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Ten years after the arrival in Ghana of Larger Grain Borer: Farmers' responses and adoption of IPM strategies

(*Keywords: Prostephanus truncatus*, subsistence farmer, food security, Coleoptera, pest, insecticide)

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Abstract. Small-scale on-farm storage of maize in Africa is changing, in part due to shifts in the threat from insect pests. A questionnaire survey of 242 households in four closely situated districts in the Volta Region of Ghana, where *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) arrived ten years ago, was used to show how maize storage practices have changed over the last five years. The survey included asking farmers about changing use of contact insecticides in maize storage in order to guide research and future recommendations. We found high uptake of recommendations developed by a project for reducing Larger Grain Borer damage. Farmers are being pro-active in preventing extensive damage from this pest by replacing the wood of their storage structures, increasing inspection of maize in their stores, and increasing their use of grain protectants. There were differences in post-harvest practices according to district, ethnic group and gender. Grain protectants (traditional methods or commercially available products) were used by 45% of farmers. Cost was the most often cited constraint to the use of recommended commercial products. Farmers reported that their three most important sources of information on maize storage were the agricultural extension services, radio programmes and local networks of friends, family and fellow farmers.

1. Introduction

It is now just over twenty years since the beetle *Prostephanus truncatus* (Coleoptera: Bostrichidae), commonly referred to as the Larger Grain Borer or LGB, was first detected in maize and cassava storage systems in Africa (Dunstan and Magazini, 1981). The initial devastation caused by this exotic intruder to the grain stocks of small-scale farming communities elicited considerable efforts to develop ways of limiting its impact. Farming communities, in-country agricultural support systems, and donor-funded research and development, have played important roles. However, the external support (from outside Africa) against the pest has dwindled in recent years as some control options have been identified and promoted (Golob, 1991; Giles *et al*., 1995; Boxall and Compton, 1996; Borgemeister *et al*., 1997).

The Volta Region of Ghana has been a focus of a relatively large effort to combat LGB damage. The beetle initially entered Ghana from Togo in 1989 and the Volta Region, situated just across the Togolese border, may still be the worst LGB-affected area in Ghana (Dick *et al*., 1989). From 1993 to 1996 the UK government funded a technical co-operation (TC) project with the Ghanaian Ministry of Food and Agriculture with the aim to, '... develop appropriate and acceptable techniques to minimise losses in on-farm maize storage... in particular those due to the LGB...' (Boxall and Compton 1996; Compton, 1997).

Research into the pest in Ghana has continued and it has become clear that attack shows very considerable year to year variation in severity (Hodges and Birkinshaw, 1999) unlike other storage pests such as weevils (*Sitophilus* spp) which appear to present a relatively constant threat. Such variation has the potential to interfere with the uptake of storage improvements against LGB since those farmers not adopting them will often be seen to be as successful as those who do. Many existing storage practices are relatively incompatible with the control of this pest. In the Volta Region, maize is often stored on the cob stacked on a wooden platform, known as an Ewe barn (figure 1a) or in an inverted cone (figure 1b). Cobs are then withdrawn as needed for food, sale, seed and other functions. The most common initial response to reduce the LGB damage in the Volta Region was to remove maize from the store early and sell, thereby reducing food security and income, since maize prices increase as the storage season progresses (Magrath *et al*. 1996). The LGB TC project worked with farmers to develop eight control options as follows:

- Storage hygiene
- Changing or smoking storage platform woods or treating with lindane insecticide or engine oil
- Selecting maize varieties with good husk cover for storage
- Timely harvest
- Treating maize in husk with Actellic Super® dilute dust (permethrin + pirimiphos-methyl)
- Shelling and then treating the maize grain with Actellic Super® dilute dust
- Shelling at a threshold of infestation determined by external examination of the store
- Traditional methods of insect control.

Dissemination of these control options by the LGB TC project was undertaken using a wide variety of innovative techniques. These included training extension staff, traders, and farmers and the projection of written print-based materials, plays, radio broadcasts, T-shirts and car stickers, a decision tree and newspaper articles.

We undertook a questionnaire survey to determine the extent to which storage practices have changed in the years

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since the LGB Project, record the extent of adoption of project recommendations and identify which information routes are currently important and what the farmers think of them. The choice of questionnaire survey follows, and builds on, similar successful studies of earlier LGB control projects in East Africa (Golob 1991; Golob *et al*., 1998). During the survey we have taken special interest in establishing which methods of disseminating information impact most on farmers. This is because our own current research project is the development of an improved method of treating farm stores with insecticide which, in due course, will need to be promoted. The treatment of maize with formulations of contact insecticides is an effective, fast-acting control option for farmers (Dales and Golob, 1997). Safety, cost, availability issues and the detrimental effect on biological control agents, are all issues raised by increases in the use of such chemicals. Farmers are asked here about their changing use of contact insecticides in maize storage (including naturally derived products such as botanicals) to guide our research and future recommendations in this controversial area.

a)

b)

Figure 1. Two common structures for the storage of maize cobs in the Volta Region of Ghana, a) an Ewe-style barn under construction, which has an thatched roof added at the end and b) an inverted cone.

2. Methods

A stratified sample of farmers was interviewed by four staff of the Post-harvest Development Division of the Ministry of Food and Agriculture based in Ho, Volta Region. Villages were selected from four Districts to represent the main maize producing areas in the Volta Region that either produce a lot of maize for sale or have this grain as their main staple. Surveys were undertaken between April and June, 2000, and a total of 242 maize farmers interviewed (figure 2). Ten respondents were interviewed in most villages.

The survey was based around a questionnaire (see Appendix 1) that was developed in collaboration with the survey team. The questionnaire included questions about storage practices as well as questions about the respondents themselves, particularly their sex, ethnicity, age and educational background. These were included as it seemed probable that such factors could affect either the uptake of extension messages and/or responsiveness to particular dissemination pathways. The questionnaire was then tested in Hodzo and Kodzobi on 27 and 28 March 2000. More revisions were then made following suggestions made by the survey team.

The survey team selected respondents by walking through each village looking for signs of maize storage. They then attempted to locate those responsible for maize storage in that household. They encouraged women to speak for the household even if they were not in charge of the barn and the person responsible was not available. Sampling was not entirely randomised, since occasionally, the team came across households where nobody was available to participate. Within these constraints the survey team included a range of respondents, both men and women, producing various quantities of maize. After initial analysis of the survey data, we revisited some of the survey villages to gain farmers' opinions on the likely explanations for some of our results. In order to establish whether respondents could distinguish different storage pests, dead specimens of LGB, *Sitophilus zeamais* and *Tribolium castaneum* were presented to farmers in Petri dishes. Were possible live insects taken from farmers' barns were also used.

The raw data were entered into an Access 7.0 database. Differences were compared statistically using chi-squared (χ^2) tests on the numbers of respondents in each category.

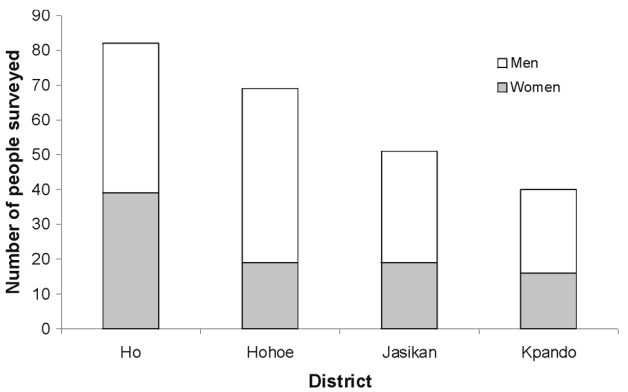

Figure 2. Numbers of men and women interviewed in each of the four Districts.

3. Results

3.1. Interviewees

Overall, there was a male bias in our sample, 62% men compared to 38% women (figure 2). The sex ratio sampled also varied by District. An approximately equal sex ratio was sampled in Ho and Kpando, and the most male-biased sample was from Hohoe.

The most prominent ethnic group in our sample was Ewe (83%), the next most frequent was Buem who were only found in the Jasikan sample and comprised two thirds of this sample. The majority (85%) of our sample were middle aged, with just seven male adolescents and 29 Elders. Those classed as adolescents were generally under 20, middle-aged, 20–50, and Elders generally older than 50.

Primary education lasts for about six years, middle education for about four years and secondary education from 5–7 years (although this system is currently being revised). The majority of our sample had finished their formal education after middle school. More women than men (even though overall the sample is male biased) had received no formal education, and only three of thirty-one respondents who had attended secondary education or university were female. The overall level of formal education received by our sample population is likely to be less than average since it is drawn from those not skilled in another trade, i.e. those who have remained on-farm and not taken up jobs elsewhere.

The number of people depending on maize for their livelihood (a measure of household size) ranged from one to 23, but the modal value was six.

3.2. Maize uses

The three most frequently mentioned uses of maize were for family food, sale and seed. When ranked, food for family was rated as the most important use. The mean amount of maize allocated for sale, by those who were selling and who were prepared to give us an estimate of the amount sold, was around 400–500kg. This is approximately twice as much as that cited for family food. This may however be an underestimate since the survey team felt that many people would not mention small quantities of maize that they had sold and the figure only represents the relatively large-scale sellers.

3.3. Maize variety and decision to store

Local maize varieties were grown and stored by the vast majority of households in our survey. Respondents in Ho District mostly grew and stored in only one season (called the major season). Most farmers in the other Districts grew and stored maize in two seasons (called the major and minor seasons) (figure 3). The length of time at least some of the maize was kept in store is also shown in figure 3. There is no suggestion from our data that improved varieties (generally more susceptible to damage during storage) were disposed of earlier than local varieties.

3.4. Changes in storage problems

Within the past five years, about half of our respondents said that they had experienced changes in storage problems. There was significant variation among Districts (Ho 65%, Hohoe 53%, Jasikan 25%, Kpando 53%) with fewer respondents in Jasikan reporting changes ($\chi^2 = 9.56$, 3 d.f., $p < 0.025$). The two most mentioned problems were rising insect infestation and difficulties in obtaining barn construction materials. These were mentioned significantly more frequently than the third and fourth mentioned problems, lack of barn builders and rodent damage (figure 4). There were differences between the Districts. In Ho, the issue of barn materials was cited more than increasing insect damage.

3.5. Insects reported in stores

Almost all farmers questioned had *Sitophilus* spp. in their stores and were able to recognise it when shown live samples by the survey team (figure 5). In contrast, approximately 15% of respondents did not recognise LGB and only up to 50% of respondents in any one District reported that they had had LGB in their stores in the past year.

3.6. Changes in storage practice

Over half of respondents reported at least one change in their storage practice in all Districts. Although there was no significant difference between the numbers of men and women reporting that there had been at least one change in storage problem, there was, however, a significant difference between

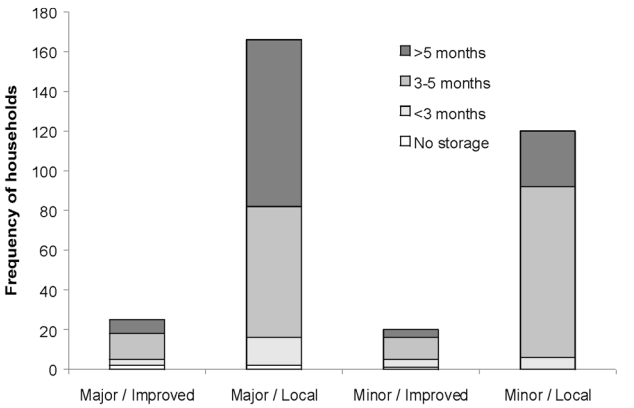

Figure 3. Frequency of households harvesting major and minor maize or local and improved varieties. Bars divided by storage period.

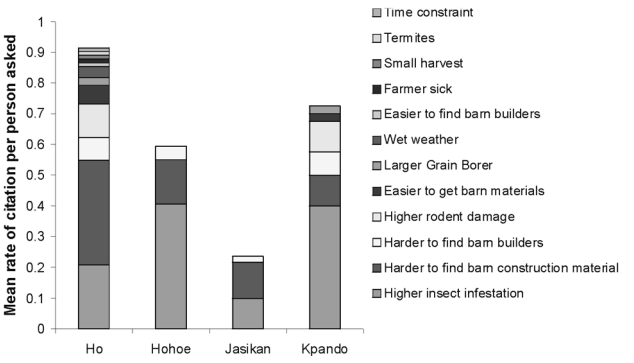

Figure 4. Change in storage problems cited in different Districts. Overall, considering all Districts together: Insect infestation vs. barn construction materials $\chi^2 = 1.42$, $p > 0.5$(n.s.); Insect infestion vs. barn builders $\chi^2 = 17.8$, $p < 0.001$; Barn construction materials vs. barn builders $\chi^2 = 10.04$, $p < 0.005$.

men and women reporting that they had changed their storage practice ($\chi^2 = 6.17$, 1 d.f., $p < 0.025$). Of the women, 55% reported that there had been a change whereas 74% of men reported a change.

Farmers reported that the most common change in practice was a shift towards increased inspection of their barns and action taken when insect infestations reached a certain level. Some possible preventative actions were also being taken against insect damage. For example, some but not many farmers were shelling and selling early, some were sun-drying more frequently and some were replacing barn wood more often, particularly in Ho District. Just over a quarter of respondents in all Districts, reported that they have recently begun shelling maize when it becomes infested (figure 6).

3.7. Storage structures currently used

The range and frequency of storage structures used by the farmers we interviewed in each District are shown in figure 7. There was no significant difference in the structures used for major and minor maize crops at harvest (total: $\chi^2 = 0.39$, 3.d.f., $p > 0.90$; treated: $\chi^2 = 2.66$, 3.d.f., $p > 0.25$) or if the maize was moved later (total: $\chi^2 = 1.71$, 2.d.f., $p > 0.90$; treated: $\chi^2 = 0$, $p > 0.99$). We have therefore limited our analysis to the major harvest. Maize is most commonly stored on the cob on raised platforms and then, if it is moved during the storage season, it is most commonly threshed and bagged (figure 8). Maize stored as cobs in a room or in inverted cones (figure 1 b) was less often treated than in the other store types. This difference in the chance of different store types being treated at harvest was significant ($\chi^2 = 9.68$, 3.d.f., $p < 0.025$). In cases where maize

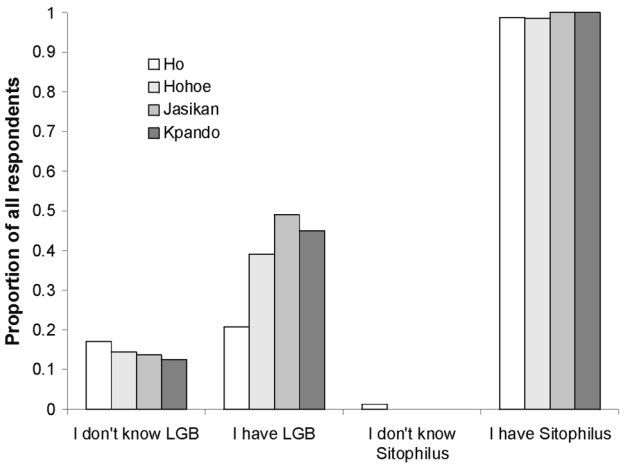

Figure 5. Which insects do you find in your store? Data shown for LGB and Sitophilus spp. only (by far the most frequently mentioned).

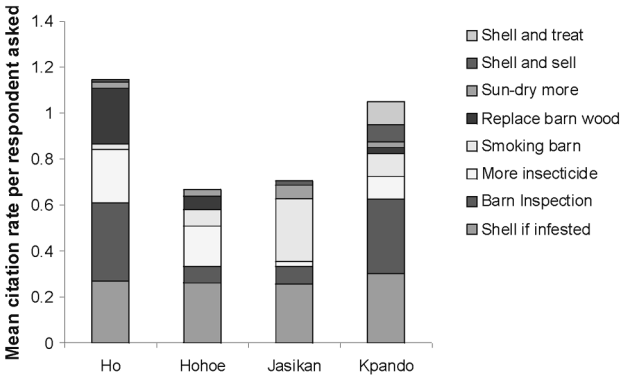

Figure 6. Change in storage practice by District.

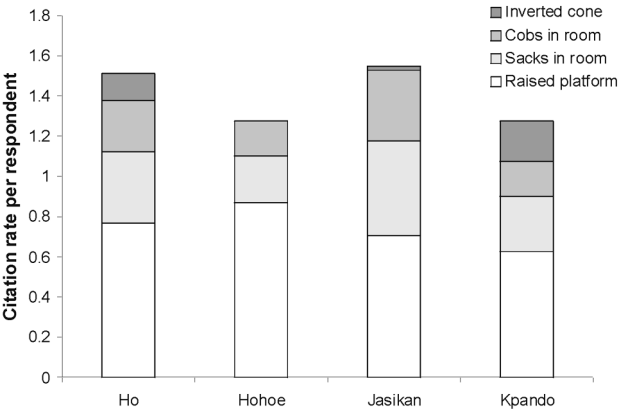

Figure 7. Use of different storage structures in different Districts. N.B. Each farmer can mention more than one type of storage structure.

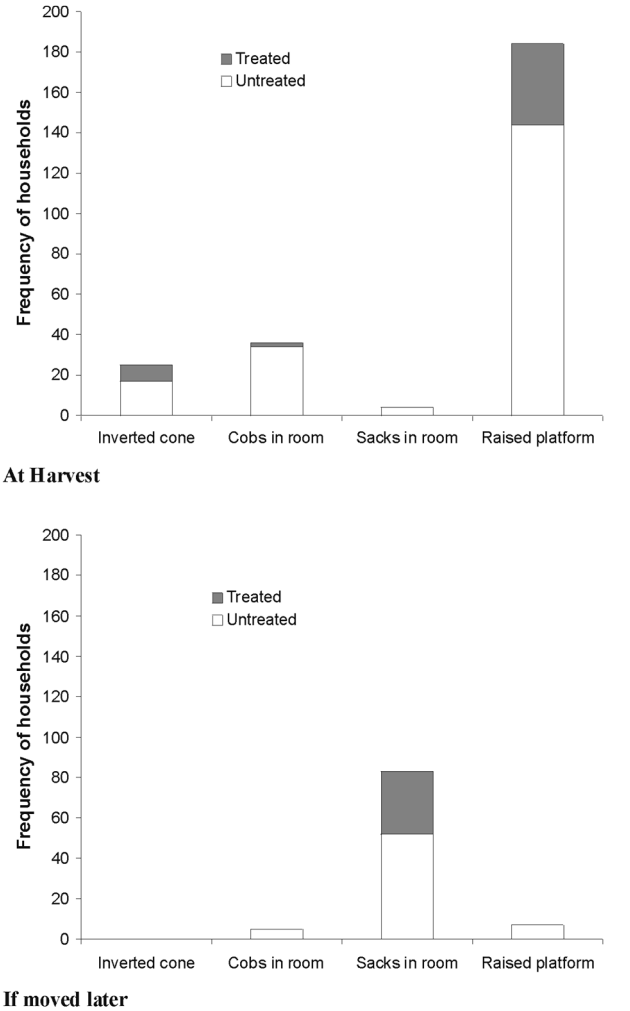

Figure 8. Store types used by households for the major season maize at harvest and then later if the maize is moved. The portion of those stores that have been treated with a protectant of any type are shaded.

was moved into different storage structures later in the season, only grain moved into sacks was treated.

3.8. Use of protectants

Grain protectants were used by only 45% of respondents, this includes botanicals and ash as well as commercial synthetic products. There was no evidence that those selling their maize were more likely to treat since only 48% of those who said they had maize for sale used protectants. There were also remarkably few differences in use of protectants between households storing different total quantities of maize over the year (figure 9), with perhaps some trend for those storing very little to be less likely to treat their maize. There was also a trend for respondents who had had fewer years of formal education to report that their household did not use protectants (figure 10).

Cost was the most frequently mentioned constraint to the use of commercial insecticide and was cited by approximately 40–50% of respondents in all Districts and significantly more than the next most cited constraint (health hazard) ($\chi^2 = 30.0$, 1d.f., $p < 0.001$) (figure 11). Three of the constraints cited have been grouped together in figure 11 under the heading, 'no need for treatment' (No damage, small quantity of maize, or use maize quickly). This new heading then becomes the third most cited reason for not using commercial insecticides. Some of the constraints cited are consequences of shelling and storing in sacks, which is often the preferred way of storing treated maize. For example rodents were cited because they damage the sacks, and space was mentioned because grain in sacks is easier to steal than grain in other storage structures. This obliges farmers to keep the sacks in their houses where space is limited.

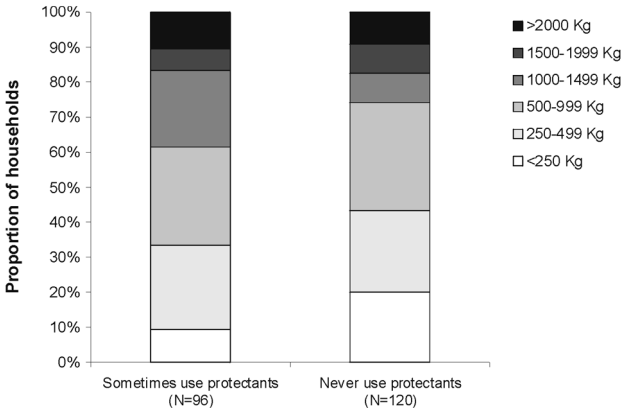

Figure 9. Is there any difference in the use of protectants (any) between households storing different amounts of maize?

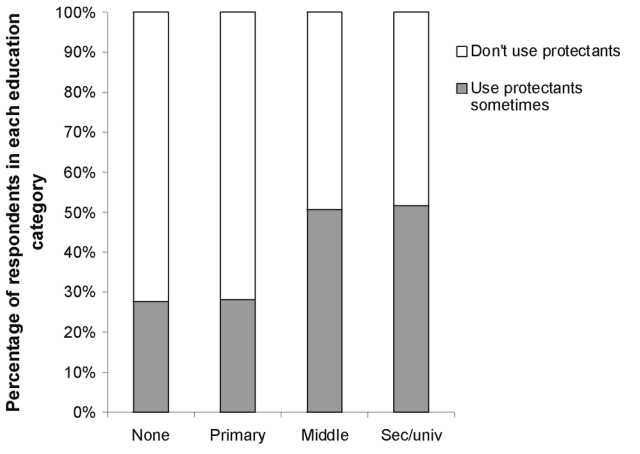

Figure 10. Is there any difference in the use of protectants (any) reported by responders of different levels of formal education? Significant difference between education classes in likelihood that respondents use protectants ($\chi^2 = 8.57$, 3d.f., $p < 0.05$).

Commercial insecticides appear to be readily available to those with the money to buy them. Availability was mentioned only rarely as a constraint that prevented their use. When those who had used commercial insecticides recently were questioned, over 95% said that these protectants were, 'very easy to obtain'. The survey team noticed that most farmers felt that all protectants work. Certainly, very few people cited inefficacy as a constraint to use of commercial insecticides.

The use of various categories of insecticides by District is given in figure 12. We have classed camphor, Commando (recommended for public health use), Gammalin 20 (recommended for cocoa crops), DDT and unknown chemicals as, 'inappropriate chemicals'. This will be an overestimation of the misuse of chemicals since some of the 'unknown chemicals' and DDT (sometimes used as a general name for insecticide) citations may in fact be use of registered grain protectants. The registered grain protectants mentioned were Actellic (pirimiphos-methyl), Actellic Super (pirimiphos-methyl and permethrin) and Sumicombi (fenvalerate and fenitrothion).

In approximately half the cases of use of botanicals, neem was specifically named; in the other half no name was given. It can be seen from figure 12 that there is a considerable difference in the choice of protectants used between Districts. There was no reported use of botanicals as grain protectants in Jasikan (although it could be argued that smoking is a use of botanicals and this was mentioned under, 'changes in storage practice'). Respondents in Jasikan were most likely to cite the

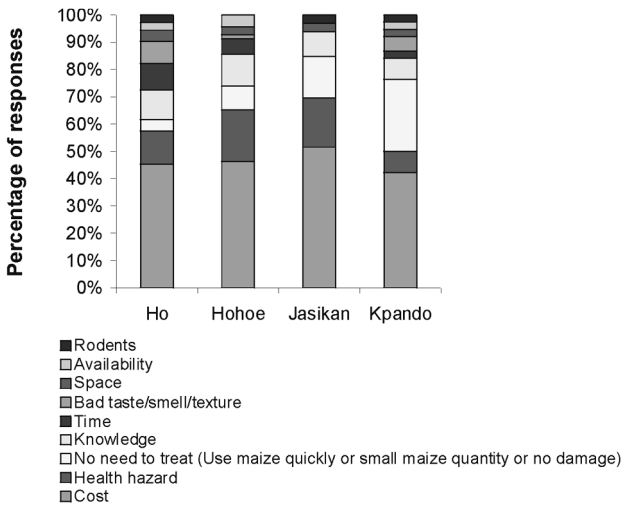

Figure 11. Citation rate of constraints to the use of commercial chemical grain protectants given in different Districts. Cost cited significantly more than next most cited constraint (health hazard) ($\chi^2 = 30.0$, 1d.f., $p < 0.001$).

use of registered grain protectants and least likely to say that they used inappropriate chemicals compared to the other Districts.

3.9. Storage decisions and information networks

Storage decisions were reported to be taken more often by men than women, although not exclusively so (figure 13). It is common for members of the same household to own separate barns and take sole responsibility for decisions involving that barn.

Men and women cited the same top three sources of information, extension services, radio/TV, and friends, family and fellow farmers (figure 14). There is a slight tendency for women to cite extension services less often, and friends, family and fellow farmers more than men. We obtained very similar citation rates for the different sources of information in the different Districts. However, when we explicitly asked about the frequency of contact with extension services there were some differences, with respondents in Jasikan reporting the most visits from extension officers.

From the comments we received about the various sources of information, it is clear that the extension services are held in high regard. The respondents often valued the chance to ask questions and observe practical demonstrations of techniques that they may have only heard about on the radio.

There was some division in opinion of the value of the information coming from the radio. On the positive side it was felt to be up-to-date, regular and from reliable experts. On the other hand some felt these experts had little practical experience and sometimes gave advice that was impractical (too costly). Friends, family and fellow farmers were accessible, and mostly regarded as having good practical experience, although some said their information was sometimes unreliable. There are programs such as, 'Radio gbledela' (The radio farmer) specifically dealing with agricultural issues. One particular strength of these transmissions is that they are often repeated in many different languages (Ewe, Akan, Hausa, Ga, Nzema or Dagbani).

4. Discussion

Farmers spoke most often about increased insect infestation as a recent change in storage problems, but LGB was hardly ever mentioned explicitly. When asked how much the arrival of LGB had contributed to the higher levels of insect infestation, farmers gave mixed reports, some saying that LGB is a particular problem, others reporting that other species are also increasing in number. Variation between farmers in their experience of LGB problems was expected due to the sporadic nature of the pest (Hodges and Birkinshaw, 1999).

The survey shows some distinctive differences between the Districts despite the fact that they are quite closely located. In one case the difference possibly relates to ethnicity; there was also an apparent difference between the sexes. In Ho, most farmers stored for one season only, elsewhere there were generally two storage seasons. Ho was changing its barn materials more frequently and had significantly greater problems finding barn construction materials. In Jasikan, there was much lower use of botanical protecants of grain stocks than at the other three locations. This may be a reflection of the predominance in the Jasikan area of a different ethnic group, the Buem. In Ghana, it is known that the prevalence of plant

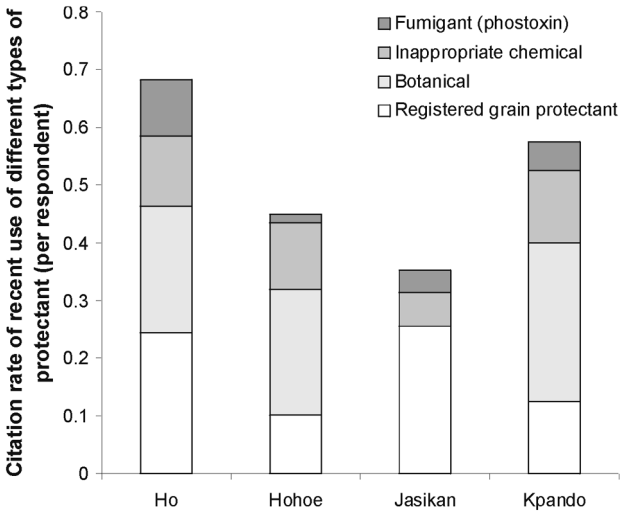

Figure 12. Types of protectants used in different Districts as reported by our survey sample.

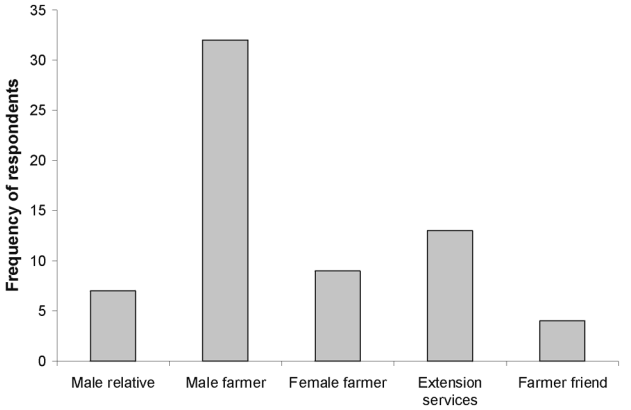

Figure 13. Who makes store management decisions?

Figure 14. Sources of information cited by men and women. Comparison of the relative frequency of extension officers, radio/TV and friends/family/fellow farmers between men and women revealed no significant difference ($\chi^2 = 3.82$, 2.d.f., $p > 0.10$).

materials usage for stock protection varies according to ethnic and cultural differences in indigenous knowledge (Cobbinah et al., 1999; Belmain and Stevenson, 2001). The sex of respondent appears also to have had some influence on technology uptake since men were significantly more likely to have changed their storage practice than women. This may represent a true sex difference in the likelihood of adopting changes. Alternatively, this may be a misleading result arising from questioning women who were not directly responsible for store management decisions and possibly not aware of changes made by the men they represented.

The clear message from this survey is that farmers have changed their storage practice to include some of the recommendations promoted by the LGB TC project in the Volta Region. The dissemination pathways adopted by that project were successful. Respondents questioned in Ho and Kpando, on average, cited more changes than the other two Districts. In Ho and Kpando, maize is important both as food and a source of income and therefore farmers might be more likely to give a detailed description of their situation. In addition, a higher citation rate of changes in practice might have resulted from particularly high LGB incidence in these Districts in the past. In contrast, in Jasikan, the lower rate of problem citing may well reflect the relatively low importance of maize as a staple for these people.

Many farmers have adopted the strategy of increased inspection and then action, if a significant infestation is detected. It would be interesting to know how early farmers are detecting insect infestations and at what point they feel action should be taken. In the early 1990s, Tanzania farmers were reported to be similarly reluctant to take a prophylactic approach to LGB control (Golob, 1991). However, this may have changed as a 1997 survey in East Africa, including Tanzania, reported that farmers were more likely to shell and often treat their grain as soon as convenient after drying, whether or not insect infestation had been detected (Golob *et al.*, 1998). Similarly, a survey of farmers in three Districts of Kenya, more than ten years after the first record of LGB in the country, showed that among farmers producing a lot of maize for sale or depending heavily on maize for their food security, there was a high rate of adoption of a prophylactic, 'shell and treat' recommendation (Farrell *et al.*, 1996).

Farmers reported that increasing difficulty in obtaining barn construction materials is due to increases in the rural population and thus the amount of land being farmed. Increasing replacement of barn wood (one of the changes in storage practice) was not explicitly given as the main reason why barn materials are now harder to find. Certainly, it has been proposed that store wood is an important harborage for LGB (Kossou 1992) but another reason given by respondents for increased replacement of barn materials was an increase in the additional use of barns as storage space for household items or as kitchen areas. These raise the importance of barns, and dictate that they are built to a higher standard. Increase in barn wood replacement was mentioned most often by farmers in Ho District. There would seem to be two reasons for this. First, farmers in Ho do not produce much minor season maize and so have to store their major harvest for a long time; it is therefore especially important to have a good strong barn to last the season. Secondly, they seem to use the least durable material, palm fronds, to make their barn platforms (other Districts use planks or bamboo).

Some farmers reported an increase in the use of insecticides, presumably to combat the increased threat of insect damage, although this might instead be related to changes in the availability and cost of insecticides, but we do not have information on this. Greater use of insecticide increases their potential health risk, particularly because inappropriate chemicals were in frequent use. Increased smoking of maize was cited most often in Jasikan. This is possibly a reflection of the high humidity of this region where smoking may be particularly useful for drying the commodity. Respondents reported a relatively high usage of appropriate storage grain protectants in this District suggesting that smoking *per se* is not a sufficient response to the threat of insect damage. In fact, earlier survey work on traditional storage methods had shown that the worst infestations of LGB were associated with smoked stores and some farmers even stopped smoking their stores in the belief that it encouraged LGB (Boxall and Compton, 1996).

For the dissemination of information within villages, the agricultural extension services and radio would appear to be the main trusted routes although fellow farmers and family also have an important role. Boxall and Compton (1996) cited traders as a very important source of stock protection information, but this was not reflected in our survey. This may be a consequence of the selection of our survey villages, which were not major trading centres.

We are currently developing methods that could reduce the amount of insecticide to be used per treatment of maize cob barns yet still give acceptable protection. Such treatment would be less expensive and should therefore widen access to stock protection for those farmers who are currently constrained by cost. This approach is seen as particularly relevant in view of the fact that nearly half of all respondents in all Districts mentioned cost as the most important constraint to the use of insecticide. The extension services are clearly assisting some farmers with insecticide treatments while others appear not to have access to good information or support. If new approaches to stock treatments are introduced the dissemination of the methods and provision of clear information on safe treatment will be needed. The best option would appear to be a campaign on the radio followed up by the extension service explaining and demonstrating the new method to key farming families; the methods identified by respondents as most effective and the key approaches used by the earlier LGB project.

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Appendix 1

FARMER MAIZE STORAGE QUESTIONNAIRE

1. GENERAL

(a) Date:.....
(b) Region: .....
(c) District: .....
(d) Village: .....

2. RESPONDENT/HOUSEHOLD INFORMATION

(a) Sex M F
(b) Age Adolescent Middle age Elder
(c) Ethnic group Ewe Akan Kotokoli Buem Other
(d) Education none primary middle secondary/univ
(e) How many dependent on household maize? .....

3. HOUSEHOLD MAIZE PRODUCTION/STORAGE

Don't worry about major vs minor harvest, simply fill in largest area at any one time.

(a) Area farmed + ...
(b) Area farmed with maize .....

	MAJOR		MINOR	
c) When do you cultivate maize? I = Improved, L = local	I	L	I	L
d) Which season do you store your maize? I, L.	I	L	I	L
How long do you store (months) <3, 3-5, >5?				

f) Harvest/ later	g) Store type (same store type can be in more than one row	h) Major (kg)*	i) How many stores?	j) Minor (kg)*	k) How many stores?
	Raised platform				
	Room sacks				
	Room cobs				
	Inverted cone				
	Other				

*Circle maize that is sometimes treated (with **ANY** protectant)

4. MAIZE USES

What is the household maize used for?

(a) Tick		(b) Ranking 1 = most important	(c) Approximate quantity (Kg)
	Food for family		
	Sale for cash		
	Food for those other than immediate family		
	Feed for animals		
	Seed		
	Payment to hired labour		
	Other		
	Other		

5. STORAGE PROBLEMS

(a) Have your storage problems changed over the years? yes / no / new (I haven't had this responsibility for long)

(b) What are the changes?

Harder to get construction material	
Harder to find people skilled in barn construction	
Larger Grain Borer	
Increased insect infestation	

(c) Have you changed your storage practice in response to this? (yes / no)

…..……..

(d) What have you been doing differently?

	Tick	(e) Comment (useful/ not useful, how has this been adapted to your particular situation?)
Better store hygiene		
Replacing barn wood more often		
Using insecticide more often		
Inspecting the barn more often		
Shelling infested		
Sun drying more often		
Other ……		

6. INSECT PESTS OF STORED MAIZE

Which insects have you ever found in your maize stores?

(a)	(b) (Y = yes I have this) (N = no I don't have this) (? = I don't know what this is)	(c) How important? VI (very important) I (important) NI (not important)	(d) Explain your answer to column (c)
Sitophilus species (weevils)			
LGB			
Other (please specify if possible)			

7. VARIATION IN INSECT DAMAGE BETWEEN YEARS

Do you remember which years were bad for damage from insects?

3 – higher than normal damage, 2 – normal level of damage, 1 – less than normal damage, 0 – can't remember/can't be sure of insect type

(a)	(b) Year before last year 97/98	(c) Last year 98/99	(d) This year 99/00
Total insect damage (use this if unsure)			
Sitophilus damage			
LGB damage			

8. USE OF PROTECTANTS

(a) Are any protectants (**local** or purchased) used? Yes No

(b) Who decides whether or not protectants should be used in the household maize stores?
I do woman farmer man farmer man and woman for separate
FLS Other.....

(c) What are the main things that might prevent you from using commercial chemical protectants?
time knowledge doesn't work cost health hazard space
rodents other (please state) .....

(d) Protectant used (e.g. Actellic, other insecticide, wood ash, plant materials) .....

(e) Formulation (e.g. dust, EC, leaves, dip, other -please state)

(f) Approximately how many years out of five do you use this?

(g) When applied during storage?
as store is loaded after a set time time depends on damage
time depends on access to protectant time depends on other

(h) Monetary cost of protectant (cedis)

(i) Other monetary cost

(j) Availability of protectant (ignoring cost)
very easy to obtain sometimes hard to obtain very difficult to obtain

9. ACCESS TO INFORMATION

(a) How do you find out about new storage ideas? Rank importance (1 = most important)

	Rank
Radio/TV	
Friends/ Family/Fellow farmers	
Village specialists	
NGO's	
Develop my own	
Extension officers	
Other (specify)	

(b) Comment on ranking of sources of info

.....

(c) How much direct contact do you have with the agricultural extension services?
Never Hardly ever Less than once a year
1–5 times a year More than 5 times a year

(b) Would you like to be asked to be involved in any future work we are doing?
If yes, what is your name.....