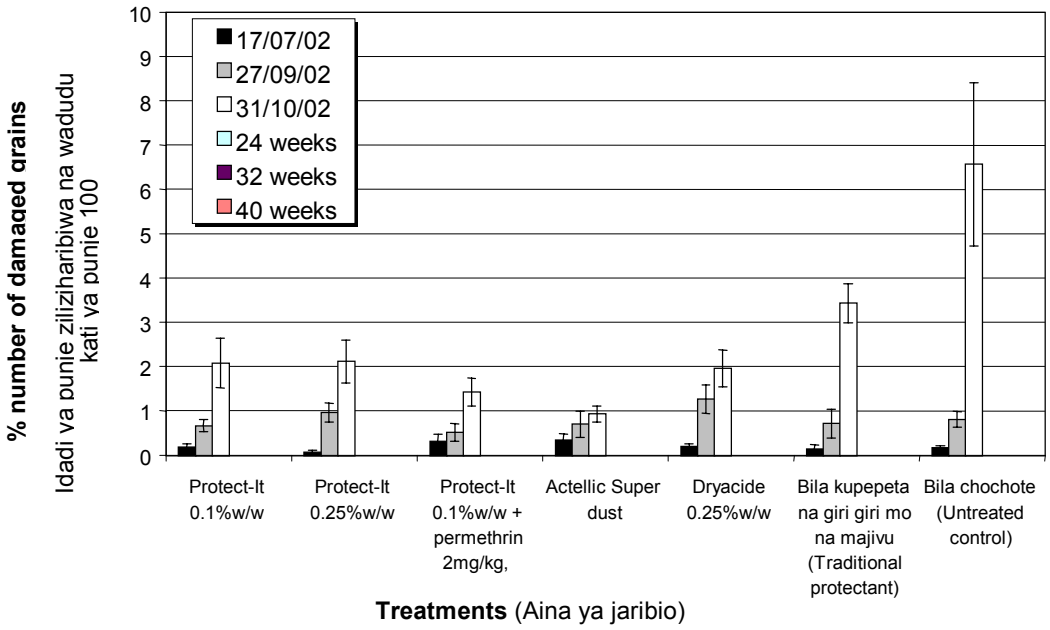


Figure 6. Bean storage trials, Singe Village, Babati District

Jaribio la hifadhi ya maharage kijiji cha Singe (2002/2003)

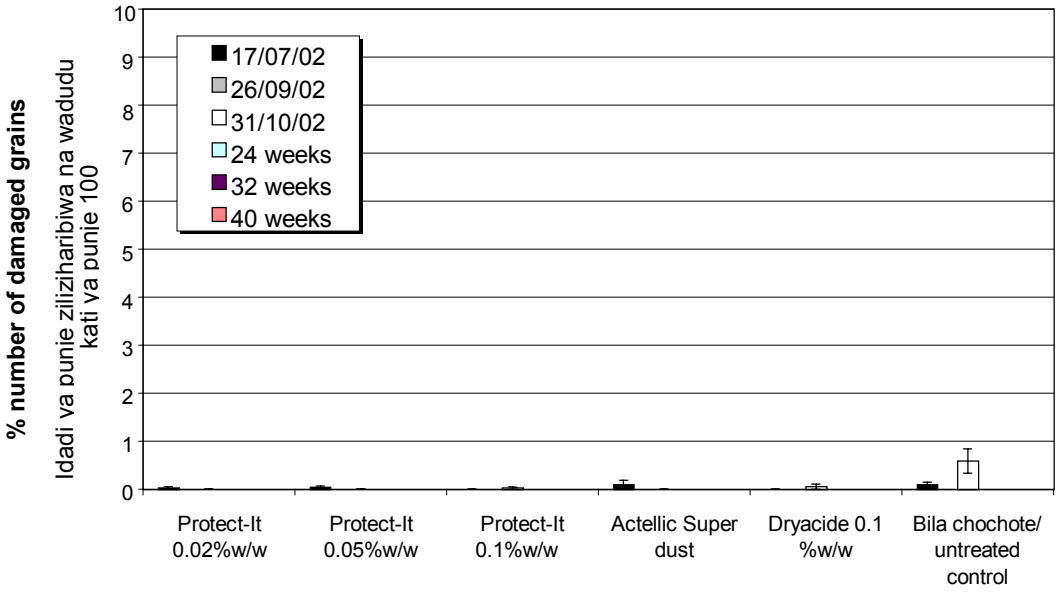
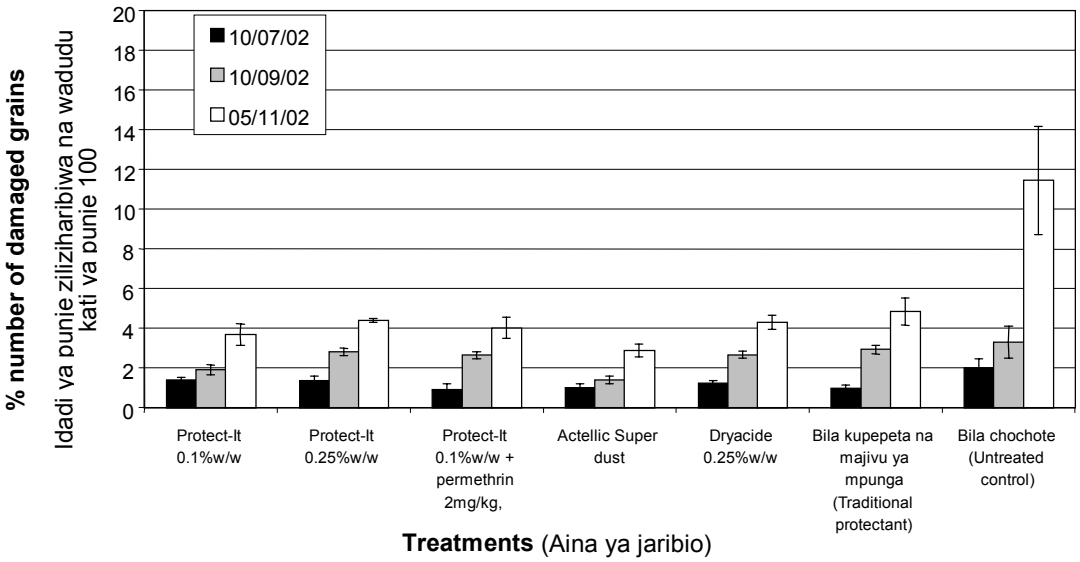


Figure 7. Maize grain storage trials, Mwamakaranga village, Shinyanga District

Jairibio la hifadhi ya mahindi kijiji cha Mwama karanga (2002/2003)



Progress in the Shinyanga trials - Mr Lazaro Kitandu

Following the workshop held in Shinyanga in August 2001, it was agreed to have two trial sites in Shinyanga Region; one in Mwamakaranga village, Shinyanga Rural District, and the other at Mwataga village in Kishapu District (then Kishapu Division and still part of Shinyanga Rural District).

Setting up of the trials in the two villages has been completed. Two types of grains have been used: maize in Mwamakaranga village; and sorghum in Mwataga village. All grain was bought from the respective villages.

A simple warehouse (or godown) was constructed in each village (see Figure 10) by local farmers to accommodate 28 vihenge of 90kg. capacity. An actual kihenge and the scaled-down vihenge for the trials are illustrated in Figures 8 and 9 respectively.

Figure 8. Kihenge in Mwamakaranga house

Figure 9. Trial vihenge at Mwamakaranga

Figure 10. Godown with vihenge inside at Mwataga village

Trial layout

Seven treatments with four replications were used in each village. The seven treatments include: Protect-It at 0.1% w/w; Protect-It at 0.25% w/w; and Dryacide at 0.25% w/w; Actellic Super dust; permethrin 2mg/kg in combination with Protect-It at 0.1% w/w; ash (from rice husks at 8kg/100kg on maize grain in Mwamakaranga village, and from the fire applied at 4kg/100kg on sorghum grain in Mwataga village); and an untreated control. Protect-It and Dryacide are two different types of commercially available DE from the USA. Following admixture, each treatment replicate was stored in a kihenge, and all the vihenge were then placed at least 30 cm. apart in a randomised block design on top of a locally made platform raised approximately two feet above the ground.

Grain sampling is carried out regularly every eight weeks. So far, three samplings have been done starting in July 2002. At each sampling 1kg of grain is collected from each kihenge using a short sampling spear (see Figures 11-13).

Figure 11. Sampling of sorghum in kihenge using sampling spear

Figure 12. Sampling maize in Mwamakaranga village

Figure 13. Sampling sorghum in Mwataga village

The initial damage (at 0 weeks) due to storage insect pests was about 1.2% in maize and 3.5 % in sorghum. The major pests found were: *Prostephanus truncatus* (Larger Grain Borer / *dumuzi*); *Sitophilus* spp. (maize and rice weevils / *tembo*); *Sitotroga cerealella* (*vipepeo, balababu*), *Rhyzopertha dominica* (lesser grain borer) and *Tribolium castaneum* (*bungua*).

The major interest in these trials is build-up of insect numbers and grain damage levels as a reflection of the effectiveness of each treatment. So far, the trend shows an increase in pest population with time particularly in the control and local protectants used in this trial.

VII. Questions and answers – all participants

The question and answer session, originally programmed to follow the last presentation – the post-harvest communication context – was brought forward to build on the participants' interest in these first presentations. The ten minutes scheduled for this session proved woefully inadequate, with the many interesting questions and comments having to be drawn to a close after thirty minutes. The essence of these exchanges is reported below:

Questions/comments	Responses
Mr Mikomangwa: What was the hypothesis of the Zimbabwean DE trials?	**Brighton Mvumi**: The hypothesis was: DEs could effectively protect maize, sorghum and cowpeas from storage insect damage in small-scale on-farm storage situations in 3 agroecological zones in Zimbabwe.
Has a cost benefit analysis been done for DE use in Zimbabwe? Might not local geological conditions mean that local DEs could actually cost more than imported DE products? How were farmers involved in Zimbabwe?	**Tanya Stathers**: As DEs are not yet commercially available in Zimbabwe, their estimated cost was based on calculations of their price at source, plus import duty and transport costs, the resulting figure was very similar to that of the price of Actellic Super dust needed to treat the same quantity. At intervals throughout the farmer-managed trials in Zimbabwe, farmers discussed and estimated the value of a 20 litre bucket of both their Protect-It and typically treated grain. The figures they gave suggested that by treating their grain with Protect-It® admixed at 0.1%w/w in comparison to their typical grain protection practice, a household, after five and seven months storage, would save US$20 and US$40 per tonne of shelled maize grain respectively or US$47 and US$54 per tonne of threshed sorghum grain respectively[8].
Mr Lugendo: Why were the Shinyanga trials set up using infested grain?	**Mr Kitandu**: The trials aim to test DEs under realistic farmer conditions. Grain is frequently infested by storage pests prior to harvest whilst still in the field, and then farmers store this grain. The maize and sorghum grain was bought directly from farmers at the

[8] Data generated between November 1999 and February 2000.

two sites and already showed low levels of infestation.

Mr Maige: What about the sustainability of the project - Protect-It is coming in from America - when will Tanzania be mining its own DEs?

How effective will local DEs be?

Mr Kitando: We already have information regarding the location of some Tanzanian DE deposits, further facilitation is needed in order to mine them. During the second season's trials we plan to include local DEs in the trials.

Mr Katua: Most synthetic pesticides are currently coming in from outside the country. Imports from Kenya say, might still be cost effective.

Tanya Stathers: We feel this is one of the aspects of the project in which we need to start encouraging private sector involvement immediately.

Brighton Mvumi: It must be clarified that we are not trying to sustain the project, but the livelihoods of the poor. It is very important to generate data that will convince the private sector that this is something that they should invest in.

Mr Mussula: There is a need to discuss the project with and involve the private sector as stakeholders to help with sustaining the issues.

Mr Mikomangwa: The mining of local DEs will be the private sectors job, but as we don't yet know how effective the local DEs are, it is premature to involve the private sector, only the Ministry of Agriculture and Food Security, the NGOs and the Geologists should be involved at this stage.

Tanya Stathers: Historically it was believed to be unnecessary to involve farmers in research but current thinking now tries to involve farmers in the research process as early as possible. Shouldn't we also involve the private sector as early as possible in this process, it can't be harmful to raise awareness about this work amongst the private sector.

Mr Mfanga: All chemicals that are registered in Tanzania need to pass through the Tanzanian Pesticide and Registration Institute (TPRI). I'm not sure the private sector in Tanzania can take this forward, it is unlikely to happen here in the same way it is happening in Zimbabwe.

Brighton Mvumi: We have already met with several representatives of agrochemical and seed companies in Arusha to discuss DEs and the project. They seemed very keen to learn more particularly with the phasing out of organo-phosphate pesticides which is gradually happening, especially in developed countries. TPRI have said that the DEs will need to follow the normal application process for registration to be effected.

Omari: Can we clarify that these trials are being set up with comparisons of traditional treatments and Actellic Super dust so that farmers can compare these DEs to the products they normally use?

Mr Kitandu: Yes, the trial has been set up with 7 treatments, these include the DEs Protect-It and Dryacide at different application rates, Actellic Super dust, traditional protectants (e.g. rice husk or fire ash admixed with grain) and an untreated control.

Mrs Bairu: What is the effect of DEs on food, do they alter the cooking process, affect the colour or taste etc.?

Brighton Mvumi: Due to the fact that DEs are not yet registered in Zimbabwe, we haven't yet been able to test that, but it is planned once Protect-It is given temporary registration.

Tanya Stathers: As DEs are already used in other countries, their effect on foods has been tested for many stored products, on wheat there was no indication that any baking or taste characteristics were affected.

Brighton Mvumi: DEs do effect grain flow, preventing grains from nestling onto each other, which can mean that for large scale storage bulk density is reduced in DE treated grain which can affect grading, however this is not likely to be important as the small-scale storage level where the bulk of the grain is kept for home consumption. We will also need to involve traders in evaluating the DEs.

Mr Kolowa: Most farmers here in Shinyanga region use traditional vihenge or bags, shouldn't the trial use storage structures similar to those used by most farmers, in case farmers then think that these DEs only work in improved storage structures.

Mr Kitandu: In Mlali village, Kongwa district, the DE trial has been set up using bags as this is how many farmers there typically store their grain.

Tanya Stathers: It was at the previous meeting of Shinyanga post-harvest stakeholders last August when the proposal was being developed that the stakeholders decided to use a mini version of the modern or improved vihenge design (with the lid, and outlet facility) to simultaneously increase farmers awareness of these alternative storage structures.

Mr Katua: If we use the traditional vihenge design we will be taking our farmers backwards not forwards.

VIII. Presentation on the communication context

Post-harvest communication context – Mr Mike Morris (NRI)

To ensure that we all share a common understanding about the project, it may be helpful to restate the project purpose, and the outputs that are aligned with that purpose. It is these outputs that the project team is contracted to deliver by the end of the project.

The purpose - long term aim - of the project is to contribute to the development of strategies which improve the food security of poor households. This will be done by developing storage technologies that increase the availability and quality of foods, and by promoting these technologies.

Of the six project outputs three of them directly relate to the development of improved technologies:

Output 1 - optimising the methods by which DEs can be used to protect grain. This has been the focus of most research activities to date.

Output 3 - farmer validation of the efficacy, cost-effectiveness and acceptability of using DEs.

Output 2 - evaluation and assessment of African/Tanzanian DE deposits as protectants.

Two further project outputs relate to the promotion of the validated technologies:

Output 4 - developing extension material appropriate to the information systems used by end and intermediate users.

Output 5 - disseminating and promoting the new knowledge

The final output (Output 6) relates to involving the project participants in the evaluation of the project processes. If there is time we should like to hear whether and how your respective organisations monitor and evaluate their activities with farming households.

Some definitions

This presentation outlines some of the challenges facing the promotion of information and/or technologies. In the case of the project, and following both the researcher-managed trials and the validation by farmers (planned for the second year), this specifically relates to Outputs 4 & 5 above.

Information does not simply flow from person to person. Rather it is continually transformed through processes of selection, interpretation and communication. (Examples given included: familiarity with the language of communication; directions (information) selected on the basis of desire to please rather than functionality).

But first it might be useful to share some definitions (most taken from Garforth and Usher, 1996):

Information (relating to natural resources) has been defined as "patterned data allowing us to give meaning to the environment" (Röling and Engel, 1991).

Technologies refer to the application of such information to the activities of human goals, either in the form of hardware (tools, equipment, machines), or as software (knowledge, experience, skills).

Information and technology may be derived from scientific research, or from farmers' own experimentation.

Promotion is the activity of making potential users aware of the information or technology, and increasing its accessibility.

Uptake is the application of the information or technology by **users.** There are two basic categories: '**end users**', which in this case include farmers and others (individuals, households, communities) who engage in grain storage; and, '**intermediate users**', who may use the research findings to produce information, technology and products for end-users.

Pathway refers to the route or channel by which information and technologies reach the 'user'.

Stakeholders are considered to include all those who affect and/or are affected by the policies, decisions and actions of a given system (Grimble *et al*, 1995). This definition should alert us to the possibility that stakeholders in a given venture, may not necessarily share the same interest (e.g. grain protectant manufacturers are both stakeholders in post-harvest storage issues and competitors).

Agricultural / Post-Harvest Knowledge and Information Systems

If the project is to significantly contribute to its identified purpose, then the validated technologies need promoting amongst potential users. However, in order to be able to supply the necessary information and support for its use, in the most appropriate form, we need first to understand how and where farmers and other stakeholders obtain and use information.

We know for example that farmers actively seek information, and that they use different sources, and different channels, for different purposes. We know too that not all farmers use or have access to the same sources or channels. For example, poorer farmers may have fewer contacts, skills or resources (e.g. they may be more remotely located, illiterate or without a radio); where men may typically secure information from market traders or by radio, women may tend to hear information at public events (e.g. weddings & funerals). The specific channels will differ between different groups and from place to place.

Similarly we know that intermediate organisations (e.g. government & NGO extension agencies, CBOs, farmers associations, networks, media) receive information from different sources, through different channels, and similarly disseminate information in diverse ways to different constituencies. For example, zonal researchers may liase with central research institutions, and communicate through writing in obscure journals; stockists may secure information using mobile phones and trade journals, but pass it on to customers in verbal format or through the manufacturers instructions.

If we want to optimise the promotion of the project findings then we first need to understand the various agricultural **knowledge and information systems (AKIS)** being used by end-users (e.g. farmers) and intermediate users (e.g. government & NGO extension agents, traders). This involves identifying the sources and channels of communication available to and used by different stakeholders, being aware of the different types of information that may be communicated, and developing an understanding of what factors may inhibit or enhance communication flows between intermediate and end-users.

Major sources of information for farmers might include: fellow farmers, family members, CBOs, local traders; stockists, market traders, agri-business; government agencies (e.g. plant health services staff, district extension staff, research stations); NGOs and Church organisations; networks (e.g. Mviwata); radio stations.

Farmers will have preferences for **different media types**, which might include:

- organised farmer to farmer visits
- workshops or seminars
- field days
- radio (or TV)
- printed materials (e.g. extension leaflet, newspaper)
- demonstrations

Information comes in different forms; **types of information** might include:

- awareness raising and understanding
- operational skills (e.g. practice)
- technical knowledge (e.g. recommended timing & concentration of treatments)
- marketing information
- policy

The flow of information between people however, is continually transformed through processes of selection, communication and interpretation.

Constraints to information flows may stem from:

- poor quality of interaction
- infrequent interactions
- inadequate human resources (e.g. in numbers or skill base of staff)
- limiting physical resources (e.g. transport)

Other factors relating to the nature or standing of the respective parties may also be crucial (e.g. mistrust, lack of commitment, impatience, dishonesty etc.)

De-motivating factors for farmers have been found to include (Rees *et al*., 2000):

- poor attendance at meetings
- ignoring information
- dishonest leaders (in CBOs)
- repeated use of same farms for demonstrations

Future project activities will include examining in detail the various knowledge and information systems used both by different intermediate agencies and by different sets of end-users.

This moves us on to the next workshop activity, the group work. The aim of the group work is to explore aspects of the information systems of the organisations represented at the workshop.

The **references** which are cited in, or have informed, the above presentation are presented as a footnote[9].

IX. Introduction to Group Work – Mr Mike Morris

Three group work activities had been prepared, but because of the extended question and answer session, and the corresponding slippage in the workshop programme, it was decided to abandon the first exercise relating to social differentiation at the farming household level. A shortened introductory draft to social differentiation is made available as a footnote for completeness[10].

It was explained to the participants that they would be undertaking two participatory activities, and that this work would be more suitably undertaken in small groups. Three seemed to be the optimal number, creating groups of five or six people. The groups would be selected to maximise the mix of different types of stakeholders (e.g. NGO staff, stockist, Church project, district and/or municipal staff) in each group. Mr Kitandu, with help from Dr Mvumi, helped the participants form three groups with a suitable mixture of members. The participants were invited to observe the usual practices associated with group work (e.g. chairing, recording, timekeeping), and reminded that everyone's opinion was valid and should be accorded equal treatment.

The two participatory activities to be undertaken by each group were:

- **Group Work I**: To identify grain storage stakeholders and represent their relative 'importance' to a farming household.

[9] Garforth, C. and Usher, R. (1996) Methodologies for analysing and improving the effectiveness of promotion and uptake pathways for renewable natural resources information and technology: a review paper.
Grimble, R., Chan, M.K., Aglionby, J. & Quan, J. (1995) Trees and Trade-Offs: A Stakeholder Approach to Natural Resource Management. Gatekeeper Series No. 52. London: International Institute for Environment and Development.
Rees, D., Momanyi, M., Wekundah, J., Ndungu, F., Odondi, J., Oyure, A.O., Andima, D., Kamau, M., Ndubi, J., Musembi, F., Mwaura, L. and Joldersma, R. (2000) Agricultural Knowledge and Information Systems in Kenya - implications for technology dissemination and development. Agren Network Paper No. 107. London: Overseas Development Institute.
Röling, N. and Engel, P. (1991) The development of the concept of agricultural knowledge and information systems. In Rivera, W. and Gustafson, M. (eds.) Agricultural Extension: worldwide institutional evolution and forces for change. Elsevier, Amsterdam, pp 125-137.

[10] Most if not all of the workshop participants are potential intermediate users of the project's findings. Typical end-users (i.e. farmers and farming households) are not as such represented. The first activity is to explore through group discussion to what extent farmers and farming households may be considered as a homogeneous group (similar to each other, like peas in a pod), or may be differentiated (e.g. by farming system, wealth, location, gender, age). You are asked to generate a list of any differentiation that might be usefully applied, and the rationale behind it. Please also specify if and how the different organisations represented differentiate farming households for the purpose of their work. An understanding of differentiation at the household level will help the project in its selection of farmers for the farmer validation exercise, Output 3, and in terms of providing a basis for exploring potentially different information systems amongst the farming community (Output 4).

- **Group Work II**: For each group member to complete an information linkage matrix between themselves and all other organisations represented at the workshop.

Group Work I

Groups were asked to identify as many stakeholders as possible, writing their names down on the yellow 'post-its'. They were asked to consider whether there were any stakeholders whose activities could be considered to impact negatively on farmers' post harvest activities, or be in competition with their own interests? Having generated a list of stakeholders they were then invited to graphically represent the relative importance of these stakeholders to a farming household (e.g. using venn diagams or lines of influence etc.) Time allowing they might also indicate why one stakeholder was considered more 'important' than another (e.g. VEOs are physically closer, make frequent visits), and whether the relationship is one-way or two-way (see Figure 14).

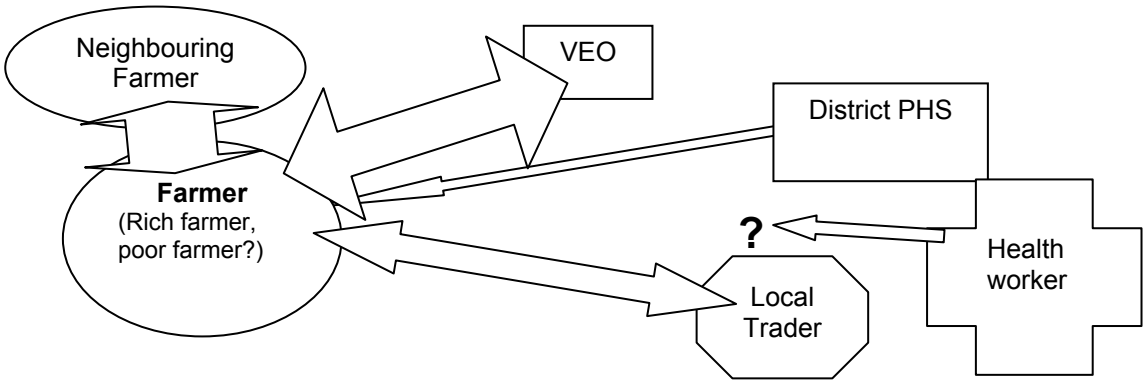


Figure 14. Graphical representation of the relationship between stakeholders and the farming household

Group Work II

Storage Information Linkage Matrix: The groups would explore the information flows between each of its members and the full set of workshop participants' organisations. Three criteria would be used to assess the information flows: whether it was one-way (i.e. information received or dispensed, but not both) or two-way; the frequency of information sharing (e.g. poor / less than 6 monthly, modest / monthly, frequent / more than weekly); and, the quality of the information (e.g. poor, OK, good). The participants were reminded that the context was that of post harvest (and/or storage) information, and invited to use their own judgement as to scales that might be used.

Figure 15. Diagrammatic representation of linkage matrix

_List of Participating Organisations ➔ List of Group Members ⬇	**Organisation 1**	**Organisation 2**	**Organisation 3**	**Organisation 4**	⋮	⋮	**Organisation 15**
member 1							
member 2							
member 3							
member 4							
member 5							

Direction: 0 or no communication → one-way ↔two-way Frequency: 1-Poor; 2-OK; 3-Good Quality: 1-Poor; 2-OK; 3-Good	**Organisation Y**
Member x	↔(2-way) **2** (monthly) **3** (Good)

To record the information each group would be given a flip chart with a grid or matrix drawn upon it. A list of all the group members would be set out on the left hand side, and the full set of participants' organisations listed across the top. Following group discussion of how the three criteria - direction, frequency and quality - might generally be graded, individuals should take it in turns to complete the entries, three per box, against their name.

The groups were reminded that time was particularly short - less than an hour remained - so that they would need to be disciplined in their aproach.

The groups identified for the group work were as follows:

Group A	Group B	Group C
Mrs Paulina Maganga	Mr Henry Kolowa	Mrs Thereza Bairu
Mr Gurisha Mfanga	Mr Dickson Msula	Mr Martin Katua
Mr Omari Ngalawa	Mrs Magreth Wembe	Mr Rweikiza
Mr A.J. Lugendo	Mr Said Mpembeg	Mr Godfrey Wawa
Mr Naanjela Levira	Mr Antemi Chuwa	Mr Zengo Mikomangwa
	Mr Pius Karega	Mr D.J. Maige

The work was facilitated by Mr Kitandu, Dr Brighton Mvumi, Ms Tanya Stathers and Mr Mike Morris.

Following a break for refreshment the groups set about their work enthusiastically.

X. Group Work I

The stakeholders identified by all the group are aggregated and presented according to organisational type and level of operation[11] in Table 2. The individual group lists and/or diagrams are reproduced beneath in photographic format (Figures 16-19). Time was particularly limited. While Group A returned to further elaborate their diagram after completing the second group work, Group C, who identified the largest number of storage stakeholders, did not have time to present them in a relationship context.

Figure 16. Group A at work

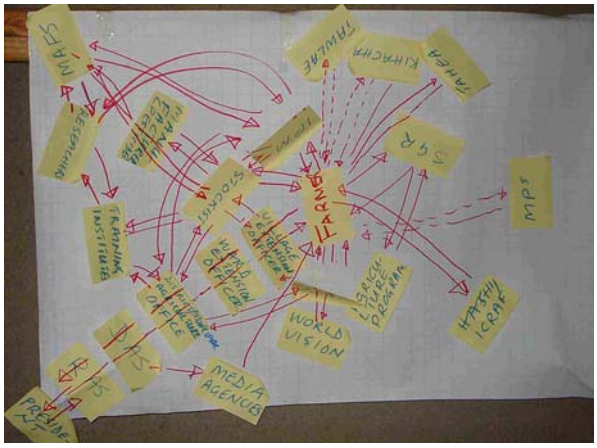


Figure 17. Stakeholders identified by Group A

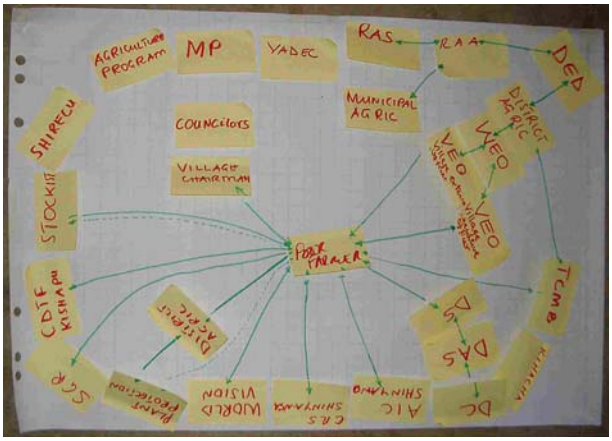


Figure 18. Stakeholders identified by Group B

Figure 19. Stakeholders identified by Group C

[11] Within the Ministry of Agriculture and Food Security there are currently 7 Zonal Research Centres, 5 Zonal Plant Protection (Plant Health) Service Centres and 6 Post-Harvest Management Service (PHMS) Centres. PHMS Lake Zone covers Mwanza, Mara & Kagera, PHMS Western Zone covers Shinyanga, Tabora & Kigoma.

XI. Group Work II

The storage information linkage matrices generated by the three groups and reproduced in photographic format in Figures 20-23 below, are presented in aggregate form in Table 3. The list of participants (actors) on the left hand side (LHS) is complemented by their respective organisations along the top of the matrix. The aggregated matrix provides a ready view of who amongst the organisations represented at the workshop is communicating with whom. The assessment made by individual representatives (LHS) in any row, may be cross-checked against the multiple assessments made by all other participants in the organisational column. Some differences do occur and have been coloured (shaded) in. Further enquiry would be needed to determine whether these represent inconsistencies, or simply reflect divergence between the individual and organisational communication profiles.

Figure 20. Group A's linkage matrix

Figure 21. Group B's linkage matrix

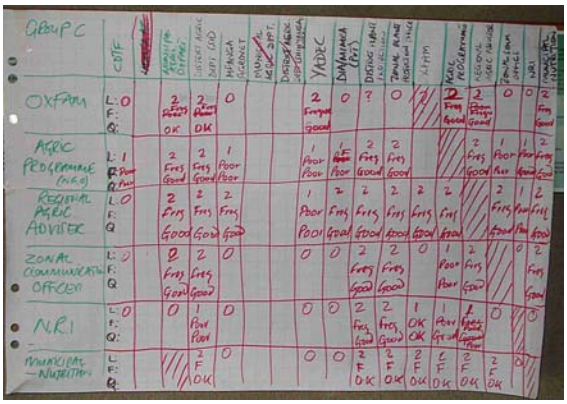


Figure 22. Group C's linkage matrix

Figure 23. Group B at work

The emergent picture is not a revelation, but nonetheless provides a platform from which further work may be carried out. We would hope to both expand the matrix to include any key storage stakeholder groups not represented at the workshop. These would certainly include disaggregated farmers groups, and as group work I suggests might also include media representatives and various associations and councils working with youth and/or women's groups, food processors and vendors. A further steer for this will come from planned work to explore those sources and channels of information already used by different groups of farmers. Together with expanding the matrix, we shall also further elaborate the type and quality of information being shared by those organisations identified as key by farmers.

For the moment however, we see for example: that NRI's profile is unsurprisingly low amongst some local stakeholders; of the NGOs and Church organisations present that the Catholic Diocese of Shinyanga Agricultural Programme, Oxfam and YADEC, enjoy relatively good contact with most other participants, and CDTF a little less; that the zonal communication office linkages are oriented toward government agencies in Shinyanga.

Table 2. Identified stakeholders by organisational type and operational level

Storage/Post-Harvest Stakeholders - Aggregated from Group Work				
Operational Level ➔ Stakeholder Types ⬇	**National (& *international*)**	**Zonal* / *Regional***	**District / *Municipal***	***Ward*, Village or Household**
Government (policy formulation and practice)	President's Office MAFS: - Crop Development Division/Plant Health Service. - National Food Security Division /Post-Harvest Management Service.	IPM, Lake Zone. Plant Health Service Centres, Western Zone. *RAS - Regional Administrative Sec.* *RAA - Reg. Agricultural Adviser.* SGR (Strategic Grain Reserve)	District Administrative Secretary (DAS). District Executive Director (DED). District Extension Officer (DEO). DALDO & DAO Bwanafya - health officers *MAO - Municipal Agricultural Office.* *Municipal Plant Protection Officer.*	*Ward Extension Officers.* *Ward Executive Officers* Village Extension Officers Village Executive Officers
Parastatals	Tanzania Cotton Marketing Board National Milling Corporation			
Politicians / elected officials			DC - District Commissioner. Shinyanga District Council *Municipal Council* MPs (Members of Parliament)	Village Chairman. Village Councillors.
Education, training, research, and reform Institutions	IDS; UDSM. Tanzanian Food and Nutrition Centre (TFNC). Tropical Pesticides Research Institute (TPRI). *NRI; University of Zimbabwe*	Zonal Agricultural Research and Training Institutes (e.g. LZAR&DI, Ukiriguru; HR&TI, Tengeru)	Secondary Schools Prisons.	Primary Schools
'Projects' (larger scale donor funded initiatives undertaken with Govt.)		*ICRAF/* HASHI (Hifardi Ardhi Shinyanga). PIDP (Participatory Irrigation Dev. Project)/IFAD		
Private Sector	Agro-Chemical Industries / Pesticide Manufacturers	SHIRECU (1984) Ltd. (Shy Regional Co-operative Union)	Stockists Middlemen Food Processors Food Vendors	Food Vendors
NGOs, Church Organisations & Community Based Organisations (CBOs)		Care Tz. CRS (Catholic Relief Services) Oxfam (GB) TAHEA (Tanzanian Home Economics Association) TAWLAE (Tanzania Association of Women Leaders in Agriculture and Environment). WVT (World Vision Tanzania). YADEC (Youth Advisory & Dev. Council) – Shinyanga, Tabora, Singida & Mwanza regions.	AIC (Africa Inland Church) CARITAS CDAP (Catholic Diocese of Shinyanga Agricultural Programme. CDTF (Community Development Trust Fund). WEGCC (Women's Economic Group Coordination Council)	
Networks	MVIWATA	Mviwashi KIHACHA (Kikundi cha wakiki na chakula)		
Media	National Press Mass media			

Table 3. Storage information linkages: type, frequency & quality

KEY for entries – Communications **Type**: -none; →one-way; ↔two-way **Frequency**: 1-Poor; 2-OK; 3-Frequent **Quality**: 1-Poor; 2-OK; 3-Good		Government								Private		NGOs & Church Organisations				Int
		ZCO	ZPP	SGR[#]	RAA	DAD	DPP	MAD	MN	Mfanga	Mussul	CDAP	CDTF	Oxfam	YADEC	NRI
Government	Zonal Communication Officer		↔ Fr Gd	?	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	-	-	→ Pr Pr	-	-	-	
	Zonal Plant Protection / IPM Co-ord.	↔ 1 3		↔ 1 2	↔ 3 3	↔ 2 3	↔ 2 3	↔ 2 3	↔ 1 2	↔ 2 3	↔ 2 2	↔ 2 3	↔ 1 2	↔ 1 2	↔ 2 2	↔ 1 3
	Strategic Grain Res. FS Officer	-	↔ 2 2		↔ 2 2	?	-	?	-	-	-	-	-	↔ 2 2	-	-
	Regional Agricultural Adviser	↔ Fr Gd	↔ Fr Gd	?		↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	-	↔ Fr Gd	→ Pr Pr	→ Pr Pr
	Distr. Agric. Department Ext. Officer	↔ OK Gd	↔ OK Gd	↔ OK OK	↔ OK Gd		↔ OK Gd	↔ OK OK	↔ OK Gd	↔ OK OK	↔ OK Gd	↔ OK Gd	↔ OK OK	-	-	-
	District Plant Prot. Officer	-	↔ 3 3	-	→ 1 1	↔ 2 2		↔ 2 2	↔ 2 2	↔ 2 2	↔ 2 2	↔ 2 2	-	-	-	↔ 1 3
	Municipality Agricultural Dept & Ext*	↔ 2/2 2/2	↔ 2/2 2/3	- ↔ OK OK	↔ 2/2 2/3	↔ 2/2 3/3	↔ 2/2 2/3		↔ 2/2 2/3	↔ 2/1 3/3	↔ 2/1 3/3	↔ 2/2 3/2	-✔	- ↔ 2 2	- ↔ 2 2	-✔
	Municipal Nutritional Office	↔ Fr OK	↔ Fr OK	?	↔ Fr OK	↔ Fr OK	↔ Fr OK	?		-	-	↔ Fr OK	?	↔ Fr OK	-	-
Private Sector	G S Mfanga Agrovet Agent	-	↔ OK OK	↔ OK Gd	↔ OK Gd	↔ OK Gd	↔ OK Gd	↔ OK Gd	↔ OK OK		↔ OK Gd	↔ OK OK	-	→ OK OK	-	-
	D Mussula Stockist	-	↔ 2 2	-	-	↔ 2 2	→ 1 1	↔ 2 2	-	↔ 2 2		↔ 2 2	→ 1 1	→ 1 1	-	-
NGOs & Church Organisations	Catholic Dc. Agric Prog. Director	→ Pr Pr	↔ Fr Gd	?	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	↔ Fr Gd	→ Fr Gd	→ Pr Pr	→ Fr Pr		→ Pr Pr	?	→ Pr Pr	→ Pr Gd
	Com. Dev. Trust Fund Proj. Coord.	-	↔ Pr OK	-	-	↔ We Gd	↔ Mo Gd	-	-	-	-	-		-	-	-
	Oxfam (GB) Project Manager	-	-	?	↔ Fr Gd	↔ Fr OK	?	↔ Fr OK	↔ Fr Gd	-	-	↔ Fr Gd	-		↔ Fr Gd	-
	YADEC Food Technologist	-	↔ 2 2	-	-	↔ 2 2	-	↔ 2 2	↔ 2 2	-	-	-	↔ 2 2	↔ 2 2		-

*Municipal Plant Protection Office & Municipal Agricultural Extension Office not differentiated in group work
[#]Strategic Grain Reserve omitted from Group C matrix, hence '?'.

Matching pairs of coloured (shaded) boxes located symmetrically on either side of the shaded diagonal indicate a disparity between the assessment by member x of communications with organisation y, and that of member y with respect to organisation x. While these invite further enquiry they may simply reflect the different experiences of the two people from the respective organisations.

The box entries follow the formats (numbers or text) adopted by the individual groups.

XII. Evaluation & closing remarks

Regrettably time was too short for the proposed feedback session on the group work.

Mr Kitandu examined the initial expectation cards completed by participants at the beginning of the workshop. Five of these related to learning more about grain storage (in general); three specified learning more about food security; seven specifically referred to learning more about DEs; two related to understanding stakeholder linkages; one related to hearing about the project; and four to exchanging (unspecified) experiences with others. It was agreed that the workshop had delivered something against all these expectations, albeit the links to food security are still to be realised.

Participants were invited to offer further comments on the workshop, and the following remarks were made by individuals:

- There had not been enough time to undertake the information flow exercises; it was suggested that two or three days would be needed.
- Hand-outs (in addition to the flyer) circulated in advance would also have been useful.
- Information from the Zonal Office tends not to be made available in official form, only 'unofficially' i.e. published records are often not readily available to the public, but rather information takes the form of verbal reports or hearsay, which people find unsatisfactory. (This point may be reflected in the storage information linkage matrix (Table 3), which confirms that the Zonal Communication Office relates predominantly to government agencies with little contact with the private sector, NGOs or Church agencies.
- Why were there no farmers at the workshop? (Mike Morris indicated that this workshop was designed for the intermediary users of the project's findings, but that it had been hoped that the project team would indeed learn from the participants how best to select and work with farmers. This knowledge could then be put to use in future project activities, including workshops with farmers. Time however had caused this particular exercise to be cut from the agenda. It should be noted that farmers were involved in the Aug 2001 Shinyanga workshop at which the project was developed.)
- It was interesting to learn that DEs were to be found in Dodoma and Kagera regions, but where exactly? (The answer to this question will be elaborated in a future project newsletter).

Tanya Stathers, the project leader, gave a vote of thanks to all participants.

Mr Katua indicated that he would arrange a trip for all participants to one of the trial sites, and promised that participants would receive progress reports on the project in the future.

Figure 24. Workshop in session

Figure 25. Workshop participants

XIII. Ex-post evaluation (by design team)

Key points and lessons to be learnt:

- The (design team) approach had generally worked well. The main difficulty related to setting aside enough time for the design (and evaluation) in the context of other pressing duties.

- The time allowed for the workshop (9.00 - 1.00: 4 hours) was too short to explore the themes identified for the group work, for which a whole day was probably needed to thoroughly address the (three original) themes and allow for group work presentations by the participants. Under the circumstances however, the compromise reached with respect to the two workshop objectives seemed sensible. Moreover, given the quality time spent with the participants (and the address list), follow up work on outstanding issues (e.g. how stakeholders differentiate farmers) could be further advanced through questionnaires etc.
- Timekeeping was generally good, and/or responsive to perceived needs.
- Chairing, moderation and facilitation seemed to work well. The group work would have benefited from prepared diagrams and handouts. Presentations on progress worked well and provoked interesting questions.
- Reporting seems to have worked well enough? Tanya in particular captured the questions and answers in detail. The digital camera ensured an accurate record of all written materials produced before and during the workshop, and is highly recommended for this sort of work.
- The contribution made by the participants was excellent.
- The contribution of all the IPM project staff, including support staff, was very much appreciated by the visitors.

Appendix I. Project Flyer

Small-scale farmer utilisation of diatomaceous earths during storage: Could fossil dusts be an option for increasing food security in sub-Saharan Africa?

Diatomaceous earths, are soft whitish powders formed from the fossils of tiny organisms (planktons) which live in oceans, rivers and lakes. When diatomaceous earths come into contact with insects they absorb the wax from the skin of the insect, the insect then looses water, dehydrates and dies. By mixing diatomaceous earths with grain, we can kill the insects that try and attack the grain. Diatomaceous earths have extremely low toxicity to mammals and are therefore very safe to mix with food.

Following the finding that diatomaceous earths were effective grain protectants against insect damage for small-scale on-farm storage systems in Zimbabwe, further work to evaluate these fossil dusts has been initiated in Tanzania where the larger grain borer is already widespread. The larger grain borer (*Prostephanus truncatus*) is the most destructive of the storage insect pests, causing storage losses of up to 40%. *P. truncatus* is believed to have arrived in Africa from Central America in a food aid shipment in the 1980's. The pest multiplied rapidly and caused such destruction to farm stored maize that farmers in Tanzania marched on parliament demanding help. *P. truncatus* has now spread throughout many countries in East, West and Southern Africa, but to date has not yet reached farmers stores in Zimbabwe. So although the field trials in Zimbabwe showed that diatomaceous earths could offer protection against insect attack for periods longer than 8 months, this was not in the presence of *P. truncatus*.

Farmers throughout Tanzania are known to suffer serious losses to their stored produce due to insect damage. For many people these losses threaten household food security or undermine market returns, which drives them to seek improved but affordable treatment options for their grain during storage.

In addition to many of the traditional storage protectant practices such as admixing with ash or plant materials, and funds allowing they can purchase synthetic chemical pesticides. The main one is Actellic Super dust, an organophosphate-pyrethroid cocktail (pirimiphos methyl and permethrin, respectively). *P. truncatus* is not killed by the organophosphate alone, and insects such as *Sitophilus* spp. are not killed by the pyrethroids so the cocktail is used to control the full spectrum of insect pests.

Unfortunately, since the distribution of this product was privatised, farmers have experienced widespread adulteration problems. One farmer in Shinyanga region actually managed to breed *P. truncatus* in what had been sold to him as Actellic Super dust. The government and the supplier have been working together to try and reduce these problems. New packaging displaying special symbols was issued to help customers identify the authentic product. Lists of registered pesticide distributors in each region were published to facilitate the sale of authentic products to customers.

In response to farmers' demands for alternative grain protectants, a collaborative research project - *Small-scale farmer utilisation of diatomaceous earths during storage* - was launched in June 2002. The collaborators include the Tanzanian Ministry of Agriculture and Food Security, the UK Natural Resources Institute, the University of Zimbabwe, the Zimbabwean Institute of Agricultural Engineering, EcoMark Ltd, and Diatom Research and Consulting, and the project is funded by the DFID Crop Post Harvest Programme.

The 'Small-scale farmer utilisation of diatomaceous earths during storage' project has been designed to explore and identify safe, effective and affordable treatments for rural householders. To do this community research trials have been set up in three regions of Tanzania (Shinyanga, Dodoma, Arusha) to first test and compare the effectiveness of a number of different grain protectants at protecting grain from insect damage during storage under differing environmental conditions. These initial comparative tests are being run for the 8-month storage season from July 2002 - March 2003. The treated commodities include maize, sorghum and beans. The treatments include:

- the diatomaceous earths', Protect-It® and Dryacide® at two concentrations 1g/kg and 2.5g/kg (these concentrations were chosen based on laboratory studies with *P. truncatus*)
- Protect-It® (1g/kg) in combination with permethrin (2mg/kg)
- Actellic Super dust (100g/90kg)
- Traditional local grain protectant practice, which varies between each trial site but is typically admixture of unwinnowed grain with rice husk or animal dung ash or a mixture of ash and dried plant material,
- Untreated control



These initial storage trials will be analysed for insect presence and damage on a bimonthly basis and evaluated by the communities throughout the 8 month storage period. To optimise the eventual uptake account will be taken of the manner in which different farmers (e.g. by gender, wealth) access and share storage knowledge, and of the mechanisms used by organisations to receive and disseminate information to these groups.

Those grain protectants that are found to be most effective, affordable and safe - will then be further tested by farmers in their own trials during the next storage season. This will not only confirm their effectiveness when used by farmers, but will also establish that they meet the farmers' wider requirements (e.g. their use does not involve unrealistic amounts of work or time, or effect seed viability etc).

The project believes in team-work and participation, and involves collaboration between the organisations mentioned above and: the communities of Mlali village in Dodoma region, Mwama karanga and Kishapu villages in Shinyanga region, Arri and Singe village in Arusha region; and the NGOs - Africare, Farm Africa, Care, Oxfam, World Vision and the Catholic Dioceses of Shinyanga Agriculture Programme in Tanzania.

Although the diatomaceous earths, Protect-It and Dryacide come from America, diatomaceous earth deposits can also be found in East and Southern Africa. During the first year of the project we will be testing diatomaceous earth samples from Kagera, Dodoma and Singida regions in Tanzania, and from Northern Zimbabwe for efficacy against storage insect pests. If local diatomaceous earth samples look promising they will be included in the community managed grain protection trials during the second storage season.

For further information about this work please contact:

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Appendix II. Workshop Participants and contact details

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