New designs for storage structures give farmers important options

RIU

Validated RNRRS Output.

Modified farm stores are providing vital solutions to long-standing storage problems in Africa and elsewhere. While grain storage structures help protect against crop losses from insects, rodents, moulds, theft and fire, traditional designs are not always effective and building them is difficult for poor communities where hardwood supply is limited. Smallholders in Zimbabwe are using PVC pipes filled with concrete to replace timber, with the added advantage that rodents and termites don't attack these posts. A manual and video are facilitating extension to other countries. More than 1000 farmers in Ghana are using mud silos successfully, and guidelines for their promotion are available. Finally, metal silo storage is widely used in Latin America as well as in Swaziland.

Project Ref: **CPH23:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

Document Contents:

Description

CPH23

Research into Use
NR International
Park House
Bradbourne Lane
Aylesford
Kent
ME20 6SN
UK

Geographical regions included:

Ghana, South America, Swaziland, Zimbabwe,

Target Audiences for this content:

Crop farmers, Processors, Traders,

A. Description of the research output(s)

1. Working title of output or cluster of outputs.
In addition, you are free to suggest a shorter more imaginative working title/acronym of 20 words or less.

Better grain stores for farmers and traders

2. Name of relevant RNRRS Programme(s) commissioning supporting research and also indicate other funding sources, if applicable.

Crop Post-harvest Programme

3. Provide relevant R numbers (and/or programme development/dissemination reference numbers covering supporting research) along with the institutional partners (with individual contact persons (if appropriate)) involved in the project activities. As with the question above, this is primarily to allow for the legacy of the RNRRS to be acknowledged during the RIUP activities.

R6311 (1995 – 1996) Improving the use of phosphine for small-scale fumigation of grain on farms (Ghana)

R6658 (1996 -1999) Improved design of indigenous stores – including minimising the use of hardwood resources (Zambia, Zimbabwe)

R6502 (1996 – 1999) Mud-based silos: farm stores for silos (Ghana)

R8265 (2002 – 2005) Improving household food security by widening the access of small-holder farmers to appropriate grain store pest management (Ghana)

Natural Resources Institute, University of Greenwich, Central Avenue, Chatham Maritime, Kent, ME4 4TB, UK
Contact Person: Dr Rick Hodges, Email: R.J.Hodges@gre.ac.uk Tel: +44 (0) 1634 883813

Lead institute (R8265):

Ministry of Food and Agriculture, Tamale, Ghana

Contact Person:

Mr Fusieni Andan, Email: princefuhaan@yahoo.co.uk; Tel: +233 208164891

Dr Samuel Addo, Email ssbaddo@yahoo.com

Other contacts
R6311 and R6502
Dr A.B. Salifu, Savanna Agricultural Research Station (SARI), PO Box 52, Nyankpala, Tamale, Ghana

R6658
Mr Jonas Chigariro, Email: jonas@africaonline.co.zw

Dr Brighton Mvumi, Email: mvumibm@agric.uz.ac.zw

4. Describe the RNRRS output or cluster of outputs being proposed and when was it produced? ***(max. 400 words)****. This requires a clear and concise description of the output(s) and the problem the output(s) aimed to address. Please incorporate and highlight (in bold) key words that would/could be used to select your output when held in a database.*

Farm grain storage structures need to offer protection against crop losses due to insects, rodents, moulds, theft and fire. In this regard, traditional grain storage structures vary considerably in their suitability, and in addition building them may be difficult for poor people in parts of Africa where hardwood supply is limited and travel is required to find suitable timber. Shortages may also be exacerbated by termite damage. A project in Zimbabwe (1996-99) and three projects in Ghana (1995-2004) have addressed this issue.

In Zimbabwe, a **modified farm store** design was developed using PVC pipes filled with concrete to replace traditional vertical timber supports, which totally excluded rodents and termites. There is a manual and video to show construction methods.

In Ghana, **mud silos** (Bimoba type) were investigated as alternative structures to replace stores built from timber and woven mats. Mud silos rendered with a bitumen/soil mix or concrete proved the most resistant, although it remains necessary to ensure that crops placed in them have an initial low moisture content (e.g. for maize this would be 11% or lower). Clear recommendations have been made on how mud silos should be promoted to households and groups wishing to adopt them. Evidence however shows that mud silos are not fumigable. Even when they were made gas-tight, their deterioration over two years was sufficient that there was almost total gas loss within two days. Research has shown that **metal or plastic storage structures** can be fumigated and that these offer very effective alternatives if farmers or traders can afford them.

5. What is the type of output(s) being described here?

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
	X		*X*		

6. What is the main commodity (ies) upon which the output(s) focussed? Could this output be applied to other commodities, if so, please comment

The grain stores in question could be used for a wide range of cereals such as maize, millet, sorghum, paddy rice, wheat and potentially for other durable commodities such as ground nut, dried cassava etc.

7. What production system(s) does the output(s) focus upon?
Please tick one or more of the following options. Leave blank if not applicable

Semi-Arid	High potential	Hillsides	Forest-Agriculture	Peri-urban	Land water	Tropical moist forest	Cross-cutting
X	X			X			

8. What farming system(s) does the output(s) focus upon?
Please tick one or more of the following options (see Annex B for definitions).
Leave blank if not applicable

Smallholder rainfed humid	Irrigated	Wetland rice based	Smallholder rainfed highland	Smallholder rainfed dry/cold	Dualistic	Coastal artisanal fishing
X				X	X	

*9. How could value be added to the output or additional constraints faced by poor people addressed by clustering this output with research outputs from other sources (RNRRS and non RNRRS)? (**max. 300 words**). Please specify what other outputs your output(s) could be clustered.*

Besides using improved traditional methods for grain storage, farmers could also be encouraged to consider adopting more modern methods such as metal or plastic silos (tanks). In Swaziland, the use of corrugated galvanised-iron silos of about 1.0 to 8.75 tonne capacity has been popular since the 1960s and their performance was documented in the 1990s and again in 2004; they can be fumigated and are very effective storage containers. Similarly, a metal silo of up to 2.7 tonne capacity was designed and promoted by the Swiss Agency for Development and Cooperation (SDC) in Latin America for 22 years which was similarly fumigable and very effective as a storage container. Plastic water tanks can be adapted and this has been demonstrated for use by cowpea traders in northern Ghana. Metal/plastic grain tanks are relatively expensive so putting them beyond the reach of the poorest farmers.

A range of storage structure are on offer to farming households. In extending this range of options there is a challenge in matching the technology options to the means and requirements of varied households. The 'Diversity Response Approach' (see dossier for R 8265) offers a way of achieving this.

Validation

B. Validation of the research output(s)

*10. **How** were the output(s) validated and **who** validated them?*
Please provide brief description of method(s) used and consider application, replication, adaptation and/or adoption in the context of any partner organisation and user groups involved. In addressing the "who" component detail which group(s) did the validation e.g. end users, intermediary organisation, government department, aid organisation, private company etc.. This section should also be used to detail, if applicable, to which social group, gender, income category the validation was applied and any increases in productivity observed during validation (max. 500 words).

Mud silos (Mamprusi now usually called Bimoba type) - were evaluated by socio-economic survey and technical studies in Northern Ghana. The socio-economic survey (PRA) examined expectation and demand, and showed that expectations of the effectiveness of mud silos were similar to the reality of what they provide. There was an on-station technical appraisal of 16 mud silos, four had been rendered with soil/bitumen mix, four with cement and four unrendered to compare performance with the traditional kambon/kunchun woven mat stores. In selected villages, the Ministry of Food and Agriculture (MoFA) and the Adventist Development and Relief Agency (ADRA) constructed mud silos in six districts of Northern Region as a demonstration. By 2000, the positive feedback on the use of mud silos led the Opportunity Industrialisation Centre of Tamale (OICT) with ADRA and MoFA to undertake a large mud silo extension programme in Gushiegiu/Karaga district with USAID funding. To evaluate the success of programmes to promote the silo to new users, an eight-day field survey was undertaken in Northern Ghana of 60 farmers to examine impact on food and cash security and observe any problems encountered with these new structures. The rendered silos were not part of the promotional package and so have not been validated.

PVC/concrete legs - were initially validated by on-station trials with 12 modified and 12 unmodified stores by researchers from the Institute of Agricultural Engineering (Zimbabwe) and NRI (UK). Further, demonstration stores were built elsewhere and a rapid assessment made of their appropriateness to farmers' needs. Relevance and affordability were greater in some locations than others.

Metal silos – several technical/sociological evaluations by consultants hired by the SDC, up to 2002, have reported that metal silos in Latin America are very effective as storage structures used by small-holders and their promotion has proven very successful. Metal silos in Swaziland were similarly evaluated in 1994 in a study commissioned by DFID which again validated these as very effective storage structures with very widespread use despite the fact that they had not been actively promoted.

Plastic tanks - several years of tests of options for a viable warehousing business model for rural enterprises, using brick and mortar stores, butyl rubber stores and plastic tanks have shown the latter to be the best option. The use of plastic tanks was validated by traders who stored and fumigated cowpea in them.

*11. **Where and when** have the output(s) been validated? Please indicate the places(s) and country(ies), any particular social group targeted and also indicate in which production system and farming system, using the options provided in questions 7 and 8 respectively, above **(max 300 words)**.*

Mud silos – the adoption of mud silos by new users was validated in June/July 2003 in three districts in Northern Ghana – Saboba/Cheriponi, East Mamprusi and Gushiegu/Karaga. The farmers included in the validation process were selected at random, every third household on a transect through a village was chosen. The production system/farming system for all districts was the same, semi-arid, small-holder rainfed dry.

PVC/concrete legs – outputs validated by on farm-trials in Binga district Zimbabwe in 1996. Subsequently, demonstrations were undertaken in Buhera and Mutoko districts. The areas concerned have semi-arid production system and small-holder rainfed dry-farming systems.

Metal/plastic silos – Metal silos have been validated in Latin America in wide ranging production systems and farming systems and in Swaziland particularly in the middle veld (high potential) small-holder rain-fed farming system. Plastic water tanks were validated at 13 sites in 2001 in the semi-arid production system and small-holder rainfed dry-farming systems of northern Ghana.

Current Situation

C. Current situation

*12. **How and by whom** are the outputs currently being used? Please give a brief description **(max. 250 words**).*

Mud silos - several mud silos adoption programmes were launched in Northern Ghana to offer this structure to small-holder farmers who traditionally do not use it. Rendering of the outer surface has not been used but mud silos have been adopted by many farmers who are currently using them successfully. Further promotion of mud silos is not currently being undertaken but guidelines for achieving better promotion are available from a leaflet on the CPHP website -

(Andan F.H. (2004) Ensuring better promotion of mud silos in northern Ghana. Leaflet. Ministry of Food and Agriculture, Tamale, Ghana. 2 pp, at http://www.cphp.uk.com/media/default.asp?step=3&sf=2).

PVC/concrete legs – Zimbabwian small-holder farmers at several locations are using granaries with concrete legs. The technology has not been extended to other countries but a manual and video are available to facilitate this.

Metal silos - under the SDC project there have been 266,000 official transfers of metal silos in Latin America, mostly to small-holder farmers. However, it is estimated that the actual number transferred to date is between 400,000 and 500,000. The latest evaluation estimated that subsides represented 40% of the effective demand and that this is growing because the governments of the three countries concerned (Honduras, Paraguay and Dominican Republic) are planning massive transfer programmes of their own. Metal silo storage has also been used successful in Swaziland where in a survey in 2001/02, 55% of all farmers used these as a storage structure and it is estimated that there are 100,000 tanks in the country.

Plastic tanks –currently used for cowpea storage by traders.

*13. **Where** are the outputs currently being used? As with Question 11 please indicate place(s) and countries where the outputs are being used **(max. 250 words).***

Mud silos – adopted by over 1,000 farmers in the Gushiegu/Karaga district of northern Ghana, most of those surveyed are currently using them successfully

PVC/concrete legs - currently, in Zimbabwe those farmers who previously adopted stores with concrete legs, in Binga, Buhera and Mutoko districts will have continued using them as they are durable and would be effective for many years.

Metal silos - widespread use of metal silos in Latin America and Swaziland.

Plastic silos - limited use of plastic tanks in 13 sites northern Ghana.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading

(max 250 words).

Mud silos – these are the traditional method of storage in many districts of northern Ghana and have been adopted by large numbers of farmers in Gushiegu/Karaga district as a result of promotion campaigns over the last ten years. However, improvements in design such as rendering, have not been adopted despite the demonstrated advantage, apparently there has been no extension effort to do this. Use is probably not currently spreading.

PVC/concrete legs - it has become harder for smallholder farmers to invest in PVC pipes due to high costs. The logistics of making the pipes available locally in Zimbabwe is problematic and the business community in the Zambezi Valley no longer stock the PVC pipe because of low demand. When economic conditions improve it would be expected that the use of concrete legs in store construction would resume because smallholder farmers although apparently not desperately short of timber do know that timber of the right size and species for store building is dwindling.

Metal silos – current scale of use in Latin America is relatively large with probably about 1.5 units for every 100 head of population and set to increase as the three countries concerned (Honduras, Paraguay and Dominican Republic) are planning transfer programmes. In Swaziland, current use is about 10 units per 100 head and stable, maintained by a strong incentive framework for maize production. When properly sited and used with adequately dried grain the metal tank shows major pest control advantages over traditional systems of storage.

Plastic silos – in October 2006 the situation was that plastic tanks had been used and traders found that they were sufficiently hermetic that when filled with cowpea there were no insect problems even without fumigation. However, usage has declined, only a few traders **still using them since Nestle Ltd (Ghana), who had been interested in purchasing cowpea, would not do so because produce quality was below specification.**

15. In your experience what programmes, platforms, policy, institutional structures exist that have assisted with the promotion and/or adoption of the output(s) proposed here and in terms of capacity strengthening what do you see as the key facts of success? ***(max 350 words).***

Mud silos - the Ministry of Food and Agriculture (MoFA) in Ghana has given strong support to farm storage initiatives and this has encouraged donor funding for the further extension of mud silos in northern Ghana. This was achieved with the collaboration of several NGOs working together with post-harvest staff of MoFA. A key to the success of the programme was that local artisans were available who could demonstrate the building of mud silos and this was easily achieved since groups who traditionally construct mud silos lived adjacent to group who use other store types and were the subject of the extension programme.

PVC/concrete legs – following the development of this technology, its extensions was inhibited by a serious weakening of agricultural support services in Zimbabwe coupled with problems in the supply of PVC pipes. At the time, the project was supported by staff of the Institute of Agricultural Engineering, which provided essential capacity to advise on building issues.

Metal silos – in Latin America these have been the subject of large-scale extension programmes involving donors, government organisations and NGOs. Success has been achieved by promotion to farmers and their households and simultaneous support to micro-industries meet demand for the silos. To implement metal silo programmes it is essential to have both the materials (sheet metal of appropriate quality) and to train the local artisans to construct them to the required standard.

Plastic silos – the initial success of plastic tank in northern Ghana was based upon an opportunity to supply a commercial company in southern Ghana with local produce (cowpea). The opportunity was identified by an NGO and the technology adapted successfully to the traders benefit. However, the continued and expanded use of the technology was hindered by a failure in the ability of traders to secure cowpea of sufficient quality from farmers. The lesson in this case being that the needs of each link in a new market chain must be carefully defined and supported until the whole chain is well established.

Environmental Impact

H. Environmental impact

24. What are the direct and indirect environmental benefits related to the output(s) and their outcome(s)? ***(max 300 words)***

This could include direct benefits from the application of the technology or policy action with local governments or multinational agencies to create environmentally sound policies or programmes. Any supporting and appropriate evidence can be provided in the form of an annex.

There would be advantages in the reduction of usage of wood in store construction. In stores that are hermetic or can be fumigated then the use of synthetic insecticides would probably not be needed, an environmental and health benefit.

25. Are there any adverse environmental impacts related to the output(s) and their outcome(s)? ***(max 100 words)***

No adverse impacts are expected.

26. Do the outputs increase the capacity of poor people to cope with the effects of climate change, reduce the risks of natural disasters and increase their resilience? ***(max 100 words)***

Better storage methods lead to increased food availability and potentially higher incomes. The resilience of poor people, including those who are HIV positive, would be increased by better food availability, particularly in the two or three months before the new harvest is due when food shortages become acute. Adoption of storage methods such as plastic or metal tanks that are either hermetic or allow fumigation with phosphine, avoid the need to admix organophosphorous insecticides which are alleged to be detrimental to people who are HIV+.
