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Study of the Maize and Cassava Farming and Storage Systems in Central Togo with reference to the Impact of the Larger Grain Borer

(ETUDE SUR LA CULTURE ET LE SYSTEME DE STOCKAGE DU MAIZE ET DU MANIOC DANS LE CENTRE DU TOGO AINSI QUE SUR LES EFFETS DU GRAND CAPUCIN DU MAIS)

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Project No. T0007

Integrated Pest Management for Improved Food Security in Maize-Based Farming Systems: Strategies to Control the Larger Grain Borer

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GLOSSARY OF TERMS

cossette	Stored form of dried cassava, known as *cossette de manioc*.
DESA	Direction des Enqûetes et Statistiques Agricole;
DGDR	Direction Générale du Developpement Rural;
DRDR	Direction Régionale du Developpement Rural;
encadreur	Extension agent;
foufou	food staple made from fresh, boiled and pounded yams or cassava;
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation Office)
IFDC	International Fertilizer Development Centre, Lomé.
Katchalla	Store in the form of an inverted cone made of straw on a wooden frame with a thatched roof;
Kédélin	Raised platform type store made from wood covered with a thatched roof;
Kpéou	Beaten earth type of store;
LGB	Larger Grain Borer, *Prostephanus truncatus* (Horn)
M.D.	Missing Data
NRI (ODNRI)	Natural Resources Institute, Chatham, formerly ODNRI, the scientific division of ODA;
ODA	Overseas Development Administration of the British Government;
SORAD	Société Togolaise d'Amenagement et Developpement, the forerunner of DRDR;
SOTED	Société Togolaise du Developpement;
SOTOCO	Société Togolaise du Coton;
SRCC	Société Nationale pour la Rènovation et le Developpement de la Cacaoyère et de la Caféière Togolaises.
TOGOGRAIN	Togolese parastatal responsible for ensuring food crop security and price stability;
Tonneau	Barrel shaped store made out of woven mats on a wooden frame covered with a thatched roof;

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EXECUTIVE SUMMARY

This report contains the results of a socio-economic survey of the maize/cassava farming and storage system in central Togo, and the impact of the Larger Grain Borer (LGB), *Prostephanus truncatus* (Horn) on that system.

The report characterises the maize and cassava farming, storage and marketing systems and examines the impact of LGB. A further 3 month study scheduled for March-May 1992 will assess the cost-effectiveness of proposed control methods, carry out additional informal surveys and establish means of disseminating results. This will coincide with the end of the entomological component of the LGB project in Togo.

The survey was conducted over three regions of central Togo (northern Plateaux, Centrale and Kara), where the storage of maize and cassava (known as "*cossettes de manioc*"), both of which are attacked by LGB, is widespread. All three regions fall within the Guinea Savanna agro-ecological zone, with annual rainfall of between 900-1500 mm and unimodal precipitation, resulting in a single cropping season.

Using a two-stage random sample; 331 heads of households were interviewed in 65 villages in central Togo. The results of the survey are outlined in the summary of key characteristics (pages VII-VIII). In the survey area 66% of farmers grew both maize and cassava, 28% grew only maize and 5% only cassava, while just 2% grew neither crop.

The study area is characterised by small-scale subsistence farming, with an average farm size of 4.4 ha, and low use of purchased inputs such as fertilizer and storage chemicals. The majority of respondents were under 36 years of age, with little or no formal education. Agriculture is the most important source of income for 90% of the survey sample, and livestock the second important source of income for 50%; only 16% had other sources of income.

In farmers' opinion insects are their most important storage problem, and levels of damage were thought important for both crops by the majority during the reference period, the 1989/90 storage season, although only a minority thought levels of damage had increased. There are however important differences in cropping patterns, storage and marketing practices and farmers perceptions between the regions examined, suggesting a gradual decrease both in importance of maize and cassava cultivation, storage and insect problems with progress northwards, but an apparently increasing importance of both crops in consumption terms, which should be noted.

Plateaux Region

This is the most important region in Togo for the production of maize, contributing 45% of maize production in 1989/90, and 19% of cassava production. Only the northern part of the region was covered by the survey, approximately one-third of its area which represented unimodal precipitation and cropping, where the storage of maize and cassava is widespread.

Maize is the most important food crop, and is produced and stored by all farmers; cassava is grown and stored by the vast majority of farmers. The most common forms of storage are maize with husk on a platform type of store, and *cossettes* in sacks: This region has the lowest use of agricultural chemicals either as fertilizer or storage chemicals in the survey area, and the greatest percentage of farmers who had received no extension training. Maize is stored without further drying after harvest, for the longest mean period of all the regions. Drying time for *cossettes* is less than in other regions, and a small percentage of farmers do not store *cossettes* but make them as required throughout the year. The lowest percentage of cassava production is transformed into *cossettes*, and is commonly consumed fresh or made into gari.

The largest proportion of farmers store maize and *cossettes* for sale as well as consumption in this region, and greatest percentages of both crops were sold, with sales at sub-regional markets and to retailers and wholesalers most common. In comparison with the other regions, insects were seen as the most serious storage problem, damage levels perceived as important and to have increased by the greatest percentage of farmers. *Sitophilus spp* was identified as the most important insect infesting maize, and LGB infesting *cossettes* by the greatest percentage of farmers, while the lowest percentage said they had no insects or damage to either crops.

Centrale Region

Centrale region produced 14% of maize and 17% of cassava nationally in 1989/90, although the percentage of cassava increased to 20% in 1990/91. Although maize is the most important food crop to the majority of farmers, sorghum and cassava are also significant food crops; the production and storage of maize and cassava is carried out by the great majority of farmers. Maize is most commonly stored on the cob with husk cover on a platform type of store, although a substantial minority store maize shelled in sacks. *Cossettes* are most commonly stored in the *katchalla* type of store although the *kpeou* is used by a substantial minority; for both crops a range of other store types were used by a minority of farmers.

This region showed the smallest mean quantity of maize harvested and stored, but the largest mean quantity of *cossettes*, with the lowest mean period of storage. It also demonstrated the highest use of traditional protective storage treatments and the recommended combination of storage chemicals for stored maize; it was the only region studied where a minority of farmers applied the same chemicals to their *cossettes*. The greatest percentage of farmers transformed over 75% of their cassava production into *cossettes*. This combined with the fact that it showed the largest mean quantities produced and stored meant it was considered to be the most important region for production and storage of *cossettes*. A substantial percentage of farmers consume cassava fresh or as *gari*.

Both crops are stored for consumption and sale. Centrale region had the largest minority who separated stocks for consumption and sale, and treated the stock for sale with storage chemicals. Marketing of maize is generally carried out at local, nearby or sub-regional markets to wholesalers, retailers and consumers. Marketing of *cossettes* is done at local or nearby markets to consumers and wholesalers, and the largest mean quantity was sold.

Centrale region had the lowest percentage of farmers who said insects were their most important storage problem, and the highest percentage who thought the level of damage had not changed for both crops. The damage assessment surveys that were carried out in this region only showed that LGB was the most important storage pest in both maize and *cossettes*.

Kara Region

This was the most northern region examined, and the least important in terms of production of maize and cassava, having contributed only 7% of maize and 3% of cassava to national production in 1989/90. This was confirmed by the fact that sorghum was given as the most important food crop, followed by maize and millet, and had the lowest percentage of farmers growing maize and/or cassava.

The region however demonstrated some interesting characteristics. It had the highest percentage of farmers reached by the extension services, using improved varieties of maize, chemical fertilizer, and storing maize as grain in sacks with storage chemicals. The most common form of storage for *cossettes* is the beaten earth *kpeou* store followed by storage in sacks. Periods of drying were found to be longest for both crops before storage, and the practice of boiling *cossettes* during preparation is used by a substantial minority. Lowest mean quantities of *cossettes* harvested and stored were found in this region, but were stored for the longest mean period. The greatest percentage of farmers transform all their cassava into *cossettes* and use of cassava as gari was not common.

Storage of both crops for consumption is more important in Kara region, with a lower percentage of farmers selling any of their crop, farmers selling a smaller percentage of the crop, and selling locally to consumers; the smallest mean quantities of *cossettes* were sold in this region. Insects were considered the most important storage problem but the lowest percentage of farmers said levels of damage were important, while the greatest said they had no damage or insects in their stored crops. Despite this, the greatest number of farmers were found to have changed their maize or cassava storage practices in this region, which may once again reflect a more effective extension service.

These and other key characteristics are outlined in the following table.

TABLE I: KEY CHARACTERISTICS OF THE SURVEY AREA

	Plateaux	Centrale	Kara	Overall
GENERAL				
Agro-ecological zone	Guinea Savanna	Guinea Savanna	Guinea Savanna	Guinea Savanna
Range of mean annual rainfall in 000 mm	1 - 1.4	1.1 - 1.2	1 - 1.2	1 - 1.4
Mean household size	7.78	10.19	8.60	9.13
Most important food crop	Maize	Maize	Sorghum	Maize
Avg. size of holding	5 ha	4 ha	4 ha	4.4 ha
% Maize producers	100	95	88	94
% Cassava producers	87	79	48	71
% Maize & cassava	87	75	48	66
% Neither crop	0	1	4	2
MAIZE				
% National production (1989/90)	45 (1)	14	7	N.A.
Month of harvest	August	Sept.	Oct.	Sept.
Mean yields t/ha (2)	1.3	1.5	N.A.	N.A.
Mean quantity harvested in kgs (3)	1100	900	1200	1000
Mean quantity stored in kgs (3)	1100	800	1200	1000
% of harvest stored	97	88	94	93
% Using chemical fertilizer	15	30	71	39
% Storing maize	100	96	98	98
% Using storage chemicals	25	27	27	27
% Using Actellic+ K-Othrine	4	19	7	12
% Storing on cob	97	83	59	80
% Storing shelled	3	17	41	20
Mean length of storage (months)	8	7	7	7
Most common type of storage	Platform	Platform	Sack	Platform
% Using this type	92	72	33	61
% Selling maize	77	72	64	71
% Production sold/farmer	47	43	29	39
Mean Quantity sold in kgs (3)	800	700	900	700

(1) Percentage for whole of Plateaux region.
(2) National production figures.
(3) Estimated by farmers in 100kg sacks of grain.

TABLE I: KEY CHARACTERISTICS OF THE SURVEY AREA (cont'd.)

CASSAVA

	Plateaux	Centrale	Kara	Overall
% National production (1989/90)	19 (1)	17	3	N.A.
% Growing bitter varieties	46	83	60	68
% Growing sweet varieties	78	56	69	65
% Growing both varieties	25	39	29	33
Most important month of harvest	Dec.	Dec.	Dec/Jan	Dec.
% Using chemical fertilizer	0	1	4	1
Mean yields t/ha (2)	7.5	11.7	6.1	8.4
Mean quantity harvested in kgs (3)	480	600	300	480
Mean quantity stored in kgs (3)	420	600	300	480
% Producing *cossettes*	98	95	94	96
% Storing *cossettes*	86	93	94	91
% Using storage chemicals	0	10	0	5
% Using Actellic+ K-Othrine	0	5	0	3
% Boiling *cossettes*	2	2	27	7
Mean length of storage	6	7	8	7
Most common type of storage	Sack	Katchalla	Kpéou	Kpéou
% Using this type of storage	55	44	57	34
% Selling *cossettes*	60	51	37	51
% Production sold/farmer	40	26	16	28
Mean quantity sold in kgs (3)	300	480	180	360

(1) Percentage for whole of Plateaux region.
(2) National production figures.
(3) Estimated by farmers in sacks of 60 kgs.

Impact of LGB

Insects are considered to be the most important storage pest by farmers, but there was little awareness of any change in the status of insect pests in the survey area, probably because of the resemblance of *Dinoderus spp* to LGB. A small percentage of farmers had made changes to their storage practices as a result of damage caused by insect pests.

Plateaux region appears to be the most important region in terms of maize storage and to have the greatest storage problems in terms of damage by insects to both crops; while Centrale region is the most important region for the production, storage and marketing of *cossettes*. It is likely that farmers have always suffered substantial levels of damage to *cossettes* caused by *Dinoderus spp.*, and that might explain the lack of awareness in any change to the status of storage insect pests. Kara region is more marginal for the production of both maize and cassava, and appears to have a slightly lesser problem of storage insect pests.

LGB was found in the same seven out of ten villages during the rapid damage assessment surveys, those where LGB was not found were far from the main north-south highway. Losses were found to be 9% in maize after 6 months and 11% after 8 months, and in *cossettes* 5% after 1 month and 15% after 3 months. LGB was also shown to be the most destructive primary storage pest, associated with between 2-3 times more damage per adult insect than *Sitophilus spp.* in maize. LGB was also found present in small numbers in sorghum stores examined near stores heavily infested with LGB. Storage losses showed a decrease with progress north, approximately corresponding with that indicated by farmers' perceptions.

Insect pests have also had an impact on marketing practices, making some farmers sell their stocks, probably making many more sell earlier than they would have otherwise, and consequently for a lower market price. It was not however possible to differentiate the impact of LGB compared with all insect pests.

LGB not only causes physical losses, but in the case of *cossettes* can cause an important change in the nature of their contribution to the 'pate', the preferred staple foodstuff for which they are used, which affects its nature and acceptability.

The apparent north-south change in storage insect problems suggested by the survey is either due to longer presence of LGB in the south, or to agro-ecological conditions which affect all storage insect pests. Statistical analysis of a range of variables which it was thought might influence level of damage such as variety, store type, store location, and form of storage, showed no conclusive significant differences, although some relationships were suggested.

The overlapping storage periods for both maize and *cossettes* means that both crops can act as reservoirs for cross infestation, and carry over from one season to the next. Some practices such as use of crop residues might assist this.

Recommendations

It is recommended that further research should focus on the following areas:

1. Constraints to changing practices, particularly towards the short term production and storage of *cossettes*;

2. Constraints to the adoption of recommended storage practices including chemicals;

3. Quantifying of the amount of cassava production stored as *cossettes* and in other forms such as gari;

4. The following aspects of the storage system which the survey results suggested might influence LGB presence, but were not conclusive, in order to allow better recommendations for improved storage to be formulated:

    a) the potential of the *kpéou* type of store to protect crops from insect attack, and possible constraints to its adoption by farmers;

    b) susceptibility of different varieties of maize and cassava to LGB attack;

    c) the susceptibility of maize stored on the cob with husk cover,(particularly on the platform above a kitchen fire) to LGB attack;

5. A more detailed examination of agro-ecological conditions is needed, which together with the work currently being undertaken on insect ecology should identify which factors influence LGB.

RESUME

Le présent rapport contient les résultats d'une enquête socio-économique menée sur la culture et le système de stockage du mais/manioc dans le centre du Togo, ainsi que sur les effets du Grand Capucin du Mais (GCM), *Prostephanus truncatus* (Horn) sur ce système.

Le rapport cerne les caractéristiques des systèmes de production, de stockage et de commercialisation du mais et du manioc tout en examinant l'impact du GCM. Une étude supplémentaire de trois mois qui devrait avoir lieu de mars à mai 1992 étudiera la rentabilité des méthodes de contrôle envisagées. Elle mènera aussi des enquêtes supplémentaires informelles et établira les moyens de diffuser les résultats. Ceci coincidera avec la fin de la composante entomologique du projet GCM au Togo.

L'étude a couvert trois régions du centre du Togo (celles du nord des Plateaux, la région Centrale et de la Kara), dans lesquelles le stockage du mais et du manioc (appelé cossettes de manioc) est répandu. Les deux produits font l'objet d'attaques par le GCM. Toutes les trois régions sont situées dans la zone agro-écologique de la Savane de Guinée dont la pluviosité annuelle moyenne s'élève à 900-1500 mm, sous forme d'une précipitation unimodale, d'où une saison unique de culture.

Procédent à une enquête par sondage à deux étapes, 331 chefs d'exploitation choisis au hasard ont été interrogés dans 65 villages du centre du Togo. Les résultats de l'enquête sont exposés en grandes lignes dans le résumé des caractéristiques clés (pages vii-viii). Dans la zone couverte par l'enquête, 66% des exploitants cultivaient le mais et le manioc, 28% ne cultivaient que le mais, 5% cultivaient uniquement le manioc tandis que 2% seulement ne cultivaient aucune des deux cultures.

La zone etudiée est caractérisée par une agriculture de subsistance à petite échelle, les dimensions d'une ferme moyenne étant de 4,4 hectares, ainsi que par une utilisation limitée d'intrants commercialisés tels que les engrains ou les produits chimiques utilisés pour le stockage. La majorité des personnes interrogées étaient des personnes âgées de moins de 36 ans, ayant bénéficié de peu ou d'aucune formation scolaire. Pour 90% des personnes interrogées, l'agriculture constituait la source principale de revenue. Le bétail venant en deuxième lieu, en était la source pour 50%. Seuls 16% avaient d'autres sources de revenue.

De l'avis des exploitants, les insectes constituaient le problème le plus important en ce qui concerne le stockage, et selon la majorité, l'étendu des dégâts a été considérable pour les deux cultures au cours de la période de référence, à savoir, la saison de stockage 1989/90. Toutefois, ceux que estimaient que le niveau des dégâts s'était accru étaient en minorité. Néanmoins, il existe dans les régions étudiées, de grandes différences dans les systèmes de mise en culture et de stockage, ainsi que dans les pratiques de commericalisation et dans les perceptions des exploitants, suggérant une diminution progressive de l'importance de la cultivation du mais et du manioc ainsi que des problèmes relatifs au stockage et aux insectes, au fur et à mesure qu'on avançait vers le nord. Cependant,

en ce qui concerne la consommation, les deux cultures devenaient de plus et plus importantes, ce qu'il convient de noter.

La Région des Plateaux

La Région des Plateaux est la région le plus importante quant à la production du mais dans le pays. En 1989/90, sa contribution à la production du mais s'est élevée à 45%, tandis qu'elle se situait à 19% pour le manioc. L'étude n'a touché que la partie nord de la région, une zone couvrant approximativement un tiers de cette région. La région reçoit un précipitation unimodale, et partant, une seule saison de mise en culture. Le stockage du mais et du manioc y est répandu.

Le mais est la culture vivrière la plus importante, et il est produit et stocké par tous les exploitants; tandis que le manioc est cultivée et stocké par la grande majorité des exploitants. En ce qui concerne le stockage, les méthodes les plus répandues sont le stockage du mais en spath sur une plate-forme qui sert de magasin, tandis que les *cosssettes* sont stockées dans des sacs. Dans la zone étudiée, c'est dans cette région qu'on utilise le moins les produits chimiques agricoles, soit en tant qu'engrais ou en tant que produit de stockage. La région a aussi le plus grand nombre d'exploitants n'ayant pas bénéficié de formation dispensée dans le cadre des services de vulgarisation. C'est également dans cette région que le mais est stocké pendant la plus longue période moyenne, par rapport à toutes les autres régions, sans lui faire subir un séchage supplémentaire après la récolte. La période de séchage des *cossettes* est aussi plus courte que dans les autres régions et un petit pourcentage des exploitants ne stocke pas de *cossettes* et s'en procurent au fur et à mesure du besoin au cours de l'année. C'est dans cette région que l'on transforme le plus petit pourcentage de la production de manioc en *cossettes*. Il est généralement consommé frais ou transformé en gari.

C'est dans cette région que la plus grande proportion des exploitants stocke le mais et les cossettes pour la vente aussi bien que pour la consommation. C'est ici aussi que les plus grands pourcentage de ces deux cultures vivrières ont été vendus, les ventes s'opérant le plus souvent sur les marchés sous-régionaux, fréquemment vendus à des détaillants et à des grossistes. Par rapport à d'autres régions c'est ici que le plus grand pourcentage d'exploitants ont désigné les insectes comme le plus grande problème en ce qui concerne le stockage. Ils ont aussi estimé que l'étendu des dégâts était importante et s'était accrue. Le *Sitophilus spp.* a été désigné par le plus grand nombre d'exploitants comme l'insecte qui s'attaque le plus au mais, tandis que le GCM s'attaquait aux *cossettes*. Le plus petit pourcentage des exploitants ont dit qu'ils n'avaient pas d'insectes chez eux et qu'aucune de ces deux récoltes n'avait subi de dégâts.

La Région Centrale

La Région Centrale a produit respectivement 14% et 17% de la production nationale du mais et du manioc au cours de l'année 1989/90; bien que le pourcentage du manioc ait atteint 20% en 1990/91. Quoique le mais soit la culture vivrière la plus importante pour la majorité des exploitants, le sorgho et le manioc sont aussi des cultures vivrières d'une importance certaine. La grande majorité des paysans cultivent et stockent le mais et le manioc. Le mais est, dans la

pluspart des cas, stocké en spathe sur l'épi dans un grenier en forme de plate-forme, bien qu'une minorité importante stocke le mais égrené dans des sacs. Les *cossettes* sont généralement stockées dans des greniers du type *katchalla* mais une minorité importante utilise le *kpéou*; en plus, toute une gamme d'autres types de greniers sont utilisés par une minorité d'exploitants

On a noté pour cette région, la plus petite quantité moyenne de mais récolté et stocké, mais elle a produit la quantité moyenne la plus élevée des *cossettes* avec la plus basse période moyenne de stockage. C'est dans cette région que les méthodes traditionnelles de protection des récoltes stockées ont été le plus utilisée. C'est aussi la région dans laquelle les combinaisons recommandées pour les produits chimiques dans le stockage ont été le plus respectées. C'est la seule région dans laquelle une minorité des exploitants ont utilisé les mêmes produits chimiques pour leurs *cossettes*. Le plus grand pourcentage des exploitants ont transformés plus de 75% de leur récolte de manioc en *cossettes*.

Etant donné que cette région a produit et stocké les quantites moyenne les plus élevées, elle a été considérée comme la région la plus importante en ce qui concerne la production et le stockage des *cossettes*. Un pourcentage important des exploitants consomment du manioc frais ou sous forme de gari.

Les deux aliments sont stockés pour la consommation et pour la vente. C'est dans la Région Centrale qu'on a trouvé la plus grande minorité ayant séparé les stocks de consommation de ceux qui étaient destinés a la vente, et ayant traité les stocks destinés à la vente avec des produit chimiques. La commercialisation du mais se fait généralement sur les marchés locaux voisins ou sous-régionaux, il est vendu aux grossistes, aux détaillants ou aux consommateurs. Les *cossettes* sont vendues dans les marchés locaux ou avoisinants, aux consommateurs ou à des grossistes. On y a vendu la quantité moyenne de *cossettes* la plus élevée.

On a trouvé dans la Région Centrale le nombre le plus bas d'exploitants qui ont dit que les insectes constituaient leur plus grand problème en ce qui concerne le stockage, et le plus grand pourcentage de ceux qui estimaient que le niveaux des dégâts n'avait pas changé pour les deux produits. Les études menées dans cette région en vue d'évaluer les dégâts n'ont révélé qu'une chose: que le GCM était le plus important ravageur qui s'attaquait au mais et aux *cossettes* dans les greniers.

<u>La Région de la Kara</u>

Parmi les régions qui ont été étudiées la Région de la Kara est celle qui est située la plus au nord. Elle est aussi la moins importante en ce qui concerne la production du mais et du manioc, n'ayant contribué que 7% du mais et 3% du manioc à la production nationale de l'année 1989/90. Ceci a été confirmé par le fait que le sorgho a été cité comme la culture vivrière la plus importante, suivi par le mais et le mil. La région avait le plus bas pourcentage d'exploitants cultivant le mais et/ou le manioc.

La région a cependant manifesté quelques caractéristiques intéressantes. Elle avait le plus grand pourcentage d'exploitants qui

avaient bénéficié des services de vulgarisation, qui utilisaient des variétés améliorées du mais, des engrais chimiques et qui stockaient le mais égréné, et se servaient de produits chimiques. Le type de grénier le plus utilisé pour les *cossettes* est le *kpéou* de la terre battue, suivi par stockage dans les sacs. On a noté que les periodes de séchage avant le stockage étaient les plus longues pour le mais tout comme pour les *cossettes*, et que l'usage de bouillir les *cossettes* pendant leur préparation était répandu chez une minorité importante. C'est dans cette région qu'on a trouvé les plus petites quantités moyennes de *cossettes* récoltées et stockées, mais elles ont été stockées pendant la plus longues periode moyenne. Le plus grand pourcentage d'exploitants transforment leurs manioc en *cossettes* et la transformation du manioc en gari n'etait pas répandue.

Le stockage des deux produits à des fins de consommation s'est révélé le plus important dans la région de la Kara, un plus petit pourcentage d'exploitants vendaient leur récoltes, vendant localement, aux consommateurs, un plus petit pourcentage de leurs récoltes. C'est dans cette région qu'ont été vendues les plus petites quantités moyennes de *cossettes*. Les insectes ont été cités comme les plus grand problème en ce qui concerne le stockage, mais les exploitants qui on dit que le niveau des dégâtes était important constituaient le plus petit pourcentage, tandis que le plus grand pourcentage on dit que leur récoltes stockées n'avaient pas d'insectes et n'avaitent pas subi de dégâts.

Celles-ci ainsi que d'autres caractéristiques clés sont presentées dan le tableau suivant.

TABLEAU I: CARACTERISTIQUES CLES DE LA ZONE ETUDIEE

	Plateaux	Centrale	Kara	Globaux
GENERAL				
Zone agro-écologique	Savanne guinéenne	Savanne guinéenne	Savanne guinéenne	Savanne guinéenne
Précipitation moyenne annuelle en 000 mm	1 - 1.4	1.1 - 1.2	1.1 - 1.2	1 - 1.4
Grandeur moyenne des familles	7.8	10.2	8.6	9.1
Culture vivrière la plus important	Mais	Mais	Mais	Mais
Grandeur moyenne de terres affermées	5 ha	4 ha	4 ha	4.4 ha
% producteurs de mais	100	95	88	94
% producteurs de manioc	87	79	48	71
% mais et manioc	87	75	48	66
% aucune des deux cultures	0	1	4	2
MAIS				
% de la production nationale (1989/90)	45 (1)	14	7	S.O.
Mois de la récolte	Août	Sept.	Oct.	Sept.
Rendements moyens t/ha (2)	1.3	1.5	S.O.	S.O.
Quantité moyenne récoltée en t. (3)	1.1	0.9	1.2	1.0
Quantité moyenne stocké en t. (3)	1.1	0.8	1.2	1.0
% de la récolte stocké	97	88	94	93
% utilisant engrais chimiques	15	30	71	39
% stockant du mais	100	96	98	98
% utilisant des produits chimiques de stockage	25	27	27	27
% utilisant Actellic+ K-Othrine	4	19	7	12
% stockant sur épi	97	83	59	80
% stockant égrené	3	17	41	20
Durée moyenne de stockage (mois)	8	7	7	7
Type de grenier le plus répandu	Plat-forme	Plat-forme	Sac	Plat-forme
% utilisant ce mode	92	72	33	61
% vendant mais	77	72	64	71
% de la production vendu	47	43	29	39
Quantite moyenne vendue en kgs (3)	800	700	900	700

TABLE I (cont.)

MANIOC	Plateaux	Centrale	Kara	Globaux
% de la production nationale (1989/90)	19 (1)	17	3	S.O.
% cultivant les variété amères	46	83	60	68
% cultivant les variété douces	78	56	69	65
% cultivant les deux variétés	25	39	29	33
Mois le plus importante de récolte	Déc.	Déc.	Déc-Jan.	Déc.
% utilisant engrais chimiques	15	30	71	39
Rendements moyens t/ha (2)	7.5	11.7	6.1	8.4
Quantité moyenne récoltée en kgs. (3)	480	600	300	480
Quantité moyenne stocké en kgs. (3)	420	600	300	480
% produisant des *cossettes*	98	95	94	96
% stockant des *cossettes*	86	93	94	91
% utilisant des produits chimiques de stockage	0	10	0	5
% utilisant Actellic+	0	5	0	3
K-Othrine	4	19	7	12
% faisant bouillir les *cossettes*	2	2	27	7
Durée moyenne de stockage (mois)	6	7	8	7
Mode de stockage le plus répandu	Sac	Katchalla	Kpéou	Kpéou
% utilisant ce mode de stockage	55	44	57	34
% vendant mais	60	51	37	51
% de la production vendu	40	26	16	28
Quantité moyenne vendue en kgs (3)	300	480	180	360

(1) Pourcentage pour toute la Région des Plateaux.
(2) Chiffres pour la production nationale.
(3) Estimation des exploitants en sacs de grains de 100 kgs pour le mais et de 90 kgs pour les cossettes.

L'impact du Grand Capucin du Mais

Les insectes sont considérés par les exploitants comme le plus nuisibles des fléaux pour les produits stockés. Cependant très peu de gens étaient consients du changement de statut des insectes ravageurs dans la régions étudiée, probablement à cause de la ressemblance entre le *Dinoderus spp.* et le GCM. Un petit pourcentage d'exploitants avaient changé leurs méthodes de stockage suite aux dégâts causés par les insectes ravageurs.

La Région des Plateaux est apparemment la région la plus importante quant au stockage du mais; elle semble avoir aussi les plus grands problèmes en ce qui concerne les dégâts causés par les insectes aux deux cultures; tandis que la Région Centrale est la région la plus importante en ce qui concerne la production, le stockage et la commercialisation des *cossettes*. Il est fort probable que les exploitants aient toujours connu des niveaux importants des dégâts causés par les attaques du *Dinoderus spp.* contre leurs cossettes, ce qui expliquerait le méconnaissance de tout changement de statut des insectes nuisibles. La Région de la Kara est plus marginale quant à la production du mais et du manioc, et connaît apparemment moins de problèmes en ce qui concerne les ravageurs des greniers.

On a trouvé le GCM dans les mêmes sept villages sur dix au cours des études d'évaluation rapide des dégâts; les villages dans lesquels il n'y avait pas de GCM étaient situés loin de la grande-route principale nord-sud. Les pertes se situaient à 9% après 6 mois et à 11% après 8 mois pour le mais, et à 5% après 1 mois et à 15% après 3 mois pour les *cossettes*. Le GCM a été aussi identifié comme le ravageur primaire des greniers le plus important, causant 2 à 3 fois plus de dégâts pour un insecte adulte que le *Sitophilus spp.* chez le mais. En examinant des greniers de sorgho situés près des greniers fortement infesté par le GCM, on y a aussi découvert un petit nombre de GCM. Généralement parlant, les pertes diminuaient plus on avançait vers le nord, et correspondaient approximativement à celles que les perceptions des exploitants avaient permis de supposer.

Les insectes ravageurs ont eu également un impact sur les habitudes de commercialisation, forçant quelques exploitants de vendre leur stocks, tandis que d'autres se voyaient forcés de vendre leurs produits plus tôt qu'ils ne l'auraient autrement fait, recevant par conséquent un prix inférieur à celui du marché.

Le GCM cause non seulement des pertes physiques, mais il peut aussi, dans le cas des cossettes, provoquer un changement important dans la qualité de leur contribution à la *pâte*, le met de base favori, pour lequel elles sont utilisées. Le GCM a des effets sur sa nature et son acceptabilité.

Les différences évidentes révélées par l'étude en fait des dégâts causés aux produits stockés par les insectes sont dûes, ou à une plus longue présence du GCM dans le sud, ou aux conditions agro-écologiques qui touchent tous les insectes ravageurs des greniers. L'analyse statistique de toute une gamme de variables qu'on avait soupçonnés de pouvoir influencer l'étendu des dégâts telle que la variété, le type, l'emplacement ainsi que la forme du grenier, n'ont pas révélé de différences importantes probantes quoique l'existence de certains rapports ait été suggerée.

Etant donné que les périodes de stockage du mais et des *cossettes* se chevauchent, les deux produits peuvent servir de réservoirs pour une infestation croisée, qui se poursuit dans la saison suivante. Quelques usages tels que l'utilisation des résidues des récoltes peuvent aussi y contribuer.

Recommandations

Il est désirable que les nouvelles recherches se penchent sur les domaines suivants:

1. Les contraintes qui entravent le changement des usages, en particulier en matière de production et de stockage, à court terme, des *cossettes*;

2. Les contraintes qui entravent l'adoption des usages, recommendés de stockage y compris l'utilisation des produits chimiques;

3. Le quantification des stocks de manioc emmagasinés sous forme des *cossettes* et sous d'autres formes telles que le gari;

4. Les aspects ci-dessous du système de stockage qui seraient, selon les résultats de l'étude, susceptibles d'influencer la présence du GCM, ce qui permettrait, étant donné que ces résultats n'ont pas été probants, de formuler de meilleures recommandations en vue d'améliorer le stockage:

    a) Le potentiel de protection du grenier de type *kpéou* contre les attaques des plantes par les insectes, ainsi que les contraintes susceptibles d'entraver son adoption par les exploitants;

    b) La sensibilité des différentes variétés du mais et du manioc aux attaques par le GCM.

    c) La sensibilité du mais stocké en spath sur l'épi, non depouillé (surtout sur une plate-forme au dessus du feu de cuisine) aux attaques du GCM;

    5. Une étude plus detaillée des conditions agro-écologiques s'impose; prise en liaison avec le travail en cours sur l'écologie des insectes, elle devrait permettre d'identifier les facteurs qui influencent le GCM.

1. INTRODUCTION

1.1 STUDY BACKGROUND AND OBJECTIVES

The Larger Grain Borer (LGB) *Prostephanus truncatus* (Horn) is an insect native to Central America, which has become an important storage pest of maize and cassava since its accidental introduction into Africa in the late 1970s.

The Larger Grain Borer Project in Togo is one part of a three country study (in Mexico, Togo and Kenya) to examine the ecological characteristics and socio-economic impact of LGB, and develop an integrated pest management strategy for its control. The projects were located in Mexico as a country representative of the insect's native environment, and in Kenya and Togo because these were amongst the first countries in East and West Africa where the pest was detected.

Detailed Terms of Reference (TOR) for the socio-economic component are attached as Appendix I. This report characterises the maize and cassava farming, storage and marketing system and examines the impact of LGB on that system, (items i to iii of the TOR). The remaining items of the TOR will be covered in a 3 month study from March-May 1992, coinciding with the end of the entomological work in Togo, upon which some aspects of the socio-economic work are dependent.

A significant amount of research had already been carried out on maize storage and the impact of LGB in southern Togo (see Section 1.4), but the importance of stored cassava was less clear, and one of the issues that the survey aims to clarify. Therefore the primary focus of the Project in Togo is the impact of LGB on stored cassava, known as *cossettes de manioc*. In addition, there was a need for a systematic study to look at the interaction of the maize and cassava systems in relation to the impact of LGB.

1.2 CLIMATE AND AGRO-ECOLOGICAL ZONES

Togo has two major climatic zones. In the south the climate is sub-equatorial with bimodal rainfall resulting in two dry seasons, the main one from mid-November to March and a minor one from August to September, and two rainy seasons, the main one from April to July and a minor one from October to mid-November. In the north a sudanien climate prevails with unimodal rainfall producing one rainy season from April to October and one dry season from November to March. Throughout the country the dry season between November and February is accentuated by the harmattan, a dry wind originating in the Sahara desert. Precipitation is influenced by relief, increasing with altitude, and decreasing with latitude.

According to the classification of Africa into agro-ecological zones used by Geddes (1990) Togo has three agro-ecological zones. In the south there is the Forest/Savanna Transition with annual rainfall of 1300-1800 mm, a dry season of 4 months and one or two rainy seasons. The majority of the country falls within the Guinea Savanna zone which has between 900-1500 mm of rainfall, a dry season of between 5-7 months and most of the zone has unimodal rainfall. In the extreme north, broadly corresponding to the Savanna region, is the Sudan Savanna zone, with annual rainfall of 500-900 mm, and a dry season of 8 months. Geddes' classification combines the system for West and Central Africa used by IITA, with the provisional world-wide system devised by John Bennett of NRI, based on altitude, annual rainfall and length of dry season,

1.3 THE AGRICULTURAL SECTOR

The country is divided into five administrative regions with the following populations and size:

TABLE 1.3.1a: AREA AND POPULATION BY REGION

	Area in Km^2(1)	Population (2)
Maritime	6,395	1,040,241
Plateaux	16,972	650,393
Centrale	13,183	273,138
Kara	11,630	426,651
Savannes	8,602	329,144
TOTAL	56,785	2,719,567

Source:

(1) Cadre Macro-Economique 1991-95. Ministére du Plan et des Mines. 14 Avril 1990.

(2) Recensement Général de la Population et de l'Habitat du 9-22 Novembre 1981.

Agricultural exports contributed 30% to total exports in 1988, the most important commodities being cotton lint, green coffee and cocoa beans (FAO, 1990) which together made up over 91% of agricultural exports.

Small-scale subsistence farming prevails throughout Togo, with the greater proportion of production being stored on farm in a wide range of storage structures. Amounts stored and duration of storage vary widely, depending on many factors, but are unlikely to exceed several tons per household. According to Albert (1991) three quarters of maize harvested is stored at the farm level in southern Togo.

Most agricultural marketing is carried out by small-scale traders, who tend to be women. TOGOGRAIN is the government parastatal charged with intervening in the free market to buy and store grain to ensure food security and stabilise the price. A study of the storage of food crops in Togo, carried out in 1982 (SOTED, 1982) indicated that TOGOGRAIN'S total theoretical storage capacity was in the region of 21,000 tons, in a combination of stores and silos. However, the absence of certain equipment for drying and ventilation, and design problems which resulted in the penetration of moisture, meant that a large percentage of this capacity was dilapidated or unusable. In his study Albert (1991) found that TOGOGRAIN only played a marginal role in marketing maize in southern Togo.

Credit is only usually available for the production of cash crops such as cotton, coffee and cocoa, or to farmers groups or co-operatives, due to the failure by individuals to repay loans in the past. The use of chemical fertiliser on all food crops is low in Togo, (IFDC, 1990).

1.3.1 The Importance of Maize and Cassava

Table 1.3.1b illustrates the importance of different food crops in the diet in Togo by estimating mean annual consumption per capita. The importance of cassava and maize, the two stored crops attacked by LGB, in the national diet is clear; LGB has also been seen to attack stored sorghum, the fourth most important component in dietary terms.

TABLE 1.3.1b: ANNUAL CONSUMPTION OF FOOD CROPS

	Mean Annual Per Capita Consumption in Kgs.
Cassava	120
Yams	100
Maize	57
Sorghum/millet	48
Rice	8
Groundnuts	8
Haricot	7

Source: Production des Principales Cultures Vivrieres. Campagne Agricole 1988-89, Vol I. DESA, August 1989.

The primary focus of this study is stored maize and cassava, although sorghum is also of interest because of the possible impact of LGB. The regional importance of these crops is illustrated by Table 1.3.1c, and in more detail by prefecture in Appendix VII. Maize production and storage is important in 4 out of the 5 regions of Togo, and while the same is true of cassava production, storage as *cossettes*, is only carried out in the Plateaux, Centrale and Kara regions.

TABLE 1.3.1c: MAIZE, CASSAVA AND SORGHUM PRODUCTION IN TOGO - PERCENTAGE PRODUCTION BY REGION - 1989/90

Region	Maize % of Total	Cassava % of Total	Sorghum % of Total
1. Maritime	29	61	0.5
2. Plateaux	45.4	19	19.9
3. Centrale	14.4	17	20.8
4. Kara	6.8	2.7	19
5. Savannes	4	0	39.8
TOTAL IN TONS	287,348	408,572	152,848

Source: Adapted from DESA Report 1989/90

TABLE 1.3.1d: MAIZE, CASSAVA AND SORGHUM PRODUCTION PER HEAD OF RURAL POPULATION IN TOGO BY REGION

	Maize Kg./Head	Cassava Kg./Head	Sorghum Kg./Head
1. Maritime	108.14	321.81	0.98
2. Plateaux	177.85	107.02	41.43
3. Centrale	140.01	236.38	107.45
4. Kara	52.5	29.93	77.46
5. Savannes	31.00	0.	159.71

Source: Adapted using 1989/90 production figures (DESA) and population estimates for 1990 based on the 1981 census, (Direction des Statistiques).

Table 1.3.1d shows that of the three regions of interest Plateaux is the most important in terms of maize production per head of rural population, and Centrale the most important producer of cassava and sorghum. Recent studies by Lamboni (1989) in Centrale and Kara regions, and Ayeva (1990) in Plateaux region were not able to quantify the importance of *cossettes*, but indicated that this method of storing cassava was most important in Centrale and Kara regions.

1.3.2 Agricultural Development Institutions

The principal rural development institution is the Diréction Génerale du Dévéloppement Rural (DGDR), which is responsible for all aspects of rural development including agriculture, and is represented regionally through the Direction Régional du Dévéloppement Rural (DRDR).

In the three regions of interest, there are in addition several other institutions involved in rural or agricultural development, including the European Development Fund (FED) and GTZ integrated rural development projects, SOTOCO (Société Togolaise du Coton), SRCC (Société Nationale pour la Rénovation des Cacaoyères et Caféières), and a number of non-governmental organisations (NGO's).

For the provision of extension services the administrative Prefectures in each region are divided into sectors, and these various organisations operate in and are responsible for agricultural development and extension activities in different sectors. This has led to a fragmented institutional structure regarding responsibility for extension activities, so that for example in the regions of interest to this study we have the following government organisations or projects responsible for providing extension services in different sectors:

Region	Organisation
Plateaux	DRDR, SOTOCO, SRCC
Centrale	DRDR, SOTOCO, FED Bassar
Kara	DRDR, SOTOCO, FED Bassar

The sectors are further divided into sub-sectors, each with its own head or '*chef*', and then into zones covered by an individual extension agent or '*encadreur*' who will be responsible for a number of villages.

The LGB project is based at the national Plant Protection Service (Service de la Protection des Végétaux or SPV) which is itself one of several agricultural research institutions under the DGDR, recently grouped under the Diréction de la Réchérche Agronomique.

1.4. THE STATE OF RESEARCH ON LGB IN TOGO

A significant amount of work has been carried out on LGB in Togo since the early 1980's when it was first detected, mainly funded by GTZ at the Service de la Protection des Végétaux (SPV). The focus of the GTZ work has largely concentrated on maize, quantifying maize storage losses in the Maritime region of Togo (Pantenius 1988), developing and testing storage chemicals to reduce losses, and improved methods of storage.

This work resulted in the development of "Sofagrain", a mixture of deltamethrin and pirimiphos-methyl dust which has been promoted country-wide since the beginning of the 1990/91 storage season, for broad-spectrum pest control on maize. Unfortunately the adoption of Sofagrain suffered a serious set-back, as several months into the storage season it was discovered to be providing incomplete protection due to a problem with one of the active ingredients. This resulted in loss of confidence by farmers in the use of storage chemicals, and is a serious set-back both for the extension services and SPV.

GTZ carried out a comprehensive country-wide survey of the presence of LGB in 1989 which showed that it was detected throughout the country, and likely to be spreading into neighbouring countries. It also funded socio-economic studies of the production, storage and marketing of *cossettes* in the Plateaux, Centrale and Kara regions of Togo (Lamboni, 1989 and Ayeva, 1990). The socio-economic studies provided a great deal of useful information, but because they concentrated on important areas of *cossette* production, rather than providing a representative picture of production over the whole region, the interpretation of their results was limited. A socio-economic survey of maize storage and consumption in Maritime region was carried out by Helmut Albert (1991). The study analysed the post-harvest maize system, determined storage losses, and examined the economics of protecting stored maize, but to date the results are only available as a PhD Thesis in German (Albert, 1991).

Most recently, research was carried out on possible biological control agents *Teretriosoma nigrescens*, and parasitic protozoans (unpublished PhD theses). *T. nigrescens* was released by GTZ researchers at several sites in southern and central Togo in January 1991, and its establishment and impact on LGB are being closely monitored. A PhD student has begun a study to examine the cost-benefits of biological control using *T. nigrescens*.

The entomological component of the LGB project is carrying out experiments looking at the following:

1. LGB trapping exercises in 4 regions over a 12 month period to examine population dynamics throughout the year.

2. Quantifying losses caused by LGB and other insects in *cossettes* in Plateaux and Centrale regions.

3. Studies of LGB migration within and between stores of maize and *cossettes*.

4. Trials on the chemical control of LGB in *cossettes*.

5. Susceptibility of different varieties of cassava to LGB.

6. Range of attraction of pheromone baited traps.

2. METHODOLOGY

A survey by GTZ carried out in 1989 had established that LGB was widespread throughout the country, and therefore the regions of interest. The objectives of this study were to characterise the maize/cassava farming and storage system, and examine the impact of LGB on that system in terms of losses, changes to practices, and farmers' perceptions. Another important objective was that the survey should have as wide a coverage of the maize/cassava system as possible, and that the results be representative of the survey area.

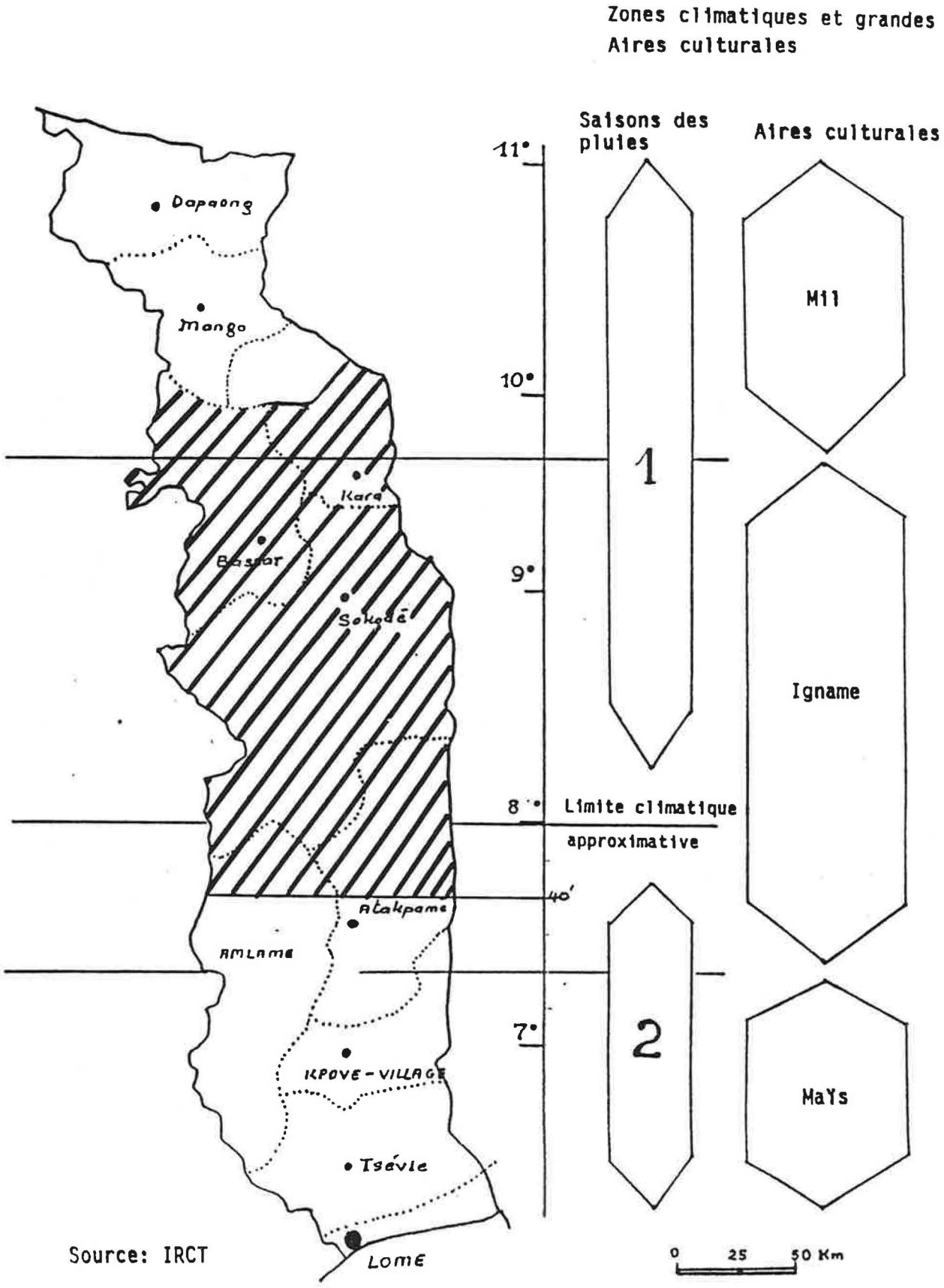
Because of time constraints the survey was carried out at the beginning of the maize storage season. which begins several months before the storage of cossettes. It was therefore decided to follow up this initial survey with two rapid damage assessment surveys which would examine damage and insect presence when both crops were in store at the same time. This would allow a more detailed examination of the impact of LGB on stored maize and cassava, and possible factors influencing its presence, than could have been done through the initial survey. It would also give an indication of the development of losses over time, since the two surveys were carried out two months apart, when maize had been in store for approximately six and eight months, and *cossettes* had been in store for approximately one and three months.

2.1 THE SURVEY AREA

The survey area was identified as that part of Togo where the cultivation and storage of both maize and cassava was carried out. Previous studies had indicated that Plateaux, Centrale and Kara were the regions of interest, covering the central part of the country, and field visits were made to confirm this.

The study was limited to the unimodal rainfall area with a single cropping season since most of the regions of interest fell within it, and the survey area is illustrated in Fig. 2.1. It covered the Kara region (excluding the prefecture of Keran because of the absence of cassava production), the whole of Centrale region, and that part of Plateaux region north of latitude 7^{o} 40' which, in the absence of more accurate information, was used as the approximate southern boundary for the unimodal rainfall area. North of the survey area cassava production is minimal, according to national statistics, while to the south is the bimodal rainfall area where cassava is produced but not commonly dried and stored.

Figure 2.1 Map of Togo Showing Survey Area (Shaded), Climatic Zones and Principal Crops



2.2 THE QUESTIONNAIRE

All interested parties at SPV were consulted about the variables that the survey should examine; the resulting questionnaire, covered the following areas:

1. General information about the household
2. Cultivation of Maize
3. Storage of Maize
4. Problems encountered in the storage of Maize (including insect presence)
5. Marketing and economic importance of Maize
6. Cultivation of Cassava
7. Storage of Cassava
8. Problems encountered in the storage of Cassava (including insect presence)
9. Marketing and economic importance of Cassava
10. Sources of income

The questions refer to the last complete growing and storage season, 1989/90. The draft questionnaire was tested in three villages in Centrale region in September. A detailed analysis of the structure of the questionnaire, the way the questions were phrased, and replies received was carried out, as a result of which it was amended and tested again at the beginning of October.

2.3 THE QUESTIONNAIRE SURVEY

For the initial survey a 2 stage simple random sample was employed, in which first the villages and then the farmers were selected at random. Sixty-five villages in the survey area were selected at random, and then the number of farmers to be interviewed were to be selected at random in proportion to the village population. This was not however always possible since population data was not available for villages in all regions, in which case 5 interviews were carried out per village. A list of villages covered by the survey is attached as Appendix III.

The sample size was chosen, assuming a normal distribution, on the basis of a 95% confidence level that gives a z statistic of 1.96. Assuming a variation in the population (c) of 50% in the characteristics of interest (such as presence or absence of LGB), and an accuracy (x) of between $\pm$5% and $\pm$10%, the sample size (n), was calculated by the formula:

$$n = \left| \frac{zc}{x} \right|$$

where: $x = \pm 10\%$
$z = 1.96$
$c = 50\%$
$n = 96$

where: $x = \pm 5\%$
$n = 384$

The range x = ±5 - 10%, suggested a sample size of between 96 and 384, and the final survey sample was as follows:

Region	Nos. villages	Nos. interviews
Plateaux	15	75
Centrale	30	148
Kara	20	108
TOTAL	65	331

Interviews were carried out between October and December 1990, using a team of 5 enumerators originating from the survey area, and therefore able to communicate in a range of local languages. Although some personnel changes did take place 4 out of the 5 enumerators were the same for the whole period of the survey in order to minimise error in how questions were asked.

2.4 THE DAMAGE ASSESSMENT SURVEYS

The more detailed Damage Assessment Surveys were restricted to Centrale region, identified from the initial survey as the most important region for the storage of *cossettes*. These studies concentrated on farmers exhibiting some characteristics of interest to be followed up. This meant ideally farmers storing both crops, using traditional storage structures and practices including storing maize on the cob, and not using chemicals on their stored crops.

Two detailed damage assessment surveys were conducted in Centrale region at periods two months apart, the first in February/March and the second in April/May 1991. The damage assessment surveys were conducted in the largest 10 villages in the initial survey, which in practice gave a good geographical spread throughout the region, with an average of 5 or 6 farmers interviewed per village and their stores examined. Efforts were made to include the same farmers used from the initial survey but in many cases this was not possible for a number of reasons, such as farmers not having the required crops in store or not being available.

The damage assessment surveys covered the following:

	Nos of Villages	Nos of Farmers Interviewed	Nos of Maize Stores	Nos of *Cossette* Stores	Nos of Sorghum Stores
1st.	10	58	54	40	0
2nd.	10	54	37	42	13

The methodology used to carry out the damage assessments involved randomly selecting samples of 20 cobs or *cossettes* from each store sampled, and classifying the damage found, which consisted of two elements:

1. **A visual scale of damage** - this allowed a rapid classification of damage for both maize cobs and *cossettes*. These scales were calibrated so that percentage weight loss could be calculated per cossette, store, village and overall, (see Compton 1991, and Compton et al., 1991 for full details of the development of this methodology, transformation and statistical analysis of the data.)

Damaged maize cobs and cossettes were classified into the following classes of damage:

Maize	1 - 4
Cossettes	1 - 5

Each class of damage was photographed so that they could be referred to during field-work.

2. **A scale of insect numbers** - used to classify the primary insects found infesting the maize or cossettes, ie. LGB and *Sitophilus spp.* in maize and LGB and *Dinoderus spp.* in *cossettes*. The scale used was modified from the first visit to the second, because of the large number of insects anticipated and found on the second visit. The final scale used was as follows:

Category:	2nd Damage Survey Nos of insects (all species)
0	0
1	1-2
2	3-5
3	6-10
4	11-20
5	21-40
6	>40

Results from both damage assessment surveys are included in this report.

3. ANALYSIS OF THE SURVEY

3.1 GENERAL HOUSEHOLD CHARACTERISTICS

A knowledge and understanding of general characteristics such as ethnic group, education, household size and composition, etc is important as these factors may have an influence on existing practices, and will influence the ability of farmers to change and adopt new recommendations.

A total of 331 heads of farming households or "Chefs d'exploitation" were interviewed in 65 villages throughout the survey area, of which 98% were men and only 2% were women. This possibly reflects the influence of Islam and the male dominated social structure, where for example if a husband dies the wife generally becomes part of the household of the closest male family member. In southern Togo, Albert (1991) found that 15% of farms were run by women, but this reflects a very different ethnic mix where the influence of Islam is much less common. Tables 1 to 3 in Appendix IV give full details of the general household characteristics briefly described in this section.

3.1.1 Age and Education

The structure of the survey population is given in Table 2 of Appendix IV, and shows that the largest proportion of farmers (35%) were in the 26-35 age group, and the majority of farmers (65%) had no education. Of those 35% that had received some education, 12% had primary level education (of between 1-6 yrs) and 23% had secondary level education (7 years or more). There was slight regional variation; a higher percentage of farmers had secondary education in Plateaux region (32%), and a lower percentage in Centrale region (18%). An examination of age and level of education showed that none of the over 46 age group had secondary education, and only 2% had primary education.

3.1.2 Ethnic Groups

Togo has a great ethnic diversity, with over 40 different ethnic groups, of which the largest are the Ewé, Kabyè, Ouatchi, Cotocoli and the Mina.

This diversity was reflected in the survey area, where respondents belonged to a total of 21 different ethnic groups. Table 2 (in Appendix IV) shows that the Kabyè dominated, comprising 36% of the sample as a whole, and were an important group in all 3 regions, followed by the Cotocoli (12%), while all other groups made up less than 10% of the survey sample. The variation between regions can also be seen, with the Ana/Ifé, Akébou and Kabyè dominating in Plateaux region, the Kabyè and Cotocoli in Centrale and the Kabyè and Konkomba in Kara region.

3.1.3 Household Size and Composition

The farming household or "ménage" varies a great deal in size and composition because of the extended family. It was defined as those members of the family living under direction of the household head, and reliant for their food on the area cultivated by him.

Mean household size was found to be 9 persons, comprising 2 adult males, 2 adult females and 5 children under the age of 16. There was some slight variation between regions as can be seen in Table 3 in Appendix V. The mean number of active male and female household members is slightly higher than the number of adults because this is defined as all those involved in cultivating the landholding, including children.

3.1.4 Extension Training

To obtain an idea of the coverage of the extension services, farmers were asked whether they had received any form of extension from any organisation. The result given in Table 3.1.4 illustrates the fragmented nature of responsibility for agricultural production already described. The figures indicate that 85% of the survey population had received some form of extension, which probably reflects bias within the survey, resulting from the need to work with the Extension Agents or *encadreurs* at village level during its execution. The table shows that 52% of farmers had received extension training from DRDR extension agents, who are responsible for 54% of the villages surveyed (see Section 1.3.2 for further details of the structure and operation of the extension services).

TABLE 3.1.4: % WHO HAD RECEIVED SOME FORM OF EXTENSION

Name of Organisation	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
None	29	12	7	15
DRDR	0	76	54	52
SOTOCO	53	6	0	15
Project FED	0	3	38	13
SRCC	17	0	0	4
Name not known	0	3	1	2
TOTAL	100	100	100	100

3.2 THE FARM ECONOMY

Agriculture is the most important source of income for 90% of farmers, and livestock the second source of income for 50%. Only 16% gave other sources of income either as the most important or as alternatives, and only 6% gave a third source of income. Regional differences lie mainly in the importance of livestock, and are illustrated in Table 3.2a.

Maize is the most important food crop (in terms of consumption), given by 47% of farmers, followed by sorghum, cassava and millet. There is however an important regional variation illustrated in Table 3.2b, so that maize was by far the most important food crop in Plateaux region (82%), while in Centrale region sorghum and cassava were important in addition to maize. In Kara region sorghum was the most important food crop given (43%) followed by maize and millet, while cassava was only given by 3%. These differences reflect the agro-ecological conditions prevailing in the three regions, which in turn influence production of these crops and therefore which staple foodstuffs are consumed (see Appendix VII for national production figures by region).

Cotton was found to be the most important crop grown for sale throughout the survey area (see Table 3.2c). Other crops grown for sale show regional variations, so that coffee is important in Plateaux, while groundnuts are important in Centrale and Kara regions. Maize, cassava and sorghum do not feature prominently as crops grown for sale, although they do contribute to farm income as can be seen from the proportions sold (see Sections 3.6 and 3.9). Twelve percent of farmers grew no crops for sale.

TABLE 3.2a: SOURCES OF INCOME IN ORDER OF IMPORTANCE (%)

	Plateaux n = 75			Centrale n = 148			K a r a n = 108			Overall n = 331		
	1	2	3	1	2	3	1	2	3	1	2	3*
Agriculture	89	9	0	91	5	<1	89	7	1	90	7	<1
Livestock	1	52	1	1	38	1	4	67	3	2	50	2
Others #	9	5	4	7	5	3	7	7	4	7	6	3

* In order of importance 1=1st 2=2nd 3=3rd.

\# Includes masonry, carpentry, tailoring, teaching, basket-weaving, and labouring.

TABLE 3.2b: MOST IMPORTANT FOOD CROP GROWN (%)

	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Maize	82	41	33	47
Cassava	7	19	3	11
Sorghum	6	29	43	28
Millet	0	1	15	5
Yams	4	5	2	4
Others *	1	5	4	5
TOTAL	100	100	100	100

* Includes cowpeas in Plateaux, rice, cowpeas and haricot beans in Centrale and rice, cowpeas, voandzou (Bambara groundnuts) and groundnuts in Kara regions.

TABLE 3.2c: MOST IMPORTANT CROP GROWN FOR SALE (%)

	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Cotton	48	47	45	47
Groundnuts	3	17	35	20
Coffee	20	3	0	6
Rice	8	2	5	4
Maize	0	4	5	3
Yams	1	3	2	2
Others*	4	8	4	6
Nothing	16	16	5	12
TOTAL	100	100	100	100

* Includes cowpeas, cassava, sorghum, tomatoes, okra and soya.

3.3 THE FARMING SYSTEM

Decisions concerning the farming activities and cropping patterns are almost always made by the head of the farming household (99% of cases), only in one case did the respondent say they were made jointly with his wife. Where the farmer was a woman (in 2% of cases), five out of six of these female farmers said they made the decisions, and in the one other case they were made by the husband. No questions were asked about marital status, so it is not possible to say if the five female farmers were all widows.

Information on size of land holdings was given by farmers themselves, and indicates that the average size of holding is 4 ha. although this figure is larger in Plateaux region at 5 ha (see Table 3.3a). Although some farmers do know the exact size of their holdings or certain fields where these have been measured by extension agents, in general these figures should be regarded as estimates only.

Thirty-four percent of male farmers interviewed had wives with their own fields (n=325); the number of wives varied from one to four. A higher proportion of farmers wives had fields in Plateaux compared to Centrale region, possibly because of a larger Muslim community in the latter.

Cropping patterns are illustrated by Table 3.3b which shows the frequency and average area of various crops grown, either as pure stand or intercropped. The most commonly grown crops, maize, cassava, sorghum and yams, are most frequently grown as pure stands. Associations of 3 or 4 crops are sometimes grown, and crop associations seem to be more common in Plateaux region where a farming systems survey carried out by SRCC found up to 50 different crop associations with maize.

The importance of maize and cassava in the survey area is illustrated by Table 3.3c which shows the percentage of farmers growing both maize and cassava (66%), either maize (28%) or cassava (5%) and neither crop (2%). These figures reflect the decrease in importance of maize and cassava production in Togo with progress northwards as agro-ecological conditions change, (see Appendix VII).

TABLE 3.3a: MEAN SIZE OF HOLDING IN HECTARES

	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Mean size	5.0	4.0	4.0	4.4

TABLE 3.3b: CROPPING PATTERNS IN THE SURVEY AREA - % OF FARMERS CULTIVATING AND MEAN PLOT SIZE

	Plateaux		Centrale		K a r a		Overall	
	%	Avg ha.	%	Avg ha.	%	Avg ha.	%	Avg ha.
Maize pure	16	1.9	66	1.1	60	1.1	53	1.2
Cassava pure	50	1.0	55	0.7	37	0.4	48	0.7
Sorghum pure	13	1.3	43	1.1	46	1.4	37	1.2
Yams pure	53	1.2	60	0.7	48	0.6	55	0.8
Maize/sorghum	40	1.9	18	1.3	14	1.3	22	1.5
Sorghum/Oth (1)	0	0	10	1.8	32	1.2	15	1.4
Maize/Oth (2)	21	1.7	7	1.2	13	0.7	12	1.2
Maize/Cassava	22	1.5	6	1.3	0	0	8	1.5
Cassava/Oth (3)	6	0.4	8	1.1	5	1.2	7	0.9
Cassava/Sorghum	4	1.3	<1	2.0	2	0.5	2	1.0
Other crops (4)	80	1.9	87	1.4	93	1.6	88	1.6

(1) Includes mainly cowpeas, groundnuts, millet, yams and rice.
(2) Includes mainly yams, rice, millet, cowpeas and sesame.
(3) Includes mainly yams, cowpeas and rice.
(4) Other crops include cash crops such as cotton, groundnuts, and coffee as well as food staples such as rice, cowpeas, soya, and fruit and vegetable crops such as okra, chilli peppers, tomatoes and bananas.

TABLE 3.3c: % GROWING MAIZE AND/OR CASSAVA IN THE SURVEY AREA

	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Maize & Cassava	87	75	40	66
Maize only	13	20	48	28
Cassava only	0	4	8	5
Neither crop	0	1	4	2
TOTAL	100	100	100	100

3.4 MAIZE PRODUCTION

3.4.1 Varieties Grown

Slightly more farmers used local varieties of maize (60%) compared to 52% who used an improved variety; some farmers grew both local and improved varieties, or more than one improved variety (Table 3.4.1a). A lower percentage used improved varieties in Plateaux region and a higher percentage used local varieties, while the opposite is true of Kara region, possibly because maize cultivation was more recently introduced into the latter region.

Local varieties of maize tend to be floury, low yielding with a long production cycle (100-110 days), and are characterised by a tight husk cover. Most farmers were unable to give the local variety a name, and those that did usually gave a colloquial name specific to their ethnic group or the word for maize in their language, (see Table 1 in Appendix V for most common names for local varieties given during the survey).

SORAD and DRDR are the rural development institutions whose extension agents have supplied the improved seed varieties, SORAD being the pre-cursor to DRDR. Thus "SORAD" and "DRDR" varieties could refer to any of the improved varieties introduced, and the names tend to be used generically to describe any improved variety. La Posta was the most common improved variety given by farmers in the survey area, it has a long production cycle (120 days) with a white flinty grain.

Farmers do not often buy new maize seed, and only 2% said they did so in the year in question (see Table 3.6d). From the damage assessment survey carried out in Centrale region, 51 samples of maize cobs were taken and identified. It was found that 99% of varieties described as improved were in fact degraded and mixed (identification by M. Eda, Seed Programme, Direction de la Recherche Agronomique, DRDR, Lomé). Some farmers also gave the wrong name to improved varieties, possibly because they grew more than one, and some varieties described as local were in fact mixed or degraded improved varieties. (See section on maize varieties in Compton, (1991) for more information).

TABLE 3.4.1a: VARIETIES OF MAIZE GROWN (%)

Type	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
Local	71	65	44	60
Improved	39	51	63	52

Improved Variety	Plateaux n = 29	Centrale n = 72	K a r a n = 60	Overall n = 161
Do not know	10	17	12	14
SORAD	21	33	8	22
DRDR	21	21	27	23
La Posta	7	3	28	13
Ikenné	10	11	7	9
Pirsaback	3	5	10	7
Posa Rica	0	8	7	6
NH1/NH2	21	0	0	4
Maquina	0	1	2	1
Mexico	7	0	0	1
TOTAL	100	100	100	100

TABLE 3.4.1b: FARMERS (n=54) OPINIONS OF ADVANTAGES AND DISADVANTAGES OF LOCAL AND IMPROVED SEED VARIETIES

A D V A N T A G E S

Local Maize	%	Improved Maize	%
1. More floury	48	More profitable	28
2. Less insect attack	21	Less insect attack	25
3. Easy to grind	11	Large cobs and grains	16
4. Sweeter taste	10	Short growing cycle	14
5. Profitable and sought after	7	Does well in all types of soil	5
6. Does well in all types of soil	2	Less infested in the field	2
7. Do not know	2	Do not know	11

D I S A D V A N T A G E S

Local Maize	%	Improved Maize	%
1. More insect attack	31	Less floury	43
2. Less profitable	21	More insect attack	25
3. Longer growing cycle	18	Hard to grind	10
4. Smaller cob and grain	13	Less sweet to consume fresh	8
5. Does not do well on poor soils	5	Less profitable and sought after	3
6. Infested on the stem	2	Does not do well in poor soil	3
7. Do not know	11	Do not know	8

During the second follow-up damage survey, confined to Centrale Region only, 54 farmers were asked their opinions on the advantages and disadvantages of local and improved varieties of maize. The results are given in Table 3.4.1b. Although these opinions are sometimes contradictory, they do indicate the main advantages and disadvantages. The main contradiction with both local and improved varieties seems to be whether they are more or less easily attacked, which particularly in relation to LGB should be investigated further, and their profitability.

3.4.2 Use of Chemicals

The use of chemicals at all stages of agricultural production, either as fertiliser or pesticides, is very low in Togo. In the country as a whole, fertilizer was used on about 28% of the area of maize in 1987 (IFDC, 1990). The percentage of area of food crops fertilized varied at between 2% and 19% in 1987, and for specific zones in the survey area were as follows:

Zone	Region	% Food Crops Fertilized
Atakpamé	Plateaux	5%
Sokodé	Centrale	12%
Bassar	Kara	18%
Kara	Kara	15%

Source: IFDC, 1990.

Overall 39% of farmers claimed to use chemical fertiliser during maize production, but no respondents mentioned using pesticides. A marked regional variation can be seen in Table 3.4.2, with lower use claimed in Plateaux and higher use in Kara region, possibly because conditions are less favourable, supporting the IFDC findings. The increase in use of fertilizer from south to north, may be for a number of reasons, particularly because of decreasing soil fertility.

TABLE 3.4.2: USE OF FERTILIZER ON MAIZE (%)

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
No fertilizer	85	70	22	59
Chemical fertilizer	15	30	71	39
Organic fertilizer	0	0	7	2
TOTAL	100	100	100	100

3.4.3 Period of Harvest

Fig. 3.4.3 is a graphical representation of month of harvest of maize throughout the survey area. The great majority (83%) of farmers harvested between August and October, with 33% harvesting in August and 31% in September. The period of harvest varies by region with progress northwards, probably related to agro-ecological conditions and rainfall in particular, so that August was the most important month for harvest in Plateaux (for 55% of farmers), September in Centrale (44%) and October in Kara (34%).

3.4.4 Harvest Practices

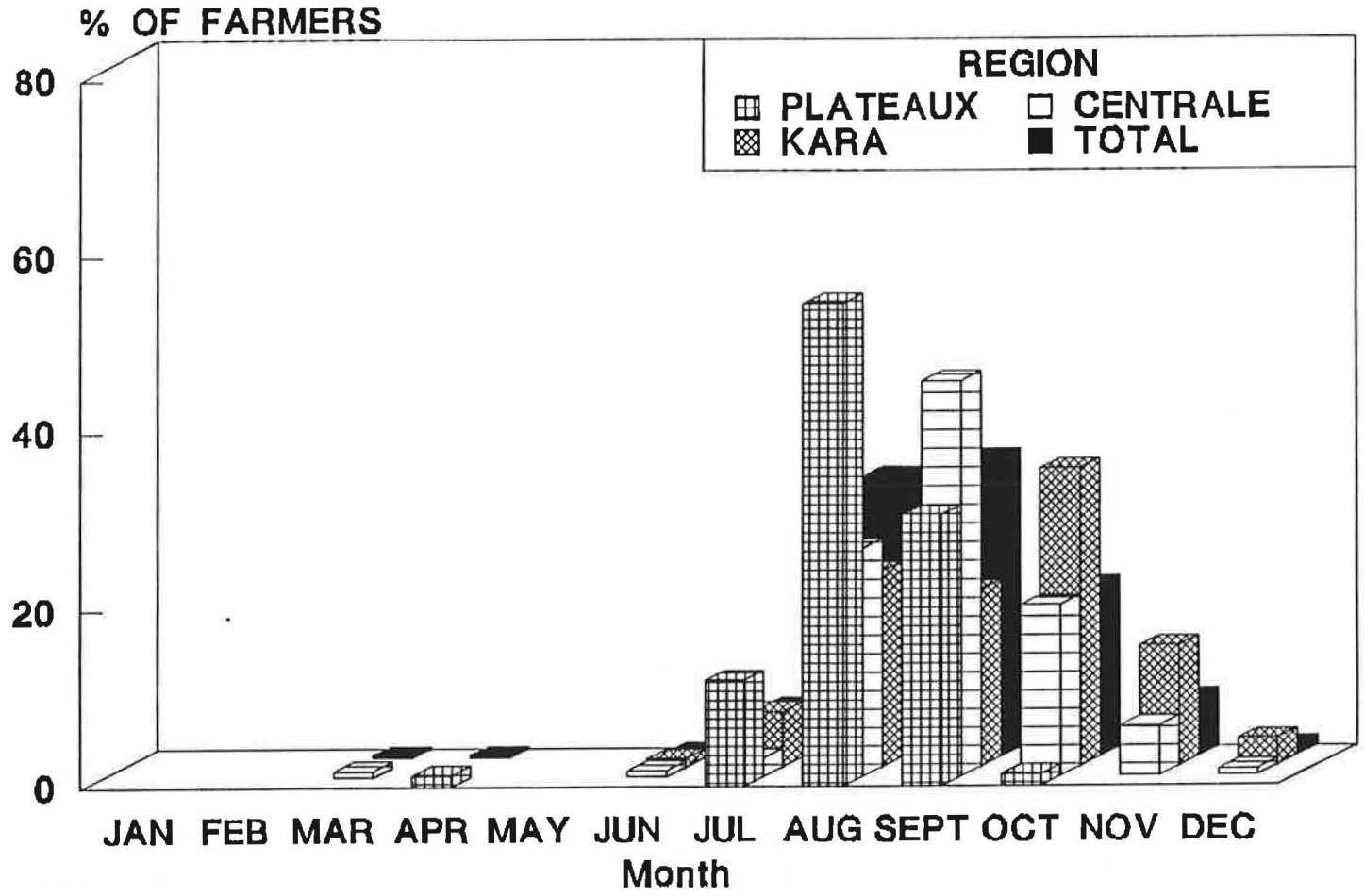
Most farmers harvest and stored their maize immediately (47%), while others leave it in a pile in the field (20%), house (21%) or elsewhere until it is transported and stored. A small number of farmers did not harvest or store any maize, possibly because their harvests were too small. The majority of farmers store within 7 days of harvesting (79%).

Sixty-one percent do not dry their maize after harvest as it is considered completely dry at time of harvest; those who do either sun dry on the ground or light a fire under the store to smoke it. The regional differences are most marked between Plateaux where a higher percentage (75%) store immediately, and all store without additional drying, and Kara region where 47% dry their maize after harvest. This difference may be explained by the different types of storage structures used (see Section 3.5.3).
Tables 2 to 5 in Appendix V give details of these harvest practices.

3.4.5 Use of Maize Crop Residues

Maize crop residues are usually left to rot in the field (64%) and incorporated into the soil during the next cultivation, or else burnt (33%). Research in Mexico has shown that maize residues have been found to assist the carry over of LGB from one season to the next. Therefore the practice of leaving residues to rot in the field is undesirable as it can provide a reservoir of LGB; good phytosanitary practices should be encouraged.

FIGURE 3.4.3: MONTH OF MAIZE HARVEST



3.5 STORAGE OF MAIZE

Almost all maize producers store part of their crop, only 2% (in Kara and Centrale regions) did not store either because their crop was devastated by animals such as wild pig and monkeys, or because their harvests were too small.

3.5.1 Quantities and Length of Storage

Quantities of maize, estimated by respondents equivalent to the number of 100kg sacks of grain, ranged from 0.25 to 105 sacks harvested and 0.25 to 100 sacks of grain stored. Estimates given are for quantities stored at the beginning of the storage season, it was not possible to examine the reduction of stock over the storage season through this type of survey.

The mean quantity harvested and stored was estimated to be 10 sacks (1.0 tonne), although mode quantities were much smaller (3 sacks). Taking the average area of maize monoculture of 1.2 ha. found in the survey area, this would give an average yield of 0.833 t./ ha., although this figure is high as it takes no account of areas of maize grown in association with other crops. Mean yields of maize in Togo over the period 1978-88 have fallen from just over 1.0 tons/ha to 0.8 tons/ha (DESA, 1990).

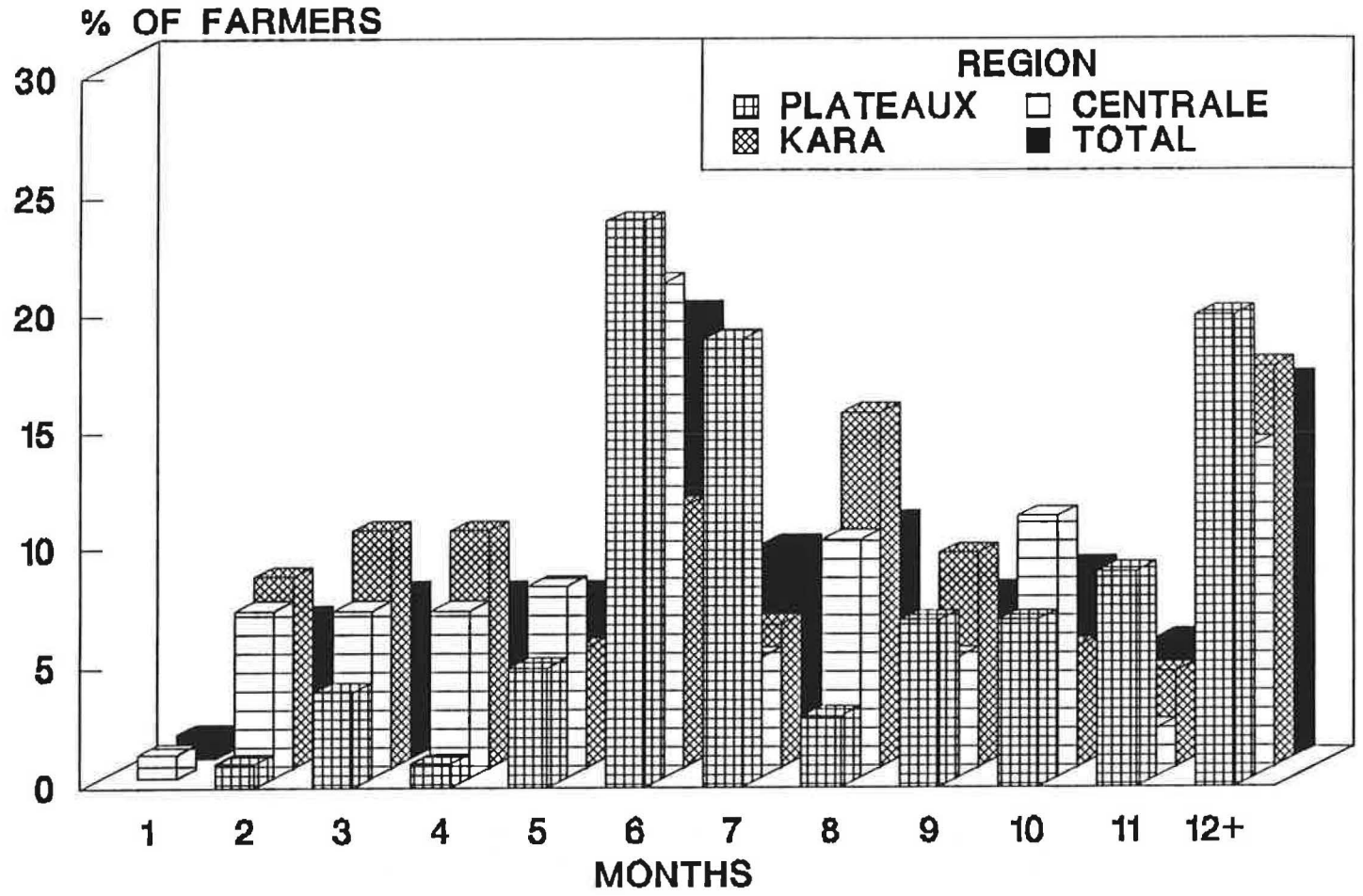
The length of storage period ranged from less than one month to 12 months or more, the start of the next harvest, and is illustrated in Fig. 3.5.1. Mean storage length was 7 months in the survey area, and slightly longer in Plateaux region at 8 months, although 6 months was most frequent length of storage (19% of farmers). The largest quantities stored (15 sacks) had a mean storage length of 7-9 months.

TABLE 3.5.1: QUANTITIES AND LENGTH OF STORAGE

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Mean quantity harvested*	11	9	12	10
Mean quantity stored*	11	8	11	10
% production stored	97	88	94	93
Mode Q harvested* (11%**)	6	3+5	1	3
Mode Q stored* (12%**)	6	2-3	3	3
Mean length of storage (months)	8	7	7	7

* Estimated in 100kg sacks of maize grain.
** % of farmers.

FIGURE 3.5.1: LENGTH OF STORAGE PERIOD FOR MAIZE



3.5.2 Storage Practices

At any particular time farmers may have maize in store in more than one form, i.e. on the cob with and without husk and shelled, depending on a number of factors including stage of the storage process. Maize is principally stored by most farmers on the cob with husk (70%), 10% stored on the cob without husk cover and 20% shelled. Table 3.5.2a shows marked regional variations, with virtually all maize in Plateaux region being stored with husk cover (97%) and only 3% shelled, while more farmers stored maize shelled in Kara region (41%), and 24% without husk cover. These differences can be partially explained by the use of different types of storage structures, which is in some cases itself related to ethnic group, (see Section 3.5.3) and possibly to agro-ecological conditions.

A larger mean quantity of maize was stored on the cob (10 sacks with husk and 11 sacks without husk), than shelled maize (8 sacks). Also, maize on the cob had a longer mean length of storage (8 months with husk, 7 months without husk) compared to only 6 months for shelled maize. This may be because larger producers store for longer, use the traditional types of stores which have larger capacities, and/or have greater constraints to storing maize shelled, such as labour requirements, cost of sacks, etc.

A range of traditional and chemical treatments are used on maize at the time of storage, and details are given in Tables 3.2.5b. Only 18% of those who stored maize used a traditional treatment, of which 8% used ash, 6% used smoking (by lighting a fire under the store or storing above the kitchen fire) and 3% used a range of plant material including the leaves of basil, neem, karité or shea nut, bitter leaves, bark of an unidentified tree or fruit of the baobab tree. The most noticeable difference between regions is that smoking appears to be only used at time of storage in Centrale region. However, this is not supported by the percentages using storage structures with fires, or smoking during storage, so perhaps this question was misinterpreted, resulting in contradictory replies (see below and Section 3.5.3). Ash was more commonly used in Plateaux and Kara regions.

Of those farmers who used a traditional treatment (n=55), the majority thought smoking and the use of plant material effective in protecting their maize, but ash ineffective. The origin of these traditional treatments is usually family and neighbours (58%), although 25% gave the extension agent as the source, particularly for the use of smoking and ash (16% missing data). These figures should be interpreted with caution due to the small numbers using the different treatments, and the large percentage of missing data.

Only 27% of farmers used a chemical treatment to protect their maize at time of storage, and of these 12% said they had used Actellic (Pirimiphos methyl) and K-Othrine (Deltamethrin) together, which was the recommended treatment against LGB and *Sitophilus spp.* in Togo before the development of Sofagrain (a formulation of the two chemicals). The highest percentage of users of chemicals were in Kara and Centrale regions and the lowest in Plateaux, with the highest percentage of users of the recommended treatment Actellic with K-Othrine (19%) in Centrale region. This suggests greater

activity or success by the extension services in this region, and should be further investigated. Other products used included Andrine (which could be Endrine used on cotton, and often generically used to describe any chemical) and those recommended for use on coffee and cotton.

The majority of users of Actellic and/or K-Othrine thought they gave effective protection to their stored maize, while those who used other chemicals thought them ineffective (Table 3.5.2c). This suggests that, although only a minority of farmers use recommended chemicals, they had a positive attitude towards their efficacy, although after the problems with Sofagrain during the 1990/91 storage season this attitude may have changed (see Section 2.1.2).

The source of chemicals used was usually the extension agent (86%) although family and neighbours accounted for 11%, (2% missing data). The market for agricultural chemicals is very undeveloped in Togo, and although not yet controlled by legislation this means that outlets for agricultural chemicals outside Lomé have been restricted to government departments such as DRDR, SPV, SOTOCO and SRCC. This has the advantage that the aggressive and chaotic marketing and over-application of agricultural chemicals found in some countries has so far been avoided. Attempts to liberalise the marketing of agricultural chemicals by involving the private sector are under way.

Users of storage chemicals stored a greater mean quantity (14 sacks) compared to those not using chemicals (9 sacks). The use of chemicals did not make a difference to mean length of storage for maize in general or of maize on the cob, (between 7-8 months). However, shelled maize with chemical treatment was stored for longer at 7-8 months compared with only 5 months without chemicals, and 6 months for shelled maize as a whole.
This suggest that larger producers and those shelling maize are using chemicals, which could be for a number of reasons such as greater disposable income, less incentive to use chemicals on smaller quantities, or because those not using chemicals suffer greater losses and consequently store for less time.

Forty-one percent of respondents said that at the time of storage they sort maize cobs to remove those that were visibly attacked, mouldy, germinating, dehusked and the smallest cobs, which were put aside to be consumed first. The fact that the majority (59%) do nothing increases the possibility that pre-harvest infestation can easily spread to uninfested maize.

During the period of storage 48% farmers do not carry out any type of maintenance of their stock of maize, although 42% claim to light a fire underneath the platform to smoke the store either regularly or from time to time, while only 6% redried the maize in the sun.

TABLE 3.5.2a: FORM OF STORED MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Cob with husk	97	78	35	70
Cob without husk	0	5	24	10
Shelled	3	17	41	20
TOTAL	100	100	100	100

TABLE 3.5.2b: TREATMENT OF MAIZE AT TIME OF STORAGE - % USING CHEMICAL AND TRADITIONAL TREATMENTS

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
No chemical treatment	75	73	73	73
Actellic	8	4	15	8
K-Othrine	0	<1	4	2
A + K	4	19	7	12
Name not known	8	2	1	3
Other (1)	5	1	0	2
TOTAL	100	100	100	100
No traditional treatment	88	79	83	82
Smoking	0	14	0	6
Ash *	11	4	11	8
Plant material (2)	1	3	6	3
TOTAL	100	100	100	100

TABLE 3.5.2c: FARMERS OPINION OF EFFECTIVENESS OF TREATMENTS (%)

	Effec.	Not Effec.	M.D.	n =
Smoking	45	15	40	20
Ash	27	73	0	22
Leaves	69	15	15	13
Actellic	76	16	8	25
K-Othrine	60	40	0	5
Actellic+ K-Othrine	74	26	0	35
Name not known	50	50	0	10
Other (1)	33	67	0	6

(1) Includes Andrine (generically used for all chemical treatments) and products for cotton or coffee.
(2) Includes leaves of basil, neem, shea nut and bitter leaves, the fruit of the baobab tree and tree bark.

TABLE 3.5.2d: MAINTENANCE OF MAIZE DURING STORAGE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Nothing	47	29	79	48
Fire	48	58	13	42
Sun	4	7	5	6
Chemical	0	4	1	2
Other (1)	1	2	2	9
TOTAL	100	100	100	100

(1) Includes regular inspection, use of ash and plants.

3.5.3 Storage Structures

Four main types of traditional storage structures were found to be used in the survey area, which can be further sub-divided.

1. The Platform or *Kédélin*

This is a square or rectangular wooden platform with a minimum of 4 legs, usually at a height of at least 1.5 metres from the ground. Maize cobs with the husk are arranged in a circle on the platform with an outer wall built of tightly packed maize, water is occasionally sprayed by mouth over layers of cobs to facilitate the tight packing. Cobs are then poured into the central well formed by the wall, and the stack of maize is protected with a thatch roof of straw which normally covers the stack completely. The roof is often removed during the dry season to facilitate aeration and further drying of the stack.

This type of store can be located both in the household compound and out in the fields, and has the advantage of holding large quantities. Platform size and capacity varies considerably, and it is commonly used to store other crops such as sorghum and rice.

Several types of platform can be seen depending on whether or not there is a fire underneath it. The fire smokes the stack of maize to help dry the crop further and is thought by farmers to protect against insect infestation. Smoking is carried out either regularly, occasionally or only at the beginning of the storage season. During the survey the following types of platform stores were found:

a) External platform without fire underneath

b) External platform with occasional fire underneath

c) External platform with kitchen fire underneath

d) Internal platform above kitchen fire

2. The Beaten Earth Store or *Kpeou*

This type of store is basically a large "water pot" shaped mud bin made from clay (argillitic) soils or termite mounds mixed with water and straw. There is wide variation in size and shape, but it is usually about 2 metres high, and requires a person to climb into the store to fill and empty it. The stores are, in principle, completely sealed, with an opening at the top or neck which usually has a lid to complete the seal, and this is then further protected by a straw 'hat' that sits on top. These stores have a life of 20-30 years, are almost always found in or near the household compound, and are used to store most dried crops such as maize shelled, or cobs with or without husk, *cossettes*, sorghum, cowpeas, and groundnuts.

The standard *kpeou* stands on a single base or 'leg' and contains a single crop, but variations found include the following:

a) *Kpeou* without compartments.

b) *Kpeou* with compartments - normally 3 'legs' each of which may contain a different crop.

c) *Kpeou* with a chicken coop, pigsty or place for goats underneath.

3. The Thatched Inverted Cone or *Katchalla*

The *katchalla* is an inverted cone shaped structure made from wood and thatch, supported by a variable number of legs around the top of the opening, covered with a conical straw thatched roof to protect the contents from the elements. These stores vary in size and capacity, but again usually require a person or child to climb inside when filling or emptying the store. It is most often used to store maize on the cob with or without husk, *cossettes* or sorghum heads, and can be found located either in the household compound or in the fields.

4. The Woven Barrel Shaped Store or *Tonneau*

The *tonneau* is a tubular barrel shaped structure made with woven mats arranged around a wooden frame standing on a slightly raised platform, so that the base is off the ground. It is open at the top, and this opening is protected by a thatched conical roof. Again, size and capacity of the store vary considerably, but it is usually at least 2 metres in height, and is commonly used to store maize cobs with or without husk, *cossettes* and sorghum heads. They can be located either in the household compound or in the fields.

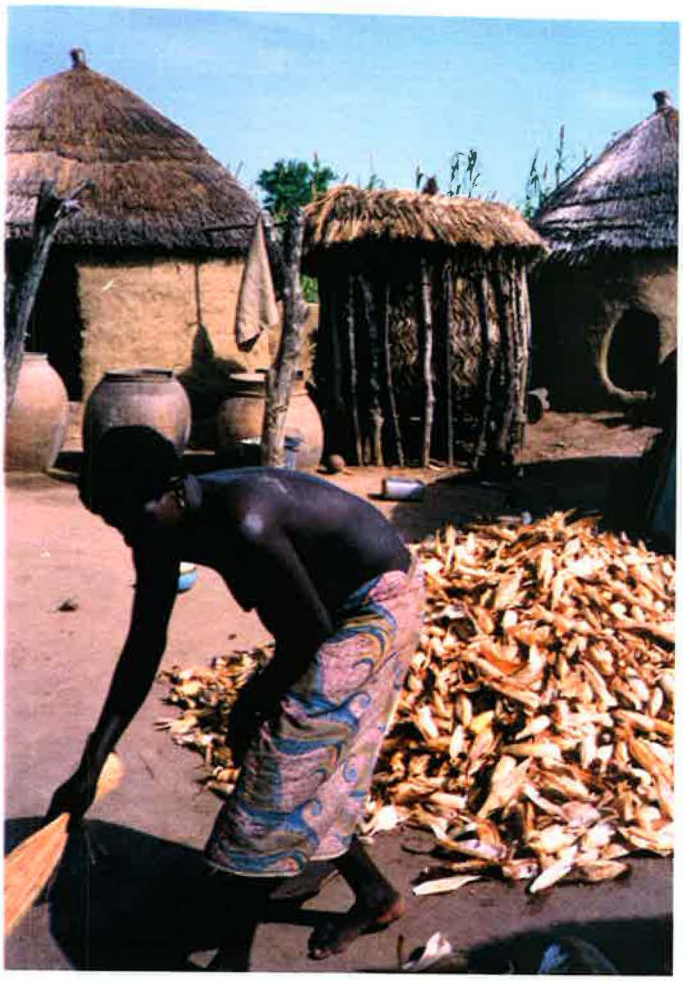
It is quite normal to find that a household will have several different types of stores used for different crops, and not unusual to find the same crop stored in more than one type of store and location depending on size of the harvest, store availability and distance from the fields. Of these four types of stores, the *Kpeou* is the only one that can be described as a closed structure, the others are all open offering varying degrees of ventilation to assist drying of the stored crop.

Figure 3.53 Traditional Storage Structures in Togo

1. Kedelin

2. Kpeou

3. Katchalla



4. Tonneau

The platform store is by far the most important storage structure for maize, used by 61% of farmers, the majority of whom used a platform with fire (46%). This is particularly true for Plateaux region where no other type of store was found used for storing maize, while in Centrale region although the platform is the most important store type for maize all other store types were also used. Kara region once again reflects a slightly different picture, with storage in sacks being most important used by 33% of farmers; the *kpeou* was the most important type of store (27%), followed by the platform and *tonneau*.

Overall only 16% of farmers stored their maize in sacks, almost always shelled (96%). Possible reasons for this low figure is ineffectiveness of the extension agents in extending the message to shell maize and store in sacks with storage chemicals, or the reluctance on the part of farmers to use this method. This may be due to conflicting labour requirements, the costs of purchasing sacks and chemicals, or the belief that maize stored in this way is more rapidly and severely attacked, and needs further investigation.

Certain store types are related to ethnic group, so that whereas the platform is used by most groups, the *kpeou, katchalla* and particularly the *tonneau* are more specific. Table 6 in Appendix V shows the percentage of each major ethnic groups covered by the survey (those comprising 5% or more of the survey population) using the different means of storage. It can be seen that while a substantial proportion of all groups use the platform for the storage of maize, the *kpeou, katchalla* and *tonneau* are only used by certain groups, while the use of sacks for storage is variable.

The platform is almost equally located in the household compound or in the field, probably depending on distance from the fields to the house and likelihood of theft. The *katchalla* is more commonly found in the field rather than household compound, again probably for the same reasons, however it is less commonly used for the storage of maize (only in 3% of cases). The *kpeou* and *tonneau* are always located in the household compound, in the case of the *kpeou* possibly because its construction requires a much greater financial investment than other types of stores.

Mean storage period for maize was 7 months, although this was slightly longer in Plateaux region at 8 months. All types of stores had similar mean lengths of storage; 7 months for the *kpeou*, 8 months for the platform, *katchalla* and *tonneau*, but only 6 months for sacks. This is further illustrated when examining mean length of storage of the different forms of maize, where it can be seen that this is slightly longer for maize stored with the husk (8 months) compared to 6 months for shelled maize.

Maize stored on the platform had the lowest mean drying time of 1 day, compared with 9 days for the *kpeou* and storage in sacks. Maize stored with the husk also has a lower mean drying time of 2 days compared with 8 days for shelled maize, normally stored in sacks, and 9 days for maize without husk. This is as would be expected since maize with husk is usually stored on the open platform where it will continue to dry, while maize is stored in

the *kpeou* either shelled or without husk, and needs to be much drier when stored or else it will rot.

TABLE 3.5.3a: MEAN LENGTH OF STORAGE OF MAIZE IN DIFFERENT FORMS (MONTHS)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
All maize	8	7	7	7
Maize cob+husk	8	7	8	8
Maize cob-husk	-	6	8	7
Shelled maize	6	6	6	6

TABLE 3.5.3b: STORAGE STRUCTURES USED FOR MAIZE (%)

	Plateaux n = 75	Centrale n = 141	K a r a n = 97	Overall n = 313(1)
Platform+fire	59	64	11	46
Platform-fire	33	8	10	15
Kpeou	0	6	27	11
Katchalla	0	6	0	3
Tonneau	0	<1	18	6
Sack	3	12	33	16
Other (2)	5	3	1	3
TOTAL	100	100	100	100

(1) Includes multiple answers.
(2) Includes storage in baskets or other containers, in piles in a room, or in the roof space.

TABLE 3.5.3c: STORE TYPE RELATED TO LOCATION (%)

	Plateaux		Centrale		K a r a		Overall	
	H	F	H	F	H	F	H	F*
Platform	47	53	41	59	90	10	49	51
Kpeou	0	0	100	0	100	0	100	0
Katchallas	0	0	33	67	0	0	33	67
Tonneau	0	0	100	0	100	0	100	0

* H= Household compound or F=Field.

TABLE 3.5.3d: FORM OF MAIZE STORED RELATED TO STORE TYPE (%)

	With Husk	Without Husk	Shelled	Total	n =
Platform	98	1	1	100	192
Kpeou	17	43	40	100	35
Katchalla	67	33	0	100	9
Tonneau	50	50	0	100	18
Sacks	4	0	96	100	51

3.5.4 Utilisation of Stored Maize

Table 3.5.4a shows that maize was stored for both consumption and sale by 73% of farmers; 23% stored solely for consumption while only 1% stored only for sale. The percentage storing for consumption increased northwards while that storing for sale decreased, implying maize became increasingly important as a food staple and decreasingly important as a source of revenue with progress northwards.

As might be expected, farmers who said they stored both for consumption and sale stored larger mean quantities (12 sacks) and stored for a longer mean period (8 months) compared to those who stored for consumption only (mean quantity of 3 sacks, and mean storage length of 6 months). Those who stored only for sale stored a mean quantity of 10 sacks, and stored for a mean length of 6 months.

Only a minority of farmers who stored both for consumption and sale separated their stocks (21%), although this figure was slightly higher in Centrale (29%) (Tables 3.5.4b-c). Of the small number who separated their stocks (n=47) a minority treated the two stocks differently, most notably 28% of these farmers used a chemical on the stock for sale.

During the second damage assessment survey in Centrale region 54 respondents, where possible the farmers wife, were asked questions about food preferences in order to help establish the position of maize and *cossettes* in the daily diet. 60% said that their preferred food was a '*pate*' made from a mixture of maize flour and cassava flour from *cossettes*. The most important reasons for this preference was firstly its consistency or texture, followed by its taste while the availability of foodstuffs was only given as the third reason. Other foodstuffs preferred by 40% of respondents included staple dishes such as '*foufou*' made from fresh boiled and pounded yam or cassava, '*pate*' made from sorghum and cassava flour, or rice

When the preferred foodstuffs were not available, 33% gave the '*pate*' made from maize and *cossettes*, as their preferred alternative 30% gave the '*pate*' made from sorghum and *cossettes* for reasons of consistency, availability and taste in that order.

TABLE 3.5.4a: REASONS FOR STORING MAIZE

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Consumption	19	24	33	26
Sale	1	2	1	1
Both	80	74	66	73

TABLE 3.5.4b: SEPARATION OF MAIZE STOCKS FOR CONSUMPTION AND SALE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
No	87	70	82	78
Yes	12	29	18	21
M.D.	1	0	0	1
TOTAL	100	100	100	100

TABLE 3.5.4c: TREATMENT OF SEPARATED MAIZE STOCKS (%)

	Plateaux n = 7	Centrale n = 29	K a r a n = 11	Overall n = 47
Sale-chemical	43	17	45	28
Sale-traditional*	0	3	9	4
Consumption-trad*	0	3	9	4
No treatment	57	76	36	64

* Traditional treatments include fire underneath the store, mixing shelled maize with sand, and use of plant material.

3.5.5 Storage Problems

The majority of farmers interviewed (73%) gave insects as their most important problem in relation to the storage of maize; this can be seen in Table 3.5.5a which also shows that this figure was substantially higher in Plateaux region (93%). Other problems given include rodents (10%), termites, moulds and caterpillars or larvae.

Samples of LGB *Sitophilus spp.* and *Tribolium spp.*, three insects commonly found infesting maize in Togo, were shown to all respondents, who were asked to identify the most important insect found in their maize. The results, given in Table 3.5.5b show that *Sitophilus spp.* was most commonly identified (67% of farmers) while only 15% identified LGB, and 6% claimed they had no insect infestation in their maize. This might be because *Sitophilus spp.* is a more 'visible' insect, easily identified by its elongated snout and its mobility when disturbed, compared to LGB which tends to dig in and bury itself when disturbed, or because LGB has only recently arrived.

Overall, 57% of farmers thought level of damage in their maize had been "important" the previous season (although "important" was not defined), while 5% claimed their maize had no damage at

all. An examination of the figures on a regional basis suggests a change in level of damage from south to north (Table 3.5.5c); a greater percentage of farmers in Plateaux said they had had an important level of damage (79%) and a lower percentage in Kara region (43%). This same trend is reflected in the percentage who said they had low levels and no damage at all, which increases from 0% in Plateaux region in the south to 14% in Kara in the north. This suggests that insect damage levels in maize may increase southwards, possibly caused by a number of factors such as changing agro-ecological conditions, slightly longer storage of maize, a lower percentage of farmers using recommended chemicals during storage and maize being dried for less time further south, or most probably a combination of these factors.

Cross tabulations and significance tests were carried out, using a Chi-squared test based on a loglinear model for analysing contingency tables, between perceived damage levels and most important insect recognised, and for each of these against the following variables:

- drying time
- where maize was kept before storage
- number of days between harvest and storage
- chemical and traditional treatments used
- quantity stored
- how maize was stored
- maintenance during storage
- storage length
- store type
- location of store

The following relationships were found to be significant:

1. How maize was stored was associated with most important pest recognised by the farmer (significant at 1%) and with perceived damage level (0.1%). Storage shelled coincided more often than expected with "no pests" and was associated with lower damage levels. In both cases, the reverse was true for storage with the husk.

2. Store type was associated with perceived damage levels (significant at 0.1%). The platform store type (particularly platform with fire beneath) was associated with higher levels of damage and those not using a storage structure (i.e. storing in sacks) were associated with lower damage levels.

3. Farmers using chemicals (Actellic, K-Othrine or both) were associated with lower reported damage (significant at 0.1%)

4. Where maize was kept before storage was associated with perceived damage level (significant at 0.1%). Farmers storing immediately, without additional drying, were associated with higher incidence than expected of important levels of damage.

TABLE 3.5.5a: FARMERS OPINION OF THEIR MOST IMPORTANT PROBLEM DURING STORAGE OF MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Insects	93	63	70	73
Rodents	5	13	10	10
Termites	1	2	5	3
Moulds	0	6	2	3
Caterpillars	0	4	3	3
Other	0	1	0	<1
M.D.*	0	11	10	8
TOTAL	100	100	100	100

* Includes those with no problems.

TABLE 3.5.5b: IDENTIFICATION BY FARMERS OF MOST IMPORTANT INSECT FOUND INFESTING THEIR MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Sitophilus	76	70	55	67
Prostephanus	19	9	22	15
Tribolium	5	15	11	11
None	0	5	13	6
M.D.	0	1	0	<1
TOTAL	100	100	100	100

TABLE 3.5.5c: FARMERS' OPINION OF LEVEL OF INSECT DAMAGE IN MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Important	72	57	43	57
Average	19	21	23	21
Low	9	18	20	17
None	0	2	14	5
M.D.	0	1	0	<1
TOTAL	100	100	100	100

TABLE 3.5.5d: FARMERS' OPINION OF CHANGES IN LEVEL OF DAMAGE IN MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Same level	59	60	47	56
More damage	31	21	22	24
Less damage	11	15	20	15
No damage	0	2	11	4
M.D.	0	2	0	<1
TOTAL	100	100	100	100

In order to obtain qualitative information on recent changes in insect pest status, possibly caused by the introduction of LGB, farmers were asked about changes in damage levels, and storage practices. The results given in Table 3.5.5d show that 56% said damage levels the previous season had been the same as in earlier years, while only 24% thought the level of damage had increased. Of this 24% of farmers (n=72) the majority gave lack of an effective treatment as the reason (60%), implying a lack of awareness of the recommended storage treatment for maize, or constraints to their adoption which should be further investigated, while only 7% said it was because of an increase in insects (see Table 7 in Appendix V).

Only 13% of all farmers said they had made any changes to their storage practices in recent years, with a slightly greater percentage in Kara compared to Plateaux or Centrale regions (Table 3.5.5e). Changes made by these farmers (n=40) were mainly in adopting the use of chemicals to protect their maize (by 25%), and storing maize shelled in sacks with chemicals (by 18%), or a change in store type (by 30%). The overwhelming reason given for changing storage practices was insect damage (81%), slightly more so in Plateaux and Centrale regions than in Kara. The majority had made changes within the year before the 1989/90 season, including the beginning of the storage season (49%), although in Kara 59% said they had made changes more than 2 years previously (see Table 8-10 in Appendix V).

Farmers were asked what they did with badly damaged maize. Respondents indicated that it is usually given to animals, particularly chickens and goats, although the flour can be regarded as a total loss as they are unable to consume it. Maize rejected completely (by 20% of farmers) is probably also consumed by scavenging farm animals in the household compound. Twenty-nine percent of farmers said that they still consume badly damaged maize, although this may vary with size of harvest, time during the storage season, degree of damage and alternatives available (see Table 9 in Appendix V).

TABLE 3.5.5e: CHANGES MADE IN MAIZE STORAGE PRACTICES (%)

	Plateaux n = 8	Centrale n = 15	K a r a n = 17	Total n = 40	Overall n = 304
Changed store type	25	27	35	30	4
Used chemicals	50	13	24	25	3
Stored shelled in sack+chemicals	25	13	29	18	2
Stored shelled in sack	0	13	6	12	2
Other*	0	33	6	15	2
TOTAL	100	100	100	100	13

* Includes regular redrying; applying diesel or oil on the platform before storage; using traditional methods such as ash; stacking sacks on a raised platform; changing the location of the store; and renewing the construction material of the store.

3.6 MAIZE MARKETING PRACTICES

Seventy percent of farmers who grew maize sold some during the season, and overall 39% of production was sold although this varied between 29% in Kara region and 47% in Plateaux. Quantities sold ranged from less than 0.25 of a sack (25 kgs) to 75 sacks, with a mode quantity of 2 sacks. The estimated mean quantity sold of 7, sacks plus the fact that those who store for consumption and/or sale tend to store larger quantities (see Section 3.5.4) implies that it was mainly larger producers who sold. Sale was overwhelmingly in order to meet financial requirements (83%) such as repayment of debts, ceremonial obligations, and school fees, although 7% did so in order to avoid damage during storage, while only 5% said they sold because of the price or surplus production.

Sales are most frequently occasional in order to meet financial requirements, or once or twice; those who sold regularly comprised only 12% of the survey population. The marketing is normally carried out by the farmer's wife or a female family member (68%), although a substantial number of farmers were also responsible (27%). Maize was most often sold at the local market or a market nearby (58%), possibly because transport to larger markets is a constraint, although 35% sold at regional or sub-regional markets, where sale is likely to be to retailers and wholesalers.

In the survey area as a whole, sales to consumers, retailers and wholesalers were of almost equal importance, although Tables 3.6a to 3.6c show that there is some regional variation in marketing practices (see also Tables 11-12 in Appendix V). In Plateaux region a higher proportion of farmers sold maize and did so to avoid insect damage (17%), more sold to retailers at sub-regional markets and less to consumers. Fewer farmers sold maize in Kara region, more sold at local markets or to Farmers Groups, and fewer sold at regional or sub-regional markets.

Nineteen percent of farmers interviewed bought maize during the season. Of those (n=62), 5% did so because their stocks had been damaged by insects, while 12% bought for consumption because they had not produced and/or stored sufficient for their needs. Only 2% bought for seed. This is consistent with observations during the damage assessment survey where 99% of maize samples taken from farms turned out to be local or degraded/mixed improved varieties.

During the damage surveys, several farmers who had been found with LGB infestation during the first had emptied their stores by the second visit, and either consumed or sold their remaining stock. It was observed in one case where the female farmer had separated the maize into 4 different categories, the first for sale, the second and third for human consumption, and the last to be given to the chickens.

TABLE 3.6a: MARKETING OF MAIZE

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
% Who sold	77	72	64	71
	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
% Production sold	47	43	29	39
Mean Quantity (in 100 kg sacks)	8	7	9	7

TABLE 3.6b: MARKET FOR MAIZE (%)

Market	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
Local/Nearby	43	53	79	58
Sub-regional	53	35	10	32
Regional	0	5	2	3
Other (1)	3	7	10	7
TOTAL	100	100	100	100

(1) Includes sale from the house, or Farmers Group store, or in the field.

TABLE 3.6c: DESTINATION OF MAIZE SOLD (%)

	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
Consumers	9	25	32	23
Retailers	45	21	24	28
Wholesalers	18	30	23	25
Togograin	1	2	1	2
Farmers Groups	0	0	5	1
DRDR/SOTOCO	0	1	2	1
Do not know	28	21	13	20
TOTAL	100	100	100	100

TABLE 3.6d: % FARMERS WHO PURCHASED MAIZE AND REASON FOR PURCHASE

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
None purchased	80	79	79	79
For consumption	9	11	16	12
Due to insect damage	9	4	5	5
For seed	1	4	0	2
M.D.	0	2	0	1
TOTAL	100	100	100	100

3.7 PRODUCTION OF CASSAVA

Details of cassava production in the survey area are set out in Table 3.7.1a. Seventy-one percent of farmers interviewed grew cassava; the proportion decreased northwards from 87% in Plateaux region compared to only 48% in Kara region. This reflects national production in Togo (see Appendix VII), in that Plateaux region produced 19% of total production in 1989/90, while Centrale region contributed 17% and Kara region only 3%.

Cassava is almost always grown without any purchased inputs such as chemical fertilizer, (only said to have been used by 1% of farmers, Table 3.7.1a), or pesticides. It is primarily grown as pure stand, but can also be found intercropped, as either the primary or secondary crop, with maize, sorghum, yams, cowpeas and rice, or alternatively grown as a small strip around the edge of a field.

3.7.1 Varieties Grown

Cassava varieties can be divided into bitter and sweet, as well as into local and improved varieties. Table 3.7.1a shows that the majority of farmers (72%) said they grew local varieties, while 45% grew improved varieties and 17% grew both a local and improved variety. Almost equal numbers said they grew bitter or sweet (68% and 65%) and a third (33%) said they grew both types of cassava. Table 1 in Appendix VI shows names of all the varieties given by farmers, and percentages of farmers growing each variety. Improved varieties were called either SORAD or DRDR after the rural development institutions that introduced them, as with improved maize varieties, and are generally regarded as being higher yielding than local varieties but bitter.

Both bitter and sweet cassava have a growing cycle of up to 24 months. Sweet cassava is generally grown to be consumed fresh (87%), although it is also transformed into *cossettes* and gari, made by grating cassava and drying over a fire to produce a coarse flour which is then used in a number of ways. Bitter cassava was above all used to make *cossettes* (by 99% of farmers), possibly because the drying process reduces the level of cyanide in the tuber, and makes it more palatable; only 7% use bitter cassava to make gari. Regional variations are shown, so that more farmers grow sweet cassava and make gari in Plateaux region, where bitter cassava and *cossettes* are less important. Bitter cassava is more important in Centrale region, while gari is less common in Kara region (see Tables 3.7.1a and 3.7.1b).

During the second damage assessment survey 54 farmers were asked their opinions about the advantages and disadvantages of local and improved varieties. The results, contained in Table 3.7.1c, suggest that local varieties are sweet varieties since they are considered good for fresh consumption. Improved varieties are not suitable for fresh consumption, and are probably bitter with higher levels of cyanide, but are liked for their profitability, probably because they are higher yielding.

TABLE 3.7.1a: PRODUCTION OF CASSAVA (%)

% Growing	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Cassava	87	80	48	71
	n = 65	n = 118	n = 52	n = 235
Sweet Cassava	78	56	69	65
Bitter Cassava	46	83	60	68
Sweet & Bitter	25	39	29	33
Local variety	85	55	94	72
Improved variety	22	69	19	45
Use of Fertilizer	n = 65	n = 118	n = 52	n = 235
No fertilizer	100	99	92	98
Chemical fertilizer	0	1	4	1
Organic fertilizer	0	0	4	1
TOTAL	100	100	100	100

TABLE 3.7.1b: USE OF CASSAVA* (% GROWING EACH TYPE)

Sweet Cassava	Plateaux n = 51	Centrale n = 66	K a r a n = 36	Overall n = 153
Consumed fresh	84	95	75	87
Cossettes	71	29	67	58
Gari	47	36	3	20
Bitter Cassava	n = 30	n = 90	n = 31	n = 159
Cossettes	97	100	100	99
Gari	17	6	0	7

* Includes multiple answers.

TABLE 3.7.1c: FARMERS OPINIONS OF ADVANTAGES AND DISADVANTAGES OF CASSAVA VARIETIES (n=54)

ADVANTAGES	%		%
Local Varieties		Improved Varieties	
1. Good consumed fresh	64	More profitable	46
2. Less attacked	16	Short production cycle	16
3. More profitable	7	More resistant/ Less attacked	14.5
4. Short production cycle	3.5	Not liked by wild animals	5
5. More floury	3.5	Lasts a long time	4
6. Not good in poor soil	3.5	More floury	2
7. Lasts in the soil	1.7	Do not know	14

DISADVANTAGES	%		%
Local Varieties		Improved Varieties	
1. Less profitable	30	Not good consumed fresh	54
2. Long production cycle	15	More attacked	18
3. Tubers do not last long/ less resistant	17	Long production cycle	4
4. Liked by animals/thieves	13	Liked by wild animals	4
5. More attacked by insects	12	Less floury	4
6. Less floury	3	Do not last in the soil	2
7. Do not know	15	Do not know	14

3.7.2 Sweet Cassava

Figs. 3.7.2a and 3.7.2b illustrate the months and age at which cassava is harvested by region and in the whole survey area. Fig. 3.7.2b shows that sweet cassava can be harvested at almost any time during the vegetative cycle (1 farmer said he harvested at 36 months), but is most frequently harvested after 12 months of growth (41%) in all regions, although there are minor peaks at other times.

Fig. 3.7.2a shows that the sweet cassava harvest is concentrated in two periods from November to January and again from June to August, only 4% of farmers growing sweet cassava said they harvested at any time of the year, mainly farmers in Centrale region. A range of reasons were given for harvesting in a particular month (see Table 3.7.2), the most important for sweet cassava being maturity of the crop (44%), or the presence of sunshine and the dry season (27%) which corresponds to the peak harvest period from November to January. The lesser peak from June to August corresponds with the other main reasons for time of harvest, for consumption either while work in the fields (13%) or as replacement of other food staples (11%). This period would correspond to just before the new maize harvest when food stocks are likely to be low or already exhausted.

All this suggests that sweet cassava is both a flexible crop in the farming system and a versatile food staple, which can be consumed or processed and stored in different forms. It can be harvested at almost any time, and can satisfy the farming population's consumption needs throughout the year in several different ways depending on changing circumstances.

3.7.3 Bitter Cassava

Bitter cassava is not usually harvested before 6 months of growth, and the peak age of harvest tends to be at 12 months, with minor peaks throughout the 24 month vegetative cycle (see Fig. 3.7.2b). Fig. 3.7.2a shows that bitter cassava only has one peak period for harvest, from December to February, which coincides with the dry season, the main reason for harvest given by 89% of farmers, when sunshine is available to dry *cossettes* (Table 3.7.2).

In view of the fact that the main use of bitter cassava is for storage as dried *cossettes* (by 99% of those who grow bitter cassava), this suggests that bitter cassava is a less flexible crop in the farming system, as the production of *cossettes* is constrained by the dry season. However this does not mean bitter cassava, stored as *cossettes*, is necessarily less important to the household as a food staple; the importance of *cossettes* as an ingredient of preferred food staples has already been indicated in Section 3.5.4.

TABLE 3.7.2: REASONS FOR TIME OF HARVEST OF CASSAVA (%)

Sweet Cassava	Plateaux n = 51	Centrale n = 66	K a r a n = 36	Overall n = 153
Maturity	59	38	33	44
Dry sunny period	14	23	53	27
To eat in the field	12	18	6	13
Consumption	12	14	6	11
Other (1)	2	3	3	3
Did not harvest	0	2	0	>1
M.D.	2	2	0	2
TOTAL	100	100	100	100

Bitter Cassava	Plateaux n = 30	Centrale n = 90	K a r a n = 31	Overall n = 159
Dry sunny period	80	92	87	89
Maturity	17	2	10	6
Other (2)	3	4	3	4
Did not harvest	0	1	0	<1
M.D.	0	1	0	<1
TOTAL	100	100	100	100

(1) Includes time available, and to have stems for the next planting for sweet cassava.
(2) Includes time available, for sale for financial reasons, rotation of crops and to avoid rotting for bitter cassava.

FIGURE 3.7.2a: MONTH OF CASSAVA HARVEST

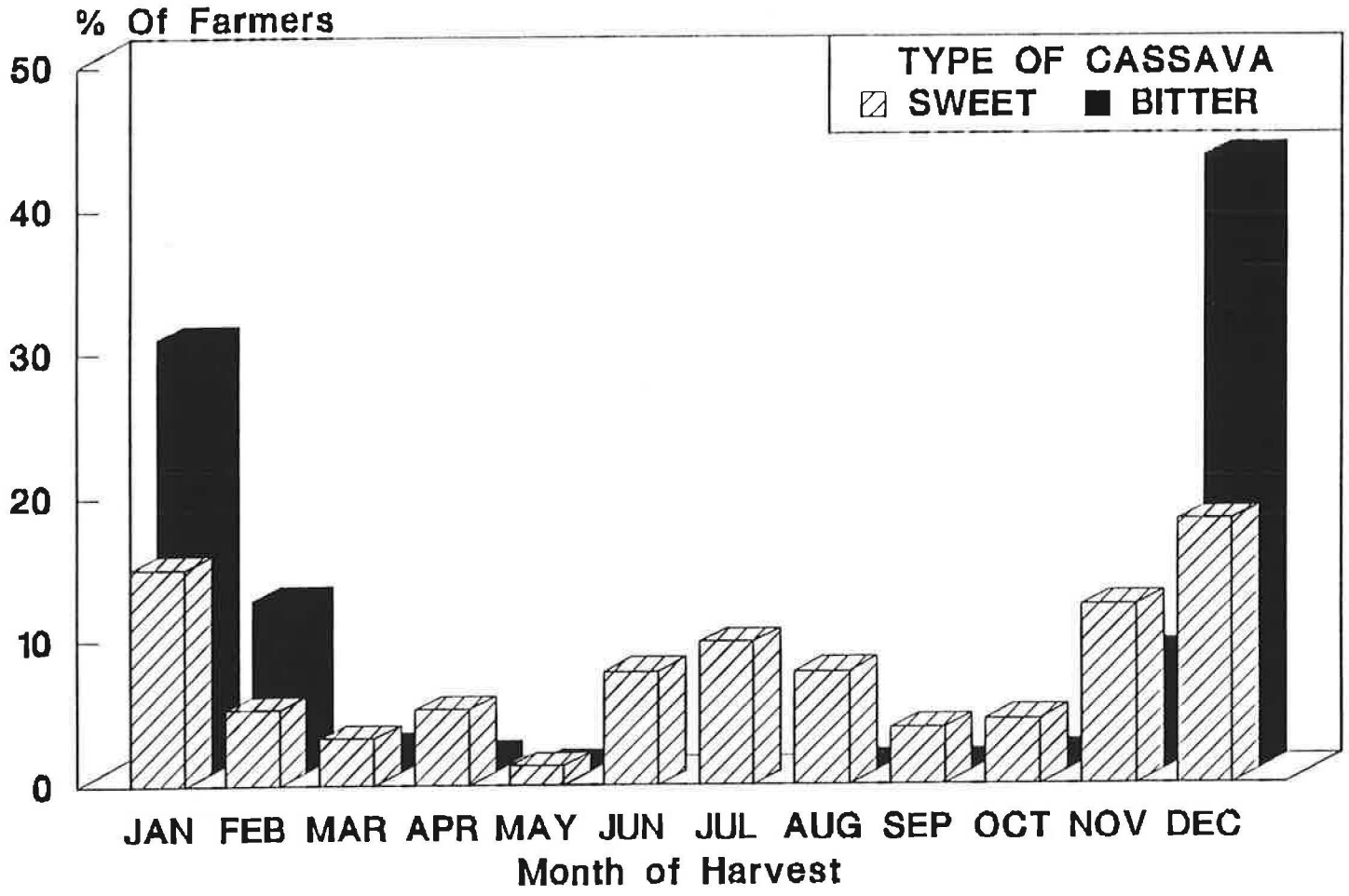
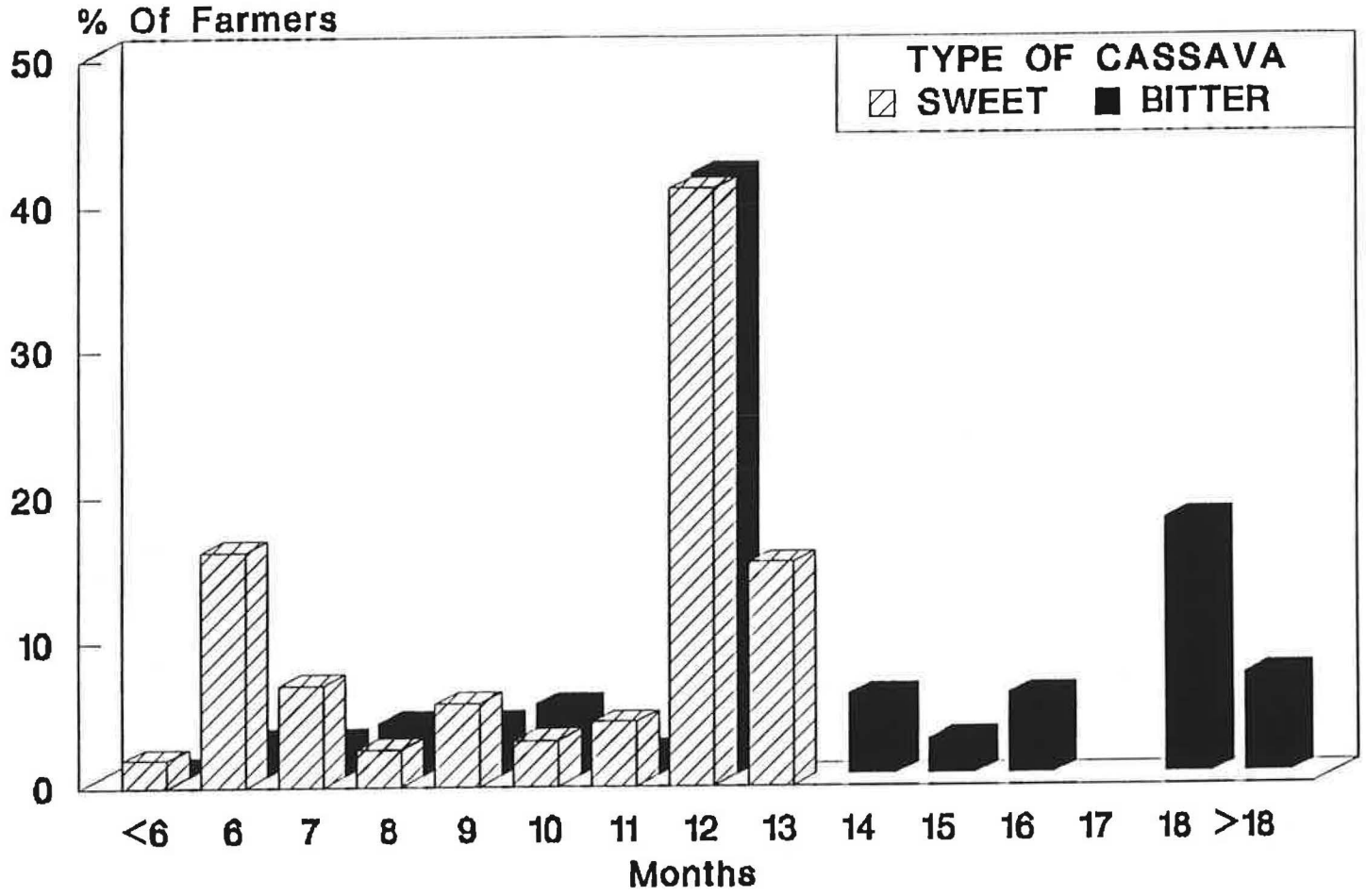


FIGURE 3.7.2b: AGE OF CASSAVA AT HARVEST



3.8 STORAGE OF CASSAVA

Ninety-six percent of farmers who grew cassava made and 91% stored *cossettes*, therefore 5% of farmers in the survey area made but did not store *cossettes* (see Table 3.8.1a). On a regional basis the biggest difference was in Plateaux region where only 86% of farmers growing cassava stored *cossettes*. This supports the findings in Ayeva's (1990) survey in the region, who concluded that it was more variable, with some farmers making smaller quantities more often, rather than only once and storing for longer.

3.8.1 The Importance of Stored Cassava

Although statistics on production of all crops, including cassava are regularly collected by DESA, no statistics are available on the processing or transformation of cassava into different forms such as *cossettes* or gari. Establishing the importance of *cossettes* as a form of storage and consumable food staple in Togo is one of the objectives of this survey, as without it an evaluation of the impact of LGB and other insects pests on *cossettes*, or the costs and benefits of different methods of control cannot be made.

Table 3.8.1b and Fig. 3.8.1 illustrate the percentages of cassava production that farmers interviewed estimated that they transformed into *cossettes*. These figures do not allow an absolute estimate of cossette production to be made. However, if they are taken to be a reflection of practices in the regions covered by the survey, and national production statistics are considered, they enable a judgement to be made of the most important region for cossette production.

Although farmers in Kara region appear to transform a greater percentage of cassava into *cossettes* (94% of farmers transformed 50% or more) the region only contributed 3% of national production in 1989/90. Both other regions produce a significant percentage of national production (between 17-20%; see Tables 1 and 2 in Appendix VIII). Centrale region was taken to be the most important region for the production and storage of *cossettes* because of the three regions a larger percentage of farmers (74%) converted 75-100% of their cassava into *cossettes* (compared with 58% in Plateaux). Using farmers estimates of quantities also indicated that the largest mean quantities were made and stored in this region (Table 3.8.2).

A qualification must be made in the case of Plateaux region. The survey only covered approximately one third of the northern part of this region, and therefore the results cannot be said to be representative of the region as a whole. Plateaux region reflects more complex agro-ecological conditions because it spans the unimodal/bimodal rainfall area, and therefore has one- and two-season cropping, as well as having greater topographical variation to the west. The survey was confined to the one-season cropping area, and cannot therefore be said to reflect farming and storage practices in the entire region.

TABLE 3.8.1a: FARMERS PRODUCING AND STORING *COSSETTES* AS PERCENTAGE OF FARMERS GROWING CASSAVA

	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
% Producing	98	95	94	96
% Storing	86	93	94	91

TABLE 3.8.1b: PERCENTAGE OF CASSAVA PRODUCTION TRANSFORMED INTO *COSSETTES*

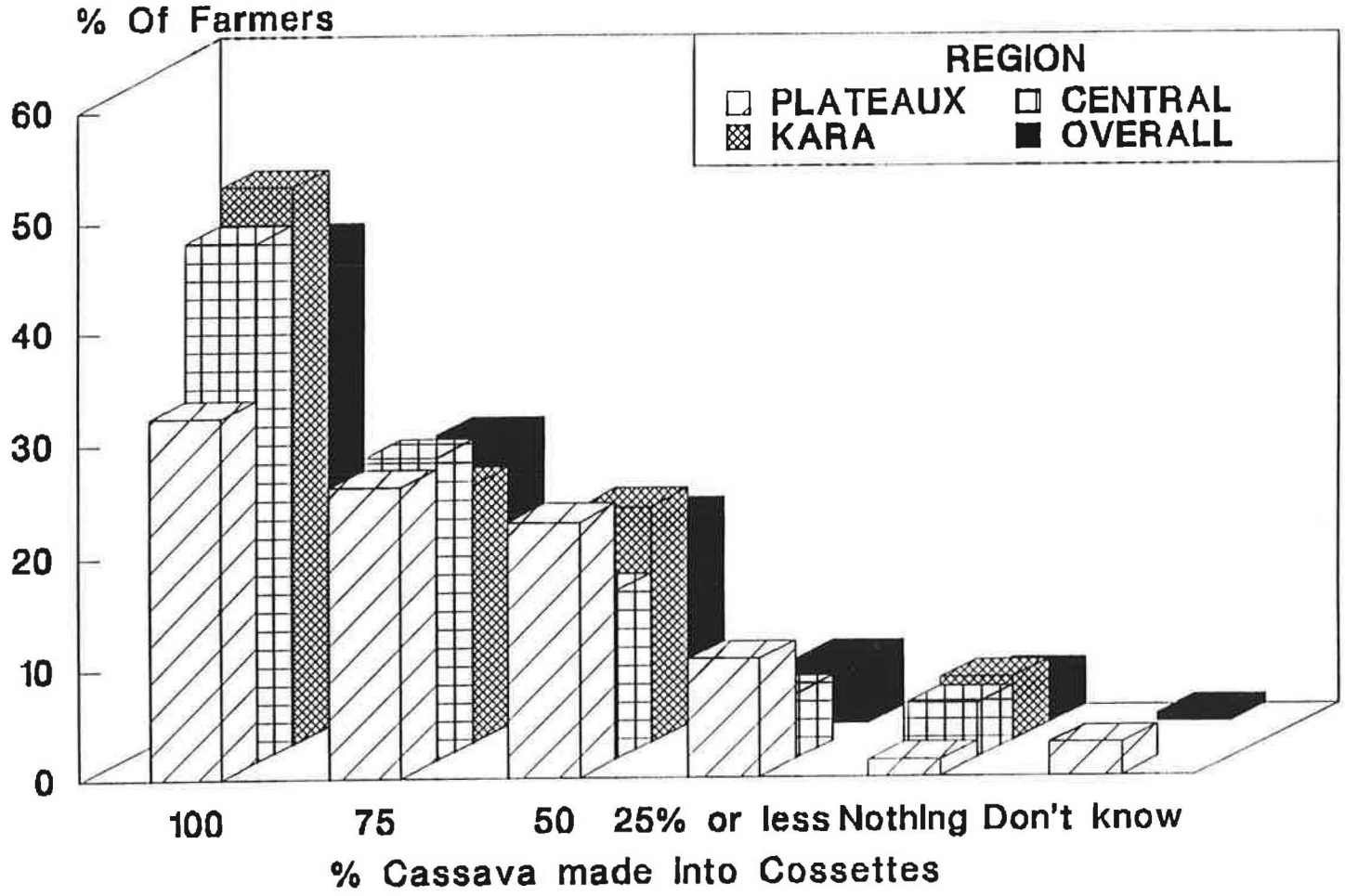
	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
100%	32	47	50	43
75%	26	27	23	26
50%	23	15	21	19
25% or less	11	6	0	6
0%	2	5	6	4
Do not know	3	0	0	1
M.D.	3	0	0	1
TOTAL	100	100	100	100

TABLE 3.8.2: ESTIMATED QUANTITIES OF *COSSETTES*

	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
Mean Quantity harvested (sacks)	8	10	5	8
Estimated Q in kgs*	480	600	300	480
Do not know (%)	17	16	13	16
Mean Quantity stored (sacks)	7	10	5	8
Estimated Q in kgs*	420	600	300	480
Do not know (%)	12	14	17	14

* On the basis of 60 kgs per sack.

FIGURE 3.8.1: % OF CASSAVA MADE INTO COSSETTES



3.8.2 Quantities Harvested and Stored

Quantities of cassava harvested and stored were estimated by farmers in units of a standard sacks which holds approximately 60kgs of *cossettes*. However a large percentage of farmers were unable to give an estimate of the quantities harvested or stored (16% and 14% respectively). The number of sacks harvested and stored ranged from less than one to 95, and the estimated mean quantity harvested and stored was 8 sacks or 480kgs (8x60); the mean quantity harvested and stored is higher in Centrale region (10 sacks or 600kgs).

Mean values indicated that larger quantities were stored and for a longer length of time with chemicals; farmers using Actellic and K-Othrine together (n=6) stored a mean of 20 sacks and showed a mean storage length of 8 months, while the majority of farmers who did not use chemical stored only 7 sacks and a duration of 7 months.

3.8.3 Period and Duration of Storage

The storage period can last 12 months until the next harvest, and 19% of farmers said that their stocks lasted 12 months or more. The mean storage period was 7 months, although this increased with distance northwards, from 6 months in Plateaux, 7 in Centrale and 8 in Kara regions. This could be for a number of reasons such as less damage during storage or the greater importance of *cossettes* for consumption with progress northwards, and the greater availability of alternative foodstuffs in the Plateaux region.

Farmers producing larger quantities stored for a longer period of time, so that those storing for 10-12 months produced a mean of 10 sacks (26% of farmers) while those storing for more than 12 months produced a mean of 16 (only 4% of farmers). Those farmers who store for 12 months or more would be in a position to sell *cossettes* when prices are highest from September to November, just before the new harvest. The percentage of farmers storing for 10-12 months or more increases northwards throughout the survey area from 22% in Plateaux, to 30% in Centrale and 41% in Kara region.

Ayeva's study (1990) suggested that in Plateaux region farmers were changing their practices, and making smaller quantities more frequently, thereby storing for a shorter duration. This was not supported by this survey, as less than 3% said they made *cossettes* at any time throughout the year, although 28% gave more than one month ie. a range of months over which *cossettes* are made. This suggests that the making *cossettes* is carried out over a number of months.

During the damage assessment survey farmers in Centrale region were asked how many times they harvested and made *cossettes*; 86% said once only while 14% made several harvests (1 farmer said all year round). However, in N'Kengbe one of the villages visited which is close to the border with Plateaux region, the practice of making small quantities many times and storing for short periods was encountered. During the rainy season the *cossettes* were dried above the kitchen fire, giving them a blackened appearance and the *pate* a grey colour, but the texture and taste was said to be the same as sun-dried *cossettes*. N'Kengbe was one of the 3 villages where LGB was not found, and farmers and the extension agent interviewed said *cossettes* had always been stored in this way.

3.8.4 Method of Preparation

Cassava tubers are either stored as dried pieces known as *"cossettes de manioc"* or as gari (described in Section 3.7.1); one farmer in the survey area said he stored his cassava as flour (see Table 3.8.4).

The preparation of *cossettes*, usually done by women, involves peeling the tuber, cutting it into pieces and sun-drying, which is why the period of cossette production coincides with the dry season. This method was used by 90% of farmers overall, but there are several variations. The most important one of which is that in some areas the dried *cossettes* are placed into boiling water to harden the external surface of the cossette and make it more resistant to insect attack, and then redried. Only 8% of farmers in the whole survey area used this method, but as Table 3.8.4 shows it was used by 31% in Kara region. More farmers know of this method than actually use it; reasons for not doing so include lack of time and difficulty in finding sufficient quantities of wood for the fire.

Other modifications to the basic method of preparation include drying over fire (3 farmers), applying a chemical to the fresh tuber before drying (2 farmers) or covering the peeled and cut tubers with leaves from the shea nut tree for several days before drying (1 farmer).

Length of drying of *cossettes* varies from a few days to over a month, but was most commonly 14 days (38% of farmers). Table 3.8.4 shows the regional variation, so that in Plateaux region *cossettes* are dried for shorter periods of time, while with progress northwards to Kara region the percentage of farmers drying for longer increases, possibly because of longer storage (see Section 3.8.6), or a longer dry season.

Drying of *cossettes* takes place most commonly in the fields where they are left on a bed of stalks and leaves to facilitate air circulation and drying, or in the household compound on the ground or on roofs, above the kitchen fire, or any suitable surface such as on rocks or tarmac by the roadside.

TABLE 3.8.4: PREPARATION OF *COSSETTES DE MANIOC* (%)

Method of Preparation	Plateaux n = 64	Centrale n = 111	K a r a n = 49	Overall n = 224
Peel cut and dry	94	98	69	90
Use boiling water	1.5	2	31	8
Stored as flour	1.5	0	0	<1
M.D.	3	0	0	1
TOTAL	100	100	100	100
Drying Time				
1-7 days	41	12	10	20
8-14 days	45	45	31	42
15-21 days	9	28	16	20
22-30 days	0	13	37	15
<1 month	0	2	6	2
Do not know	2	0	0	<1
M.D.	3	0	0	1
TOTAL	100	100	100	100

3.8.5 Storage Practices

Very few farmers use any sort of treatment to protect their *cossettes* during storage, either chemical or traditional. Table 3.8.5 shows that only in Centrale region were farmers found to use chemicals on their *cossettes* (10%). The most common traditional treatment is to place the *cossettes* in boiling water after drying and redrying, used mainly in the Kara region. Other traditional treatments were used by only 3% of farmers, and are the same as those used for maize including use of plant material, smoking over the fire and ash.

On the whole, of all treatments boiling *cossettes* and the use of Actellic were thought effective by those who used them. However such small numbers were involved, (n=11 for chemical and n=23 for traditional treatments) that it is not possible to draw any firm conclusions. During the damage survey in Centrale region one farmer was found who had stored some *cossettes* made in the normal manner and others which had been boiled; both made at the same time and stored in close proximity. Although the boiled *cossettes* had a better external appearance, as boiling and redrying gave them a smoother, sealed, slightly yellow exterior, they were equally if not slightly more damaged by LGB and *Dinoderus spp.*.

Family or neighbours were almost always the source of advice on traditional treatments, and the extension agent the source of chemical treatments, although the unnamed chemicals originated from neighbours.

During storage few farmers carried out any type of maintenance of their stocks; over 90% said they did nothing, and the remaining 10% either re-dried the *cossettes* periodically, inspected the stores occasionally or lit a fire under the stores; less than 1% said they used a chemical during the period of storage. These figures are not surprisingly since no improved method of storage is promoted by the extension services.

TABLE 3.8.5a: TREATMENT OF *COSSETTES* AT TIME OF STORAGE - CHEMICAL AND TRADITIONAL (%)

Chemical Treatment	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Actellic	0	2	0	1
Actellic + K-Othrine	0	5	0	3
Other chemicals (1)	0	3	0	1
None	100	90	100	95
TOTAL CHEMICAL	100	100	100	100
Traditional Treatment	**n = 56**	**n = 109**	**n = 49**	**n = 214**
Boiling water	2	2	27	7
Smoking	3	1	0	1
Other traditional (2)	2	0	6	2
None	93	97	67	89
TOTAL TRADITIONAL	100	100	100	100

TABLE 3.8.5b: FARMERS OPINION OF EFFECTIVENESS OF TREATMENT (%)

	Effec.	Not Effec.	M.D.	n =
Actellic	100	0	0	2
Actellic+K-Othrine	50	50	0	6
Other chemical (1)	33	67	0	3
Boiling water	62	19	19	16
Smoking	50	50	0	2
Other traditional (2)	50	25	25	4

(1) Name not known.

(2) Includes plant material (neem, karité, tree bark) or ash.

3.8.6 Storage Structures

The same four types of storage structures are used for storing *cossettes* as are used for maize (see Section 3.5.3).

The most common storage structure used overall for *cossettes* was the *kpeou* (34%) followed by the *katchalla* and storage in sacks (see Table 3.8.6b). Table 2 in Appendix VII shows that the use of some store types are specific to certain ethnic groups, so that the Cotocoli and Tchamba use the *katchalla* while the Kabye, Losso and Lamba mainly use the *kpeou* and the Konkomba use the *Tonneau*. Again, the location of stores varies with store type; the *kpeou* is almost always found in or near the household compound, the *katchalla* can be equally found in the household or field, while the platform and *tonneau* are more often in the household compound but can also be located in the field.

The average length of storage for all *cossette* stores was 7 months; it tends to be longest in the *tonneau* at 10 months and shortest in sacks at 6 months. Greatest quantities were stored in the *katchalla* (16 sacks) and the *tonneau* (10 sacks) stores and least in sacks (6) and other containers such as baskets (3 sacks). An examination of average drying time of *cossettes* by store type shows that the *cossettes* stored in sacks have the shortest number (13 days), for the platform and *katchalla* it is 15 and 17 days respectively, and greatest for the *kpeou* and *tonneau* at 20 and 23 days respectively. The *kpeou* is a semi-sealed structure with little air circulation, therefore a lower humidity of the *cossettes* is necessary at time of storage.

TABLE 3.8.6a: MEAN LENGTH OF STORAGE OF *COSSETTES*

	Plateaux	Centrale	K a r a	Overall
Months	7	6	8	7

TABLE 3.8.6b: STORAGE STRUCTURES USED FOR *COSSETTES* (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Platform+fire	7	2	2	3
Platform-fire	7	3	6	5
Kpeou	14	34	57	34
Katchalla	13	44	2	26
Tonneau	2	3	8	4
Sack	55	9	16	23
Other *	0	5	6	5
M.D.	2	0	0	<1
TOTAL	100	100	100	100

* Includes in a basket, basin, barrel or jar.

3.8.7 Utilisation of Stored *Cossettes*

Cossettes were stored for both consumption and sale, with only 1% of farmers storing solely for sale. However, as with maize the percentage that stored for sale was greater in Plateaux region and decreased northwards, while the percentage storing for consumption increased northwards. As with maize this suggests that *cossettes* are a source of revenue to more farmers in Plateaux and less in Kara, while a more important foodstuff for farmers in Kara compared to those in Plateaux region. This may be because producers in Plateaux region are meeting demand from Northerners who have settled in the south.

Smaller producers stored for consumption only and the larger producers for consumption and sale. Those storing for sale only, stored for the longest mean period of time when prices would be highest. The mean quantity stored was 8 sacks and a mean storage period of 7 months; farmers storing for consumption only stored a mean of 4 sacks but also for an average of 7 months. Those storing for consumption and sale stored the greater mean quantity (11 sacks), while those storing for sale only stored 7 sacks but for the longer period of 9 months.

Of those farmers who stored *cossettes* for both consumption and sale (n=117) over 70% did not separate their stocks for sale and for domestic consumption. Of those who did separate stocks (n=31), only 3% treated the two stocks differently, either by using a chemical on the stock destined for sale or periodically drying the stock for consumption. The pattern of utilisation of stocks is variable and can be weekly or occasionally, according to the households needs.

Cassava *cossettes* are an important ingredient in the staple foodstuff known as a '*pate*', made by mixing ground maize or sorghum with a lesser quantity of cassava flour (approximate proportions 3:1) and formed by adding boiling water. A '*pate*' can also be made entirely of cassava flour, but is less well liked and possibly only eaten out of necessity. Information on preferences for foodstuffs and the importance of maize and cassava as ingredients are given in Section 3.5.4.

TABLE 3.8.7a: REASONS FOR STORING *COSSETTES* (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Consumption	36	41	59	44
Sale	4	1	0	1
Consumption and Sale	61	58	41	55
TOTAL	100	100	100	100

TABLE 3.8.7b: SEPARATION OF COSSETTE STOCKS FOR CONSUMPTION AND SALE (%)

	Plateaux n = 34	Centrale n = 63	K a r a n = 20	Overall n = 117
Yes	23	33	10	26
No	71	67	90	72
M.D.	6	0	0	2
TOTAL	100	100	100	100

TABLE 3.8.7c: TREATMENT OF SEPARATED COSSETTE STOCKS (%)

	Plateaux n = 34	Centrale n = 63	K a r a n = 20	Overall n = 117
Nothing	91	97	100	96
Sale-chemical	0	3	0	2
Consumption-dried	3	0	0	1
M.D.	6	0	0	2
TOTAL	100	100	100	100

TABLE 3.8.7d: PATTERN OF UTILISATION OF STORED *COSSETTES* (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Once only	4	2	2	2
Daily	7	5	16	8
Weekly	32	50	29	41
Monthly	2	17	4	10
Occasionally	55	26	49	39
TOTAL	100	100	100	100

3.8.8 Storage Problems

Insects were the most serious storage problem in *cossettes* for 80% of those farmers who stored; this figure is substantially higher in Plateaux region (96%) and decreased northwards. Other less important storage problems encountered by farmers included rodents, caterpillars or larvae, and mould (Table 3.8.8a).

The same insect samples used for the maize questions were shown and farmers were asked to identify which they thought was the most important insect found infesting their *cossettes*. The results given in Table 3.8.8b show that LGB was identified by 49% of farmers, although its similarity to *Dinoderus spp.* which also commonly infests *cossettes* in Togo means that these results should be interpreted with caution. Six percent of farmers said they had no insects; this figure increased northwards from 3% in Plateaux to 8% in Kara. Latitude reflects changing agro-ecological conditions which appear to influence the insect population and degree of damage.

Sixty-seven percent of farmers thought the level of damage to their *cossettes* the previous season was important; this figure decreased northwards from 73% in Plateaux to 55% in Kara. The percentage of those who said they had no damage also exhibited a similar pattern, increasing northwards from 2% to 6% in Kara.

Cross tabulations were made between perceived damage levels and most important insect recognised against the following range of variables, and tested for significance using a loglinear model for analysing contingency tables:

- each other
- chemical and traditional treatments
- maintenance during storage
- store type
- location of store
- storage length
- quantity stored
- drying time
- where *cossettes* were kept before storage

No significant relationships were found.

For an indication of recent changes in pest status farmers were asked whether the level of damage was the same that year as in previous years, or how it had changed. Table 3.8.8d shows that most farmers (62%) thought the level was no different from previous years, while 27% said it had increased. Most of those who said the level had increased (65% of n=58) gave lack of an effective treatment as the reason, which could be interpreted as an increase in damage because of insects, while only 9% said it was directly due to an increase in insects. Only 6% of all farmers had made any changes to their storage practices, overwhelmingly (92% of n=13) because of insect damage. The most important changes made were either storing in sacks or changing the type of store used, and the majority (69% of n=13) had made these changes in the last 2 years.

Badly damaged *cossettes* are either thrown away or given to animals, although 34% of farmers said they still consumed them, in which case they sieve out the insects first (Table 5 in Appendix VI). However, *cossettes* which have been badly infested with insects, so that they are friable and crumble easily, do not give the '*pate*' the elasticity or texture that good *cossettes* normally do, and can give it an unpalatable bitter taste. It is the elasticity or texture which was the most important criteria given by farmers for preferring the '*pate*' made of maize and *cossettes* over other foodstuffs (see Section 3.5.4). Overall 3% of farmers said they had no badly damaged *cossettes*, and this figure increased northwards from 2% in Plateaux to 6% in Kara regions.

TABLE 3.8.8a: FARMERS OPINION OF THEIR MOST IMPORTANT PROBLEM DURING STORAGE OF *COSSETTES* (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Insects	94	74	78	80
Rodents	0	8	6	6
Caterpillars	2	4	10	5
Mould	2	5	2	3
M.D.*	2	9	4	6
TOTAL	100	100	100	100

* Includes those who said they had no problems.

TABLE 3.8.8b: IDENTIFICATION BY FARMERS OF MOST IMPORTANT INSECT FOUND INFESTING THEIR MAIZE (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
None	3	6	8	6
Sitophilus spp	11	31	19	24
Prostephanus	61	47	40	49
Tribolium spp	23	13	23	18
Other *	2	0	8	2
M.D.	0	1	2	1
TOTAL	100	100	100	100

* Includes caterpillars or none of these insects.

TABLE 3.8.8c: FARMERS' OPINION OF LEVEL OF INSECT DAMAGE IN *COSSETTES* (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Important	73	69	55	67
Medium/average	14	11	24	15
Low	11	17	14	15
None	2	3	6	3
TOTAL	100	100	100	1000

TABLE 3.8.8d: FARMERS OPINION OF CHANGES TO LEVEL OF DAMAGE AND REASONS FOR INCREASES (%)

Level of damage	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Same level	59	70	49	62
More damage	37.5	21	29	27
Less damage	3.5	8	12	8
None	0	1	4	1.5
M.D.	0	0	6	1.5
TOTAL	100	100	100	100

Reasons for Increase	Plateaux n = 23	Centrale n = 21	K a r a n = 14	Total n = 58	Overall n = 214
Do not know	14	30	14	21	6
Increase in insects	0	22	0	9	2
Lack of treatment	86	39	79	65	18
Other reasons *	0	9	7	5	1
TOTAL	100	100	100	100	27

* Includes ineffectiveness of treatment in Kara region, long storage and lack of drying in Centrale region.

TABLE 3.8.8e: CHANGES MADE TO COSSETTE STORAGE PRACTICES (%)

	Plateaux n = 2	Centrale n = 6	K a r a n = 5	Total n = 13	Overall n = 214
Storage in sack	50	33	20	31	2
Changed store type	0	17	40	23	1
Other *	50	33	40	38	2
M.D.	0	17	0	8	<1
TOTAL	100	100	100	100	6

* Includes use of plant material, chemicals, diesel, changing the construction material or location of the store.

3.9 COSSETTE MARKETING PRACTICES

Of all farmers who grew cassava 51% sold some *cossettes*; a mean quantity of 6 sacks were sold. The largest amounts sold were in Centrale region (8 sacks), although the proportion of production sold was highest in Plateaux at 40% and lowest in Kara region (16%). Possible reasons for these differences are proximity to markets and the availability of alternative foodstuffs, particularly in Plateaux region, and the greater importance of *cossettes* as a staple food particularly in relation to the smaller quantities produced in Kara region.

The most important reason for sale is to meet financial needs (81% of responses), although 8% said they did so to avoid damage. The frequency of sale is not normally regular (weekly or monthly) but either only once or twice, probably in larger quantities, or occasionally. As with maize, marketing is traditionally a female occupation, carried out in the majority of cases by the farmer's wife or a female family member (76%) (see Tables 8-10 in Appendix VI).

Most farmers sell their *cossettes* in the local or a nearby market (61%), probably because transport to larger markets poses a problem. This figure is substantially higher in Kara region (89%) and lower in Plateaux region (41%). Thirty-one percent of farmers sold in the sub-regional or regional markets; prices are higher if these are consumer markets, and lower if these are producer markets where sale is more likely to be to wholesalers or retailers. Sale at sub-regional markets was more characteristic of marketing practices in Plateaux region where more farmers sell to retailers (49%), and less so in Kara where sales to consumers are more important (45%). Overall slightly more farmers sold to consumers (35%) although a substantial number sold to retailers and wholesalers (27% and 17% respectively).

The majority of respondents who grew cassava did not buy *cossettes* during the season (89%). Of the 10% who did (n=23) the main reason was for consumption, implying that they had not produced and/or stored enough to meet the households' needs (8%), while only 2% gave insect damage as the reason. It is possible that those who did not buy simply replaced staples requiring *cossettes* as an ingredient with other foodstuffs such as *foufou* from fresh yams or cassava.

TABLE 3.9a: MARKETING OF *COSSETTES*

	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
% Who sold	60	51	37	51
	Plateaux n = 37	Centrale n = 53	K a r a n = 16	Overall n = 106
% Production sold	40	26	16	28
Mean Quantity sold (60 kgs sacks)	5	8	3	6

TABLE 3.9b: MARKET FOR *COSSETTES* (%)

	Plateaux n = 41	Centrale n = 61	K a r a n = 19	Overall n = 121
Local/Nearby	41	65	89	61
Sub-regional	46	13	5	23
Regional	0	15	5	8
Other *	5	5	0	4
M.D.	7	2	0	3
TOTAL	100	100	100	100

* Includes sale from the house or by the roadside.

TABLE 3.9c: DESTINATION OF *COSSETTES* SOLD (%)

	Plateaux n = 41	Centrale n = 61	K a r a n = 19	Overall n = 121
Consumers	15	44	45	35
Retailers	49	15	24	27
Wholesalers	12	24	5	17
Do not know	19	15	26	18
M.D.	5	2	0	3
TOTAL	100	100	100	100

TABLE 3.9d: % OF FARMERS WHO PURCHASED *COSSETTES* AND REASON

	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
None purchased	89	91	87	89
For consumption	9	5	12	8
Due to insect damage	2	2	2	2
M.D.	0	2	0	1
TOTAL	100	100	100	100

3.10 GENDER RELATIONSHIPS

Traditionally, the male head of household is responsible for ensuring the household's food supplies; if a woman is widowed she and her dependants often become the responsibility and part of the household of a close male family member. When a woman produces, stores and sells crops, those crops and the revenue resulting from their sale are hers to dispose of as she wishes. Thirty-four percent of (male) farmers interviewed had wives with their own fields; normally only one wife but some had up to 4. Production from the wives' fields was not taken into account in quantities harvested and stored.

In the survey 98% of respondents were male and only 2% were women (n=6). In 5 out of these 6 cases (1.5% of the survey sample) the women said that they were responsible for making decisions on farming activities, and in only 1 case did the respondent say this was done by her husband. The marital status of respondents was not investigated so it is not possible to say whether these female respondents were widowed or not. However, the mean size of their households was smaller than for the whole sample, comprising 1.5 male adults, 1.3 female adults and 2.8 children making a total of 5.6 (compared with 9.13); only in one female headed household were there no male adults.

Total area cultivated by the female farmers interviewed ranged from 0.5 to 5.25 ha, with a mean of 3.95 ha (compared to the overall survey mean of 4.4 ha).

3.10.1 Maize

Women are involved in all stages of maize production, particularly in the harvest and transportation from field to store, and also to a lesser extent with the storage. Other tasks traditionally done by women include lighting the fire underneath the stores, sorting/grading, shelling, winnowing, and marketing the maize. Female respondents produced maize in 4 out of the 6 cases, and in 3 of these they were also responsible for the marketing; in the one other case this was done by her children.

The management of the household's maize stores is the responsibility of the head of the household, who is usually male. In the 2% of cases where this was a woman 5 out of 6 said they managed the household's stores, and only in one case was the respondent's husband responsible; in one other case the farmer said that he and his wife did so together. During the damage assessment survey, a woman who's husband was working far away from the village and only visited occasionally, was asked to sell a sample of maize badly attacked by LGB, but although willing she would not do so without his permission. This illustrates the rigid control over food stores exercised by the male household head, even when absent, women are only allowed to take from the stores with his permission.

Marketing is traditionally a female occupation; in 68% of cases the wife or female member of the family was responsible for marketing the maize.

3.10.2 Cassava

Women are also involved in all aspects of harvesting and storing cassava, particularly in the transportation from field to store, and the making of *cossettes* (peeling, cutting and drying the tubers). Five out of 6 female respondents produced cassava and stored *cossettes*, but in none of these cases did they sell any.

As with maize stores, the management of the *cossette* stores in the responsibility of the male head of household (96% of cases), particularly so in Plateaux and Kara regions where this figure was 100%. However, in Centrale region 7% of farmers said it was the responsibility of their wife, (4% for the survey area as a whole).

As with maize marketing of *cossettes* is a female occupation; carried out by them in 76% of cases where any *cossettes* were sold.

4. RESULTS AND DISCUSSION

The primary objective of this survey was to examine the impact of LGB on the maize/cassava farming system in terms of cropping, storage and marketing, and identify factors which might influence the insects presence or absence. In addition it has provided useful information on the interactions of these two crops.

4.1 THE IMPACT OF LGB ON THE MAIZE/CASSAVA FARMING SYSTEM

The impact of LGB on the maize/cassava farming and storage system cannot be examined in isolation, but has to be considered together with the impact of other insect pests. It can be illustrated in several ways. Quantitatively this impact can be demonstrated in terms of losses to the stored crops. Qualitatively it can be demonstrated by farmers perceptions of their problems, and also through changing practices resulting from the pest's impact.

4.1.1 Losses

Previous research using standard loss assessment methods suggest weight losses of up to 20% in maize after 6 months, caused by storage pests in Togo, although a figure of 30% has often been quoted (Albert, 1991). No reliable method for assessing losses in *cossettes* had previously been developed, and this is one area currently being investigated as part of the LGB IPMI Project in Togo by Wright.

A rapid method for assessing damage in maize and cossettes was required to complete the findings of the socio-economic survey, by providing an indication of level of damage and insect presence and abundance. The assessments were limited to farmers with representative storage practices, identified from the initial survey, so that a more rigourous analysis could be carried out to examine whether any of these characteristics influence the presence of LGB. These were farmers using the most common traditional storage structures, storing maize on the cob (both with and without husk), and not using storage chemicals on maize or *cossettes*.

The development of the rapid damage assessment method used is described in detail in Compton (1991). Twenty cobs or cossettes were selected at random and classified using damage scales, then destructively examined for insect presence and numbers. In Compton et al. (1991) it has been demonstrated how the results obtained can be transformed to produce % Weight Losses for both maize and cossettes, and statistical analysis can be carried out to relate damage levels to the numbers of the most important pest species found. The results from the two damage assessment surveys were transformed using this methodology, to produce Percentage Weight Loss for maize after approximately six and eight months storage, and for cossettes after approximately one and three months storage. Losses by village are illustrated in Figures 4.1.1a for maize and 4.1.1b for *cossettes*.

FIG 4.1.1a: MEAN % WEIGHT LOSS IN MAIZE

BY VILLAGE (* INDICATES VILLAGES WHERE LGB WAS FOUND)

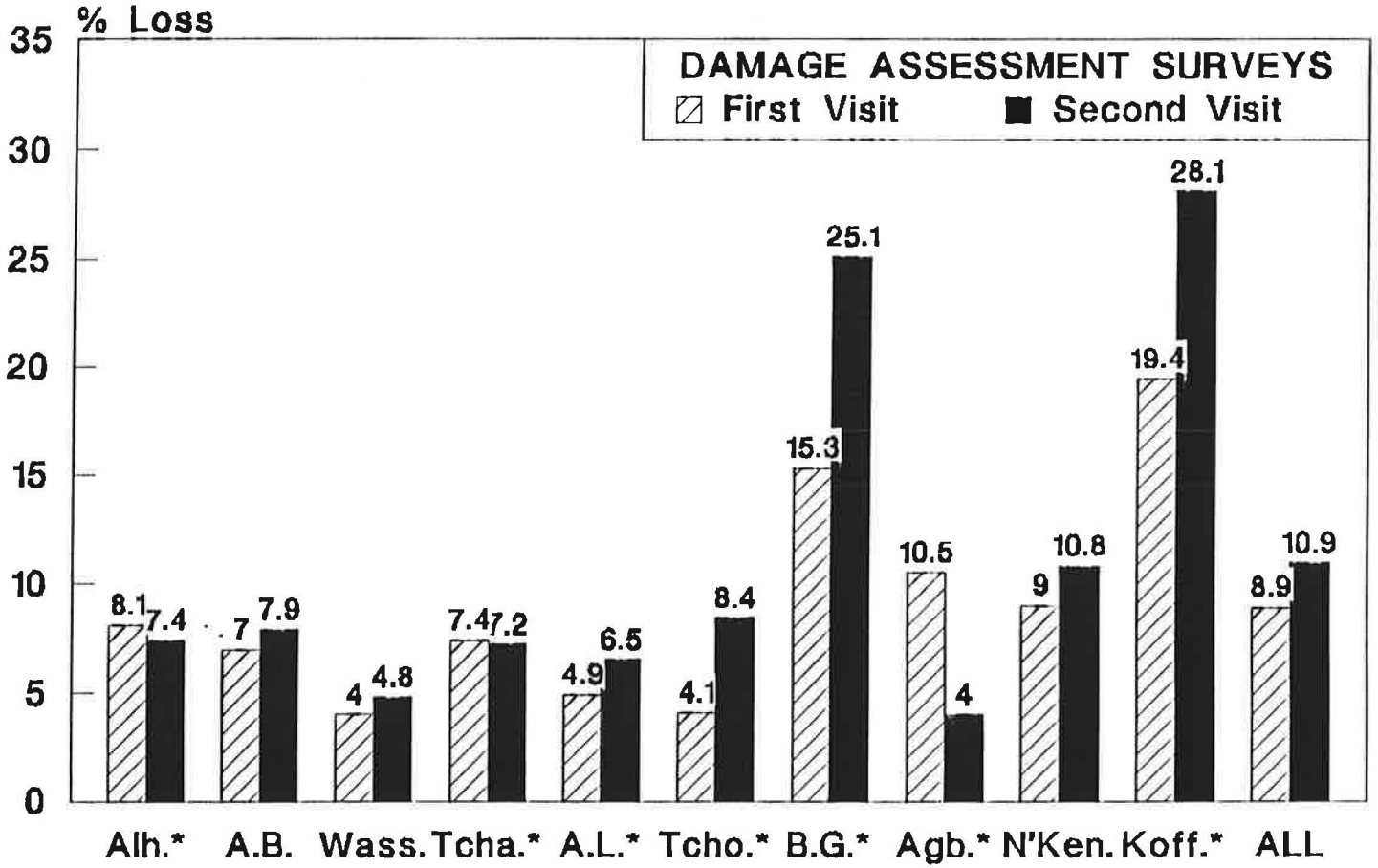
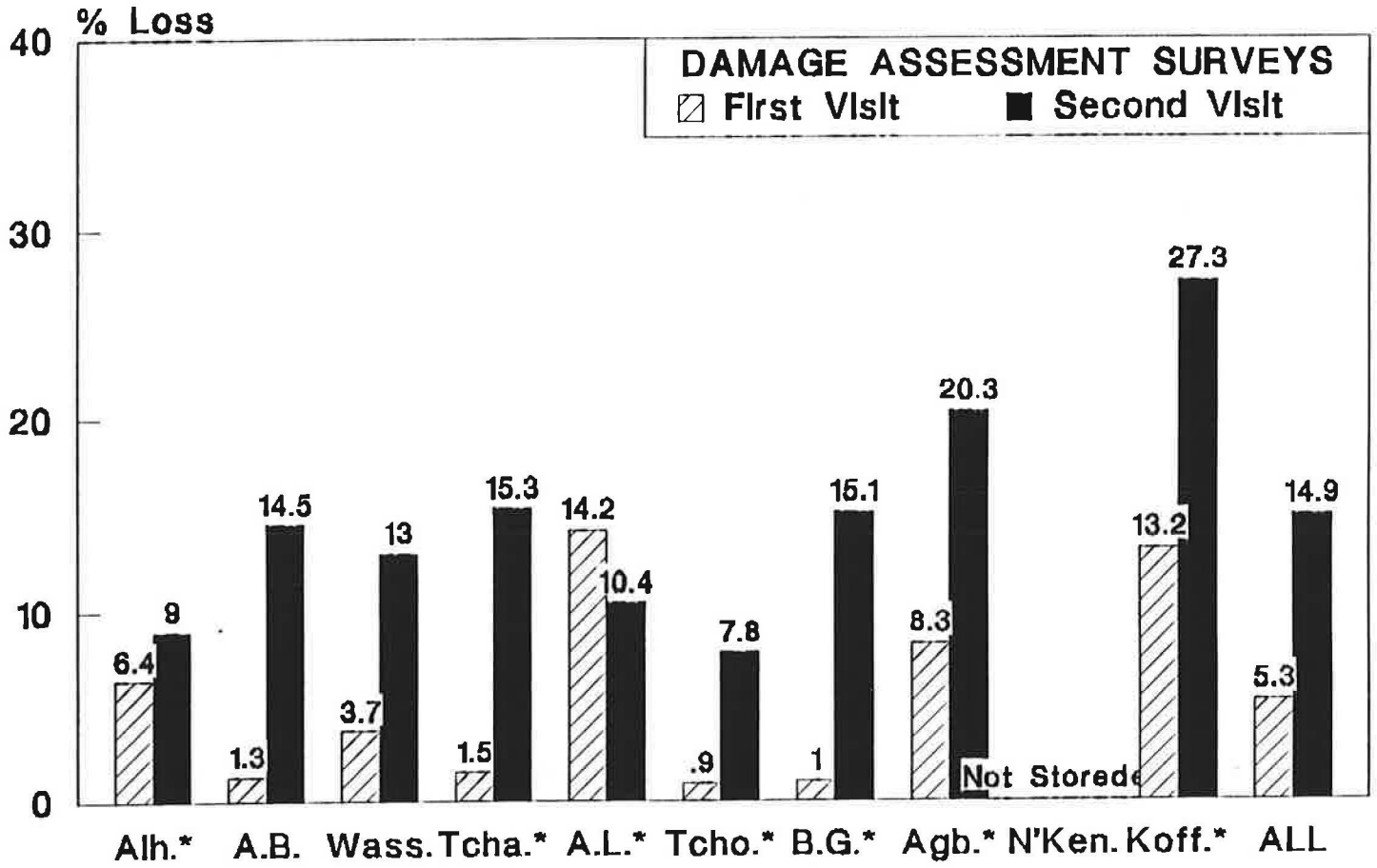


FIG 4.1.1b: MEAN % WEIGHT LOSS IN COSSETTES

BY VILLAGE (* INDICATES VILLAGES WHERE LGB WAS FOUND)



In maize the percentage weight loss had increased from 9% after six months storage to 11% after approximately eight months of storage. It should be noted however that many of the badly infested stores examined in the first assessment no longer existed by the time of the second, they had been emptied of maize which had been either sold off and/or consumed, otherwise losses would probably have been higher. For cossettes percentage weight loss increased substantially from 5% after approximately one month of storage to 15% after approximately three months of storage.

This rapid method can only be said to give an indication of losses for that portion of the store surveyed at a particular time. Statistical analysis does however suggest that the method is relatively accurate, with a low Standard Error (Compton et al, 1991). When compared to a more detailed method being used by Wright, the results obtained for *cossettes* appear to be very similar after the same length of storage (Wright, pers. comm.).

4.1.2 Factors Influencing Presence of LGB

The two damage assessment surveys found LGB present in the same 7 villages (out of 10) on both visits (see Table 4.1.2); the 3 villages in which LGB was not found were all far from the main north-south highway. In maize a similar level of infestation was found on both visits after approximately 6 and 8 months of storage; LGB was found in 31-32% of stores, with 19% of stores having high levels of damage (defined as the majority of cobs classified on damage scale 3-4). In *cossettes* a marked increase in damage levels was found over the two visits, when the *cossettes* had been in store for approximately 1 and 3 months. The percentage of stores with LGB increased from 23% to 64%, and the number with high levels of damage (defined as the majority of cossettes classified as levels 3-5 of the damage scale), increased from 10% to 48% after only 3 months of storage. These results are given in Table 4.1.2.

On the second visit sorghum stores were also examined in cases where LGB was present and sorghum was stored by the farmer in close proximity. No attempt was made to assess levels of damage, only insect presence and numbers were noted. LGB was found in 3 out of 13 stores examined (in 5 villages), and in all cases small numbers of the insect were found (only 1 or 2 LGB per sorghum head) in 1 or 2 heads out of the 20 examined. The most important primary insect pests in terms of numbers were *Sitophilus spp* and *Rhizoperta dominica*.

TABLE 4.1.2: RESULTS OF DAMAGE ASSESSMENT SURVEYS

	1st visit Feb./Mar.	2nd visit Apr./May
Nos of villages surveyed	10	10
Nos villages with LGB	7	7
MAIZE		
Nos maize stores examined	54	37
Overall % weight loss	9	11
Approximate length of storage (months)	6	8
Nos maize stores with LGB	17	12
% maize stores with LGB	31	32
% stores with low damage (scale 1-2)	81	81
% stores with high damage (scale 3-4)	19	19
COSSETTES		
Nos *cossette* stores examined	40	42
Overall % weight loss	5	15
Approximate length of storage (months)	1	3
Nos *cossette* stores with LGB	9	27
% *cossette* stores with LGB	23	64
% stores with low damage (scale 1-2)	90	52
% stores with high damage (scale 3-5)	10	48
SORGHUM		
Nos sorghum stores examined	0	13
Nos sorghum stores with LGB	-	3
% stores with LGB	-	23

Data from the two damage assessment surveys was analysed by means of ordinal logistic regression using the statistical analysis package GENSTAT. The dependant response variable (damage level) was related to the following explanatory variables:

- insect numbers
- month of beginning storage
- variety of maize or cassava
- whether maize was stored with or without husk cover
- store type
- location of store (field or village)

This analysis provided a study of the degree and direction of association between damage level and the possible explanatory variables. The results must be interpreted with caution as they only reflect adult insect numbers at the particular moment of the survey, but they suggest the following:

1. Damage levels in both maize and cassava seemed to be associated with the levels of both primary insect species considered: LGB and *Sitophilus spp.* in maize and LGB and *Dinoderus spp.* in *cossettes.*

2. LGB clearly seemed to be the more destructive pest, on the basis that LGB numbers explained a much greater percentage of between-store variation in damage levels, and also by the fact that the coefficients in the models fitted were greater for LGB, indicating a higher level of destruction per insect specimen counted. Regression analysis, carried out using the transformed survey data for maize (Compton et al., 1991), suggested that each adult LGB was associated with between two and three times as much damage as each adult *Sitophilus spp.*

3. For maize the following relationships were suggested:

a) The month of beginning of storage might be related to damage, with greater damage the earlier storage began. However because of the correlation between this and levels of LGB infestation it is difficult to isolate the two effects.

b) Maize stored with husk cover might be more attacked than maize stored without. General observation supported this, maize stored in the most common traditional manner, with husk cover above a kitchen fire appeared to be most seriously damaged.

c) Levels of damage might be lower for maize stores located in the fields.

4. There were no statistically significant differences in damage levels that could be attributed to any of the other factors considered such as type of store, varieties of maize or cassava, except the suggestion that sweet varieties of cassava might be more prone to damage than other varieties. This has since been confirmed by research into susceptibility of cassava varieties to LGB attack, carried out by Wright in Togo (pers. comm.).

These results suggest that although farming and storage practices can positively influence the presence of LGB, there are probably other more important factors which have not been examined. The apparent north-south increase in importance of insect damage and losses indicated by farmers perceptions, and to some extent from the damage assessment surveys, suggests it may be due to different agro-ecological conditions, although it could equally be due to the longer presence of LGB in the south. Wright has found a similar trend in LGB population and damage caused to cossettes in the three regions surveyed (pers comm.). Ecological work being carried out in Mexico, Togo and Kenya should help clarify this important point.

4.1.3 Farmers' Perceptions and Changing Practices

The survey has shown that in the farmer's opinion insect pests are their most serious storage problem in both maize and *cossettes*. More than half the farmers considered that damage caused by insect pests during the previous storage season was important; this figure was slightly greater for *cossettes* than for maize (67% compared with 57%), and decreased from Plateaux region northwards for both crops.

There appears to be little awareness amongst farmers of any change in the status of insects infesting their maize. Most farmers thought levels of damaged had not changed in recent years, and of those who thought it had increased (24% for maize and 27% for *cossettes*) only 2% said this was directly due to an increase in insects. The majority gave lack of effective treatment as the reason for increased damage, suggesting that in the case of maize the recommendations for improved storage are either not reaching farmers or they are constrained in adopting them.

Recent changes in practices due to insect pests are an indication of their impact and that of LGB in particular. Pest problems either during cultivation or storage do not appear to be influencing the area of maize or cassava cultivated; the majority of farmers had not reduced the area of maize (75%) or cassava (84%). The minority that had, did so for a variety of reasons such as old age or illness, lack of time, or problems with wild animals, but none gave insect infestation as a reason.

Although only a small percentage of farmers had made changes to storage practices for these two crops within the last 5 years (13% for maize and 6% for *cossettes*), the overwhelming reason given was because of damage by insects (83% for maize and 92% for *cossettes*). For maize, changes in storage practices included the use of chemicals (43% of n=40), of whom 18% had adopted the recommendations to store shelled maize in sacks with chemicals, or a change of the type of store used (30%). For *cossettes* changing practices included storing *cossettes* in sacks (31% of n=13) and changing the type of store used (23%); use of chemicals on *cossettes* was only mentioned by one farmer.

Two aspects of the impact of insects pests on marketing practices were examined by the survey, the sale of maize and cassava either to avoid or because of damage, and the purchase of either crop because of losses in store. In over 80% of cases the main motivation given for selling either crop was financial need, however for both crops the next most important motivating factor was to avoid or because of insect damage in store, given by 7% of farmers for maize and 8% for cassava; insect damage was a more important factor than price or crop surplus. Unless losses reach a much higher level, financial need is likely to continue to be the main motivating factor, but insect damage has made an important contribution. It is making farmers sell earlier than they would otherwise have done, and therefore for a lower price for this reason, and because of poorer crop quality. These findings are summarised in Table 4.1.3 below.

TABLE 4.1.3: THE IMPACT OF INSECTS ON THE MAIZE/CASSAVA FARMING, STORAGE AND MARKETING SYSTEM

	Plateaux	Centrale	Kara	Overall
CULTIVATION				
% who had reduced the cultivated area of:				
- maize	0	0	0	0
- cassava	0	0	0	0
STORAGE				
% for whom insects were the most important storage problem:				
- in maize	93	63	70	73
- in *cossettes*	94	74	78	80
% of farmers with important levels of damage in stored maize (1)	72	57	43	57
% of farmers with no damage in stored maize (1)	0	2	14	5
% of farmers with important levels of damage in stored *cossettes* (1)	73	69	55	67
% of farmers with no damage in stored *cossettes* (1)	2	3	6	3
% of farmers who had made changes to methods of storing				
- maize (n=304)	11	11	18	13
- *cossettes* (n=214)	4	5	10	6
% of farmers who had made changes to storage practices because of insects in:				
- maize (n=41)	87.5	87.5	76	83
- *cossettes* (n=13)	100	100	80	92
MARKETING				
% who sold to avoid or because of damage				
- in maize	17	1	8	7
- in *cossettes*	17	3	10.5	8
% who bought because of damage in				
- maize	9	4	5	5
- *cossettes*	2	2	2	2

(1) Farmers' opinion

Most farmers who grew the crop did not purchase maize (79%) or cassava (89%); consumption was the main reason for purchase, but a small number did so because of losses due to insect damage in store, (5% for maize and 2% for cassava). This suggests that farmers have alternative food crops to bridge the gap between the end of storage and the next harvest, most probably fresh (sweet) cassava and yams amongst others.

4.2 THE INTERACTION OF THE MAIZE/CASSAVA SYSTEMS

The Farming Calendar (Fig. 4.2) gives an indication of how the maize/cassava farming system interrelates, this has been produced using information from both the main survey and follow up damage assessment survey in Centrale region. It shows that periods of sowing and planting of maize and cassava overlap, while the most important months of harvest follow each other, so do not appear to have competing labour requirements. However, since the entire farming system was not studied it is not possible to say anything conclusive about labour requirements because those for other crops such as cotton may compete.

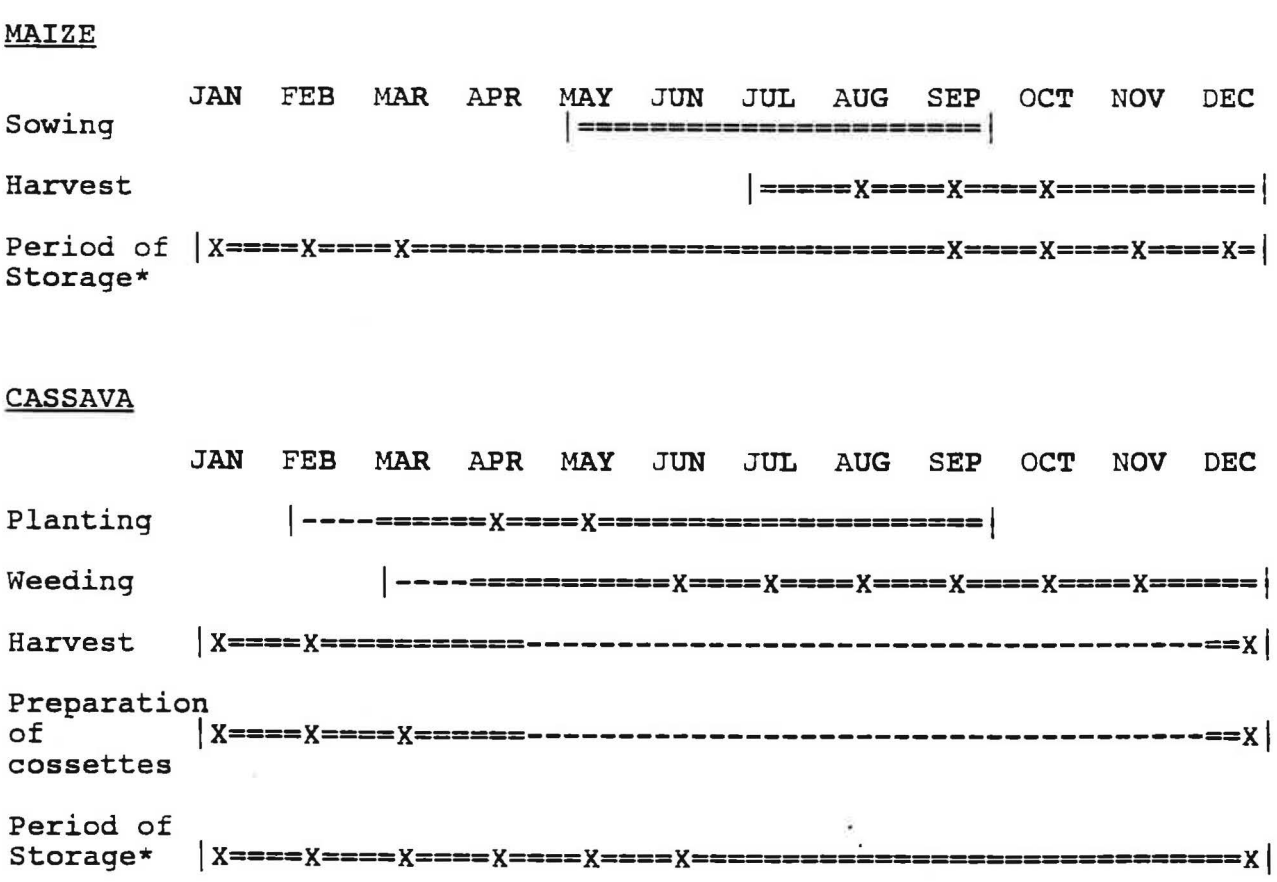
As has already been shown, although cassava is a flexible crop within the farming system, the harvest and production of *cossettes* is constrained by the dry season and presence of sunshine and drying winds for their production. This period (December to March) also coincides with what is generally referred to as the 'dead' time before the start of the next rainy season, when there is least agricultural activity and most free time for other activities such as hunting and traditional celebrations.

The survey has shown that both maize and cossettes are important food crops in the survey area. They are combined to make a *pate*, the preferred staple foodstuff in Centrale region, the most important region for cossette production and storage; a *pate* from sorghum and *cossettes* is the preferred alternative when maize is not available. Although not considered to be their most important sources of income, maize and *cossettes* contribute to the incomes of the majority of farmers.

There are several aspects of the farming and storage practices in the survey area that are likely to lead to cross infestation by LGB from on crop to the other, and act as a reservoir for the carry over of LGB from one season to the next. The storage periods for maize and *cossettes* overlap from at least December to March (see Figure 4.2) and probably longer. Work carried out by Wright (pers. comm.) in the survey area suggests that LGB is a late season pest, not commonly found in *cossettes* before March, although it has a strong preference for *cossettes* over maize. Albert (1991) found LGB only evident in maize after 3 months of storage in southern Togo.

The low use of storage chemicals in maize, combined with apparent lack of inspection for infestation both at the time of storage, and during storage of both crops, by the majority of farmers increases the likelihood of infestation spreading. Research from the LGB Project in Mexico has shown that maize crop residues, which in Togo are normally left to rot in the fields, can assist the carry over of LGB from one season to the next. LGB has also been shown to survive on cassava stems, which are generally kept from one season to the next for new planting, (unpublished PhD research funded by GTZ at SPV, Togo).

FIG. 4.2: FARMING CALENDAR FOR THE MAIZE/CASSAVA FARMING SYSTEM IN THE SURVEY AREA



5. CONCLUSIONS

The survey of the maize/cassava system has shown:

1. This is a small-holder subsistence farming system, with farmers primarily growing and storing for consumption by the farming household, with little use of purchased inputs in cultivation and storage, and regional differences in cultivation, storage and marketing practices.

2. There appears to be a progression northwards of decreasing importance of maize and cassava, increasing use of inputs and improved cropping and storage practices, and an apparently decreasing impact of insect pests. These may be related to a number of factors, including changing agro-ecological conditions such as decreasing rainfall and humidity, and/or possibly the longer presence of LGB in the south of the country. A correlation between agro-ecological factors and LGB population dynamics has not yet been proved, but ecoloical work in Togo, Kenya and Mexico might do so.

3. *Cossettes*, are an important stored crop, although with the current analysis it has not been possible to quantify this, and needs to be investigated in future work.

4. Centrale region is the most important region for the production and storage of cassava as *cossettes*, both in terms of percentage of cassava harvest made into *cossettes* and mean quantities produced and stored. National production statistics show that it has the highest yields of the three regions (t/ha) and contributed 20% of production in 1990.

5. Using a rapid damage assessment method, weight losses of 9% were found in maize cobs after approximately 6 months storage, and 15% in *cossettes* after approximately 3 months storage.

6. The damage assessment surveys carried out in 10 villages in Centrale region showed LGB to be the most damaging primary insect pest found in stored maize and *cossettes*, associated with between 2-3 times more damage per adult than *Sitophilus spp.* in maize.

7. Although farming and storage practices such as variety of cassava, and storing maize with husk might result in greater damage caused by LGB, there appear to be other more important factors that influence its impact, and these are likely to be agro-ecological.

8. Insect pests are having an impact on storage, and marketing practices in the study area, particularly in maize. This was supported by anecdotal evidence that some farmers were selling maize early because of infestation, when prices would be lower, although this was less true for cossettes.

9. It is probable that farmers have always suffered an important level of damage in stored cassava due to *Dinoderus spp.*, which can also cause substantial damage, even before the introduction of LGB. Its close resemblance to LGB would help to explain farmers apparent lack of awareness of any change in insect pest status.

10. Some aspects of the interaction of the maize/cassava system have been illustrated that might assist cross infestation, particularly the overlapping storage periods for these crops, which may act as a reservoir for the carry over of LGB from one season to the next.

11. The effect of LGB and other insect pests on *cossettes* not only causes physical losses but also affects the nature of its contribution to the staple foodstuff known as a *pate*, made with cassava flour and either maize or sorghum, giving the *pate* a bitter, unpalatable taste. Because of this, in many cases badly damaged *cossettes* and the flour resulting from insect infestation are thrown away, and therefore would be considered as a total loss. However, a substantial minority of respondents said they would still consume badly damaged *cossettes*, and this practice would be influenced by a number of factors, particularly size of harvest, and available alternative foodstuffs.

6. RECOMMENDATIONS

From the current survey no strong relationships were identified in the traditional maize/cassava system that appear to offer potential solutions in terms of limiting the impact of LGB on the maize/cassava storage system. There are however several aspects of the system which should be further investigated, these are:

1. Constraints to changing the practice of long term storage of *cossettes*. The production of smaller amounts of *cossettes* throughout the year, thereby reducing the period of storage and damage levels, is already carried out by a minority of farmers. In the absence of chemical and other control methods this offers some potential to reduce losses caused by LGB and other insect pests.

2. Why farmers are not adopting recommendations for improved storage of maize using chemicals. This has important implications both for maize and *cossettes* if a chemical control is identified, and should be examined country wide, not only in the survey area.

3. Quantify the percentage of total cassava production which is stored as *cossettes* in order to establish the importance of stored cassava, and evaluate the threat posed by LGB on a regional basis. This should be examined in the context of cassava transformed into all other forms e.g. gari and *cossettes*, and linked to the COSCA study on cassava being conducted in a number of other African countries.

4. Research on the following aspects of the traditional maize/cassava storage system would allow better recommendations for improved storage to be formulated:

a) An investigation of the *kpeou* type store to see if it offers better protection than the other more open traditional types of stores, and how its characteristics could be utilised. Possible constraints to its adoption, such as construction costs, availability of building materials, storage capacity and farmers perceptions should also be investigated.

b) Differences in damage by LGB and other pests to different maize and cassava varieties, particularly sweet and bitter cassava, as well as local and improved varieties.

c) Whether maize stored with husk cover is more susceptible to LGB damage than maize without husk. Unpublished research by the GTZ project shows that husked maize always shows markedly lower damage levels than dehusked maize.

5. A more detailed examination of agro-ecological conditions, is needed to identify factors which are influencing LGB. This, related to the work on insect ecology currently being undertaken, in Togo, Mexico and Kenya should help to clarify whether storage factors or simply the length of time that the insect has been present explains the north-south difference in storage problems.

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APPENDIX I

TERMS OF REFERENCE

The terms of reference for the socio-economic component of the LGB project in Togo are as follows:

(i) To work with the entomologist as a member of a multi-disciplinary team in identifying and conducting work programmes. This would include assisting in the identification and testing of technology appropriate at the farm level.

(ii) To study the impact of the Larger Grain Borer and other pests on farmers producing maize and cassava. To assess the cost of storage losses in these crops in relation to the costs of control measures proposed, and to examine the strategies adopted as a result of the spread of LGB.

(iii) To carry out surveys of cropping, storage and marketing practices of small scale farmers. Emphasis should be placed on the methods and management (including gender roles) of maize and cassava storage, and examining constraints to improved crop protection.

(iv) To establish an effective means of disseminating research results and to identify constraints to delivery of extension messages to farmers within the existing extension system.

(v) To consider the potential for replication of the farm level recommendations in other countries of the region.

APPENDIX II

WORK PROGRAMME IN TOGO

July 1990	Familiarisation and field visits
August 1990	Questionnaire formulation
September 1990	Questionnaire testing; selection of Survey Area and sample frame
October to December 1990	Execution of Questionnaire Survey in Centrale, Plateaux and Kara regions
January 1991	Data entry
February 1991	Data analysis; preparation for first Damage Assessment Survey
Feb/March 1991	Execution of first Damage Assessment Survey; Data analysis
April/May 1991	Execution of second Damage Assessment Survey; Data analysis
June 1991	Data analysis and report writing; presentation of preliminary results to SPV
July 1991	Finalisation of Preliminary Draft Report at NRI

APPENDIX III

LIST OF VILLAGES SURVEYED BY REGION

PLATEAUX REGION

Prefecture Ogou

Afolée
Akaba
Alfa Kopé
Dote Kopé
Illougba
Konigbo
Kpatala
Kpèhoun
Ogou Kinko
Ofé Awo
Tchékita
Télékopé

Prefecture Wawa

Djakpodji
Dzon Adapé
Yalla

CENTRALE REGION

Prefecture Tchamba

Afem-Boussou
Hezoudé

Pefecture Sotouboua

Yeloum-Lekehim
Agbeninou
Fodjayé
Koffiti
Matekpo
Tchinié
Lalamila
Yeloum-Banya
Pakouté
N'Kingbé
Yegué
Lama-Wéré
Tassi
N'Konta
Tchoidé
Blitta-Gare
Boalé
Aou-Mono
Kelebo

Prefecture Tchaoudjo

Wassarabo
Assamilade/Douboreda
Aou-Losso
Tchalo
Teloudé
Aleheridé
Asanadé
Tchanalidé
Tchavadé

KARA REGION

Prefecture Bassar

Sante-Haut
Koulamon
Bele Mele
Kalanga
Toni
Kadjol
Natchiboré
Sansabé
Natchitikpi

Prefecture Kozah

Liou
Kpezindè
Houloung
Pya Tchamadé
Tchare-Nyandé
Atchangbadé

Prefecture Doufelgoue

Agbassa
Koukou
Boga Waré

Prefecture Assoli

Bouladé

Prefecture Binah

Pessaré

APPENDIX IV

TABLES OF GENERAL HOUSEHOLD CHARACTERISTICS

TABLE 1: SURVEY POPULATION STRUCTURE (%)

Age Group	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
25 or less	23	16	12	16
26-35	35	30	43	35
36-45	21	20	22	21
46-55	11	15	11	13
Over 55	11	18	12	15
TOTAL	100	100	100	100

TABLE 2: ETHNIC COMPOSITION OF SURVEY SAMPLE (%)

Ethnic Group	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Kabyè	19	33	51	36
Cotocoli	1	26	1	12
Ana/Ifé	41	0	0	9
Losso	5	13	5	8
Konkomba	0	0	19	6
Akébou	20	0	0	5
Bassar	0	1	12	5
Lamba	3	6	5	5
Others	10	20	5	13
M.D.*	1	0	2	1
TOTAL	100	100	100	100

* M.D. = Missing Data

TABLE 3: HOUSEHOLD SIZE AND COMPOSITION

Mean Size	Plateaux n = 75	Centrale n = 148	K a r a n = 108	Overall n = 331
Male	1.72	2.16	1.41	1.82
Female	1.78	2.06	1.85	1.93
Children	4.28	5.97	5.34	5.38
TOTAL	7.78	10.19	8.60	9.13
Active male	1.82	2.25	2.33	2.18
Active female	1.81	2.06	2.03	1.99
TOTAL	3.63	4.31	4.36	4.17

APPENDIX V
Page 1

TABLES FROM ANALYSIS - MAIZE SYSTEM CHARACTERISTICS

TABLE 1: NAMES GIVEN TO LOCAL VARIETIES OF MAIZE GROWN

Local Name	Ethnic Group	% Growing (n = 186)			
		Plat.	Centr.	Kara	Overall
Do not know	All	70	68	88	74
Agbando/Agbado	Cotocoli, Kabyè, Tchamba	0	4	0	2
Agoé/Agové	Losso, Lamba	0	4	0	2
Bankam/Bouquam	Cotocoli, Kabyé, Peul	0	3	5	3
Kpalma/Kpaloma	Losso, Lama Dessi	7	1	0	3
Kpèlèkètè/ Kèrèkètè	Cotocoli Kabyé	0	3	0	2
Tchimila/ Titimila	Losso, Lamba	0	3	0	2
Outougbé/ Koutouké	Akébou	7	0	0	2
Atakpamé	Kabyé, Akébou	4	0	2	2

TABLE 2: WHERE MAIZE KEPT BETWEEN HARVEST AND STORAGE (%)

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
Stored immediately	75	37	41	47
Left in house	11	14	39	21
Left in field	12	32	7	20
Left in barn/store	2	4	7	4
Did not store	0	4	2	2
M.D.*	0	10	3	5
TOTAL	100	100	100	100

* M.D. = Missing Data due to incorrect or inconsistent responses

TABLE 3: TIME BETWEEN HARVEST AND STORAGE OF MAIZE (%)

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
0 days	75	36	40	47
1-7 days	19	40	33	32
8-14 days	3	10	10	8
> 14 days	0	6	14	7
Did not store	0	3	2	2
M.D.	4	5	2	4
TOTAL	100	100	100	100

TABLE 4: LENGTH OF DRYING OF MAIZE AFTER HARVEST

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
0 days	100	50	46	61
1-7 days	0	26	29	21
> 7 days	0	12	18	11
Do not know	0	8	4	5
Did not store	0	3	2	2
TOTAL	100	100	100	100

TABLE 5: USE OF MAIZE CROP RESIDUES (%)

	Plateaux n = 75	Centrale n = 141	K a r a n = 95	Overall n = 311
Left in field	49	84	69	64
Burnt	47	16	27	33
Fodder	1	0	3	1
Local soap	3	0	0	2
TOTAL	100	100	100	100

TABLE 6: METHOD OF STORAGE RELATED TO ETHNIC GROUP (%)

Group	Platform n = 192	Kpeou n = 34	Katchalla n = 8	Tonneau n = 18	Sacks n =	n =
Kabyè	58	21	1	0	21	111
Cotocoli	51	3	14	0	23	35
Tchamba	40	0	40	0	20	5
Ewé	44	22	0	0	33	9
Losso	84	8	4	0	4	25
Lamba	56	25	0	6	13	16
Ana/Ifé	94	0	0	0	0	31
Bassar	21	0	0	28	50	14
Akébou	87	0	0	0	0	15
Konkomba	30	0	0	60	10	20
Others	61	6	0	3	13	31
M.D.						

TABLE 7: FARMER'S OPINION OF REASONS FOR INCREASED LEVEL OF DAMAGE (%)

Reasons for Increase	Plateaux n = 29	Centrale n = 23	K a r a n = 20	Total n = 72	Overall n = 304
Increase in insects	0	17	0	7	2
Lack of effective treatment	70	34	85	60	14
Ineffectiveness of treatment	26	7	15	15	4
Do not know	4	31	0	14	3
Other reasons*	0	10	0	4	1
TOTAL	100	100	100	100	24

* Includes longer storage, rodents and lack of drying.

TABLE 8: TIME OF CHANGED MAIZE STORAGE PRACTICES (%)

	Plateaux n = 8	Centrale n = 16	K a r a n = 17	Total n = 41	Overall n = 304
Last year	75	69	17	49	6
Last 2 years	25	19	12	17	2
<2 years	0	6	59	27	4
M.D.	0	6	12	7	1
TOTAL	100	100	100	100	13

TABLE 9: DESTINATION OF BADLY DAMAGED MAIZE (%)

	Plateaux n = 75	Centrale n = 136	K a r a n = 93	Overall n = 304
Animals	41	44	53	46
Consumed	36	30	23	29
Rejected	23	23	12	20
None damaged	0	1	13	5
M.D.	0	1	0	>1
TOTAL	100	100	100	100

TABLE 10: FREQUENCY OF SALE OF MAIZE (%)

	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
Occassionally	38	43	54	45
Once/twice	59	41	31	43
Weekly	3	10	15	9
Monthly	0	6	0	3
TOTAL	100	100	100	100

TABLE 11: REASONS FOR SALE OF MAIZE (%)

	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
Financial need	81	85	82	83
Avoid damage	17	1	8	7
Price	2	7	5	5
Surplus	0	7	5	5
TOTAL	100	100	100	100

TABLE 12: RESPONSIBILITY FOR SALE OF MAIZE (%)

	Plateaux n = 58	Centrale n = 101	K a r a n = 61	Overall n = 220
Farmer	41	16	30	27
Wife/female relative	55	82	57	68
Other *	4	2	13	5
TOTAL	100	100	100	100

* Includes children, and the Farmers Groups or 'Groupement' particularly in Kara region.

APPENDIX VI
Page 1

TABLES FROM ANALYSIS - CASSAVA SYSTEM CHARACTERISTICS

TABLE 1: % OF FARMERS GROWING DIFFERENT VARIETIES OF CASSAVA

% Growing	Plateaux n = 65	Centrale n = 118	K a r a n = 52	Overall n = 235
SORAD	8	32	10	20
DRDR	11	18	2	12
Improved Don't know	3	19	8	12
Ankra	11	2	0	4
Bassila	0	6	0	3
Egnowouté	8	3	0	4
Kalaba	3	8	2	5
Kwamino	0	3	0	2
Sabé/Savé	5	2	0	2
Odogbo/Odongbo	8	0	0	2
M'bom	0	0	8	2
Local Others	9	13	8	11
Local Don't know	48	30	82	46

TABLE 2: METHOD OF STORAGE RELATED TO ETHNIC GROUP

	Platform n = 17	*Kpéou* n = 73	*Katchall* n = 56	*Tonneau* n = 8	Sacks n = 49	n = 214
Kabyé	8	62	8	0	19	63
Cotocoli	3	10	81	3	3	38
Tchamba	0	0	100	0	0	5
Ewé	17	67	0	0	0	6
Lossso	0	53	27	0	13	15
Lamba	0	64	9	9	18	11
Ana/Ifé	11	11	11	4	63	27
Bassar	13	0	25	0	38	8
Akébou	36	0	9	0	45	11
Konkomba	0	0	0	60	40	5
Others	9	30	17	9	17	23
M.D.	0	50	0	0	50	2
Overall	8	34	26	4	23	214

TABLE 3: STORE TYPE USED FOR *COSSETTES* RELATED TO LOCATION (%)

	Plateaux		Centrale		K a r a		Overall	
	H	F	H	F	H	F	H	F*
Platform	50	50	60	40	100	0	65	35
Kpeou	100	0	97	3	100	0	99	1
Katchalla	57	43	47	53	100	0	49	51
Tonneau	0	100	67	33	100	0	75	25

* Household compound or Field.

TABLE 4 : % OF FARMERS WHO HAD CHANGED THEIR COSSETTE STORAGE PRACTICES

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
No	96	94	90	94
Yes	4	5	10	6
M.D.	0	1	0	>1
TOTAL	100	100	100	100

TABLE 5: REASONS FOR CHANGING COSSETTE STORAGE PRACTICES (%)

	Plateaux n = 2	Centrale n = 6	K a r a n = 5	Total n = 13	Overall n = 214
Insect damage	100	100	80	92	6
Extension agent	0	0	0	0	0
Theft	0	0	20	8	>1
TOTAL	100	100	100	100	6

TABLE 6: TIME OF CHANGED COSSETTE STORAGE PRACTICES (%)

	Plateaux n = 2	Centrale n = 6	K a r a n = 5	Total n = 13	Overall n = 214
1 year	50	50	40	46	3
2 years	0	17	40	23	1
>2 years	50	0	20	15	1
M.D.	0	33	0	15	1
TOTAL	100	100	100	100	6

TABLE 7: DESTINATION OF BADLY DAMAGED COSSETTES (%)

	Plateaux n = 56	Centrale n = 109	K a r a n = 49	Overall n = 214
Rejected	53	48	16	42
Consumed	34	34	33	34
Animals	11	15	45	21
None damaged	2	3	6	3
TOTAL	100	100	100	100

TABLE 8: FREQUENCY OF SALE OF COSSETTES (%)

	Plateaux n = 41	Centrale n = 61	K a r a n = 19	Overall n = 121
Once/twice	66	31	32	43
Occassionally	27	51	32	40
Weekly	0	15	32	12
Monthly	2	2	5	2.5
M.D.	5	2	0	2.5
TOTAL	100	100	100	100

TABLE 9: REASONS FOR SALE OF COSSETTES (%)

	Plateaux n = 41	Centrale n = 61	K a r a n = 19	Overall n = 121
Financial need	78	83	79	81
Price	0	2	0	1
Surplus	0	11	0	7
Avoid damage	17	3	10.5	8
M.D.	5	2	10.5	3
TOTAL	100	100	100	100

TABLE 10: RESPONSIBILITY FOR SALE OF COSSETTES (%)

	Plateaux n = 41	Centrale n = 61	K a r a n = 19	Overall n = 121
Farmer	29	14	16	19
Wife/female relative	61	85	84	76
Farmer's children	5	0	0	2
M.D.	5	2	0	3
TOTAL	100	100	100	100

APPENDIX VII

TABLE 1: NATIONAL PRODUCTION OF MAIZE AND CASSAVA IN PLATEAUX, CENTRALE AND KARA REGIONS OF TOGO BY PREFECTURE - 1989/90

REGION	PREFECTURE	MAIZE PROD IN TONS	MAIZE % OF TOTAL	CASSAVA PROD IN TONS	CASSAVA % OF TOTAL
PLATEAUX	Amou	11.134	4	4.583	1
	Haho	50.881	18	15.281	4
	Kloto	12.398	4	24.505	6
	Ogou	40.092	14	10.194	2
	Wawa	16.004	5	23.967	6
	TOTAL	130.509	45.4%	78.530	19%
CENTRALE	Sotouboua	35.645	12.4	38.562	9.5
	Tchamba	2.678	1	9.177	2
	Tchaoudjo	3.206	1	22.370	5.5
	TOTAL	41.528	14.4%	70.109	17%
KARA	Assoli	594	0.2	6.771	1.6
	Bassar	13.477	4.7	1.893	0.4
	Binah	481	0.2	32	>0.01
	Doufelgou	2.768	1	1.215	0.3
	Keran	580	0.2	0	0
	Kozah	1.710	O.6	1.271	0.3
	TOTAL	19.611	6.8%	11.181	2.7%
OTHER REGIONS:					
MARITIME		83.591	29%	248.752	61%
SAVANNES		11.819	4%	0	0%
TOTAL TOGO		287.348	100%	408.572	100%

SOURCE: Production des Principales Cultures Vivrieres. Campagne Agricole 1989 - 1990. DESA.