

CROP POST HARVEST PROGRAMME

Improvement in the Storage and Marketing Quality of Legumes (Phase II)

R7442

FINAL TECHNICAL REPORT

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ACRONYMS & CLARIFICATION

AAGDS	Accelerated Agriculture Growth and Development Strategy (Gh)
Action Aid (K)	International NGO with working office in Katakwi (Ug)
ACDEP	Association of Church Development Projects (Ug)
ADO	Agricultural Development Officer (Ug)
AEA	Agricultural Extension Agent (Gh)
AgSSIP	Agriculture Services Sector Investment Programme (Gh)
AKIS	Agricultural Knowledge Information System
AT (Uganda)	Appropriate Technology (Uganda)
CAPSARD	Community Action Program for Sustainable Agriculture and Rural Development
CIDA	Canadian International Development Agency
COORD	Client-Oriented Agricultural Research and Dissemination project (Ug)
DADU	District Agricultural Development Unit (Gh)
DAO	District Agricultural Office/r (Ug)
DDO	District Development Officer (Gh)
DEC	District Extension Coordinator (Ug)
DENIVA	Development Network of Indigenous Voluntary Associations
DFID	Department for International Development (UK)
EU	European Union
FEW	Field Extension Worker
FRI	Food Research Institute (Gh)
FSD	Food Security Department (NRI)
GoU	Government of Uganda
KADIFA	Katakwi District Farmers' Association (Ug)
KARI	Kawanda Agricultural Research Institute (Ug)
KUDFA	Kumi District Farmers' Association (Ug)
LEISA	Low external input sustainable agriculture
MACOPECA	Malera Cowpea Pest Control Association (Ug)
Matilong	Soroti-based NGO also known as MYMFO (Ug)
MoFA	Ministry of Food and Agriculture (Gh)
MYMFO	Matilong Youth Mixed Farming Organisation (Ug)
NAADS	National Agricultural Advisory Service (Ug)
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research System
NGEDEP	(Technoserve's) Northern Ghana Enterprises Development Program
NGO	Non Governmental Organisation
NR	Northern Region (Gh)
NRI	Natural Resources Institute (UK)
OVI	Objectively Verifiable Indicator
PEAP	Poverty Eradication Action Plan (Ug)
PHU	Post-Harvest Unit (MoFA, Ghana)
PM	Project Memorandum
PMA	Plan for the Modernisation of Agriculture (Ug)
PRSP	Poverty Reduction Strategy Paper
RRA	Rapid rural appraisal
RAAKS	Rapid (or relaxed) appraisal of agricultural knowledge systems
RADU	Regional Agricultural Development Unit (Gh)
SARI	Savannah Agricultural Research Institute, Tamale (Gh).
SAARI	Serere Agricultural and Animal Production Research Institute (Ug)
SL(A)	Sustainable Livelihoods (Approach)
SOCADIDO	Soroti Catholic Diocese Development Organisation (Ug)
SODANN	Soroti District Association NGO Network (Ug)
ToT	Training of Trainers
UER	Upper Eastern Region (Gh)
UDS	University for Development Studies, Nyankpala (Gh)
UNFA	Uganda National Farmers' Association
Vision Terudo	NGO working in Kumi District (Ug)
World Vision	International NGO with offices in Tamale and Gushegu (Gh)

1. EXECUTIVE SUMMARY

Resource-poor farmers tied to food crop production for survival in the semi-arid areas of Ghana and Uganda have hitherto received minimal attention from the state, and yet include some of the most impoverished and vulnerable groups in either country. The purpose of the project is to develop and effectively promote strategies that will improve the food security and livelihoods of such households.

Specifically the project has sought to address technical constraints to the on-farm storage of legumes, and to identify and improve uptake pathways best fitted to the circumstances of these poorer households. Poorer food crop farmers are currently faced with deteriorating food stocks, and are effectively excluded from the possibility of securing price premiums associated with clean grain.

Working predominantly through the Ministry of Food and Agriculture (MoFA) in Ghana and with a coalition of state researchers and extension staff, farmers' associations and NGOs in Uganda, the project engaged a mix of farmers in validating new and improved methods for post-harvest pest control. The selection of methods was already the 'best bet' options from earlier on-farm trials carried out by research and extension staff, and included monthly solarisation, solarisation at harvest then an admixture of Shea nut butter, and solarisation at harvest then an admixture of ash. All treatment methods proved better than the control, but in Ghana the admixture of ash was noticeably less successful. With this notable exception, participating farmers indicated that they would recommend the treatments. Their recommendations were however graded against a number of criteria, including cost of materials, time, effectiveness, appearance, marketability, viability, palatability and cooking time.

In parallel with coordinating the farmer-field trials the project sought to develop understanding amongst the collaborators about the different information networks available to farmers and the constraints to effective organisational linkages. This was effected through on-farm discussions and interviews with farmers and a series of more structured workshops and meetings with organisational stakeholders. The process and insights gained were integrated into the production of extension material based on the farmers' findings and tailored to take account of the needs of different groups.

The unfolding of the project processes in both countries albeit with a different set of organisational players, has helped move forward ways of working which put farmers to the fore, amongst organisational stakeholders. The knowledge and capabilities of organisations have been improved as evidenced by (improved contributions to) new projects and proposals being initiated by the respective collaborating groups. While these initiatives however seek to improve the food security and livelihoods of poorer groups, through greater involvement of farmers in the decision-making processes effecting the fit and transfer of technologies, they remain dependent on donor funds.

In Ghana use by traders of the fumigation centre in Tamale market has been successfully promoted, while MoFA has established and consolidated training programmes for traders based on earlier research findings.

2. BACKGROUND

Country information

Modest economic growth in Ghana throughout the 1990s had largely bypassed the poorer North of the country, where the proportion of people in extreme poverty¹ and the depth of their poverty continued to increase. Recent studies have confirmed that poverty and vulnerability are worst amongst households tied to food crop production, who are increasingly unable to meet their food security needs during the 'hungry' period and forced to adopt coping strategies (e.g. out-migration by male youths; liquidation of assets, including livestock and personal effects) to offset seasonal strains (ROG, 2000; Kunfaa, 1999). Moreover, improvements to life expectancy, which is deemed to have risen in Ghana as a whole from 57 to 59 between 1993 and 1998, may be under threat from the rising incidence of HIV/AIDS.

Government policy in the agricultural sector has been to support economic growth based on export agriculture through a combination of research and advisory services and progressive market liberalisation, notably in the cocoa sector. The recent Accelerated Agriculture Growth and Development Strategy² (AAGDS) devised by the Ministry of Food and Agriculture (MoFA) is underpinned by two basic tenets, namely reliance on the private sector to lead investment and economic growth, and the devolution of significant responsibilities from central government to district assemblies.

The AAGDS recognises the key role played by small-scale farmers countrywide in meeting the national food needs and producing the bulk of cocoa for export. The strategy stresses improvements in "the generation, transfer and dissemination of cost effective technologies that are responsive to the needs of farmers, but which ensure sustainability", and argues for emphasis on food security and rural employment. The intended vehicle for the strategy is the Agriculture Services Sector Investment Programme (AgSSIP), which has been developed in parallel to the Ghana Poverty Reduction Strategy Paper (PRSP). As above however, the poorest food crop farmers have received minimal attention.

Recent evidence from Uganda suggests that growth-oriented policies throughout the 1990s have contributed to widespread reductions in poverty at the household level. Some commentators however argue that these developments are simply a rehabilitation stage following the economic crisis of the 1970s and 1980s. Northern and eastern provinces in particular remain poorer than other areas and continue to be affected by insecurity. Large numbers of the rural poor in these areas are tied into subsistence production and largely outside the monetary economy (Kidd *et al.* 2001). The weak linkages between research, extension and farmers are generally acknowledged to be one of the main factors causing low productivity (NARO, 2000)

In 1997 the government initiated the Poverty Eradication Action Plan (PEAP), a modified version of which has now been accepted as a PRSP. The Plan for the Modernisation of Agriculture (PMA), is a core, sector-wide initiative for agricultural development flowing directly from the PEAP. Decentralised, demand-driven extension services, backed by public funds through the National Agricultural Advisory Services Program³ (NAADS), were heralded by the PMA in 2001. Responsibility for technology development and support is being decentralised to district and sub-county levels. Advisory services demanded by farmer organisations at sub-county level will be contracted out to private sector agencies. Whether the PMA's faith in market mechanisms for poverty eradication will reach down to those vulnerable households in the rural areas whose pattern of livelihoods is prescribed by subsistence agriculture underpinned by coping strategies, remains to be seen.

¹ Those unable to meet basic nutritional requirements even if the entire budget is devoted to food. In the North malnutrition is widespread with 30% of under fives stunted and 26% underweight (Kunfaa, 1999).

² AAGDS supersedes the sector-wide Medium-Term Agricultural Development Strategy (MTADS).

³ NAADS is largely funded by the World Bank, EU and DFID, with counterpart funding from the GoU.

Project background

This project was preceded by the first phase project, *Improvement in the Storage and Marketing Quality of Legumes, R6503*, which ran from March 1996 to February 1999 and was undertaken by NRI in collaboration with various Ghanaian agencies. The objectives of the first phase project were to identify qualitative and quantitative losses in the storage of grain legumes by small-scale farmers in northern Ghana and to develop means of reducing these losses. Its intended purpose was to contribute to improving food security and reducing poverty amongst poorer smaller-scale farmers.

Cowpea (*Vigna unguiculata* (L.) Walp.) and bambara groundnut (*Vigna subterranea* (L.) Verdc.), which play an important role in the diet and economy of many small-scale farmers in northern Ghana, were known to suffer substantial damage and loss of quality as a result of infestation by members of the Bruchidae family, *Callosobruchus maculatus* (F.) and *C. subinnotatus* (Pic). The damage that typically occurs during on-farm and market storage, is caused by the bruchid larvae (Coleoptera: Bruchidae), which hatch from the eggs attached by the adults to the seed, or also in the case of cowpea to the pod before or after harvesting. Quantification of the losses due to bruchids in Africa however had not been well documented, and on-farm damage and losses had rarely been studied (Tran and Golob, 1999).

Participatory survey work during the first phase provided data on the prevailing post-harvest situation and identified the main constraints to the storage and marketing of pulses in northern Ghana. Data relating to farmers included the quantity of cowpea and bambara typically stored, the duration of storage, the reasons why this storage is not prolonged, the extent of the damage due to insect pest, and the ways used by farmers to attempt to limit this damage. Information on the storage and marketing of cowpea by traders included the duration of storage, the extent of damage, methods of insect control, and the price fluctuations in time due to insect damage.

The project findings endorsed the view that damage due to bruchids was an important limiting factor in both on-farm and market storage. They confirmed that prevailing control methods used by farmers were largely ineffective, identified and selected new or improved methods for on-station trials, and tested the most promising in farmers' stores. Of the nine different treatments, the most effective with under 10% of damage after 2 months was hermetic storage (using sealed plastic bucket), which unfortunately was also the most expensive. Other treatments that provided some control included thermal disinfestation - solarisation - admixtures of shear nut butter, and an infusion of kim-kim, *Synedrella nodiflora* Gaertn. (Labiatae).

Damage to traders' stocks of cowpea was found to increase sharply during the first five months of storage, with an inverse correlation between damage and price for high levels of damage, but a less clear relationship at low levels. The price of cowpea was found to have a large seasonal fluctuation, suggesting that returns from storage were high, albeit they declined when the seeds were heavily damaged. Other factors influencing price were found to include location, exogenous factors (e.g. new market entrants such as relief agencies), different types of transaction (e.g. bulk selling *c.f.* small-scale transactions), and loss of quality not attributable to insect damage (discoloration, shrivelled or broken grains).

Pest control by traders was found to be either non-existent or ineffective and potentially hazardous. Safe control methods were devised and tested - fumigation with phosphine before storage followed by the use of inert dusts (Dryacide) or physical barriers (e.g. light plastic or cotton cloth sheeting) - all of which provided protection from re-infestation for five months. The success of the fumigation demonstrations led to a large scale (120 x 30 m.) facility being developed with a fumigation chamber capable of accommodating four hundred 100 kg. maxi-bags at a time. Located at Tamale market, the new fumigation centre was completed and formally commissioned in March 1999 in readiness for the 1999/2000 storage season.

The second-phase project, which is the focus of this report, was envisaged and developed as a successor to the preliminary phase. It would seek to actively engage farmers in validating new and improved methods for post-harvest pest control, identified in the first phase, as safe, sustainable and

relevant. Moreover, it would attempt to facilitate the dissemination and uptake of appropriate treatments, through developing a better understanding of the mechanisms whereby rural households secure agricultural information and promoting improved linkages between key stakeholders in these systems.

Project identification and design stage

i) The importance of the livelihood constraint/s that the project sought to address

Poorer people typically have access to less, often more infertile, land, but more crucially they have less access to, fewer or none of the key resources - labour, 'manpower' for opening land, oxen or tractors, ploughs, time or finance - essential for cultivating their holdings. In the northern savannah regions of Ghana where the natural resource base is relatively poor and prone to degradation and rainfall unpredictable, low yields and food insufficiency amongst the poor is interactively compounded by inadequate access to agricultural extension, health and education services. In the highly variable savannah zone of eastern Uganda, insecurity persists, and many of the rural poor are trapped in subsistence and coping strategies, with very limited opportunities or support for strategic changes to their livelihoods.

Many farmers in the semi-arid areas grow grain legumes both for cash and consumption. In the Kumi and Pallisa districts of eastern Uganda, for example, better-off farmers plant *improved* varieties of cowpea after the first rains (end of March, April) for seed production and sale. Many of the producers spray against pests. Harvesting takes place at the end of June, early July, and cowpea is often exported to Kenya. In the adjacent Katakwi district cowpea is mainly a food crop and production remains more traditional (i.e. using a local small-seeded variety and without the use of chemicals). Planting takes place after the first rains and again after the second rains at the end of August, beginning of September. For the latter harvesting commences in October-November. Subsistence production here, as in northern Ghana, nonetheless provides a safety net - albeit incomplete - for many rural people.

Present modes of on-farm storage fail to deter pests. Insect infestation is primarily responsible for poor quality and weight loss, which can be severe over the storage season. In Ghana insect damage may amount to more than 30 percent during on-farm storage, but farmers appear to consume or sell their cowpea when losses approach 5 percent by weight. Significant levels of damage also equate to loss of value in the market. Poorer householders presently have few effective options to help improve the storage of cowpea. Moreover, if or when circumstance determines that they sell cowpea from their store (e.g. to meet unforeseen medical expenses or school fees, cash shortfalls shortly after harvest), they are less able to realise the premiums associated with clean cowpea. Planning to take advantage of the growing premiums associated with clean cowpea and linked to scarcity value as the storage season extends, is not a starting option for the poor.

ii) Building on previous research (Phase I)

While the identification of the project followed on from the earlier phase its design sought to extend the more traditional research focus by giving farmers a greater role in the research process. This required that more account be taken of the diversity of small-scale farmers' livelihoods and the context in which they operated. Constructive suggestions from the Deputy Manager of the CPHP, Ms Karen Wilkin, between the concept note stage and production of the project memorandum, greatly contributed to this shift in thinking. Moreover the methodology explicitly involved the identification of key organisational players (i.e. the *target institutions* referred to in the project memorandum format) in the respective local agricultural knowledge information systems (AKIS). It was anticipated that a number of these organisations would be involved in the design and production of extension material and training inputs, and that dissemination and uptake would be enhanced by utilising existing linkages, and to some extent developing new ones as appropriate, within and between target organisations and farmers.

For this second phase it was proposed that work be undertaken not only in the northern regions of Ghana but also in a similar climatic zone in East Africa, namely the eastern province of Uganda, to better ensure a range of robust solutions with greater potential for wider applicability.

In Ghana the main collaborator remained the Ministry of Food and Agriculture (MoFA) in Tamale, and in particular Mr Fuseini Haruna Andan, the officer heading up the Post-Harvest Unit (PHU). In Uganda collaborative arrangements were set up with Dr Ambrose Agona, Head of the post-harvest research programme at Kawanda Agricultural Research Institute (KARI). He in turn recommended that the project specifically collaborate with the sister NARO research station of Serere Agricultural and Animal Production Research Institute (SAARI) in Soroti district, Eastern Province. Not only did SAARI have people with a suitable research experience but also it was located in an area where many people grew cowpea to meet food security and cash needs.

While the project memorandum was shared with the collaborators, time and financial constraints, and to no little extent prevailing practices within the former food security department (FSD) of NRI precluded any serious opportunity for the collaborators to do more than familiarise themselves with the proposed project design.

Incentives for collaboration in both Ghana and Uganda were (presumed to be) associated with the overlap between the project purpose, the mandated responsibilities of the respective organisations and the professional interests of their staff. To what extent these incentives are facilitated or constrained by institutional factors⁴ (e.g. leadership qualities, management practices, salary scales, career development opportunities) is less clear. By extension, motivation might also include the potential for downstream benefits associated with North-South cooperation, either with respect to organisations (e.g. future collaborative work) or for individuals (e.g. future work and training opportunities). The nature of such work also typically provides short-term tangible benefits both for the organisational domains of lead collaborators (e.g. vehicles, electronic equipment) and for individuals (e.g. on the job training inputs, per diems). The *ownership* of the project at the design stage remained effectively if not exclusively with NRI. With hindsight it appears that the project (and other research projects) was primarily viewed by many as a task with resources attached rather than as a potential learning process. To what extent the specific lack of sharing in the project design or broader systemic issues and the inertia of the status quo, inhibited collaborators from more assertively demanding an earlier, more active, role in the project processes, is unclear.

In addition to the aforementioned collaborators seven other *target institutions* are identified in the proposal for each country. Both lists were derived from the earlier experiences of NRI researchers, which in the case of Ghana included contacts developed during the first phase. The degree of systematisation adopted in the selection of these organisations is not made apparent in the original proposal, but included assessment of potential agencies by function or expertise (e.g. research, extension, trade) cross-checked against NRI researchers' working but subjective experiences⁵. While some of these organisations may have played an indirect advisory role in the design of the project, their contributions essentially commenced after the initiation of the project. Further discussion of their roles will thus be found in a later section.

3. PROJECT PURPOSE

The purpose of the project overlaps with two of the Crop Post Harvest Programme (CPHP) outputs. It is aligned with the CPHP output that anticipates *the development of strategies that will improve*

⁴ The use of the terms *institution/al* throughout this report follow the definition offered by North (1995) "*Institutions are the rules of the game of a society, or, more formally, are the humanly devised constraints that structure human interaction. They are composed of formal rules (statute law, common law, regulations), informal constraints (conventions, norms of behaviour and self imposed modes of conduct), and the enforcement characteristics of both.*" Organisations include groups, associations, offices, agencies, companies, firms; they comprise human beings, and are the visible and measurable structures associated with many institutions. *Target institutions*, as used by the CPHP, might thus be considered to refer to organisations suitably disposed and positioned to redefine the formal and informal constraints on development.

⁵ In the case of in-country research contacts these experiences had included the failure of individuals to deliver, and of parent organisations to expiate staff shortcomings.

the food security of poor households through increased availability and improved quality of cereals and pulse food crops and better access to markets. It also shares the CPHP output that anticipates *the effective promotion of these strategies to improve the food security of poor households.* Specifically it seeks to develop and effectively promote strategies that will improve the food security of those resource-poor households in rural areas who are essentially engaged in food production for their survival.

The project primarily seeks to address technical constraints to the on-farm storage of legumes, and to identify and improve uptake pathways best fitted to the circumstances of poorer rural households. Poorer people in the rural areas are currently faced with deteriorating food stocks, and are also effectively excluded from securing the premiums known to be associated with clean grain. In addressing issues directly affecting poorer individuals and groups, the research has a focused poverty aim. While the trial technologies were themselves selected in anticipation of their relevance to poorer farmers and smaller-scale operations, this does not preclude their use by other groups, say for home consumption. Moreover, the approach adopted seeks to mainline the role of farmers in better articulating their needs and selecting appropriate technologies, and in improving the fit and understanding of those state and civil society agencies who seek or are mandated to respond to farmers' demands.

4. RESEARCH ACTIVITIES

The Implementation Process

If circumstance and prevailing cultures and/or systems inhibited broader participation in the design process, the sets of strategic activities envisaged for realisation of the project outputs necessitated the identification of and active engagement of multiple project partners. While the implementation process would also reveal some of the difficulties associated with developing participatory approaches, it ensured a higher profile in the project for civil society organisations, promoted a participatory and farmer-focused approach, and encouraged reflective practices and networking amongst the partner organisations. This approach is in line with new thinking on extension, which emphasises pluralism, inclusion and empowerment in meeting people's requirements⁶.

Moreover, understanding of the circumstances of the rural communities with whom the project worked was developed over the project lifetime from a sustainable livelihoods (SL) perspective. This involves understanding that people's access to resources is constrained or facilitated by the interplay of multiple factors: endogenous factors such as social relations, institutions, and organisations; and, the exogenous factors associated with economic trends and policies, shocks such as HIV/AIDS, drought or floods, and seasonality. The unfolding of these processes, in which outcomes consolidate or deplete assets over time, charts the resilience or vulnerability of households and/or individuals in sustaining their livelihoods or merely surviving.

It was anticipated that working with and through selected organisational partners and farmers would engender broader ownership of the proposal and lead to a better fit and/or adaptation of the proposed technologies (derived in part from existing practices) to the requirements of rural householders. In turn if the knowledge, skills and technologies developed through the process were to be more relevant to farmers, then the likelihood of it being put to use locally and subsequently disseminated more widely, should increase.

The extent of the adoption of the approach itself evolved over time. Initially the process involved the NRI team in multiple exchanges with organisational partners to establish shared interest in the project's aims and approach, identify institutional differences and seek resolution of institutional constraints. With the original collaborators discussions understandably focused on the proposal,

⁶ Rather than being secured from a monolithic state system, the information required by rural people is typically secured from overlapping information networks in multiple forms (e.g. formal and informal, civil society and state sector). Inclusion provides opportunities for understanding how people learn and supporting their efforts to negotiate bureaucracies and lay claim to needed resources (ODI, 1999).

project outputs and associated activities, and their implications for organisational roles and responsibilities. Given however the approach, albeit mostly implicit in the original project memorandum, and the project's active interest in developing understanding of existing linkages and information flows - Output 2 - the operational characteristics and capabilities of the collaborating team were tested. The strategic relevance of the sets of activities identified with each output at the pre-implementation stage, which always included some overlap, effectively changed as in-country partnerships evolved and realisation of the project purpose was revisited.

Implementation in Ghana inevitably built on the partnerships and practices established in the preliminary phase and associated with other CPHP projects being led by NRI. This determined that MoFA in Tamale (Northern Region), and in particular the Post Harvest Unit (PHU), was the lead in-country collaborator. While continuity provided for ease of understanding and operational fluidity at a practical level, the precedent whereby the PHU serviced the needs of NRI *owned* research projects, essentially inhibited a more strategic role for MoFA⁷ and the development of wider organisational capacity⁸. While PHU and MoFA staff generally are familiar with the rhetoric of participatory approaches, progressive efforts to promote understanding of the link between the *processes* of implementation and strategic aims, appeared to be overwhelmed by more perfunctory organisational demands.

In Uganda this role was formally filled by the Post-Harvest research programme of Kawanda Agricultural Research Institute (KARI), with researchers at Serere Agricultural and Animal Production Research Institute (SAARI) initially providing the operational team. Visits by NRI staff were ably facilitated throughout the project by Dr Agona of KARI, who also had a specific professional interest in the validation of the treatments. SAARI's lead role in coordination and implementation at the research locations was taken over after the first year by Matilong Youth Mixed Farming Organisation (MYMFO), a local NGO with headquarters in Soroti.

The reason for this, which also has bearing on linkages between local organisations is elaborated later in the report, stemmed from the competing requirements of different donor projects on SAARI staff time, and the preferences as expressed through their actions of the researchers concerned. While with hindsight this switch appears to have ultimately benefited the project and all agencies concerned, it nonetheless caused delays and frustration, which in turn impeded the implementation of the farmer field trials. Bureaucratic concerns at the SAARI end effectively inhibited the timely transfer of project funds to Matilong and their use of the project vehicle (both already in the possession of SAARI).

That all the individuals concerned managed to cope and overcome these frustrations is commendable, and the same agencies and individuals have since cooperated in two further research projects funded under the NARO/DFID COARD project.

The outcome of changes in the planned roles in Uganda meant that implementation and monitoring of the farmer fieldwork in the two countries followed divergent courses, if not different approaches. In Ghana the execution procedure adhered more closely to a 'traditional' approach with instruction passing in linear fashion from the NRI scientist, through the regional PHU, state extension staff at the district and village level, to the farmers - albeit extensionists and farmers interacted freely with the research team when present. In terms of following protocols the farmers' work was more prescribed and the monitoring process more rigorous. Developments in Uganda meant that the approach became less one-way and more diffused. The research protocols were introduced by the NRI scientist to staff of the coordinating NGO, but demonstrations were also held with representatives of different agencies at district level. While subsequent activities involving farmers

⁷ The MoFA hierarchy, confronted with many other major operational and strategic constraints, has not to our knowledge expressed concern about the nature of these arrangements.

⁸ The post-harvest unit of MoFA in Tamale has been heavily subsidised by CPHP research projects led by NRI. While the extent to which this investment has contributed to wider organisational capacity is questionable, specific contributions have been made, most notably in terms of formal and informal training in-puts for the PHU officer.

were less rigorously monitored, the leeway may also have afforded farmers a greater sense of experimentation.

Finally, as the implementation period and processes unfolded, it became apparent that complementary focus on the central market traders, while unquestionably relevant to food security and safety issues for downstream (urban) consumers and the well-being of traders, was not key to the realisation of the project purpose with respect to the targeted rural poverty groups. Moreover the sale of cowpea by poorer subsistence farmers in the rural areas appears predominantly to be undertaken with intermediary traders, often less poor farmers with sufficient financial assets to enable them to engage in off-farm diversification. Intermediary traders do not however store the cowpea but quickly sell it on to traders further up the commodity chain. The work on larger scale fumigation technologies for traders continued at Tamale market, but the main focus has been on the farmer validation of storage technologies and promoting their dissemination.

Activities associated with Output 1: Farmer-validated series of methods for protecting stored grain legumes produced.

OVI: One set of at least three control methods available for promotion in Ghana by end of 2000 and in Uganda by end of 2001.

Two main activity sets were identified in the project memorandum with this output.

1.1 An RRA in Uganda to identify damage, loss and other constraints to grain legume storage and marketing, as well as methods used for grain protection.

From the first phase of the work in Ghana new or improved methods had been identified and selected for on-station trials, and the most promising tested by researchers in farmers' stores. Demand for this area of research had been established in a number of earlier studies in Ghana (Golob *et al.*, 1995; Brice *et al.*, 1996). In Uganda, while it was known that food security, including post-harvest issues, was a prioritised area of research for NARO (a major needs assessment for agricultural research in the Teso and Lango Farming Systems was conducted in 1998 by NARO, funded by DFID⁹), a more focused post-harvest appraisal to confirm household demand for the project had been considered necessary. The RRA in Uganda thus effectively complemented work undertaken in Ghana during the first phase.

It was conducted in four districts of the Teso and Lango farming systems of Uganda in November 1999. The project team included personnel from the collaborating research institutes (KARI and SAARI), from the district agricultural staff, two local NGOs (Matilong and Vision Terudo), and NRI personnel. The assessment utilised a farmer survey questionnaire and a rapid market assessment exercise. A total of 160 farmers in 57 villages were interviewed.

The survey identified what farmers considered to be the key constraints at different stages (i.e. between crop maturity and harvest, harvest and storage, during processing and marketing) before crops are consumed or sold. Insect damage amongst others featured prominently at all stages, and particularly during storage. The availability or cost of transport for conveying crops from the field to the store and difficulties in adequately drying crops were of major concern between harvest and storage. The market exercise characterised local produce markets and identified constraints and issues in both the marketing of specific crops and in the general marketing system. The appraisal led to a number of recommendations being made which identified areas for improvements in on-farm post-harvest technologies and the efficiency of local markets (see Goodland *et al.*, 2000).

In addition to confirming the relevance of and demand for the proposed research, the RRA provided the first opportunity for individuals from KARI and SAARI, agricultural officers from Apac and Lira districts, NGO staff (Matilong and Vision Terudo), and NRI, to work together.

⁹ See Akwang, A.A., Obuo, J.P., Okwadi, J. and Orykot, J. (eds.) (1999) Needs Assessment for Agricultural Research in the Lango Sub-Farming System - Summary Report. DFID / NARO, Kampala; and Akwang, A.A., Okalebo, S. and Orykot, J. (eds.) (1998) Needs Assessment for Agricultural Research in the Teso Farming System Main Report. NARO / DFID, Kamala.

1.2 Farmer participatory research conducted in Ghana and Uganda to optimise a range of control options for protection of grain legumes.

Ghana

Site selection for the on-farm trials by both researchers and farmers was made with the guidance of MoFA. Areas in Northern (NR) and Upper Eastern (UER) regions where a majority of households were resource-poor and predominantly tied to food crop production were considered. Communities in UER visited during the first phase, which were serviced by several NGOs, were felt by the collaborators to be subject to measures of dependency and some opportunistic behaviour. The Gushegu/Karaga district in the poorly serviced eastern corridor of NR was finally selected for the on-farm trials by researchers, and for convenience and operational reasons these sites continued to be used for the current project.

During the 1998-1999 storage season (November - June) eight treatments that had been proven effective on-station¹⁰ during the two earlier storage seasons were tested on-farm by researchers and extension agents. The work was overseen by the NRI project leader, coordinated and implemented through the PHU officer at Tamale and the district development officer (DDO) for Gushegu/Karaga district, and undertaken by the agricultural extension agents (AEAs) for the villages of Kpugi and Wantugu.

The on-farm trials continued for the 1999-2000 storage season with extensionists and researchers applying the treatments and monitoring damage monthly. After 6 months storage 3 treatments were identified by the damage record as being effective¹¹, and deemed suitable. The most effective, hermetic storage, was discounted as being prohibitively expensive.

Protocols for the farmer participatory research were developed by the NRI project leader. MoFA staff were briefed and subsequently organised the involvement of 95 farmers from Kpugi and Wantugu villages. The AEAs oversaw the selection of the participating farmers, and sought to ensure adequate representation of different families and households, and gender balance. Participation was nominally on a voluntary basis, however payments at the prevailing market price were made for the use of 20 kg. of cowpea per household.

The three identified treatments, and a non-treatment as control, were allocated randomly to farmers, who were given training in the application of the treatments by the project staff. The farmers' field trials commenced in November 2000. MoFA staff returned at monthly intervals to assist the farmers in assessing damage levels for their respective treatments, and recorded the percentage damage. The trial ran for the whole storage season finishing in July 2001.

At the end of the trial, farmers' perceptions of the treatments were recorded using an individual questionnaire. The damage data and completed questionnaires were then analysed and the aggregated findings shared and discussed with the extension staff and communities in the two villages. Some farmers tested their treated cowpea for germination at the end of the trial.

Representatives of the farmers demonstrated the treatments and presented their conclusions, in tandem with a presentation of the aggregated research findings by the project leader, to other farmers, NGO workers, MoFA regional and district staff, science teachers and researchers at the final project workshop held in Tamale on 23 April 2002.

Uganda

Partner representatives had been introduced to the proposed farmer field trials at a stakeholder workshop held in February 2000, and the idea and work plan developed at the four subsequent AKIS meetings held up to October 2000. Kumi and Katakwi districts had been identified as suitable

¹⁰ The on-station trials had taken place at SARI and MoFA, Tamale, and at MoFA, Bolgatanga.

¹¹ The effective treatments were hermetic storage, monthly solarisation initiated upon harvesting, solarisation at harvest then admixture of Shea nut butter, and the use of a plant extract, Kim-Kim. The latter treatment however, which is used traditionally on bambara nuts, discolours the cowpea. Farmers rejected it in favour of solarisation at harvest then an admixture of ash.

locations for fieldwork at the workshop and through key informant interviews. Criteria for selecting farmers (including mix of wealth status, food crop and cash crop farmers, gender balance, minimum quantity of cowpea) were refined by the AKIS team members.

An earlier work plan had featured the SAARI research team and Dr Ambrose Agona of KARI in organising and overseeing the monthly farmer field trials. Lack of progress due to the busy schedule of local researchers and the frustrations it engendered amongst those AKIS team members with closer working contact with the rural community, led however to a reassignment of roles. Matilong would organise the farmer field work with and through the district level partners, and SAARI staff would provide the technical support.

In October 2000, NRI and Matilong colleagues held further meetings with the district level subgroups. In Kumi these included the acting Agricultural Development Officer (ADO) for the Kumi District Farmers' Association (KUDFA) and the District Agricultural Officer (DAO), and in Katakwi these included the acting ADO for Katakwi District Farmers' Association (KADIFA) and the Programme Officer for Community Development at Action Aid (Katakwi). The subgroups were briefed on the training of trainers for the farmer field trials, the objectives and methodology, and the solarisation process was demonstrated. Provisional costings for the farmer field trials were undertaken. A checklist for the training of trainers (ToT) and protocols for the trials were developed and circulated by Dr Tran.

The district level subgroups subsequently identified resource people to introduce and facilitate the trials, and Matilong undertook the training sessions with four trainees - field extension workers (FEWs) or link extension farmers - in each district. In Kumi the one-day training was centralised for trainees covering different sub-counties. In Katakwi the training was repeated at two different centres. The training itself, which gave rise to a number of questions that required clarification, served as a dry-run for the subsequent trials. Four sub-counties were identified in each district, and together with Matilong staff the trained extensionists identified up to 25 participants at sites within the different locations. Six of the eight identified locations were eventually used: Acowa, Obalanga, Kuju and Toroma sub-counties in Katakwi district; and Malera and Bukedea sub-counties in Kumi District.

The initial training of the farmers proceed throughout January and February 2001 in the six sub-counties. Funds to undertake this work, including a reimbursement element for the farmers, were being supplied by SAARI to Matilong. For reasons that stemmed from the switch in SAARI's role, the disbursement of funds and hence initiation of the trials in different locations, were spread over three months. These delays ran counter to the planned research, which had envisaged the first treatments taking place as soon as possible after the harvest.

From commencement of the trials the trained extension farmers in each sub-county oversaw and collected the results on a monthly basis through to and including July (September in the case of Bukedea). Matilong staff visited the FEWS or link farmers monthly and collated the results. Researchers from SAARI and NRI undertook visits to sites in March and June 2001 respectively to monitor the implementation of the trials.

The perceptions of the farmers were recorded using a questionnaire, and the results were shared and discussed by the partner organisations and farmers at a series of subsequent meetings, including those associated with the production of extension material.

Activities associated with Output 2: Improved methods for promoting technologies developed.

OVI: Agricultural Knowledge Information System (AKIS) described and operating in the two countries by 2000; AKIS members meet quarterly to review progress and develop workplans.

2.1 AKIS identified and defined in each country; workshop conducted with stakeholders to discuss system and to introduce storage technologies for farmers; test efficiency of optimised AKIS; hold final project workshop.

The methodology adopted to realise the development of improved methods for promoting technologies included the following components, although the sets of activities differed in the two study countries.

- Organisational mapping of agencies with interest in food security issues and located in the project's operational areas was undertaken. Information was secured from briefing meetings, key informant interviews with staff and third parties, and written sources.
- A literature search and collection of AKIS material was undertaken, focusing both on information systems at different local levels and on methodological aspects.
- Group meetings and key informant interviews (together with transept walks) were held to better understand how rural people, differentiated by life cycle stage and/or social position, secured agricultural information.
- Workshops and meetings were held to share experiences and explore the linkages between different organisational stakeholders with interests in poorer rural people's food security.
- In Uganda key *target organisations*, both state and civil society agencies, with an interest in food security and the welfare of poorer rural farmers, were formed into a coalition - the AKIS team - to oversee the implementation of the project and act as a steering committee.

Ghana

The initial visit by the project leader in December 1999 involved meetings with target organisations in the Northern Region. These included civil society organisations operating in the NR and regional and local government agencies in Tamale and Gushegu respectively. A preliminary directory of organisational stakeholders was further extended and elaborated during a second visit by NRI staff in March 2000. On both occasions NRI staff were accompanied by the main in-country collaborator, Mr Fuseini Andan, of the PHU, MoFA (NR), Tamale. The relevant interests of different agencies were identified, and their linkages with farmers and other organisational players noted. Literature and reference materials were also collected or identified.

In March 2000 the two main collaborators also visited villages in the region - Fazihihine, Kpugi and Wantugu. Meetings, facilitated by Mr Sulemana Stevenson of CAPSARD¹², and MoFA staff, were undertaken with the general communities, women's groups, and individual householders; a transept walk was undertaken at Wantugu village (with the assistance of Mr Iddirisu Tia).

In September 2000 a brainstorming session was held with key MoFA (NR) staff members and Mr Sulemana Stevenson, to review organisational players in the regional AKIS network. An enquiry protocol for use with key informants was developed and further discussions were subsequently held with representatives of key local organisations. A departmental linkage matrix was constructed for MoFA.

Key target organisations were kept abreast of project developments by the MoFA collaborator, both through sharing project products (e.g. project flyers, extension material) and in the normal run of his work. They were also invited to and (most) attended the final project workshop.

Participants at the final project workshop held in Tamale on 23 April 2002, organised in stakeholder groups (i.e. collaborating farmers, other farmers, international and local NGOs staff, members of RADU and DADU, researchers, science tutors and the press) completed a series of tasks. These included constructing Venn Diagrams to indicate the diverse linkages experienced by different stakeholder groups, exploring the nature of linkage and identifying indicators for good and bad relations, drafting linkage matrices, and identifying effective ways by which the research might be better disseminated.

¹² CAPSARD is a Tamale based NGO involved with extension and training inputs for farmers, and in brokering or facilitating linkages between farmers and external agencies; it was also a founder member of the Northern Ghana LEISA working group. Mr Sulemana Stevenson provided facilitation inputs throughout the project.

Uganda

In February 2000, NRI and SAARI staff visited target organisations in Kumi and Katakwi Districts. These included the District Agricultural Officers (DAOs), extension staff, and field extension workers, key NGOs engaged in agricultural and food security - Action Aid, Katakwi, and Vision Terudo, Ngora, amongst others - and representatives from Kumi District Farmers' Association (KUDFA). Discussions were also held with expatriate and local staff of the NARO/DFID Client-Oriented Agricultural Research and Dissemination (COARD) Project at SAARI. Visits were also undertaken with SAARI and Matilong staff to villages in Katakwi and Kumi districts, and meetings held with men and women's groups.

Representatives of those target organisations visited were invited, together with other stakeholders and existing collaborators, to a workshop held in Kumi town on 17 February 2000. The primary objective of the workshop was to explore linkages, and differences in the perception of those linkages, between farmers, extension agents and the research community. Secondary objectives of the workshop were to explore local perceptions of poverty and to secure additional information on the study area. The workshop was attended by farmers' representatives, district level extension staff, NGO representatives, and researchers from SAARI and NRI. Assessments made by single stakeholder groups (i.e. farmers, extensionists, and researchers) of the respective linkages between each other graphically demonstrated significant differences in their perceptions. Linkages with the research community were notably viewed by the farmers present as being 'non-existent'.

These revelations prompted adjustments to the proposed collaboration team, and a broader coalition of organisations was formed to appraise and steer the on-going research, to develop a better understanding of local AKIS, and to promote greater farmer participation. The extended coalition comprised representatives from farmers' associations, NGOs and the DAOs for the two study districts, from the NGO Matilong which with NRI had facilitated the February workshop, researchers from SAARI and from the NARO/DFID funded Client-Oriented Agricultural Research and Dissemination (COARD) project, and from NRI (see Figure 1).

The 'AKIS' team: NGOs, Farmers' Associations & District Extension Agents representing Katakwi and Kumi districts respectively (outer ring)



Figure 1: The 'AKIS' team in Uganda

Mr Herbert Okurut-Akol, a senior research scientist from SAARI was confirmed as team leader, with John Obuo, a SAARI research officer, selected as secretary. Formal representation by the

COARD project was particularly relevant, as plans existed for the project to undertake various studies relating to AKIS in the Teso and Lango Farming Systems and expatriate members, Mr David Rees and Ms Abigail Mulhall, had expertise in this area.

Coalition members, referred to as the AKIS team, met on four occasions in 2000¹³. Agenda items included reviewing issues raised at the February workshop (e.g. re stakeholder linkages), developing a common understanding of AKIS in theory and on the ground, preparing protocols, identifying criteria for selecting farmer participants, and drafting work-plan and budgets for the farmer field trials.

At the fourth meeting in October 2000, concerns were expressed about the quality of team communications, planning and resource management. The majority of members, who were based either in Katakwi and Kumi, were eager to promote the start of the farmer participatory trials, and felt that the SAARI focus (i.e. re coordination, meetings, resources) was unnecessarily hampering progress. SAARI had originally been identified (by Dr Ambrose Agona at KARI) and designated as the lead collaborator for the farmer field trials, and subsequently been resourced (finance and transport) to carry forward the project activities. It had also however become the base for the NARO/DFID COARD project, which in turn had sought the services of Herbert Okurut-Akol and his research team, to underpin their establishment¹⁴. The demands of the two projects were proving too much for the SAARI scientists, and unsurprisingly the latter, larger project with its resident expatriates, multiple demands and resources, commanded their greater interest.

By mutual agreement the leadership of the team was passed to Stephen Ecwinyu of the Soroti-based NGO, Matilong, who subsequently coordinated the implementation of the farmer field trials (see activity 1.2). While activities associated with the farmer participatory research were now largely focussed within the two study districts, dialogue continued between members with Matilong staff visiting the sub-teams on a monthly basis from October 2000 until July 2001. The leadership episode however - the disquiet of non-research team members, and researchers concerns that their role¹⁵ (and associated benefits) was being usurped - temporarily dented the level of cooperation and technical support between the SAARI research team, Matilong, and the implementation teams in the respective districts, during the farmer field trials period.

In parallel with these activities, Matilong with support from NRI, was developing a project proposal for the participatory development of related extension materials appropriate to the needs of specific groups of farmers (e.g. poorer and non-literate farmers), to be submitted for COARD funding (see activity 5.1). The project partners included the participating farmers and the existing AKIS team stakeholders (i.e. KUDFA, Vision Terudo and the DEC in Kumi district, KADIFA, Action Aid and the DEC in Katakwi district, SAARI and NRI). The proposal design commenced in October 2000, funding was approved for its commencement in April 2001, and it is currently in its final reporting stage. With their overlapping interest in the well-being of farmers, this new project provided a further incentive and focus for on-going interaction between the original coalition members.

Activities associated with Output 3: Validated methods for improving commodity storage by traders.

OVI: Guidelines for best practice trade pest management produced by end of 2001.

3.1 IPM methods developed and optimised for trader storage.

3.2 Fumigation facility's operations monitored, modified and promoted.

¹³ NRI staff attended the first and last meetings in February and October 2000, respectively.

¹⁴ The NRI project leader had been unaware of the COARD project's imminent arrival when first forging the links with SAARI.

¹⁵ While not substantiated here the subject is topical and we have heard several researchers (North and South) express concern that other agencies or stakeholders are undertaking research previously undertaken by themselves. At the final workshop in Ghana local researchers expressed dissatisfaction (in private) that MoFA had been engaged in this research project. Their concerns included issues of training and function, but equally they felt that limited resources earmarked for research/ers were being poached by non-researchers.

In 1999 safe control methods¹⁶ devised and tested during the first phase were put into practice at the newly commission fumigation centre located at Tamale market, northern Ghana.

In December 1999 the first phase project leader, Dr Peter Golob, visited Tamale to assess progress with the fumigation centre at Tamale market, to identify ways to optimise its function for traders; and to make an *ad hoc* assessment of traders' reactions to the fumigation facility.

In 2000 and 2001 two technicians were employed and trained (in tandem) to carry out the fumigation at the centre, to monitor its use and effectiveness, and to promote the use of the facility with traders.

Good practice guidelines were developed in 2001 and used to underpin on-going training sessions held by the PHU officer with groups of traders.

In 2001 MoFA and NRI were also commissioned by Technoserve to assess the potential for locally manufactured polyethylene tanks (3,000 and 4,000 l.) to be used as micro warehouses. Trials were initiated to establish optimal systems for in-tank fumigation and establish associated good practice (see Tran *et al.*; 2001).

Activities associated with Output 4: Mechanisms for providing technical and financial support to traders developed.

OVI: Training programme for traders established by 6/2001; mechanisms for credit provision identified by end of 2001.

4.1 Financial and technical support system for traders defined; workshop for stakeholders conducted; and support system initiated.

An on-going dialogue was maintained throughout the project lifetime by MoFA and visiting NRI staff, both with members of the market traders association and with the Municipal Chief Executive. MoFA's Regional Director was kept abreast of discussions by the PHU officer.

Changes in the operation of the fumigation centre were instigated by MoFA to take account of the growing appreciation and utilisation of the facility by traders, and to minimise running costs. An additional structure was built at the centre to accommodate the demands of the market traders association.

Based on the good practice guidelines, the PHU officer organised and carried out training sessions with groups of traders in Tamale during 2001 and 2002.

In July 2002 the PHU officer designed and carried out a survey of about 100 traders using the Tamale market, including those making use of the fumigation centre. The objective of the survey was to establish the degree of satisfaction amongst traders with the support provided them by MoFA and the contributions associated with this project, most notably the fumigation centre. Information about where they source their produce from, the scale of their enterprises, and from where they secure credit was also requested.

MoFA staff facilitated linkages between traders and the international NGO Technoserve. MoFA, together with NRI, had been commissioned by Technoserve to undertake fumigation tests on polyethylene tanks (see Tran *et al.*; 2001) which were being trialed as micro-warehouses for rural entrepreneurs. The remit of Technoserve's Northern Ghana Enterprises Development Program (NGEDEP) includes assistance for traders and entrepreneurs to secure finance from the banks.

Activities associated with Output 5: Extension material produced.

OVI: Extension material produced for farmers in Ghana from end of 2000 and in Uganda from end of 2001; training material for traders available by middle of 2001.

¹⁶ Fumigation with phosphine before storage followed by the use of inert dusts (Dryacide) or physical barriers (e.g. light plastic or cotton cloth sheeting) - see Tyler and Andan (1997).

5.1 Training material produced

Ghana

In September 2000 NRI staff discussed current extension methods and the production of material suitable to the needs of subsistence farmers generally, and marginalised groups in particular, with Francis Abdulai Neindow of the Extension Services Department, and Vivian Dartey of the Women in Agricultural Development Department, MoFA (NR).

Initial drafts of material (graphics and narrative) for extension workers, vetted for content by UK-based extension and storage specialists, were shared with these and the following groups, and their reactions, comments and criticisms noted:

- Regional MoFA staff in Tamale offices.
- Sulemana Stevenson of the NGO, CAPSARD (who subsequently produced a local language - Dagbani - version of the text.
- District extension agents in Gushegu (who suggested there was a need for two versions of the booklet: one with extensive information (including background on cowpea, and cowpea storage), for extension staff, and one simpler version, with minimal text, as an aide-memoire / guide for farmers.
- Farmers from Kpugi and Wantugu villages involved in the on-farm trials.

All observations, but particularly the farmers' comments on the illustrations, were used to upgrade the initial draft extension material. A modified draft was pre-tested with sample groups of marginalised farmers and a final set of alterations incorporated. Discussions were also held with farmers about the appropriateness of other media.

Group work undertaken by participants¹⁷ at the final project workshop held in Tamale on 23 April 2002, included identifying effective ways by which the research might be better disseminated and exploring opportunities for and constraints on effective linkages between different stakeholders.

Uganda

In Uganda, Matilong with support from NRI, developed a project proposal for the participatory development of extension materials appropriate to the needs of specific groups of farmers (e.g. poorer and non-literate farmers), for submission to the COARD project for funding. The design was shared and developed with the existing AKIS team stakeholders (i.e. KUDFA, Vision Terudo and the DEC in Kumi district, KADIFA, Action Aid and the DEC in Katakwi district, SAARI and NRI), who in turn introduced the concept to farmers participating in the trials.

Funding was eventually secured in April 2001¹⁸. NRI's design contributions included running training sessions on sustainable livelihood approaches, concept note development and logical frameworks, methodological inputs, project planning inputs, and promoting and facilitating the coalition. These inputs were viewed (and funded) as integral to the realisation of output 5.

The new project sought to develop extension material both appropriate to the needs of target groups and to their information networks. The outputs included the development of material specific to the validated cowpea storage technologies, and understanding of a participatory but disaggregated approach to working with farmers. It flowed from output 2 of this project, building on the multiple interactions with farmers and the findings of the farmers' questionnaire.

Strategic activities included:

- Identification and selection of local artists, journalists, radio station personnel.
- Literature search and review of extension material production practices.
- Review of local extension production practices.

¹⁷ Collaborating farmers, other farmers, international and local NGOs staff, members of RADU and DADU, researchers, science tutors and the press.

¹⁸ COARD project TPF 84: *Farmer participatory development of extension materials: Improvements in the storage of cowpea.*

- Survey of participating farmers' perceptions.
- Visits and key informant interviews with apex agencies involved in extension material production (e.g. UNFA, Faculty of Agricultural Extension/Education, Makerere University, DENIVA, Ministry of Agriculture).
- Participant workshop to reflect on the activity sets' findings, to link and prioritise media to the needs of different groups.
- Generation, pre-testing and production of extension materials.

The production of the *Final Technical Report* synthesising lessons learnt is currently being drafted by Matilong staff.

Summary of lessons learnt

Those activity sets that were more tightly prescribed, followed established working practices, and were undertaken by people familiar with them (e.g. on-farm trials by researchers), allowed for better monitoring and were readily accomplished. However, in this project the nature of the outputs and implementation process involved players in undertaking activities that were not necessarily familiar to them (e.g. Matilong in Uganda), and/or with which they were not customarily associated (e.g. the farmers' involvement in the field trials). Under these circumstances, while monitoring and maintaining the quality of research products proved more difficult, the unfolding of the process itself was intended to and provided opportunities for lesson learning. At the final workshop in Ghana for example, farmers' responses to questions about their findings suggested a finer appreciation of the research process than the researchers had hitherto realised.

Working in two countries and the effective staggering of activities between Ghana and Uganda, together with the particular in-country 'push and pull' factors, allowed or invited greater flexibility of approach. In particular the experience gleaned in Ghana with respect to different activity sets could be used to inform partners and the implementation process in Uganda, and to a lesser extent in reverse.

Engagement with the project activities (e.g. demonstrations, workshops, meetings) was characteristically undertaken with great enthusiasm by the vast majority of stakeholders - smallholders and organisational players. Many agencies however were weak in practical organisational skills, particularly those associated with record keeping¹⁹ (e.g. recording, writing-up, filing) and timely communications. Similarly most agency staff had minimal training in planning and computer skills, which were as a result somewhat weak.

The financial significance of *per diems* to the livelihoods of individuals directly, or as a resource for managers to secure and bolster team moral, was problematic for some state service providers²⁰. Decision-making around work plans, roles and responsibilities may be unduly influenced by *per diem* considerations. The implications may be worse where a more inclusive approach, involving a greater mix of individuals of different organisational and societal status, is sought.

Promoting appreciation of, and recording and evaluating *process*, were challenging. Time spent seeking to transcend the rhetoric of the project principles, or formalising methods for sharing and mutual lesson-learning, and developing strategies for capacity building, was understandably not always welcomed by people with busy agendas. Coalition building and information sharing appeared to run counter to *tradition* amongst some NGOs, where hitherto they may have felt themselves in competition (e.g. for funds, constituencies). Some researchers expressed territorial concerns with respect to non-researchers.

The capacity of some agencies to deliver was impeded by staffing issues. Competent staff looking for further qualifications (or head hunted) sought secondments; the performance of others was impeded by lack of training and often interrupted by family responsibilities, notably ill-health. One colleague died during the project period.

¹⁹ By contrast the record keeping of individual farmers was sometimes exemplary.

²⁰ In the general case the issue can and does relate to both local and expatriate personnel.

The remote management (i.e. from the UK) of more inclusive projects with only occasional visits throughout the year, is not an optimal situation. In addition the dramatic events at NRI, which caused the original project leader to be made redundant, temporarily disrupted the strategic and practical management of activities.

5. OUTPUTS

Output 1: Farmer-validated series of methods for protecting stored grain legumes produced.

OVI: One set of at least three control methods available for promotion in Ghana by end of 2,000 and in Uganda by end of 2001.

Ghana: Farmer participatory trials in 2000-2001

Ninety five farmers from the villages of Kpugi and Wantugu, in the district of Gushegu/Karaga, were randomly allocated and applied three treatments and a non-treatment as a control. These treatments were based on the three most effective control methods over six months, established by researchers and extensionists on cowpea stored by farmers during the 1999 – 2000 season:

- Solarisation monthly. To improve the effectiveness of the method the treatment is repeated every month during the storage season.
- Solarisation at harvest then admixture of Shea nut butter.
- Solarisation at harvest then admixture of ash.

i) Researchers' assessment of the effectiveness of the treatments

The average damage, as recorded by researchers and extensionists on a monthly basis, for each of the treatments at the end of the farmers' field trial is shown on the following chart (Figure 2):

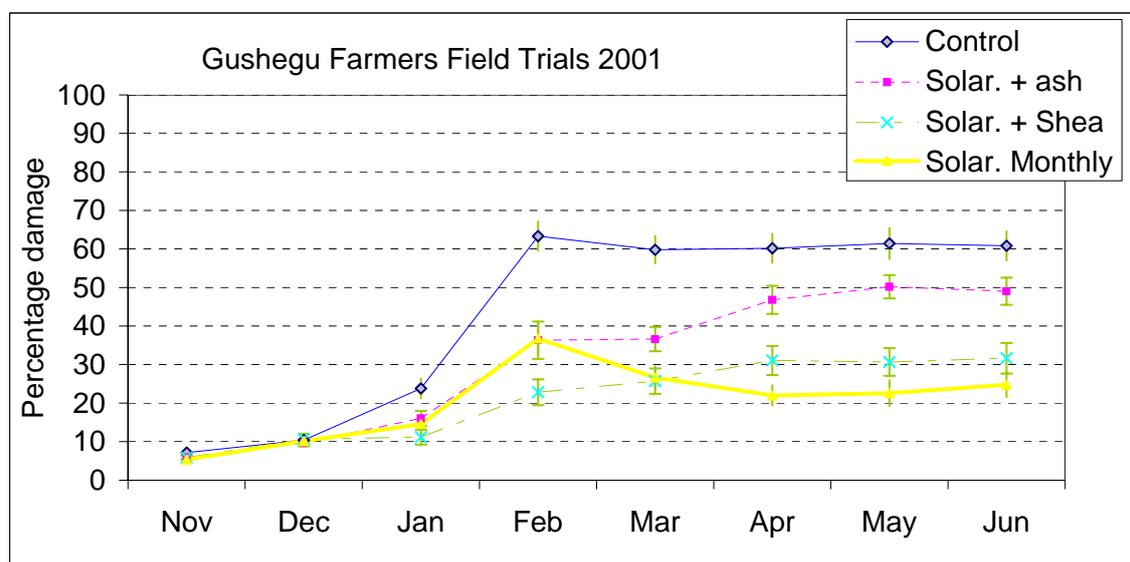


Figure 2: Average percentage damage (with SEM) over the 2000-2001 storage season

ii) Farmers' assessment of the treatments

At the end of the trial, farmers' perceptions of the treatments were recorded using an individual questionnaire. The results of the questionnaire were then shared and discussed with the two participating communities. Figures 3 and 4 below show the answers given to the questions: "What do you think of the treatment you have used?", and "Would you use the treatment again after the trial, or recommend it?". The number of positive answers are shown above the horizontal axis, the number of negative answers below.

Figure 3: What the farmers thought of the treatments they had used

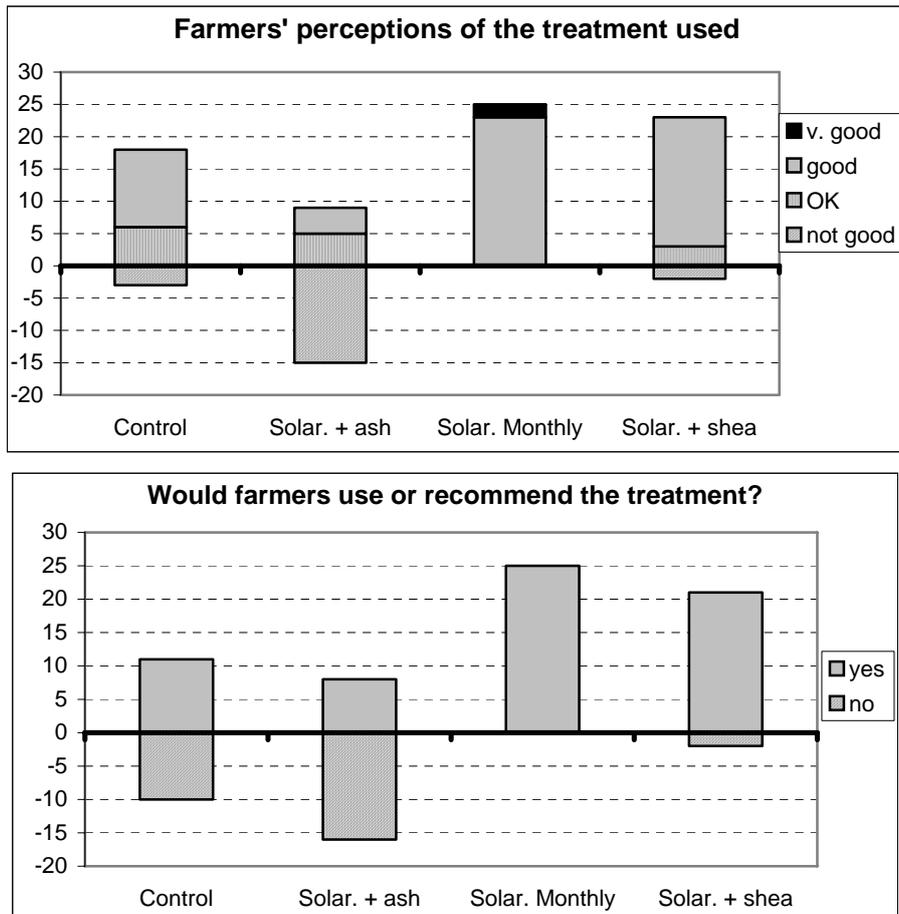


Figure 4: Would farmers use or recommend the treatment?

Farmers were invited to test their cowpea for germination at the end of the trial. The results were positive, as shown in Figure 5 below. The histograms show the percentage germination, with the number of farmers involved superimposed. The horizontal lines indicate the ranking assigned by farmers to germination as a criteria for assessment.

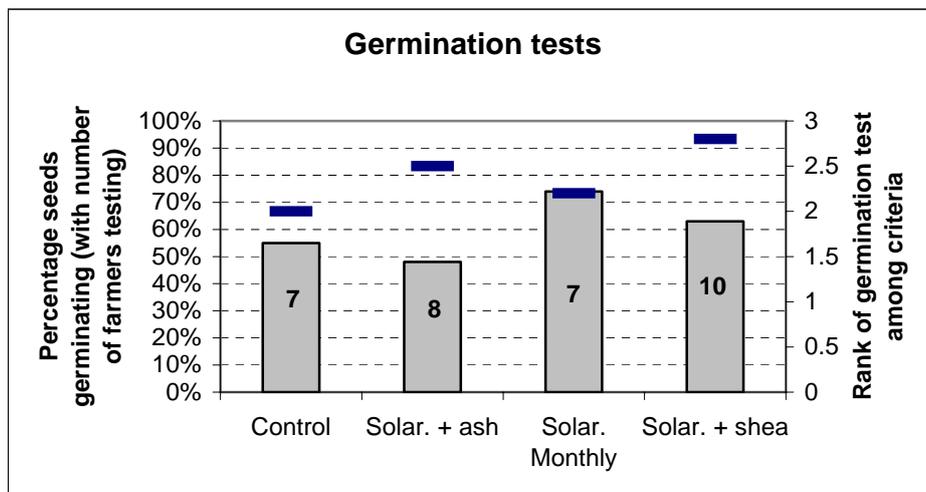


Figure 5: Percentage germination and farmers' ranking of germination as an assessment criteria

For each of the treatments and the control, farmers specified which criteria (in positive or negative) they used to judge the value of the treatment they had applied. The criteria used were (from left to right on the Figures 6-9): affordability of the materials, time involved, effectiveness, appearance of the cowpea, marketability, seed viability, palatability and cooking time:

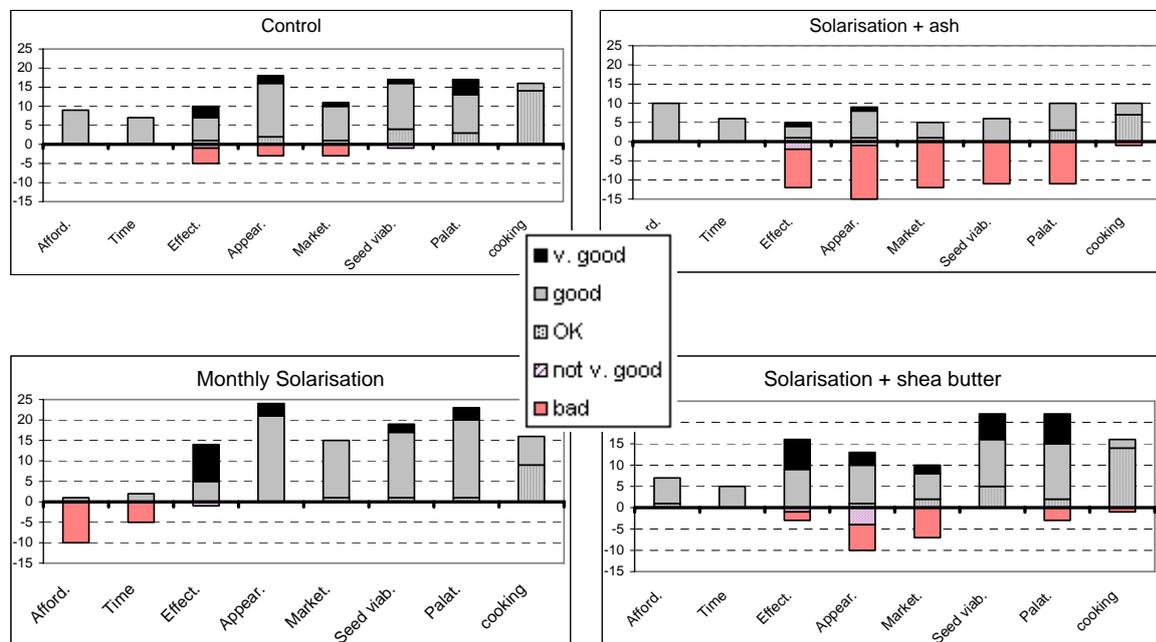


Figure 6-9: Farmers' criteria for ranking treatments

The results from the questionnaires were:

- Solarisation repeated monthly is the best treatment, its only drawbacks were perceived to be its cost, and for some respondents, the time involved.
- Solarisation followed by admixture of shea nut butter is also good but not for marketing purposes; the seed viability was liked.
- Solarisation followed by admixture of ash was rejected, on almost all accounts.

iii) Farmers overall conclusions

These results were shared and discussed with the communities, and their conclusions were:

Solarisation repeated monthly is a very good treatment. Most farmers want to use it to protect their cowpea. The two perceived drawbacks, namely cost and time, were discussed extensively.

Women said that the time involved would not be a hindrance, as they can keep an eye on the cowpea during solarisation whilst doing other household duties like cooking, washing etc.

The cost was discussed in terms of a cost-benefit analysis: the profit to be made by selling cowpea in June or July, when it is scarce and therefore expensive is at least 100% of the lowest price at harvest. It was found that an investment of 15% of the expected profit would secure the material necessary for solarisation, and all farmers agreed that this was a very worthwhile investment.

In both villages, farmers decided to purchase the materials themselves to treat their cowpea for the next storage season, and requested that project staff would come back to the villages to provide advice if necessary.

Solarisation at harvest followed by admixture of shea nut butter is a good treatment, but because of the appearance of the cowpea, it cannot be used for marketing. Farmers said that the treatment was however very good for seeds, as the germination was high in their tests, and some even liked the

taste of the cowpea (shea nut butter is also traditionally used for cooking). The conclusion was that for treating small quantities of cowpea that will not be sold, this treatment is good.

Solarisation at harvest followed by admixture of ash was rejected as it did not protect the cowpea.

Uganda: Farmer participatory trials in 2000-2001

One hundred and fifty farmers from 6 sub-counties in the districts of Kumi and Katakwi took part in on-farm trials in the season 2000-2001. In these districts of eastern Uganda (the second) harvest commences in October-November. As in Ghana the same three treatments, with a non-treatment as a control, were allocated to and applied by farmers. Unlike in Ghana however, their training was undertaken by the staff from the coordinating NGO, Matilong, with previously trained FEWs and/or link extension farmers.

Some further departures from the Ghanaian protocol must be noted:

- Farmers undertook the assessment of the damage themselves, under the supervision of the FEWs and/or link farmers, selected by the district farmers' association, agricultural office or local NGO.
- Treatments did not commence directly after harvesting but were applied between January and February, depending on the locations. This followed delays in the organisation of the training and the securing of plastic sheeting.
- The exact treatments protocol was not followed as closely as in Ghana. A few farmers did not follow the recording procedures, but more interestingly a number of farmers took to cleaning or winnowing the cowpea after each monthly assessment of the damage.

The overall results (Figure 10) nevertheless clearly show the impact of the treatments:

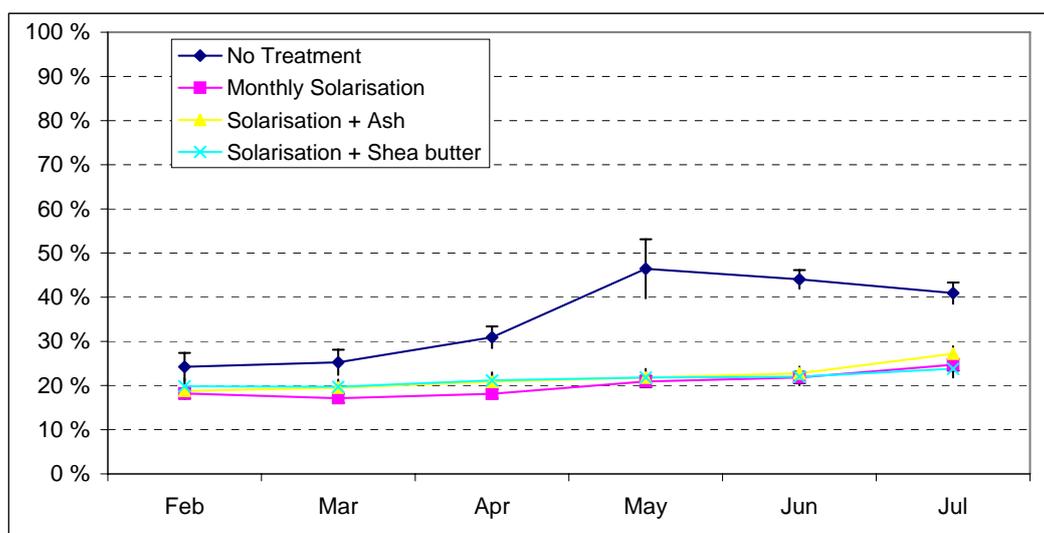


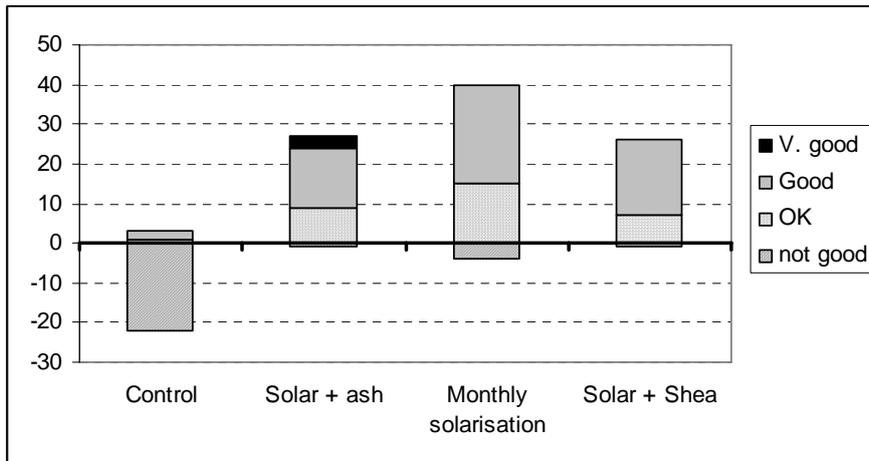
Figure 10: Average percentage damage (with SEM) over the 2000-2001 storage season

Farmers' perceptions of the treatments were recorded using a questionnaire similar to the one used in Ghana. The main results are presented below.

Most of the farmers who took part in the trials responded to the questionnaire (124/150). When they were asked to rank the treatment they had been allocated as 'not good', 'OK', 'good' or 'very good', the results were broadly similar to those obtained in northern Ghana, with two main differences:

- The non-treatment used as a control was perceived to be overwhelmingly 'not good' (in Ghana, it was perceived as acceptable)
- Solarisation then admixture of ash was perceived as being good (in Ghana it was perceived as unsatisfactory. In both cases, farmers perceptions were in accord with the damage recorded)

Figure 11: What the farmers thought of the treatments they had used



When asked whether they would use themselves or recommend the treatments to other farmers, the answers were similar to those obtained in Ghana, with the notable exception that farmers who had tested solarisation followed by admixture with ash said that they would use or recommend this treatment (Figure 11).

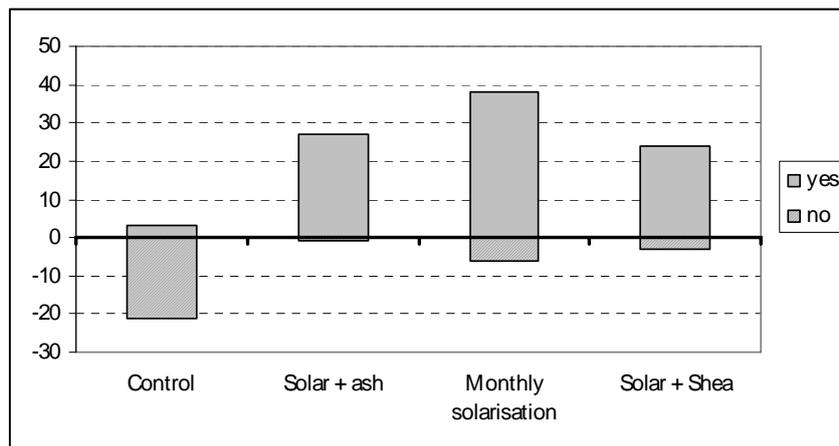


Figure 12: Would farmers use or recommend the treatment?

Farmers' feedback will be further analysed, but initial comments indicate that farmers recognise the effects of the three treatments. Solarisation was generally held to be good with respect to germination, marketability, and cooking times (normal), with positive remarks made by some for time and affordability. Some concern was however expressed about effecting solarisation during the rainy season, and about its suitability for treating larger quantities. The sourcing of plastic sheets was noted as a problem.

Solarisation followed by an admixture of ash was held to be good against most criteria - affordability, time, effectiveness, appearance, marketability, viability, palatability and cooking times - but not recommended for larger quantities.

Solarisation followed by an admixture of Shea nut butter was deemed favourable with respect to time taken, effectiveness and viability. The change of appearance it affected ('brown and oily') was deemed to reduce marketability however, and many claimed it prolonged cooking times (45 ⇐ 60 minutes). Its palatability was contested by some while others suggested that sand particles adhered to it giving it a gritty texture. The 'oiliness' was deemed to impede grinding, drying and transportation. Moreover Shea nuts were not readily available in Kumi district.

In the main farmer validation was effected for two and three treatments respectively in Ghana and Uganda. In Ghana there was greater rigour and investment in the science resulting in higher quality data outcomes, and a knock-on effect for Uganda. Following the success of the work in Ghana, the quest for scientific rigour in Uganda was subsumed by a greater focus on process (particular with respect to output 2). This in turn may have led to farmers (and organisers) there having a greater hand in the experimentation process and feeling free to improvise around the treatment protocol.

Output 2: Improved methods for promoting technologies developed.

OVI: Agricultural Knowledge Information System (AKIS) described and operating in the two countries by 2000; AKIS members meet quarterly to review progress and develop work plans. By the end of the project the main collaborators in both countries had played an active role in promoting farmer participatory research, developed understanding of the different linkages and information networks used by diverse stakeholders, and been actively involved in developing extension material appropriate to the needs of different categories of farmer (see Output 5).



Figure 13: Inception Workshop held at Kumi 17 February 2000 - Linkages between farmers, extension agents and researchers

The methodology adopted (as exemplified in Uganda) was essentially that of action-research, placing the emphasis on interaction, and action and reflection, rather than engaging in more objective hands-off research²¹. At a series of workshops (Figure 13) and ‘AKIS’ meetings, using various participatory techniques (see Figures 14 and 15), project stakeholders and/or coalition members explored the concept and reality of information networks, and the conditions which determine good and bad organisational linkages.

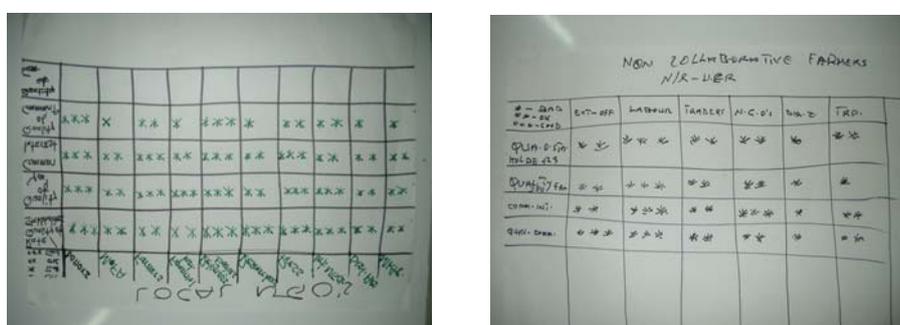


Figure 14: Linkage Matrices from a Workshop in Tamale, 23 April 2002

²¹ In Uganda the COARD project already had plans to scope agricultural information systems in the Teso and Lango Farming Systems (see Turrall *et al.*, 2002).



Figure 15: Venn diagrams from a Workshop in Tamale, 23 April 2002

In Uganda the project ‘AKIS’ team has been successful in securing further funding from the COARD project for a proposal promoting participatory monitoring and evaluation²². The coalition has also expanded to include stakeholders - target organisations - operating at the national-level (e.g. NARO Outreach; Faculty of Agricultural Extension/Education, Makerere University; DETREC). From the recent two-day inception meeting held in July 2002, it would seem that this project is set to provide an additional focus for inclusive interaction between farmers and target organisations.

While the process has been less dynamic in Ghana, the PHU officer and main project collaborator is currently playing a central role in the new CPHP coalition in Northern Ghana.

Output 3: Validated methods for improving commodity storage by traders.

OVI: Guidelines for best practice trade pest management produced by end of 2001.

A hundred traders from Tamale market were interviewed by MoFA staff during the first two weeks of July 2002 and a questionnaire completed. The traders identified themselves according to 3 categories describing the size of their business: Big, Medium or Small.

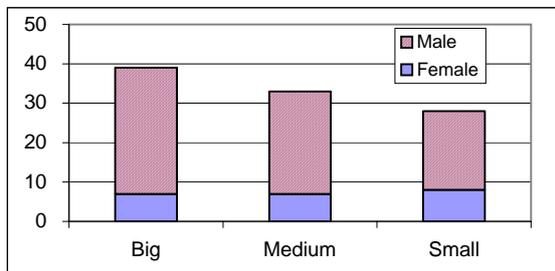


Figure 16: Number of traders in 3 size categories (gender differentiated)

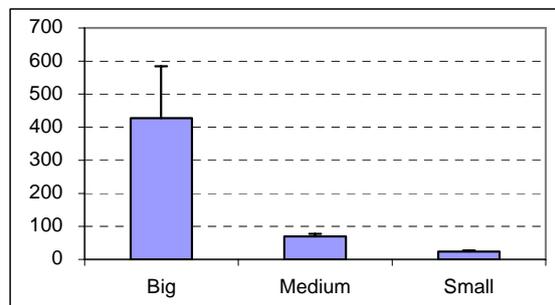


Figure 17: Average number of 100 kg bags stored, for each Trader category (with SEM)

²² COARD project TPF 2012: *Farmer participatory assessment methodologies to improve identification, development and transfer of poverty reducing technologies.*

With only 22 of the traders being female, there was a marked gender bias towards male traders in the sample interviewed, which supports the common perception that more men than women will engage in large scale trading on Tamale market.

A clear distinction appears between 'Big' traders with an average of 427 bags stored in the current year, and the Medium and Small traders with averages of 70 and 24 bags respectively.

Treatment of grain for storage.

The largest proportion of traders (41%) now use fumigation at the fumigation centre to disinfect their grain. 5 traders declared relying on Food Distribution Officials for the treatment of their grain. 20 traders store without applying any treatment, the rest will either use traditional methods (15 traders, using mainly powdered chilly pepper and wood ash, but also additional sun drying or 'kanfa'), or insecticide application (19 traders) – see Figure 18.

The insecticides used are mainly Actellic, as recommended by MoFA, or unknown chemicals sold on the market, from dubious origins. Alarming 9 traders reported using the widespread technique of wrapping phostoxin fumigation tablets in cloth before inserting them in bags (*cf.* the report to Technoserve by Tran et al, 2001). This technique is both ineffective and dangerous, as the gas is released straight through the fabric of the bags (either woven polypropylene or jute sacks) into the surrounding atmosphere. The required 7 days exposure to high concentration of gas is not attained and the pest are not killed. The practice however endangers the health of people in and around the traders' stores.

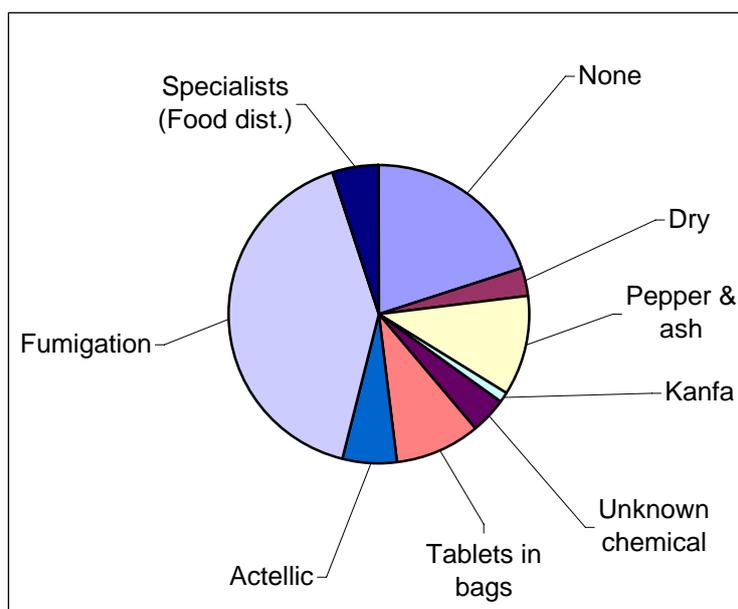


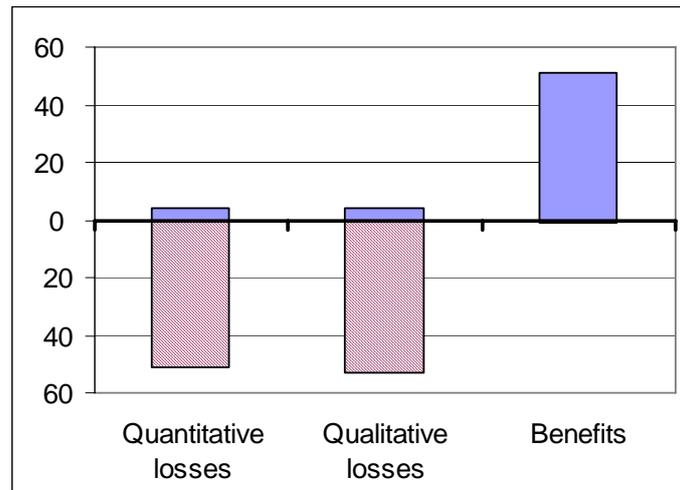
Figure 18: Methods of treatment applied by traders

The impact of the fumigation centre.

Of the 100 traders interviewed 98 were aware of the fumigation centre, 81 of them had visited it, and 53 had used it since its opening.

These traders had fumigated on average 122 bags (45.92 SEM). The minimum number of bags fumigated by trader was 10, the maximum 2000. Figure 19 below illustrates the positive perception that traders who have used the fumigation centre have of it. They were asked (1) if they experienced quantitative losses following fumigation, (2) qualitative losses, (3) if they think they enjoyed benefits out of the fumigation. The observed benefits included 'good market', 'good conservation', 'good price' and 'I learnt about fumigation'. Bars above the horizontal axis correspond to positive responses, bars below to negative responses.

Figure 19: Traders perceptions about fumigation



The best practice guidelines, which have underpinned MoFA's training initiatives with traders are annexed to the *Report on improvements in grain storage for traders, 1999-2002* (Andan *et al.*, 2002), together with the full analysis of the traders questionnaire.

Output 4: Mechanisms for providing technical and financial support to traders developed.

OVI: Training programme for traders established by 6/2001; mechanisms for credit provision identified by end of 2001.

Training provided by MoFA on good storage hygiene and pest control.

Initiated during the first phase but since elaborated, the training of traders has been done twice a year in November and December-January over the past 4 years (1998-2002).

The first training and demonstrations were undertaken by Mr. Peter Tyler assisted by Mr Fuseini Andan of the PHU (see also Tyler and Andan, 1997). Dr Tran and Mr Fuseini have since trained two technicians specifically to oversee the fumigation centre and promote its use and MoFA's training inputs to local traders.

Throughout this period, MoFA records show that 500 traders have received training in good storage hygiene and pest control, together with approximately 100 MoFA employees, and 180 students from the university (UDS) and polytechnics.

From the July 2002 questionnaire 37 of the interviewed traders had received training from MoFA; 8 of them found it useful, and the remaining 29 found it very useful. When asked if they had understood everything covered in the training, 30 said yes, but 7 said that they had not. The most common problem was about the fumigation technique itself, and particularly the mode of action of the gas (see Andan *et al.*, 2002).

NRI staff and the PHU officer have also provided technical assistance to a large-scale pilot trial initiated by Technoserve on the use of modified plastic water tanks for the storage of cowpea in northern Ghana (see Tran *et al.*, 2001).

As already indicated the project's primary targeted poverty groups were resource-poor inhabitants in the rural areas, who are mostly if not totally unaffected by improved storage hygiene and pest control in central markets. The unfolding of project processes reinforced this focus, and thus to some extent the development of support mechanisms for traders was sidelined. That said however, MoFA (and NRI) has maintained a dialogue both with the market traders association and with the municipal chief executive for Tamale, and as above traders have both received training from MoFA and are increasingly using the fumigation centre. Constraints to further development (and any exit strategy

for MoFA re the fumigation centre) have included the change of chief executives with the changing government, and the traders' fears that any benefits reaped from improvements to their rented storage facilities would be eaten up by increased rents. Privatisation of the facility is currently under discussion.

Output 5: Extension material produced.

OVI: Extension material produced for farmers in Ghana from end of 2000 and in Uganda from end of 2001; training material for traders available by middle of 2001.

Ghana

Two sets of extension material on the monthly solarisation of cowpea, in the form of black-and-white booklets, were developed in conjunction with MoFA staff, other organisational stakeholders and farmers, for use by extension workers and farmers. The graphics are the same for both versions, but the narrative in the extension workers' version includes more detailed information. The farmers' version has minimal text and was intended as an *aide memoire*. Both versions are also viewable on the project website <<http://www.patatra.net/cowpea>>.

MoFA, Tamale, have run training courses for their district extension staff using the material as a supplement to learning. The regional DFID CPHP (West Africa) has produced a coloured version of the farmers' leaflet.

Written training material for use with traders was developed, and has been used by the PHU officer for work with traders in Tamale market. The material covers the benefits of good storage practice, good storage hygiene, adequate drying, and pest control (disinfestation of stores and protection of grains after fumigation).

Uganda

In Uganda the project partners have developed (drafted and pre-tested with farmers) a series of booklets (again combining graphics with straplines) for the different treatments, under the auspices of the COARD funded project TPF 84. Matilong is presently responding to an offer from the Kampala based Development Network of Indigenous Voluntary Associations (DENIVA) to reproduce them in poster format. A radio script in local language was drafted, recorded and pre-tested, and is presently being upgraded.

A farmers group in Malera sub-county has formed the Malera Cowpeas Pest Control Association (MACOPECA), which has engaged in demonstrating the effective treatments accompanied by music and dance. The fullest record of this output will be found in Ecwinyu, 2002.

6. CONTRIBUTION OF OUTPUTS

Output to Purpose: Assessment of project effectiveness

The policy and institutional context in both countries, particularly with respect to research and extension, is currently in a state of flux. Whether decentralisation and the increased involvement of the private sector will bring improvements to the lot of poorer rural households engaged in low-risk, low-value, food crop production to survive, remain to be seen. Institutional factors however are destined to play a key role in determining whether the outputs will deliver the impact anticipated in the purpose.

The promotion of more cooperative ways of working amongst collaborators and target organisations, and the mainlining of a more central role for farmers, albeit underpinned by the resources associated with the project, have already met with modest success. In Ghana the PHU officer is playing a central role, with other collaborators, in the new in-country coalition seeking to promote new knowledge and technologies generated by CPHP projects, and hence optimise earlier investments. Similarly in Uganda the broader project coalition team, having successfully secured funding from the COARD project to engage in the participatory development of extension material, is now

engaged in identifying methodologies to facilitate farmer participatory monitoring and evaluation. This initiative, which derived from the cowpea project team and is also funded by COARD, involves a number of additional stakeholders operating at the national level (e.g. NARO Outreach; Faculty of Agriculture Extension/Education, Makerere University; DETREC).

Promotion of the farmers' findings and the related extension material, is actively being undertaken by the collaborating teams in both countries. In Ghana, together with running training courses for in-house (and some NGO) extension staff and promoting the methods and treatment at professional events, the PHU has worked with a couple of agencies in the production of funding proposals to promote the findings with specific constituencies. In Uganda where the process has been coordinated by an NGO but has involved a larger coalition of interest groups, dissemination and promotion have been more diffused. Momentum has none the less been maintained by the involvement of the Development Network of Indigenous Voluntary Agencies (DENIVER) at one end of the scale, and by the enthusiasm of individual farmers' groups at the other (e.g. MACOPECA), and is underpinned by the on-going investment and interest of the COARD project.

Uptake will need to be monitored, as too will the price and availability of the polythene sheeting used for solarisation. MoFA and Matilong for Ghana and Uganda respectively will undertake this task. For those living in more remote locations the issue of accessibility, both to information and to materials, may need a specific follow-up study.

The field trials in both countries attempted to work with a mix of farmers by gender, relative wealth, different household and family backgrounds. Work on the disaggregation of the participant farmers and households by livelihood assets and strategies is still being carried out by NRI, MoFA and Matilong, and a publication is expected later this year. While the state emphasises solutions which promote greater engagement of subsistence farmers in the market place, changing social structures might also suggest solutions which identify complementary livelihoods based on trade-offs between different wealth and occupational groups. A better understanding of the different patterns of livelihoods however, will first be required.

7. PROJECT LOGFRAME

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Goal			
<p><i>Enter the Programme Purpose that you are addressing</i></p> <p>Poor people benefit from new knowledge applied to food commodity systems in semi-arid areas.</p>	<ul style="list-style-type: none"> - By 2002, increased number of poor households, in two target countries, who use improved storage and agro-processing techniques in an environmentally sustainable manner. - By 2002, increased numbers of poor households, in two target countries, benefit from improved marketing and credit systems. - By 2005, increased contribution to nutrition of poor households from own produced food. By 2005, increase in income from the sale of fresh and processed crops by poor households, in two target countries. 	<p>National and local adoption rate surveys.</p> <p>National food security data.</p>	<p>Poor people invest benefits to improve choices and options for livelihood strategies.</p>
Purpose			
<p><i>Enter the Programme Output that you are addressing</i></p> <p>Strategies developed and effectively promoted which improve food security of poor households through increased availability and improved quality of cereals and pulse foods and better access to markets.</p>	<ul style="list-style-type: none"> - By 2002, improved and sustainable on-farm pre-storage and storage systems validated for vulnerable maize, sorghum, millet and legume harvests of poor farmers. - By 2002, new small scale agro-processes and improved traditional processes validated which meet market opportunities for poor people's crop products and by-products, and which reduce drudgery and improve waste management. - By 2003, cost-effective marketing and credit systems validated to enable small-scale producers to add value to harvested crops. - By 2002, uptake pathways established for appropriate processing and marketing strategies. - By 2003, new knowledge adopted by target institutions. - By 2004, end users in target countries aware of knowledge programme outputs. 	<p>Annual research programme reports.</p> <p>External refereeing.</p> <p>External O/P reviews.</p> <p>Target institutions' reports.</p>	<p>Resources managers, producers and processors are able to adopt new knowledge.</p> <p>Enabling environment exists for widespread adoption of new knowledge.</p> <p>Capabilities of target institutions maintained at least at current levels.</p> <p>Food production constant or increasing.</p>

Outputs			
1. Farmer-validated series of methods for protecting stored grain legumes produced.	1. One set of at least three control methods available for promotion in Ghana by end 2000 and in Uganda by end 2001.	1. Annual and quarterly reports to DFID, publications in specialised press (eg SPORE) and at least one peer reviewed publication. One paper at the VIII Int. Conf. on Stored Product Protection to be held at York in 2002 .	1. Grain legume storage pests remain a serious threat to household food security.
2. Improved methods for promoting technologies developed.	2. Agricultural Knowledge Information System (AKIS) described and operating in the two countries by 2000; AKIS members meet quarterly to review progress and develop workplans.	2. Annual and quarterly reports to DFID, publications in specialised press, reports of NGOs.	2. NGOs, government extension and research organisations are willing to co-operate.
3. Validated methods for improving commodity storage by traders	3. Guidelines for best practice trader pest management produced by end 2001.	3. Annual and quarterly reports to DFID, publication in trade journal (eg Int. Pest Control) and in scientific press. Another paper at the VIII Int. Conf. on Stored Product Protection (York, 2002).	3. Traders remain aware that storage problems restrict their profitability.
4. Mechanisms for providing technical and financial support to traders developed.	4. Training programme for traders established by 6/2001; mechanism for credit provision identified by end 2001.	4. Annual and quarterly reports to DFID, publications in specialised press.	4. In country technical expertise is available to be tapped and funds are available for credit.
5. Extension material produced.	5. Extension material produced for farmers in Ghana from end of 2000 and in Uganda from end 2001; training material for traders available by middle 2001.	5. Annual reports to DFID, leaflets, radio scripts and broadcasts, video screenings, TV and radio interviews and features, newspaper features.	5. Extension material targeted appropriately.

Activities	Inputs	Means of Verification	Important Assumptions
1.1 RRA conducted in Uganda to identify damage, loss and other constraints to grain legume storage and marketing, as well as methods used for grain protection.	(£'000) y1 y2 y3 Total Staff costs 12 12 12 36 Overheads 16 17 17 50 Equipmt 5 5 T&S 7 7 7 22 Miscell. 27 25 33 85 Totals 67 60 70 197	Reports of collaborating organisations, quarterly and annual reports to DFID, publications in specialised press.	
1.2 Farmer Participatory Research conducted in Ghana and Uganda to optimise a range of control options for protection of grain legumes.		As above	
2.1 AKIS identified and defined in each country; workshop conducted with stakeholders to discuss system and to introduce storage technologies for farmers; Test of efficiency of optimised AKIS; Final Project Workshop.		As above	
3.1 IPM methods developed and optimised for trader storage.		As above	
3.2 Fumigation facility's operations monitored, modified and promoted.		As above	
4.1 Financial and technical support system for traders defined.; workshop for stakeholders conducted; support system initiated.		As above	
5.1 Training material produced.		As above	

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