Fossils bring insect control down to earth

RIU

Validated RNRRS Output.

Soft whitish powders formed from the fossils of tiny planktons that once lived in oceans, rivers and lakes can be ground and mixed with grain to kill insect pests. Known as diatomaceous earths (DEs), these powders have proven to be highly effective in a range of agro-ecological zones in Zimbabwe and Tanzania, protecting crops for more than eight months. The food security and income opportunities of many rural households in sub-Saharan Africa are seriously undermined by storage insect pests. Farmers in Tanzania and Zimbabwe who tested DEs found that they offered an effective alternative to chemical pesticides—whose safety and efficacy are increasingly questioned—and to traditional materials such as ashes, botanicals and sand, which give inconsistent results.

Project Ref: **CPH35:**
Topic: **5. Rural Development Boosters: Improved Marketing, Processing & Storage**
Lead Organisation: **Natural Resources Institute (NRI), UK**
Source: **Crop Post Harvest Programme**

Document Contents:

Description

CPH35

A. Description of the research output(s)

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

Geographical regions included:

Tanzania, Uganda, Zambia, Zimbabwe,

Target Audiences for this content:

Crop farmers, Processors,

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.

Diatomaceous Earths: Providing safer options for smallholder grain protection

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

Crop Post-Harvest Programme.

PACT Capacity Building Services Group (http://www.pactworld.org/) provided a small grant in 2006 to assess the effectiveness of the post-harvest learning alliances (PHILA) established in Tanzania and Zimbabwe.

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.

R7034: Grain storage pest management using inert dusts

Institution	Country	Key Contact Person
Natural Resources Institute	UK	Dr Pete Golob Ms Tanya Stathers
Department of Agricultural Technical and Extension Services (Agritex) [1]	Zimbabwe	Messrs Brighton Mvumi, Jonas Chigariro & Morris Mudiwa
University of Zimbabwe	Zimbabwe	Professor Denash Giga

[1] Agritex is now amalgamated with Department of Research and Specialist Services (DR&SS) into Department of Agricultural Research & Extension services (AREX)

R8179: Small-scale farmer utilisation of diatomaceous earths during storage

Institution	Country	Key Contact Person
Natural Resources Institute	UK	Ms Tanya Stathers Mr Mike Morris
Plant Health Services	Tanzania	Messrs William Riwa, Lazaro Kitandu, Kihedu Mngara and Ms Rachel Mosha
Post Harvest Management Services	Tanzania	Mr Deusdedith Mathias Ms Bertha Mjawa
University of Zimbabwe	Zimbabwe	Dr Brighton Mvumi

Department of Agricultural Research & Extension services (AREX),	Zimbabwe	Messrs Elijah Dube, Jackson Mushayapokuvaka (Buhera District); Alex Zhou, Vusimusi Moyo (Binga District)
Institute of Agricultural Engineering	Zimbabwe	Mr Rhodrick Kuseri/Mr Tirivangani Koza
Ecomark Ltd	Zimbabwe	Lewis Muhwati
Dorowa Mining Ltd & Zimbabwe Phosphate Ltd. (Sister companies)	Zimbabwe	Dr Charles Chitsora & Mr. Alex Chitake
Diatom Research and Consulting	Canada	Dr. Zlatko Korunic
Tropical Pesticide Research Institute	Tanzania	Dr Bakari Kaoneka

R8460: Post-harvest innovation: Enhancing performance at the interface of supply and utilisation

Institution	**Country**	**Key Contact Person**
Natural Resources Institute	UK	Ms Tanya Stathers Mr Mike Morris
Plant Health Services	Tanzania	Mr William Riwa
University of Zimbabwe	Zimbabwe	Dr Brighton Mvumi

R8460 spawned the post-harvest alliances (PHILA [2]) in Tanzania and Zimbabwe. These on-going alliances of diverse post-harvest stakeholders, include farmers organisations and/or union, statutory agencies (i.e. in crop health, extension, food security, regulation), local government (e.g. district agricultural authorities), private sector players, research and educational agencies, and NGOs. Lists of members are available at: http://www.nri.org/PHILA/partners/index.htm

[2] Post-Harvest Innovation Learning Alliance (PHILA)

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.*

The Problem: The **food security** and income opportunities of many **rural households** in SSA are seriously undermined by **storage insect pests**. Presently many small-scale farmers rely on imported **organo-phosphate** based **pesticides** to protect stored grain, but farmers and various authorities are increasingly questioning the safety and efficacy of these chemicals. Other households, who use traditional materials such as ashes, botanicals and sand to control storage insect pests, are faced with inconsistent and often poor results.

The Research: To address this widespread problem CPHP funded a set of research projects from the mid-late

1990s to 2005, which focused on exploring the efficacy of the **inert dusts** known as **diatomaceous earths** (DEs) [3]. These projects established that DEs were efficacious as **grain protectants** in a range of agro-ecological zones in Zimbabwe and Tanzania; that the technology – both product and process – was readily usable by diverse smallholders in the multiple research locations; and that food stocks were successfully protected for periods of more than 8 months. The research trialled both imported commercial DEs and a few of the many local deposits of DE found throughout SSA. Although the latter will probably represent more economically sound (i.e. to the state) and financially viable (i.e. to business and to farmers) options in the longer run, further work is first required to establish and implement safety, extraction and processing protocols.

In addition to examining the hardware (i.e. the DE technology) and software (i.e. the skills and knowledge required to use the technology) issues, the research also explored organisational aspects of the respective country post-harvest systems ('org-ware'). **Post-harvest alliances** have been established in Zimbabwe and Tanzania to promote improved partnerships and to develop new ways of getting relevant technologies such as DEs into economic and social use.

The Outputs:

§ A safe and readily useable product, *Diatomaceous Earth*, for protecting and extending the storage life of household grain and other food products (*prime output, R8179*);

§ Enquiry methodology: working method for extension staff to identify and map the production and post-harvest needs and priorities of diverse rural communities, to better target those farmers and households for whom the DE technology is best suited (*supporting output, R8179)*; and

§ Active post-harvest innovation learning alliances (PHILA) in Tanzania and Zimbabwe, comprising various stakeholders with interests in effecting food security and improved livelihoods amongst small-scale farmers, to better facilitate the out- and up-scaling of DEs, and other relevant post-harvest technologies (*prime output, R8460*).

[3] Diatomaceous earths (DEs) are soft whitish powders formed from the fossils of tiny planktons which lived in oceans, rivers and lakes. After processing – mining, grinding and drying – these powders can be mixed with grain to kill insect pests. When DEs come into contact with insects they absorb the wax from the cuticle of the insect which then loses water, dehydrates and dies. DEs have extremely low toxicity to mammals and are therefore very safe to mix with food. In industry they are used as filters to help clarify fruit juices, beers, wine, pharmaceuticals, and as fillers in paints, plastics, coating agents in fertilisers amongst many other things. DEs are currently registered for use as grain

5. What is the type of output(s) being described here?
Please tick one or more of the following options.

Product	***Technology***	***Service***	***Process or Methodology***	***Policy***	***Other Please specify***
X	**X**		**X**		Post-harvest learning networks

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

Cereals (maize & sorghum) and pulses (beans & cowpeas) as food, seed and feed stocks where applicable.

There is potential for application to dried cassava and sweet potato chips, and all other grains. Use of DEs as a protectant may be of particular interest to the organic farming sector in SSA e.g. for use with cotton, vegetables etc.

7. What production system(s) does/could 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	X	X			*

* Where the DE technology is limited by humidity and scale, the enquiry methodology and post-harvest learning networks are effectively cross-cutting and relevant to all production systems.

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	X	

* Where the DE technology is limited by humidity and production scale, the enquiry methodology and post-harvest learning networks are effectively cross-cutting and relevant to all farming systems.

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).

Grain production systems. The DE technology relates to protecting and extending the storage life of household grain and other food products. Value might be added were this technology part of a package of good practice aimed at optimising and building on benefits throughout the crop cycle and post-harvest sequences.

Livelihood systems. Although the prime focus of the enquiry methodology was on activities associated with the storage trial crop, its design included scoping the wider pattern of household livelihoods. It is thus specifically able to help extension staff identify the constraints faced by different poor households, and facilitate their efficient matching of the most appropriate available technologies to individual household needs and priorities. As such, it should add value to most technological options (i.e. hardware choice and good practice) put on offer by extension services. More importantly, it will enable extension staff to be more responsive to the demands of different households, and should therefore improve the capacity and quality of service provision itself.

National Innovation Systems. The learning alliance networks in Tanzania and Zimbabwe were established to facilitate new and better ways of working between key post-harvest stakeholders, with the aim of expediting the

scaling-out and scaling-up of post-harvest innovations appropriate to the needs of poorer farmers. They were intended not simply to improve the sharing and adoption of existing ideas, but to create a framework within which institutional constraints could be identified and creatively addressed, adaptive management be encouraged, and local ownership of emerging solutions thrive.

The contributions of the three outputs to these different systems are given below:

	Product / DE technology (*prime output, R8179*)	**Extension methodology** (*support output, R8179*)	**Post-harvest alliances** (*prime output, R8460)*
Food production system	ü (food security & income)	ü (good practice & appropriate technology)	ü (farmer centred / demand-led)
Livelihood system	ü (food security & income)	ü (strengthening responsiveness capacity to client diversity)	ü (out-scaling)
National innovation system		ü (farmer focused)	ü (up-scaling)

Please specify what other outputs your output(s) could be clustered. At this point you should make reference to the circulated list of RNRRS outputs for which proformas are currently being prepared.

Category	**Project/cluster title**	**R No**
Pre-harvest pest management	Maize Grey Leaf Spot Management	R8453/ R7566
	Promotion of bean ICPM	R8414, R7965, R7568, R7569, R8316
	Access to appropriate farm inputs	R8219, R7405
	Increasing food security and improved livelihoods through pest & disease management, and soil management of lowland maize	R8452, R8215
	Pigeon pea technologies	R8481, R8205, R7452
	Extension and promotion of rodent technologies	R8424, R8164, R8441, R8190
	IPM for small holder cotton	R8403, R8197
	Crop management in cotton & cereal based crop systems	R8191, R7473, R6655, R7189, R7440, R5742
Post-harvest technologies	Improved design of indigenous grain stores	R6658
	Pest & management tools & strategies	R6311, R6684, R7486, R8265
Service delivery/ communication/ knowledge management	Communication strategies for East Africa	R8428, R8349
	Linking demand with supply of agricultural information	R8429, R8281
	Increasing effectiveness of the research system	R8410

	Improving access to and management of quality information on maize	R8422
	IPM promotion through improved training manuals	R8417, R8341
	Development of private sector service provision	R8438, R8297
	Decision tools for institutional change in public & private sectors	R7502/ R6306
	Knowledge management	ZB0380, R8402
	Use of social capital to improve NRM	R7856, R8494
	African Universities Veterinary e-learning consortium (AUVEC) – Creation of common e-learning framework	R7597, R7596, R8151, R8022, R8208, R8042, R7173, R7987, R7229, R7357, R5406, R7596, R8318
	Info kiosks: assessing and meeting the information demands of poor livestock keepers	R8152, R7359, R8213
	Informing policy development through dissemination of research findings	R7596, R8318
	Voices of the poor	R8213
Registration	Support to SME supplying pheromone control technologies and promoting policy change for common production	R8413, R8304, R7465

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)**.*

Validation of the DE research involved on-farm researcher-managed trials (RMTs) and farmer-managed trials (FMTs) in three different agro-ecological zones (AEZs) in both Tanzania and Zimbabwe. The longest studies were carried out over three successive storage seasons. Farmers, national and local government staff, and NGO staff, participated in the implementation, monitoring and evaluation of the RMTs. Farmers, initially facilitated by the research team, managed the FMTs, which were designed to allow them to compare DEs with their conventional storage pest management practices. FMT participants were selected from different wealth groups and included a

majority of women. Representation of the *extreme vulnerable poor* group was small as most of these households did not have significant quantities of grain to store as food stocks, and would not therefore have need for the technology.

Esther compares her ash treatment (left) with DE treatment (right)

DEs proved extremely successful in both sets of trials, with the FMT farmers particularly impressed with the quality and quantity of grain safely stored for the duration of the storage season, especially when compared with some traditional practices (see picture).

The validation methodologies for conducting on-farm DE research were subsequently shared with and adopted by

Zambian and Ugandan researchers.

Peer review of the research findings is evidenced by publication in the following internationally refereed journals:

a. Stathers, T. E., Riwa, W., Mosha, R., Kitandu, L., Mgara, K., Kaoneka, B., Mvumi, B. M., Morris, M. (*submitted*) Do diatomaceous earths have potential as grain protectants for smallholder farmers in sub-Saharan Africa: the case for Tanzania? Crop Protection.

b. Mvumi, B. M., Stathers, T. E., Golob, P., Giga, D. P. (2006) Penetration of *Sitophilus zeamais* Motchulsky through diatomaceous earth-treated bulk maize. International Journal of Tropical Insect Science, 26, 1, 28-34.

c. Stathers, T. E., Mvumi, B. M., Golob, P. (2002) Field assessment of the efficacy and persistence of diatomaceous earths in protecting stored grain on small-scale farms in Zimbabwe. Crop Protection, 21, 10, 1033-1048.

d. Stathers, T. E., Chigariro, J., Mudiwa, M., Mvumi, B. M., Golob, P. (2002) Small-scale farmer perceptions of diatomaceous earth products as potential stored grain protectants in Zimbabwe. Crop Protection, 21, 10, 1049-1060.

The validation of the *enquiry tool* took place in villages in three different districts, two in Tanzania and one in Zimbabwe. Participating households from different wealth groups were visited three times per year for up to three years, by members of the research team and local extension staff. Participatory assessments of the two *learning alliances* were undertaken at review workshops, nine months after their inception. A further assessment of their effectiveness is currently being undertaken.

*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)**.*

The efficacy of imported commercial DEs were validated in three AEZs in Zimbabwe (Buhera and Binga districts, and Harare), for two consecutive storage seasons (1998-2000), using maize, sorghum and cowpeas, under on-farm and on-station conditions. The latter included both researcher- and farmer-managed trials. Similar work was conducted in Tanzania, where the Larger Grain Borer (*Prostephanus truncatus*), a devastating pest of stored grains, is endemic. This work, carried out over three consecutive seasons (2002-2005), took place in three further AEZs (Dodoma, Manyara and Shinyanga regions), where different post-harvest practices prevailed. These trials included maize, sorghum and beans. The efficacies of DEs from local deposits were also validated in field trials in Zimbabwe and Tanzania, during the period 2003-2005.

RMTs were implemented by the research team, district extension staff and lead farmers. FMTs were implemented by female and male farmers from different wealth groups. The trials involved smallholder farmers, in predominantly rain-fed, semi-arid (and peri-urban) production systems.

The extension methodology, which was developed jointly by researchers and extension staff in Tanzania, was used in conjunction with the FMTs in Mlali village, Kongwa district, and Arri village, Babati district, over the period 2003 – 2005. It was also tested with farmers involved in the FMTs in Buhera district, Zimbabwe, 2004 – 2005. Its deployment provided researchers and extension staff alike with a better understanding of the diverse

circumstances of the different farming households.

While the post-harvest learning alliances (PHILA) in Tanzania and Zimbabwe include a range of stakeholders operating at the respective national levels, district and sub-district activities were focused on two districts, selected for their contrasting characteristics, in each country: Singida and Manyoni district in Tanzania; and Binga and Buhera districts in Zimbabwe. Both PHILAs, which were launched early in 2005, are currently active.

Current Situation

C. Current situation

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

DE technology: DEs remain as yet unregistered for general use in Tanzania and Zimbabwe. However as many as 300 farmers in five districts, in Tanzania and Zimbabwe have trialled the DEs, and are very keen - price issues aside - to continue using them. Many other local farmers and extension staff, who have witnessed the success of the trials, are also keen to use DEs. While communities in Kagera region (Tanzania) and Beitbridge region (Zimbabwe) have long been using DEs from local deposits, to treat stored commodities and whitewash their houses, respectively.

Dissemination of the project's findings led to DEs being included in research activities in Zambia and Uganda, and enquiries have also been received from researchers in India, Iran, South Africa and Mozambique.

Extension methodology: Following demonstration of the efficacy of DEs, and the success of the 'enquiry tool', which was developed by research and extension staff together, the DE technology and the associated extension methodology have now been incorporated into the post-harvest training of extension staff (>300 in Tanzania) and university students (242 undergraduate and 14 post-graduate students at the University of Zimbabwe).

Post-harvest alliances: The learning alliances (PHILA) in Tanzania and Zimbabwe continue to provide an information platform for their memberships, and also via the website (http://www.nri.org/PHILA/), for third parties. 37,000 visits from 65 countries were made to the website in its first year. A study of the effectiveness of the alliances, and specifically the level of member participation in network activities, is currently taking place.

*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).***

In Tanzania and Zimbabwe the use of imported commercial DEs is still limited to the designated research areas. Other researchers in Uganda, and a research-entrepreneur partnership in Zambia, are also trialling DEs from local deposits. DE use has already been widely promoted in Zambia as an all-purpose pesticide.

The following table indicates where the DE technology is currently, or was very recently, in use.

Country	Region/Province	Districts	Ward/Village	Comments etc
Tanzania	Manyara	Babati	Arri	Original trial site (OTS)(2002-2005)
			Singe	OTS (2002-2005)
	Shinyanga	Shinyanga	Mwamakaranga	OTS (2002-2005)
		Kishapu	Mwataga	OTS (2002-2005)
	Dodoma	Kongwa	Mlali	OTS (2002-2005)
	Singida	Singida Rural	Mudida	Interest developed through exchange visit to Mlali organised by project (2005-2007)
	Kagera	Karagwe	Nyakanyasi	Indigenous use of local DE deposit
			Kitengule	Indigenous use of local DE deposit
	Southern Highlands	Mbozi	Igunda	On-farm RMTs examining PH aspects of disease resistant maize varieties (2003-04)
		Mbarali	Majenje	
Zimbabwe	Manicaland Province	Buhera	Ward 6	OTS (1998-2000)
			Wards 4 & 5	OTS (2003-2006)
	Matabeleland North	Binga	Siabuwa Valley	OTS (1998-2000)
			Kulima	OTS (2003-2005)
			Mbobumi Training Centre	OTS (2003-2005)
	Harare	Harare	Institute of Agricultural Engineering (IAE)	OTS (1998-2000)
			IAE	OTS (2003-2005)
	Matabeleland South	Beitbridge		Indigenous use of local DE deposit
Uganda	Kampala	Kampala	Kawanda Agricultural Research Institute	On-station DE trials
	Eastern Region	Iganga district		On-farm DE trials
Zambia				No information on spread / sales of Diatocide within Zambia yet available

Extension staff together with key staff from Plant Health Services and Post Harvest Management Services (Ministry of Agriculture, Food and Cooperatives), Tanzania, have developed considerable expertise in use of the extension methodology, and are working with the Natural Resources Institute, UK, to develop guidelines for wider promotion of the methodology. It is presently being used in Dodoma, Manyara and Singida regions in Tanzania. In Zimbabwe it has been used in Buhera district.

The two post-harvest alliances are nation-wide networks in terms of their respective memberships and membership activities. In addition the website is accessible internationally, and many people from other countries have visited it and downloaded material.

14. What is the scale of current use? Indicating how quickly use was established and whether usage is still spreading ***(max 250 words).***

The scale of current imported DE use is given in the answers to questions 12 and 13 above. Given however, that while they are not officially registered for use in the two research countries, their distribution for general (i.e, outside research) use remains prohibited (and has not taken place), it is interesting that farmers who have used or witnessed their use are still clamouring for them. Price will doubtless influence their eventual usage and rate of spread, but while available commercial pesticides are found wanting by those farmers who can afford them, it seems highly probable that, once legally available, their usage will spread rapidly. This observation is underpinned by the positive response that DEs have generated amongst the public and voluntary sector extension staff, registration agency staff, and others, involved in the trials. The active interest and rapid follow-up by researchers and/or entrepreneurs in Zambia and Uganda further corroborates this view. Currently, Dorowa Minerals Limited in Zimbabwe has claims over the Zambezi Valley deposit and is mining the local DE on an experimental basis, for industrial purposes and there is keen interest to widen the product base to include grain protectants following the research findings.

There is also some evidence that individuals familiar with the research findings have made land claims in those areas where local DE deposits exist, in anticipation of future business opportunities (e.g. in Uganda).

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).***

In neither country have existing institutional arrangements (programmes, policies etc) greatly assisted the promotion and/or adoption of the DE technology. In Tanzania this was despite growing emphasis by government and donors on improved agricultural policy, sector development strategies and programmes etc; while in Zimbabwe the political and economic situation threw up a range of institutional constraints. It was these different but constraining scenarios that compelled the research team to seek new ways of making the respective post-harvest systems more responsive, and led to the setting up of the learning alliances. These alliances, together with the very responsive print and electronic media, particularly in Tanzania, have been the prime platforms for information sharing.

In Tanzania it was the initial interest and perseverance of a senior staff member in Plant Health Services (Mr Riwa), which was key to promotion within the ministry [4]. While the core research team promoted the idea of early engagement with key stakeholders, it was this individual's authority and connections that ensured this happened. We draw attention to this as it is our repeated experience that engagement with existing institutional frameworks structures is often dependent on key individuals.

Mr Riwa's status helped ensure the engagement of his ministry colleagues (i.e. from Post Harvest Management Services; Extension Services; and the registration agency, TPRI), together with district-based agricultural staff, who now fall under local government. He was also instrumental in reviewing the current Plant Protection Act to specify registration procedures for natural products such as DEs. In Zimbabwe, the core research team member (Dr Mvumi) is based in the University. His efforts to link with the ministry [5] there were harder to make and maintain because of the economic environment.

A study of agricultural service provision by PHILA members in Tanzania suggested that specific NGOs were more effective than current public services, in meeting farmers' needs. At the district level, and issues of coverage

aside, such NGOs appear to be better geared up to developing requisite capacity. A parallel study in Zimbabwe was more favourable of the government service provider, AREX, and critical of the Zimbabwe Farmers Union.

[4] Ministry of Agriculture, Food and Cooperatives (MAF&C), formerly Ministry of Agriculture and Food Security (MAFS), Tanzania.
[5] Department of Agricultural Research and Extension Services (AREX), Ministry of Agriculture

---

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.

Potentially favourable impacts may derive from the increased awareness of service providers about the factors influencing the decision-making and actions of resource-poor farmers, be it during land preparation, fertility management, pest management, crop storage or marketing. Moreover improvements in the relationship between farmers and service providers should lead to more participatory development and promotion of appropriate, sustainable and acceptable pre- and post-harvest crop management practices.

Current misuse of organophosphate storage pesticides often puts users' and consumers' health at risk. Inappropriate pesticides such as Actellic 50 EC (liquid formulation) and livestock pesticides are being applied directly to stored food in Tanzania, because of lack of understanding by small-scale producers of the associated dangers. Unscrupulous traders and some extension staff may also be responsible for misinforming them. The dust formulations of organophosphate pesticides, widely used in Southern Africa on stored-grain, are also often applied incorrectly. Misuse of pesticides poses a threat both to human and livestock health and to the wider environment. Improved storage management practices (including use of DEs) would reduce post-harvest storage losses, minimise health and environmental risks, and could lead to more sustainable farming practices.

DE use is likely to diminish the synthetic pesticide use in storage of foods. DEs are inert, have extremely low toxicity to mammals, and are 'Generally Regarded As Safe' by the USA Environmental Protection Agency. The US Food and Drug authority has exempted DEs from requirements of fixed residue levels when added to stored grain.

DE deposits in Kagera (Tanzania) and Chemutsi (Zimbabwe) have been field-tested and shown to be effective. For mining of these deposits, environmental impact assessments (EIA) need to be undertaken by the respective companies who are interested in developing commercial DE products. In Zimbabwe, Zimbabwe Phosphate Ltd (ZimPhos) has undertaken preliminary EIA. Similar preliminary investigations have been undertaken in Uganda by researchers.

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

Currently, local people in the vicinity of the Kagera DE deposits use the materials for protecting stored beans and cowpeas. Commercialisation of the DEs might create conflict with the communities and hence there is need for a good understanding of land tenure and other relevant local bye-laws to avoid conflict and optimise mutual benefits. Uncontrolled use of the local deposits might create environmental degradation, and exposure to crystalline silica in the deposits could negatively affect health of workers in the DE deposits if protective masks were not worn.

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 200 words)***

Recurrent droughts and other adverse climatic events in sub-Saharan Africa, and especially southern Africa, increase the vulnerability and food insecurity of small-scale farmers. Soil productivity is also declining. Any strategies which promote cost-effective and safe storage of whatever food and seed grain is harvested, reduce the risk of subsequent food shortages. The *enquiry approach* moreover is aimed at increasing the 'demand' component in service delivery, at empowering producers to express their needs and priorities, and service providers to respond to these differentiated needs and priorities. Such an approach can be expected to increase the adaptive capacity of diverse producers, and their advisory system, and over time, increase their resilience. The post-harvest learning alliances should provide further underpinning of improvements in adaptive capacity amongst the institutional stakeholders; improved adaptive management practices being one of the outcomes of such alliances.