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Seed management by small-scale farmers in Zambia. A study of cowpea, groundnut and sorghum seed in the southern and western provinces (NRI Bulletin 76)

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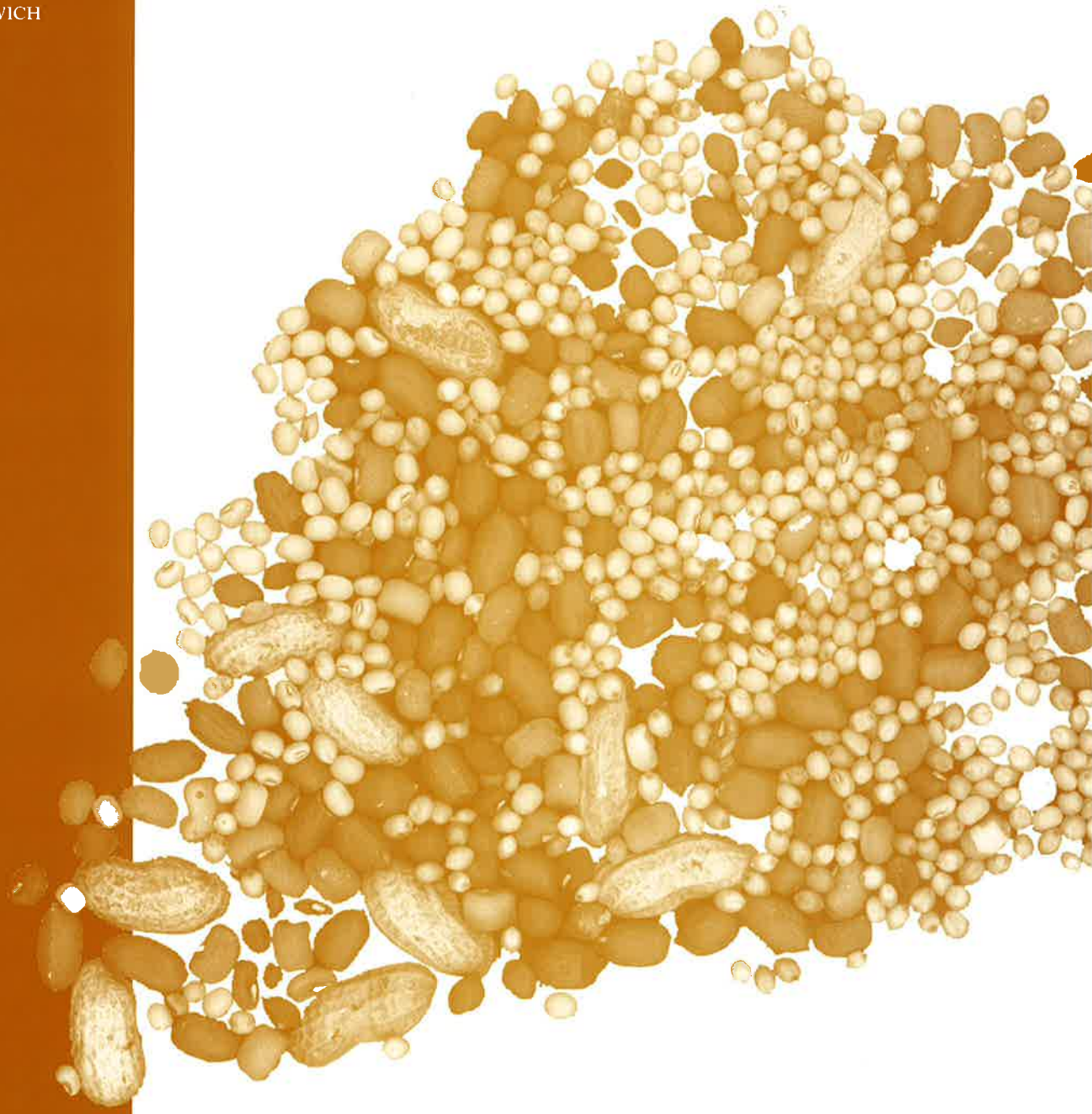
A Study of Cowpea, Groundnut and Sorghum Seed in the Southern and Western Provinces



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Seed management by small-scale farmers in Zambia

A study of cowpea, groundnut and sorghum seed in the Southern and Western Provinces

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Bulletin 76

NATURAL RESOURCES INSTITUTE, UNIVERSITY OF GREENWICH

The Natural Resources Institute (NRI) is a scientific institute within the University of Greenwich, and is an internationally recognized centre of expertise in research and consultancy in the environment and natural resources sector. Its principal aim is to increase the productivity of renewable natural resources in developing countries in a sustainable way by promoting development through science.

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The study is based on comprehensive farmer surveys conducted in two areas of Zambia. It would not have been possible without the active support of Dr Stephen Muliokela, former director of the SCCI. Initial advice from M. Ndiyoi of the Farming Systems Research Team was also valuable, as was participation from Mark Wright of the Natural Resources Institute (NRI).

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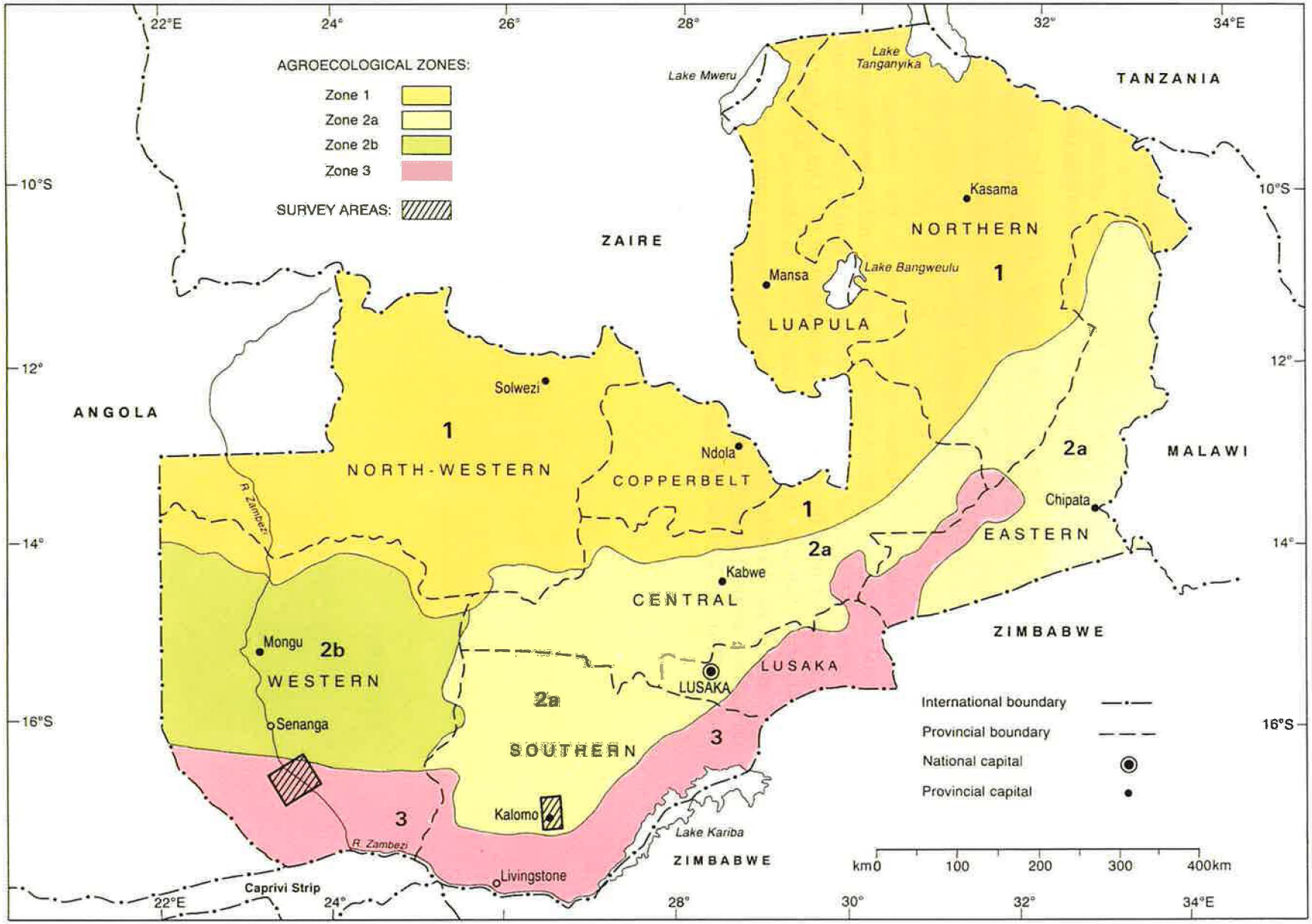

Figure 1 Seed sampling and survey sites in Zambia

Summaries

SUMMARY

Field surveys of on-farm cowpea, groundnut and sorghum management in two regions of Zambia are described. The survey included seed saved on-farm and seed sources off-farm. Samples of seeds were collected just prior to planting and assessed for germination potential. Conclusions are given on the general status and potential for improving seed quality and on farmer seed management.

RESUME

Des enquêtes de terrain portant sur la gestion du niébé, de l'arachide et du sorgho dans deux régions de Zambie sont décrites. Elles incluaient les semences mises de côté dans l'exploitation et les sources de semences extérieures. Des échantillons de semences étaient prélevés juste avant le semis et leur potentiel de germination évalué. Des conclusions sur la situation générale, sur le potentiel qui existe pour améliorer la qualité des semences ainsi que sur la gestion des semences par les cultivateurs sont présentées.

RESUMEN

Se presentan estudios sobre el terreno relativos a la gestión en explotación de fríjoles de ojo negro, cacahuetes y sorgo en dos regiones de Zambia, habiéndose incluido en estos estudios semilla reservada en explotación y semilla procedente de otras fuentes. Se procedió a la recognida de muestras de semilla immediatamente antes de su plantío y se llevó a cabo una evaluación de su potencial de germinación. Se proporcionan conclusiones relativas al estado general y potencial para mejorar la calidad de las semillas y a la gestión de semillas en explotación.

Seed management by small-scale farmers in Zambia

A study of cowpea, groundnut and sorghum seed in the Southern and Western Provinces

INTRODUCTION

This bulletin summarizes the results of farm surveys, carried out in two areas of Zambia, that examined the sources, management and quality of seed used by resource-poor farmers. The surveys form part of a larger project designed to develop appropriate extension advice for strengthening farmers' seed management capacities. The project is particularly relevant given recent evidence of the inadequacy of formal sources of seed supply for many crops in Zambia (Andren *et al.*, 1991) and the emergence of innovative schemes to develop local-level seed supply and distribution, such as the newly initiated Southern Province Household Food Security Project, sponsored by the Government of Zambia and IFAD (FAO Investment Centre, 1994), the Luapula Province Livelihood and Food Security Project sponsored by FINNIDA and the SIDA-funded Seed Multiplication and Distribution project to be targeted in the Northern, Western and North-Western Provinces.

The farm surveys examined seed management for three crops that are particularly important for farmers in the more drought-prone areas of the country: cowpea, groundnut and sorghum. Although maize is the most important food crop in Zambia, it was not a focus for this study because a high proportion of maize seed is provided by the government (through Zamseed) or by commercial companies.

The study complements and builds on research on farmer-saved seed in Ghana, Malawi and Tanzania carried out by NRI (Wright *et al.*, 1995).

Study areas

The surveys were carried out in 1995 in two locations chosen to provide a contrast in agricultural practices and yet be representative of the circumstances of a significant proportion of Zambian farmers. Survey locations were chosen in the Southern Province (where there are more opportunities for commercial agriculture) and the Western Province (where agriculture is more subsistence oriented). Figure 1 shows the location of the two survey areas.

Both survey areas, and indeed much of southern Zambia, had been affected by drought during the previous agricultural season (1994–95). Because the survey sought to examine seed management under typical conditions, specific sites were chosen that had been relatively less affected by the drought. Historical information was also collected as part of the surveys in order to assess any deviations in current seed management from that of the previous two years. Analysis of these data indicates that the seed management practices observed during the survey do not differ significantly from those of the recent past, despite the drier conditions of 1994–95.

The Southern Province is quite varied in terms of agriculture, with some parts of the province able to support productive commercial agriculture and other parts being more drought prone and marginal for agriculture. Kalomo District, where the survey was conducted, is the largest district in the Southern Province with a rainfall of 800–1000 mm/year.

Table 1 summarizes the Kalomo District cropping patterns of the farmers surveyed in 1994. (The questionnaire recorded cropping practices for 1994 and 1995; the patterns are similar, but the 1994 data are provided here because they are considered to be more representative.) Maize is a major crop and is grown for sale and home use. The majority of farmers grow some hybrid maize, seed of which is generally purchased each year at shops or agricultural depots. An even greater proportion of farmers grow open-pollinated maize varieties whose seed can be saved from year to year. Sorghum and pearl millet are less widely grown, but with the experience of recent droughts and the apparent declining economic viability of maize production, a growing number of farmers are understood to be turning to these crops. Cowpea is widely grown and its cultivation is increasing because of the frequency of drought, the increase in maize fertilizer prices and the promotion of the crop by non-government organizations (NGOs). The relative lack of experience in the Kalomo District with sorghum, pearl millet and cowpea, and the precariousness of their seed supply, is reflected in the relatively high proportion of farmers who rely on neighbours for seed. Groundnuts are widely grown, particularly in the north of the Kalomo District, where they are an important cash and subsistence crop for women. Many farmers grow small quantities of bambara nut and about half of the farmers grow sunflower, mostly as a cash crop.

In the Kalomo District, the survey was carried out in two areas. As cowpea and sorghum are not important crops in the higher rainfall (northern) parts of the district, the challenge was to find an area where these crops are important, but one which was not too badly affected by the drought. Kanchele Block was chosen for this purpose. Chilala Block, in the north of Kalomo, was also included in the survey because it is an area where groundnuts are an important crop. In this bulletin the term Kalomo will be used to indicate the Kalomo District.

The Western Province is more isolated and features less commercial agriculture. The Senanga District was selected for the survey, partly because of the presence of Farming Systems Research Team (FSRT) activities in the area (Kalonge and Heemskerk, 1989; Lof and Nchemba, 1994). Population density is very low and households depend on animal husbandry and fishing in addition to agriculture. Annual rainfall is below 800 mm.

Table 2 presents cropping patterns (again from 1994) for sample farmers in the Senanga District. Maize is an important crop, but much less dominant than in parts of Kalomo. Half of the farmers in the sample grow hybrid maize, although a significant proportion of the seed was provided through relief programmes. A larger proportion of Senanga District farmers are growing open-pollinated maize varieties than hybrid types. Both sorghum and pearl millet are important crops in the area, grown by a majority of the farmers. Although more than half of the Senanga District sample farmers plant cowpea and groundnut, these crops are less widely grown than in Kalomo. Relatively few farmers in the sample grow bambara nut and none plant sunflower.

The research sites for the Senanga District survey were Kalongola, Nalwashi, Sibunali, Silowana and Sioma. In this bulletin the term Senanga will be used to indicate the Senanga District.

Survey organization

In Kalomo, the survey enumerators were staff of the district agricultural extension office. Visits by staff of ODI and SCCI were made to a number of blocks in the district in October 1995 to interview farmers and camp officers in order to choose appropriate survey sites. A draft questionnaire was discussed and reviewed, and then two days were devoted to training in the use of the questionnaire in the local language (Tonga). Sampling was a three-stage process. In each block, three camps were purposively chosen, three or four villages in each camp were selected, and then farmers were randomly chosen from village lists that were either already available or were constructed for the purposes of the survey.

The survey was conducted in October and November 1995 by the extension agents. Supervision was provided through periodic visits from SCCI.

In Senanga, the survey enumerators were also agricultural extension staff (camp officers and district officers). Staff members of SCCI and NRI visited the area in October 1995 and worked with the Senanga District Agricultural Officer (DAO) and his staff to implement the survey. The enumerators were based in dispersed camps, but were brought to Senanga for five days of discussions, questionnaire training and evaluation. The questionnaire was administered in the local language (Lozi). The farmer sample was drawn by random selection from the registers of farmers managed by the enumerators. Enumerators were provided with final instructions and sufficient funds and supplies for carrying out the survey before returning to their respective bases. The survey was supervised by the DAO and staff from SCCI and the Food Conservation and Storage Team.

In both Kalomo and Senanga 180 farmers were surveyed; these included 60 farmers for each of the crops in the study (cowpea, groundnut and sorghum). If a farmer grew more than one of these crops, he or she could participate in two surveys. In all cases, some farmers in the original samples were found not to be growing the target crop(s), and hence substitute farmers had to be drawn from a supplementary list.

The questionnaire focused on seed sources, seed management, and farmers' perceptions of seed problems. On completion of the questionnaire, each farmer was asked to provide a small sample of seed; 0.25 kg of sorghum and 0.5 kg of cowpea and groundnut were collected. Although the survey was carried out just before planting time, there were a number of instances where the farmer had not yet acquired seed. In these cases, the enumerator made arrangements to return to the farm at a later date to collect the seed. In Kalomo, the enumerators made a cash payment to the farmers for their seed samples, based on what was judged to be a fair local price. In Senanga, enumerators exchanged an equivalent quantity of seed for the sample.

All seed samples were transferred to the laboratories of SCCI at Mount Makulu Research Station near Lusaka for testing. Germination tests were carried out on all samples.

SORGHUM

Sorghum in the farming systems of the Senanga and Kalomo Districts

Table 3 summarizes sorghum production practices for sample farmers in Senanga and Kalomo. The mean area planted by sorghum farmers in the two localities is similar (slightly under 4 limas or 1 hectare). Most of the sorghum in Kalomo is monocropped, while in Senanga a significant minority of sorghum is intercropped with maize. Very little fertilizer or other purchased inputs are used on sorghum.

Local sorghum varieties are late maturing, while the modern varieties Kuyuma and Sima, that were released around 1989, mature earlier. Sorghum is usually planted after maize. The early maturing varieties are harvested before maize, while the local varieties are harvested at the same time as, or after, the maize harvest.

Source of sorghum seed

The majority of sorghum farmers in Senanga are able to rely on their own saved seed, whilst about half of the Kalomo farmers acquire sorghum seed from off-farm sources (*see* Table 4). This partly reflects the fact that farmers have recently been shifting towards sorghum in Kalomo and possibly the on-farm seed storage practices are not yet well established.

In both areas the most important off-farm source of sorghum seed is another farmer (*see* Table 5). Grain markets are used infrequently as a source of seed, in part because there are few local markets and farmers would have to travel considerable distances to the nearest urban market. In both areas, and particularly in Senanga in 1995, various voluntary and government seed relief programmes also provided sorghum seed to some farmers.

Table 6 summarizes farmers' reasons for acquiring sorghum seed off-farm. In Senanga the most important reasons are that the previous season's harvest was insufficient; that no sorghum was planted the previous season; or that the farmer wished to try another variety. In Kalomo, the most important reason is that sorghum had not been planted the previous season. This possibly reflects the relatively recent growth of interest in the crop. When farmers in the survey reported that they sought seed of another variety, this does not necessarily mean that they wished to try a modern variety, but simply that they had decided to try something different.

When sorghum seed is acquired off-farm it may be purchased or provided as a gift or loan. Table 7 shows how the seed that farmers used in 1995 (whether stored on-farm or acquired off-farm) was originally obtained. In Senanga, it is most common for sorghum seed to be provided as a gift, usually from another farmer. In Kalomo, by contrast, most sorghum seed is purchased from other farmers. This difference might be explained by the fact that sorghum is more well established in Senanga, while in Kalomo it has only recently started to regain importance and seed, therefore, is a rarer commodity.

Sorghum seed management

Sorghum seed is stored in a number of ways (*see* Table 8). In Senanga, most farmers store sorghum seed threshed, while in Kalomo most of the farmers store seed sorghum on the head. In Senanga fewer than 10% of the farmers thresh the sorghum they store as grain for sale or consumption, so the fact

that seed tends to be threshed is an indication of the special care given to seed sorghum; 90% of farmers report storing their sorghum seed separate from the grain. The majority of Kalomo farmers also store sorghum for grain on the head, and 63% report separate storage arrangements for the seed.

A wide variety of containers are used for seed storage, but in both areas the most common containers are jute or polypropylene sacks. In Senanga, 43% of farmers store threshed sorghum seed in a variety of other containers, including pots, tins, and baskets.

Only a few farmers apply any storage protectants to sorghum seed (*see* Table 9). A few farmers mix the sorghum seed with wood ash and one farmer in the Senanga sample reported using insecticide.

However, most complaints about damage to stored sorghum seed in the past refer to insect infestation (*see* Table 10). These complaints were heard more frequently in Senanga than in Kalomo. A few farmers also reported damage to sorghum seed from rodents or moisture.

Farmers were asked to recall past problems with sorghum seed germination and to explain the causes where possible (*see* Table 11). In Senanga, the most important response was a lack of soil moisture, and this was a similarly common response in Kalomo. In neither district did farmers consider seed quality *per se* as an important cause of germination problems. Other field problems, such as insects or rodents, were sometimes cited as having led to poor stand establishment for the sorghum crop.

Farmers were also asked if they had experience testing sorghum seed when they suspected it was of unacceptable quality (*see* Table 12). About half the Senanga farmers had experience in seed testing, mostly by placing seed in water and removing those seeds that float; a smaller proportion performed a simple germination test in the soil. Only about one-third of Kalomo farmers had experience with testing sorghum seed quality, but in that district the common practice was to use the soil method, with very few using the water flotation process.

Table 13 describes the process of sorghum seed selection and Table 14 reports the major criteria used by farmers at various stages of selection. A quarter of the farmers in Senanga, but none in Kalomo, report an effort at seed selection while the crop is still in the field. Those Senanga farmers that do begin to select seed in the field seem to pay attention to the size of the head and the size of the grain more than to any characteristics of the plant itself, although a few farmers report checking for the absence of disease in the plant.

More effort is devoted to seed selection before storage. Selection criteria in Senanga focus on the size and quality of the seed, while in Kalomo the focus is on the size of the head; this difference reflects the fact that most seed is stored threshed in Senanga but on the head in Kalomo. Further selection is carried out during storage and just before planting, and in Kalomo the attention then shifts to grain rather than head qualities.

The survey also explored the gender division of seed management responsibilities. For female-headed households, seed management responsibility naturally falls to the woman. In households occupied by a married couple there is potential for division of responsibilities. Table 15 summarizes the responses of married farmers to questions about seed management. Two factors are worth noting. First, it would appear that in Kalomo the husband

plays a more important role in choosing the variety that is to be planted. Second, responsibilities for selecting and storing sorghum seed are largely assigned to wives in both Senanga and Kalomo.

Sorghum seed quality

Table 16 summarizes the results of germination tests performed on sorghum seed samples. The mean germination of 89% for Senanga and 84% for Kalomo indicates adequate germination capacity. Only a few of the samples fell below the 70% cut-off that is recommended by the FAO Quality Declared Seed System (FAO, 1993), and only one very bad sample was found (in Kalomo, from a farmer who had purchased the seed from a neighbour).

Table 17 examines the differences in sorghum germination according to the characteristics of the seed. Because the sorghum seed quality was generally quite high it is difficult to find any characteristics that might distinguish between seed management practices. There is little difference in germination between seed acquired off-farm and seed that is farm-stored. The sorghum seed that was provided by relief programmes to some farmers in Senanga appears to be of good quality.

Seed that is stored threshed has a slightly higher germination percentage than that stored on the head, but the difference is not significant. Similarly, there is no difference between seed where harvest problems had been reported and seed with no harvest problems. This would indicate that farmers are able to select adequate seed even when part of their grain crop has been damaged by weather or pests. Most seed was harvested over a period of a few months in 1995 and there was no correlation between the month of harvest and the germination percentage.

Table 18 looks at the characteristics of the farmers who provided the seed samples. In Senanga, the minority of households that reported that the male had major responsibility for seed selection showed slightly higher seed quality. No such difference was noted for Kalomo and it is not clear why this should be the case. In both areas, farmers who report experience with seed testing have seed of slightly higher germination percentage.

Very little sorghum is sold, so it was not possible to correlate the farmers' commercial orientation with seed quality. There is, however, no relationship between the area of sorghum planted and the quality of seed provided.

COWPEA

Cowpea in the farming systems of the Senanga and Kalomo Districts

Table 19 shows that cowpea farmers in Kalomo plant larger areas than farmers in Senanga. Almost all of the Kalomo cowpea farmers plant a monocrop, while the majority of Senanga farmers plant cowpea as an intercrop, most frequently with maize, but also with millet or sorghum.

Most farmers plant local cowpea varieties. The major exception is the use of the modern variety Lutembwe in Senanga, principally as a result of efforts by the FSRT of the Ministry of Agriculture. The modern varieties (Lutembwe and Bubebe) are early maturing and are bush plant types. The local cowpea varieties are spreading plant types. Cowpea is usually planted after the major grain crops.

Source of cowpea seed

Most cowpea seed is saved and stored on the farm (*see* Table 20). The use of farm-stored seed in Senanga dropped between the period 1993–94 and 1995 because of the drought and subsequent emergency seed distribution. A significant minority of cowpea seed in Kalomo has been acquired off-farm in the past three years, due, in part, to the demand for seed of this crop and its growing availability from other farmers.

Table 21 shows that in Kalomo almost all cowpea seed acquired off-farm is obtained from other farmers. In Senanga, other farmers are also an important seed source, but in 1995 seed relief was the major off-farm source, while in the previous two years many farmers obtained cowpea seed from the seed bank programme established by the local FSRT. This programme, which only operates in the Western Province, provides support to local farmers who wish to multiply seed of new crop varieties that they have tested on their farms (Lof and Nchemba, 1994).

In both Senanga and Kalomo the major reason for acquiring cowpea seed off-farm in 1995 was the inadequate harvest of the previous season (*see* Table 22). About one-quarter of the farmers, who had off-farm seed sources, reported looking for seed of a different variety than the one they had grown the previous year, although this does not necessarily imply interest in modern varieties.

With respect to the method of acquiring seed, the difference noted between Kalomo and Senanga for sorghum seed also holds for cowpea; in Kalomo the majority of farmers buy their seed, while in Senanga the majority obtain it through gifts or loans (*see* Table 23).

Cowpea seed management

About half of the cowpea seed in Senanga, and 85% in Kalomo, is stored unthreshed (*see* Table 24). Of the farmers reporting cowpea seed storage in 1995, 73% in Senanga and 56% in Kalomo stored the cowpea seed separately from the cowpea grain destined for sale or consumption. For unthreshed cowpea, the most common container is sacks. Sacks can also be used to store threshed cowpea seed, but in Senanga other containers are more commonly used.

Most cowpea seed is stored without any protective treatment; only a few farmers apply wood ash or insecticide to their stored cowpea seed (*see* Table 25).

Most reports of damage to stored cowpea seed in past years focus on storage insects (*see* Table 26).

The majority of Senanga farmers who report germination problems with cowpea seed cite low soil moisture as the principal problem (*see* Table 27). Relatively few farmers in Kalomo report any problems with cowpea seed germination and these tend to focus on damage from insects. Neither set of farmers reports many perceptions of seed quality problems as the cause of inadequate germination.

Table 28 shows that most farmers do not have experience of testing the germination potential of their cowpea seed. More farmers in Kalomo than in Senanga test their cowpea seed, mostly by doing a simple germination test with a sample of seed they plant in the soil.

Table 29 summarizes the timing of cowpea seed selection, and Table 30 presents the major criteria that are used in the selection process. Very little selection is done in the field, and it appears that in these cases only the pods, rather than plant characteristics, are examined. More selection is done before storage, and the differences in seed storage practices between the two areas are reflected in the different selection criteria; farmers in Senanga tend to concentrate on seed characteristics, while those in Kalomo (who are more likely to store cowpea for seed in the pod) concentrate on pod characteristics. Further selection is done during storage and just before planting when the criteria are largely confined to seed size and integrity.

Table 31 presents a summary of the division of seed management responsibilities in households containing a married couple. In Senanga, wives are about twice as likely to take major responsibility for cowpea variety selection as are husbands, and they are about four times as likely to take major responsibility for selecting and storing cowpea seed. In Kalomo, households seem more evenly divided between those where the husband has responsibility for variety choice and those where it is the duty of the wife. Wives are much more likely than husbands to have major responsibility for cowpea seed selection and storage in Kalomo.

Cowpea seed quality

Table 32 reports the analysis of cowpea seed germination from the two samples. The mean germination (77% for Senanga and 80% for Kalomo) is well above the minimum of 65% established for formal seed provision (FAO, 1993). Only 18% of the total sample had germination below 65%.

Table 33 relates seed management characteristics to germination. In both Senanga and Kalomo the cowpea seed that farmers acquired off-farm in 1995 had significantly higher germination percentages than those for farm-stored seed. In Senanga this is largely due to the high quality of seed distributed by relief efforts, while in Kalomo the seed acquired from other farmers is of somewhat higher quality than own-stored seed.

No significant differences were noted between seed that is stored in the pod and seed that has been threshed. No difference in seed quality was found between farm-stored seed where the farmer had reported harvest problems and seed where there were no harvest difficulties. No difference in germination could be detected in relation to the age of the seed, i.e. the time of cowpea harvest.

Table 34 summarizes some characteristics of cowpea farmers in relation to germination percentage. In no instances were there any significant differences detected between households where the man takes responsibility for seed selection and those where it is the woman's task. Knowledge of seed testing did not appear to have any effect on seed quality.

Only a few farmers in the sample reported selling any of their cowpea, so it was difficult to compare amount sold to seed quality. Nevertheless, in Senanga there appears to be a significant correlation between area planted to cowpea and germination, with larger fields associated with lower germination. Closer examination of this relationship shows that it is mostly an artefact of seed from two large fields that for some reason had low germination percentages; it would not appear to be a more general relationship.

GROUNDNUT

Groundnut in the farming systems of the Senanga and Kalomo Districts

Table 35 shows some characteristics of groundnut production practices in the two study areas. The average area of groundnut is slightly higher in Kalomo than in Senanga. The majority of groundnut in Kalomo is monocropped, while the majority in Senanga is intercropped with maize. The groundnut that is intercropped in Kalomo is planted in association with various types of vegetables such as melon, pumpkin and okra. Groundnut is planted after the major grain crops. Women tend to take responsibility for groundnut production, which is often a source of cash income.

The most common groundnut variety planted in both areas is Natal Common, which is early maturing. Chalimbana (a late maturing variety) is also grown, particularly in Kalomo. Both Chalimbana and Natal Common were released more than 30 years ago.

Source of groundnut seed

The majority of groundnut seed in both study areas is saved and stored on the farm, although the drought caused a slight decline in seed self-sufficiency in 1995 (*see* Table 36).

When seed is acquired off-farm, other farmers are normally the most common source, except for the 1995 season in Senanga, where relief programmes provided seed to a number of farmers (*see* Table 37). Markets and shops are used by a few farmers to acquire groundnut seed and a few farmers in the Senanga sample obtained groundnut seed from the FSRT seed bank.

In both areas the major reason for acquiring seed off-farm in 1995 was the poor harvest the previous season (*see* Table 38). A number of farmers in Senanga reported trying another variety.

The majority of groundnut seed that was originally acquired off-farm in both areas is purchased (*see* Table 39). In Senanga, this situation is in contrast to that for cowpea and sorghum seed, which is most often acquired by gift or loan. The most likely explanation is that groundnut is a cash crop in both areas and hence seed is more likely to be acquired by purchase.

Groundnut seed management

Virtually all of the groundnut stored as seed in Kalomo is unshelled, i.e. in the pod, and the majority of groundnut seed in Senanga is also stored unshelled (*see* Table 40). Sacks are the most common container. About one-third of the Senanga farmers report storing groundnut seed shelled in a variety of containers. Most (82%) of the farmers in Kalomo, but slightly less than half of the Senanga farmers, stored their groundnut seed separately from groundnuts destined for sale or consumption during 1995.

Some farmers in the Kalomo sample, and one farmer in Senanga, apply insecticide to stored groundnut seed (*see* Table 41).

Farmers report problems with both rodents and storage insects in stored groundnut seed (*see* Table 42).

When farmers were asked to recall germination problems with groundnut seed, the most common response in both study areas was lack of soil moisture (*see* Table 43). Termites, other insects, and rodents were also mentioned by some farmers. Very few farmers cited perceptions with seed quality *per se* as a cause of poor groundnut germination.

Only a few farmers in either area reported that they had experience with testing groundnut seed before planting (*see* Table 44). The majority of those farmers that did, used simple germination tests by planting a small sample of their seed.

Table 45 describes the timing of groundnut seed selection and Table 46 presents the major selection characteristics used by farmers. As with sorghum and cowpea, very few farmers have experience in selecting groundnut seed on the basis of plant characteristics; the few farmers who report this practice are interested in selecting earlier maturing plant types. More farmers in Kalomo than in Senanga select seed before storage, reflecting the higher proportion of farmers in the former district who store groundnut seed separately from grain. A high proportion of Kalomo groundnut farmers also undertake an additional selection before planting. In both areas, seed selection during and after storage concentrates on large and undamaged seed or pods.

Table 47 shows the division of seed management responsibility by gender in households with a married couple. In Senanga, variety choice is divided between men and women, but in most households it is the woman who takes major responsibility for seed selection and seed storage. The high level of responsibility of the women is even more marked in Kalomo, where women also have the major responsibility for variety selection.

Groundnut seed quality

The germination percentage for the groundnut samples from the two areas is summarized in Table 48. The mean germination (79% for Senanga and 89% for Kalomo) indicates very acceptable quality. Only a few samples, mainly in Senanga, fell below the recommended minimum of 60% (FAO, 1993).

Table 49 shows the germination results in relation to various characteristics of seed management. There is no difference between home-stored seed and that acquired off-farm.

In both areas groundnut seed stored shelled had somewhat higher germination than that stored unshelled, but the difference is not significant. Similarly, seed that was reported to be damaged at harvest shows slightly lower germination, but the difference is not significant.

No relationship was found between the age of the seed, i.e. time of harvest, and the germination percentage.

Table 50 summarizes the relationship between farmer characteristics and germination. In Senanga, there is a tendency for the seed selected by women to have better germination. Also, the few farmers in Senanga who are familiar with seed testing have seed with a higher germination rate.

Because the previous year's harvest had been poor it was difficult to estimate the commercial orientation of the groundnut farmers. A correlation of groundnut area and germination showed no relation.

CONCLUSIONS

The general status of seed quality

Laboratory analyses of seed germination for the samples collected from farmers in the study reveal few problems with seeds of any of the crops surveyed. Only a small minority of the seed exhibited a germination percentage that was possibly low enough to influence crop production. Sorghum seed had a mean germination potential of 89% (Senanga) and 84% (Kalomo), well above the acceptance threshold of 70%. Cowpea seed has a mean germination potential of 77% (Senanga) and 80% (Kalomo), well above the acceptance threshold of 65%. Groundnut seed had a mean germination potential of 79% (Senanga) and 89% (Kalomo), well above the acceptance threshold of 60%.

Farmers themselves did not generally doubt the quality of their seed. Only approximately 10% of farmers attributed poor field germination to quality deficiencies of the seed; most perceived lack of soil moisture and soil insects as the main problems. Most farmers do not test the germination capacity of their seed prior to planting. The proportion that has testing experience ranged from 10% (groundnut in Senanga) to 52% (sorghum in Senanga). Farmers with a knowledge of seed testing had higher germination rates in Senanga (groundnut and sorghum) and in Kalomo (sorghum).

However, despite the overall germination percentage means, it should be noted that some farmers' seed failed to match expectations. In particular, 22% of cowpea seed samples in Senanga (13% in Kalomo) had germination rates of less than the threshold. Similarly, 12% of groundnut seed samples in Senanga and 10% of sorghum seed samples in Kalomo had germination rates of less than the thresholds. These figures indicate a potential loss of farm productivity if the reduced germination is not adequately compensated by an increased sowing rate. Informed guidance on an increased sowing rate could only be obtained by the farmer undertaking a germination test.

Farmer seed management

The majority of sorghum, cowpea and groundnut seed in Senanga and Kalomo is normally saved and stored on-farm in a range of containers, of which sacks are the most common.

Few storage problems were reported, but of these, insects were the most common. Not many farmers used any protectants, but wood ash was the protectant most frequently used on cowpea and sorghum. If enough of it is used, it can be extremely effective. The only use of insecticide was reported on groundnuts. However, farmers realize that not all of the seed they plant will germinate, and planting densities can generally compensate for this; it is only if germination is very low that production is affected.

Despite the high reliance on home saving and storage practices, a significant minority of farmers each year must search for seed off-farm because of a poor previous harvest, or to obtain fresh seed or another variety. In Senanga, the survey indicated that one-sixth of cowpea farmers, one-quarter of groundnut farmers, and one-third of sorghum farmers look for seed off-farm in any given year. In Kalomo, the equivalent figures are one-half of cowpea farmers, one-sixth of groundnut farmers and one-half of sorghum farmers. A nationwide study on seed supply shows a similar dependence on off-farm sources of seed for these crops (Andren *et al.*, 1991).

When farmers have to search for seed off-farm, they normally have few options. Their main source is other farmers from whom they obtain seed through purchase, gift or loan. There are few local grain markets that might

serve as sources of seed material, and the grain markets in towns are very far away from many farmers. ZAMSEED produces a limited quantity of sorghum and cowpea seed which is not widely available.

There were no differences in quality between the seed stored on-farm and that acquired off-farm, except for cowpea where off-farm sources (albeit from other farmers in Kalomo) were better.

It is significant that more than a quarter of farmers were seeking another variety despite the fact that there is relatively little flexibility in the seed provision system, and farmers have few opportunities to learn about new or other varieties. There are two new cowpea varieties, four groundnut varieties, and three sorghum varieties that have been released in the last six years. Innovations like the FSRT seed bank make a contribution by providing access to new varieties and developing local capacity for seed production.

Although farmers devote attention before, during and after storage, to selecting undamaged and large seed for planting, there is little evidence that they do much selection in the field for either seed or plant characteristics. The field selection that did take place was mainly confined to Senanga. As there are increasing attempts to diversify the number of varieties that farmers have available to them, it will be important to strengthen seed selection techniques in the field.

Recent droughts in Zambia have led to the organization of a number of seed relief programmes by both NGOs and government agencies. The seed examined in the present study that had been provided as seed relief is of good quality, but fieldwork carried out in preparation for the study revealed concerns about the adequacy of seed provision by some relief agencies. Survey staff heard reports of seed being provided to farmers too late for the growing season, of inappropriate varieties, and of poor quality.

Strategies for improving seed quality

Despite the generally good quality of the seed, several items deserve attention. On-farm seed management practices are the result of experience gained over generations. As conditions change, and new crops are taken up, farmers have to develop their experience. This can be seen in Kalomo, where many farmers are going back to crops such as sorghum and cowpea that they had abandoned. Extension advice on seed management may be particularly useful in situations like this where the cropping scenario is changing.

This study highlights the individual and varied nature of seed management practices even within small communities. It emphasizes the importance of working with farmers, particularly women, to discuss best practices for seed storage management and to identify means by which seed quality might be improved. Women had the main responsibility for selecting and storing seeds. The men had a larger role in selecting which varieties to plant.

The question remains as to why some seed samples were of inadequate quality. Because the quality of sorghum and groundnut was generally good the data analysis did not find many linkages between management practices and quality. However, it was clear that farm-saved cowpea seed had a lower germination percentage than did cowpea seed obtained off-farm. The survey does not identify the cause of the problem, but insect infestation of cowpeas was a recognized issue to which many farmers did not respond by means of storage protectants.

During the course of the survey it was apparent, in instances where farmers had to obtain seed off-farm, that availability was a problem.

Seed security, in terms of seed quality, management and, in particular, accessibility, needs to be improved at the community level in order to make farmers better able to withstand the effects of drought and to reduce the need for emergency seed programmes.

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Appendix

TABLES

Table 1 Cropping patterns and seed sources, 1994*—Kalomo District

	Hybrid maize	OPV maize	Sorghum	Pearl millet	Cowpea	Ground-nut	Bambara nut	Sun-flower
Percentage of farmers who grow the crop	71	91	39	41	76	80	56	46
Percentage distribution of seed sources for farmers who grow the crop								
On-farm	7	88	52	68	61	78	80	30
Another farmer	8	11	39	32	34	19	18	29
Market	0	0	1	0	3	3	2	0
Shop	83	1	3	0	1	0	0	39
Relief	2	0	4	0	0	0	0	2
Total	(100)	(100)	(99)	(100)	(99)	(100)	(100)	(100)

Note: * based on 180 responses of farmers in survey

Table 2 Cropping patterns and seed sources, 1994*—Senanga District

	Hybrid maize	OPV maize	Sorghum	Pearl Millet	Cowpea	Ground-nut	Bambara nut
Percentage of farmers who grow the crop	51	81	73	72	58	52	14
Percentage distribution of seed sources for farmers who grow the crop							
On-farm	14	78	77	70	86	82	76
Another farmer	7	13	14	12	12	2	24
Market	4	3	0	1	0	3	0
Shop	33	1	0	1	0	2	0
Relief	27	0	7	1	0	0	0
FSRT seed bank	9	1	3	15	2	1	0
Total	(99)	(99)	(101)	(100)	(100)	(100)	(100)

Note: * based on 180 responses of farmers in survey

Table 3 Sorghum production practices

	Senanga	Kalomo
Mean area sown in sorghum (limas)*	3.6	3.9
Proportion monocrop	58%	90%
Proportion intercrop with:		
Maize	40%	0%
Vegetables	0%	0%
Pearl millet	2%	10%
Varieties:		
'Local'	63%	85%
Kuyuma	20%	15%
Sima	10%	0%
Other	7%	0%

Note: * 1 lima=0.25 hectare

Table 4 Source of sorghum seed

	Senanga		Kalomo	
Source	1995	1993–94*	1995	1993–94*
On-farm	40 (67%)	64 (69%)	27 (45%)	30 (51%)
Off-farm	20 (33%)	29 (31%)	33 (55%)	29 (49%)
Total	60 (100%)	93 (100%)	60 (100%)	59 (100%)

Note: * some farmers reported more than one source, others were unable to respond

Table 5 Source of sorghum seed acquired off-farm

	Senanga		Kalomo	
Source	1995	1993–94*	1995	1993–94
Another farmer	14 (70%)	21 (84%)	32 (94%)	25 (86%)
Seed relief	6 (30%)	2 (8%)	1 (3%)	2 (7%)
Market/shop	0 (0%)	2 (8%)	1 (3%)	2 (7%)
Total	20 (100%)	25 (100%)	34 (100%)	29 (100%)

Notes: * not all farmers reported the source of their seed
** one farmer reported two sources

Table 6 Reasons for acquiring sorghum seed off-farm (1995)

	Senanga	Kalomo
To get another variety	6 (30%)	8 (24%)
To get fresh seed	1 (5%)	2 (6%)
No sorghum planted previous season	6 (30%)	19 (58%)
Poor harvest/consumed harvest	7 (35%)	4 (12%)
Total	20 (100%)	33 (100%)

Table 7 How 1995 sorghum seed originally acquired

	Senanga*		Kalomo	
Purchase	12	(12%)	43	(72%)
Gift	37	(64%)	12	(20%)
Loan	8	(14%)	2	(3%)
Exchange	1	(2%)	3	(5%)
Total	58	(101%)	60	(100%)

Note: * two farmers did not report how their seed was originally acquired

Table 8 Sorghum seed storage on-farm

	Senanga		Kalomo	
On head, in sacks	3	(8%)	11	(41%)
On head, in other container	2	(5%)	7	(26%)
Threshed, in sacks	18	(45%)	6	(22%)
Threshed, in other container	17	(43%)	3	(11%)
Total	40	(101%)	27	(100%)
Farmers who store sorghum seed separately from grain intended for sale or consumption	**36**	**(90%)**	**17**	**(63%)**

Table 9 Sorghum seed treatment on-farm

	Senanga		Kalomo	
Ash	6	(15%)	2	(7%)
Insecticide	1	(3%)	0	(0%)
Other substance	0	(0%)	1	(4%)
Nothing	33	(83%)	24	(89%)
Total	40	(101%)	27	(100%)

Table 10 Reports of agents that have previously caused sorghum seed damage

	Senanga*		Kalomo	
Insects	24	(40%)	10	(17%)
Rodents	6	(10%)	1	(2%)
Moisture	3	(5%)	1	(2%)
No damage	27	(45%)	48	(80%)
Total	60	(100%)	60	(101%)

Table 11 Reports of past problems* with sorghum seed germination

	Senanga**		Kalomo**	
Seed quality	12	(15%)	1	(5%)
Lack of soil moisture	50	(61%)	6	(29%)
Birds	1	(1%)	0	(0%)
Termites	8	(10%)	1	(5%)
Insects	7	(9%)	6	(29%)
Rodents	2	(2%)	0	(0%)
Other	2	(2%)	7	(33%)
Total	82	(100%)	21	(101%)

Notes: * major problem reported by farmer
** some farmers reported more than one problem, some did not report any problems

Table 12 Experience with seed testing for sorghum

	Senanga		Kalomo	
No experience	29	(48%)	41	(68%)
Germinating seed in soil	8	(13%)	16	(27%)
Floating seed	22	(37%)	3	(5%)
Other	1	(2%)	0	(0%)
Total	60	(100%)	60	(100%)

Table 13 Timing of sorghum seed selection activities

	Senanga*(N=60)		Kalomo*(N=60)	
In field	14	(23%)	0	(0%)
Before storage	27	(45%)	35	(58%)
During storage	23	(38%)	7	(12%)
Before planting	3	(5%)	37	(62%)

Note: * sums to more than 100% because of multiple responses

Table 14 Criteria used in sorghum seed selection

	Senanga*	Kalomo*
In field	Large head, large seed, disease-free	None
Before storage	Large seed, undamaged seed	Well-filled head, large head
During storage	Large seed, undamaged seed	Undamaged seed
Before planting	Undamaged seed	Undamaged seed, large seed

Note: * most frequent responses

Table 15 Sorghum seed management responsibilities by gender (responses of married farmers only)

	Senanga (N = 47)			Kalomo (N = 51)		
Operation	Male	Female	Both	Male	Female	Both
Choosing the variety	19	24	4	33	8	10
Selecting seed	9	37	1	8	37	6
Storing seed	10	34	3	13	25	13

Table 16 Germination rate for sorghum seed samples

	No. of samples	
	Senanga	Kalomo
90–99%	36	21
80–89%	16	26
70–79%	5	6
60–69%	3	6
<20%	0	1
Total	60	60
Mean germination percentage	89%	84%
Proportion of seed samples below 70%	5%	10%

Table 17 Sorghum seed characteristics and germination rate

	Senanga			Kalomo		
Characteristic	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Source:						
Home	40	88.8	NS	27	84.4	NS
Off-farm	20	88.0		33	82.8	
Source off-farm:						
Another farm	14	86.5	NS	32	82.8	NS
Relief	6	91.3		0	–	
Market	0	–		1	74	
Shop	0	–		1	95	
Storage method:						
On head	5	87.4	NS	18	83.1	NS
Threshed	35	89.0		9	87.0	
Seed damaged at harvest:						
Yes	23	88.4	NS	5	83.3	NS
No	17	89.3		20	86.4	
Age of seed:						
(Correlation coefficient)	(0.09)		NS		(−0.07)	NS

Note: * significance of one-way ANOVA or correlation coefficient

Table 18 Sorghum farmer characteristics and germination rate

	Senanga			Kalomo		
	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Responsibility for seed selection:						
Male	9	93.3	<0.01	9	84.1	NS
Female	50	87.7		45	82.6	
Knows how to test seed:						
Yes	31	89.6	NS	19	85.8	<0.1
No	29	87.3		41	82.5	
Area planted to sorghum: (Correlation coefficient)		(−0.15)	NS		(−0.15)	NS

Note: * significance of one-way ANOVA or correlation coefficient

Table 19 Cowpea production practices

	Senanga	Kalomo
Mean area sown in cowpea (limas)*	1.3	2.0
Proportion monocrop	20%	95%
Proportion intercropped with:		
Maize	60%	5%
Millet or sorghum	18%	0%
Cassava	2%	0%
Varieties:		
Local	60%	98%
Lutembwe	32%	0%
Inia 37	3%	0%
Bubebe	5%	0%
Unknown	0%	2%
Total	100%	100%

Note: * 1 lima=0.25 ha

Table 20 Source of cowpea seed

	Senanga		Kalomo	
	1995	1993–94*	1995	1993–94*
On-farm	34 (57%)	82 (85%)	36 (60%)	48 (53%)
Off-farm	26 (43%)	14 (15%)	24 (40%)	42 (47%)
Total	60 (100%)	96 (100%)	60 (100%)	90 (100%)

Note: * not all farmers provided details of seed sources for earlier seasons

Table 21 Source of cowpea seed acquired off-farm

	Senanga*		Kalomo*	
	1995	1993–94	1995	1993–94
Another farm	5 (19%)	8 (57%)	21 (100%)	38 (95%)
Seed relief	20 (74%)	0 (0%)	0 (0%)	0 (0%)
Market/shop	1 (4%)	0 (0%)	0 (0%)	2 (5%)
FSRT seed bank	1 (4%)	6 (43%)	0 (0%)	0 (0%)
Total	27 (101%)	14 (100%)	21 (100%)	40 (100%)

Note: * not all farmers provided details of off-farm sources, and some indicated more than one source

Table 22 Reasons for acquiring cowpea seed off-farm (1995)

	Senanga*	Kalomo*
To get another variety	7 (26%)	5 (24%)
To get fresh seed	5 (19%)	1 (5%)
No cowpea planted previous season	2 (7%)	3 (14%)
Poor harvest/consumed harvest	13 (48%)	12 (57%)
Total	27 (100%)	21 (100%)

Note: * some farmers indicated more than one reason

Table 23 How 1995 cowpea seed was originally acquired

	Senanga	Kalomo
Purchase	13 (22%)	47 (78%)
Gift	26 (43%)	10 (17%)
Loan	20 (33%)	0 (0%)
Exchange	1 (2%)	3 (5%)
Total	60 (100%)	60 (100%)

Table 24 Cowpea seed storage

	Senanga	Kalomo
Unthreshed, in sacks	12 (36%)	25 (64%)
Unthreshed, in other containers	5 (15%)	8 (21%)
Threshed, in sacks	4 (12%)	4 (10%)
Threshed, in other containers	12 (36%)	2 (5%)
Total	33 (99%)	39 (100%)
Farmers who store cowpea seeds separately from cowpea grain destined for sale or consumption	24 (73%)	22 (56%)

Table 25 Cowpea seed treatment

	Senanga*	Kalomo*
Ash	5 (15%)	3 (8%)
Insecticide	1 (3%)	2 (5%)
Other substance	0 (0%)	1 (3%)
Nothing	27 (82%)	33 (85%)
Total	33 (100%)	39 (101%)

Note: * not all farmers provided information on storage protectants

Table 26 Reports of agents that have previously caused cowpea seed damage

	Senanga	Kalomo
Insects	36 (60%)	29 (48%)
Rodents	4 (7%)	1 (2%)
Moisture	1 (2%)	0 (0%)
No damage	19 (32%)	30 (50%)
Total	60 (101%)	60 (100%)

Table 27 Reports of past problems* with cowpea seed germination

	Senanga	Kalomo
Seed quality	10 (13%)	3 (14%)
Lack of soil moisture	49 (65%)	4 (19%)
Termites	5 (7%)	2 (10%)
Other insects	9 (12%)	9 (43%)
Rodents	1 (1%)	0 (0%)
Other	1 (1%)	3 (14%)
Total	75 (99%)	21 (100%)

Note: * major problem reported by farmer

Table 28 Experience with seed testing for cowpea

	Senanga	Kalomo
No experience	53 (88%)	42 (70%)
Germinating seed in soil	3 (5%)	17 (28%)
Floating seed	4 (7%)	1 (2%)
Total	60 (100%)	60 (100%)

Table 29 Timing of cowpea seed selection activities

	Senanga*(N=60)	Kalomo*(N=60)
In field	11 (18%)	0 (0%)
Before storage	25 (42%)	34 (57%)
During storage	19 (32%)	13 (22%)
Before planting	14 (23%)	37 (62%)

Note: * sums to more than 100% because of multiple responses

Table 30 Criteria used in cowpea seed selection*

	Criteria	
	Senanga	Kalomo
In the field	Mature pods	(None)
Before storage	Large seed, undamaged seed	Full pod, mature pods
During storage	Large seed, undamaged seed	Full pod, mature pods
Before planting	Undamaged seed, large seed	Undamaged seed, large seed

Note: * most frequent responses

Table 31 Cowpea seed management responsibilities by gender (responses of married farmers only)

	Senanga (N=51)			Kalomo (N=49)		
	Male	Female	Both	Male	Female	Both
Choosing the variety	16	29	6	19	16	14
Selecting seed	10	39	2	5	37	7
Storing seed	9	39	3	8	33	8

Table 32 Germination rate for cowpea seed samples

	No. of samples	
	Senanga	Kalomo
90–99%	25	10
80–89%	5	29
70–79%	12	
60–69%	8	5
50–59%	7	2
40–49%	0	2
30–39%	2	1
20–29%	0	0
<20%	1	0
Total	60	60
Mean germination percentage	77%	80%
Proportion of seed samples below 65%	22%	13%

Table 33 Cowpea seed characteristics and germination rate

	Senanga			Kalomo		
	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Source:						
Home	33	67.8	<0.05	39	77.0	<0.01
Off-farm	24	87.8		19	84.6	
Source off-farm						
Another farm	5	75.6	<0.01	21	84.2	–**
Seed relief	20	92.3		0	–	
Storage method:						
Unthreshed	17	67.1	NS	33	76.4	NS
Threshed	16	68.6		6	80.3	
Seed damaged at harvest:						
Yes	19	70.2	NS	5	73.2	NS
No	14	64.6		32	78.0	
Age of seed:						
(Correlation coefficient)		(0.05)	NS		(−0.07)	NS

Notes: * significance of one-way, ANOVA or correlation coefficient
** data does not permit ANOVA or calculation of correlation coefficient

Table 34 Cowpea farmer characteristics and germination rate

	Senanga			Kalomo		
	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Responsibility for seed selection:						
Male	3	70.3		5	66.0	
Female	28	67.7		31	78.6	
Knows how to test seed:						
Yes	7	79.7	NS	18	82.5	NS
No	53	76.5		42	78.2	
Area planted to cowpea:						
(Correlation coefficient)		(−0.42)	<0.01		(0.03)	NS

Note: * significance of one-way ANOVA or correlation coefficient

Table 35 Groundnut production practices

	Senanga	Kalomo
Mean area sown in groundnut (limas)*	1.6	2.0
Proportion monocrop	22%	77%
Proportion intercropped with:		
Maize	72%	2%
Sorghum	7%	0%
Vegetable	0%	22%
Varieties:		
Natal Common	70%	72%
Chalimbana	2%	22%
Makulu Red	2%	0%
Local varieties	22%	2%
Other or unknown	5%	5%

Note: * 1 lima = 0.25 hectare

Table 36 Source of groundnut seed

	Senanga		Kalomo	
	1995	1993–94	1995	1993–94
On-farm	37 (62%)	76 (72%)	45 (75%)	95 (85%)
Off-farm	23 (38%)	29 (28%)	15 (25%)	17 (15%)
Total	60 (100%)	105 (100%)	60 (100%)	112 (100%)

Table 37 Source of groundnut seed acquired off-farm

Source	Senanga		Kalomo	
	1995	1993–94	1995*	1993–94
Another farmer	10 (43%)	20 (69%)	14 (88%)	15 (88%)
Seed relief	11 (48%)	0 (0%)	1 (6%)	0 (0%)
Market/shop	1 (4%)	5 (17%)	1 (6%)	2 (12%)
FSRT	1 (4%)	4 (14%)	0 (0%)	0 (0%)
Total	23 (99%)	29 (100%)	16 (100%)	17 (100%)

Note: * one farmer reported two sources

Table 38 Reasons for acquiring groundnut seed off-farm (1995)

	Senanga*	Kalomo**
To get another variety	7 (32%)	0 (0%)
To get fresh seed	1 (5%)	1 (6%)
No groundnut planted previous season	2 (9%)	0 (0%)
Poor harvest/consumed harvest	12 (55%)	15 (94%)
Total	22 (101%)	16 (100%)

Notes: * one farmer did not provide a reason
** one farmer provided two reasons

Table 39 How 1995 groundnut seed was originally acquired

	Senanga	Kalomo*
Purchase	36 (60%)	44 (76%)
Loan	11 (18%)	1 (2%)
Gift	12 (20%)	12 (21%)
Exchange	1 (2%)	1 (2%)
Total	60 (100%)	58 (101%)

Note: * not all farmers provided information on original acquisition of seed

Table 40 Groundnut seed storage

	Senanga	Kalomo*
Unshelled, in sacks	20 (54%)	28 (64%)
Unshelled, in other containers	4 (11%)	15 (34%)
Shelled, in sacks	4 (11%)	1 (2%)
Shelled, in other containers	9 (24%)	0 (0%)
Total	37 (100%)	44 (100%)
Farmers who store groundnut seed separately from groundnuts destined for sale or consumption	17 (46%)	36 (82%)

Note: * one farmer did not provide information on storage procedure

Table 41 Groundnut seed treatment

	Senanga	Kalomo
Insecticide	1 (3%)	8 (18%)
Nothing	36 (97%)	36 (82%)
Total	37 (100%)	44 (100%)

Table 42 Reports of agents that have previously caused groundnut seed damage*

	Senanga	Kalomo
Insects	7 (15%)	33 (56%)
Rodents	34 (72%)	23 (39%)
Other	6 (13%)	3 (5%)
Total	47 (100%)	59 (100%)

Note: * for those farmers who reported damage

Table 43 Reports of past problems* with groundnut seed germination

	Senanga	Kalomo
Seed quality	3 (5%)	4 (13%)
Lack of soil moisture	52 (80%)	13 (43%)
Termites	0 (0%)	2 (7%)
Insects	7 (11%)	6 (20%)
Rodents	3 (5%)	2 (7%)
Other	0 (0%)	3 (10%)
Total	65 (100%)	30 (100%)

Note: * major problem reported by farmer

Table 44 Experience with seed testing for groundnut

	Senanga	Kalomo
No experience	54 (90%)	50 (83%)
Germinating seed in soil	5 (8%)	9 (15%)
Floating seed	1 (2%)	1 (2%)
Total	60 (100%)	60 (100%)

Table 45 Times of groundnut seed selection activities

	Senanga (N=60)	Kalomo* (N=60)
In field	4 (7%)	2 (3%)
Before storage	19 (32%)	48 (80%)
During storage	23 (38%)	16 (27%)
Before planting	14 (23%)	44 (73%)

Note: * sums to more than 100% because of multiple responses

Table 46 Criteria* used in groundnut seed selection

	Senanga	Kalomo
In the field	Early maturing	Early maturing
Before storage	Large seed, undamaged seed, large pods	Large pods, mature pods
During storage	Large seed, undamaged seed	Undamaged seed, large seed
Before planting	Undamaged seed, large seed	Undamaged seed, large seed

Note: * most frequent responses

Table 47 Groundnut seed management responsibilities by gender (responses of married farmers only)

	Senanga (N=48)			Kalomo (N=56)		
	Male	Female	Both	Male	Female	Both
Choosing the variety	18	23	7	3	42	11
Selecting seed	6	39	3	5	46	5
Storing seed	6	38	4	6	46	4

Table 48 Germination rate for groundnut seed samples

	Senanga	Kalomo
90–99%	13	35
80–89%	26	19
70–79%	7	4
60–69%	7	1
50–59%	3	0
40–49%	2	1
30–39%	2	0
Total	60	60
Mean germination percentage	79%	89%
Proportion of seed samples below 60%	12%	2%

Table 49 Groundnut seed characteristics and germination rate

	Senanga			Kalomo		
	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Source:						
Home	37	80.3	NS	44	88.2	NS
Off-farm	23	76.6		15	89.1	
Source off-farm:						
Another farm	10	72.2	NS	14	89.5	NS
Market	1	66.0		1	83	
Seed relief	11	83.1		1	95	
Storage method:						
Unshelled	24	77.9	NS	43	88.0	NS
Shelled	13	84.7		1	98.0	
Seed damaged at harvest:						
Yes	18	78.1	NS	15	86.3	NS
No	19	82.3		28	90.2	
Age of seed:						
(Correlation coefficient)		(−0.03)	NS		(0.14)	NS

Note: * significance of one-way ANOVA or correlation co-efficient

Table 50 Groundnut farmer characteristics and germination rate

	Senanga			Kalomo		
	(N)	Germination %	Sig.*	(N)	Germination %	Sig.*
Responsibility for seed selection:						
Male	6	69.2	<0.1	5	85.6	NS
Female	51	79.4		50	88.7	
Knows how to test seed:						
Yes	6	87.5	<0.05	9	90.2	NS
No	54	77.9		51	88.2	
Area planted to sorghum: (Correlation coefficient)		0.03	NS		0.09	NS

Note: * significance of one-way ANOVA or correlation co-efficient

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The Bulletin series features the results of research and practical scientific work carried out by the Natural Resources Institute. It covers a wide spectrum of topics relevant to development issues ranging from land use assessment, through agricultural production and protection, to storage and processing.

Each bulletin presents a detailed synthesis of the results and conclusions within one specialized area, and will be of particular relevance to colleagues within that field and others working on sustainable resource management in developing countries.

Seed management by small-scale farmers is an important aspect of national seed security in developing countries. Some seed is obtained off-farm just prior to planting, but in many instances about 80% of seed is saved on-farm from one season to the next. The role of the traditional farmer and the informal seed sector as a whole has not been well supported and is not adequately understood. The informal seed sector will continue to be a major consideration in the agriculture of developing countries for the foreseeable future.

Seed Management by Small-Scale Farmers in Zambia—A Study of Cowpea, Groundnut and Sorghum Seed in the Southern and Western Provinces presents the findings of a field survey on Seed Management by Small-Scale Farmers in Zambia. It will be of interest to all those concerned with the role of the small-scale farmer in managing his or her seed supply.