Crop Post-Harvest Research Programme Zimbabwe

A Participatory Rural Appraisal of Ward 21 Chivi District, Masvingo Province

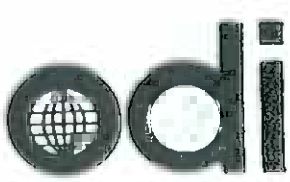
15-19 September 1997

Funded by the UK Department for International Development under the Renewable Natural Resources Research Strategy 1995 –2005.

Report on a Participatory Rural Appraisal (PRA) Survey of Ward 21 (Vidcos D, Eand F) Chivi District, 15-19 September 1997.

Boyd C.[1], Mvumi B.M.[2], Chatizwa I.[2], Nyakudya E.[2], Mudamburi B.[2], Nzuma I.[3] and Galpin M.[4]

1. *Overseas Development Agency, UK*
2. *Institute of Agricultural Engineering, Agritex*
3. *Plant Protection Research Institute (PPRI), Department of Research and Specialist Services (DR&SS).*
4. *Reading University, UK.*



PARTICIPATORY RURAL APPRAISAL FOCUSING ON CROP POST-HARVEST ISSUES

Chivi District (Ward 21, Videos D, E and F), Masvingo Province, Zimbabwe

Contents

1. INTRODUCTION

1.1 Background

The Crop Post Harvest Programme (CPHP) of the UK's Department for International Development (DFID) in collaboration with Zimbabwe's Department of Research and Specialist Services (DR&SS), is monitoring maize storage in three districts in Zimbabwe. Site selection was based on a rapid rural appraisal undertaken in 1996 (Donaldson et al, 1996). The overall objective of this Participatory Rural Appraisal (PRA) was to provide the basis for more detailed needs assessment of crop post-harvest research needs in one of the three selected districts.

1.2 Objectives

The main objectives of the PRA were as follows:

1. to gain a full understanding of the farming systems in Ward 21 of Chivi District, specifically:
   - to identify the major post-harvest constraints faced by farmers;
   - to describe methods of grain treatments currently used by farmers (maize, sorghum and millets);
   - to describe labour divisions by sex and age during post-harvest activities;
   - to gain a better understanding of the socio-economic structure of villages in Ward 21;
   - to assess the social status and representativeness of farmers participating in the maize storage monitoring trial;

2. to provide field training for resource persons in PRA following a two day class-based training workshop;

3. to provide a forum for comparing conventional PRA techniques with Participatory Farm Management (PFM) techniques which are being developed by researchers at the University of Reading in conjunction with CPHP.1

The structure of this report reflects the information objectives of the survey:

1. The first section addresses the farming system as a whole, providing brief accounts of determining factors, a ranking of farm enterprises and of crops.
2. The second section outlines the uses, production and post-harvest constraints of the main crops, with an emphasis on post-harvest constraints.
3. The third section is based on a matrix-ranking of post-harvest constraints across crops.
4. The fourth section considers issues of socio-economic differentiation, including labour divisions by gender in post-harvest activities and perceptions of wealth.

1 To facilitate comparison, findings using conventional PRA techniques and PFM techniques are kept largely separate in the text of this report.

5. The concluding section identifies researchable constraints drawn from survey findings.

2. METHODOLOGY

The survey was designed to achieve a balance between the three main objectives:

1. a comprehensive overview of the farming system as a whole together with a focus on crop post-harvest issues in particular;
2. an adequate training ground for four researchers;
3. a valid comparison with PFM techniques.

In recognition of the latter two objectives, the survey concentrated on applying field methodologies based on conventional techniques of participatory rural appraisal. Limited time was available for review of existing information or for external key informant interviews. Background information on Chivi District was provided by Donaldson et al., 1996 and Mvumi, 1996, and a single key informant interview was held with the Provincial Crops Specialist at the Department of Agricultural Technical and Extension Services (AGRITEX) in Masvingo. Primary data was collected largely through group discussion oriented by the following techniques:

- village mapping;
- farm-level mapping;
- transect walk;
- historical time-lines;
- general labour calendar of planting and harvesting activities;
- matrix-ranking of crops, and of crop post-harvest problems;
- seasonal calendars for sorghum and pearl millet;
- pairwise-ranking of on-farm enterprises (including employment) and natural grain protectants;
- wealth-ranking;
- semi-structured interviews at individual level, focusing on main crops and post-harvest constraints.

PFM techniques were also used in parallel to test their comparative performance with PRA. The main PFM methods used were causal diagrams2 and labour budgets.3

The team stayed in the village throughout the PRA exercise, which enabled further informal discussions and participation in everyday tasks.

The team held regular debriefing sessions in the evenings to compare notes and discuss emerging findings.

---

2 . Farmers first discussed their problems and listed them. They then scored the problems. From this list of problems a causal diagram was drawn, indicating the links between the problems, and adding additional causes and effects of problems.

3 Activities undertaken in each month are identified, and different types of beans are used to represent the no. of people involved in each activity and the number of days that the activity takes.

2.1 Survey Team

The multi-disciplinary team consisted of:

- Brighton Mvumi — crop post-harvest
- Ivy Mzuma — entomologist
- Bertha Mudamburi — animal draft power
- Elijah Nyakudya — agricultural engineering
- Irvine Chatizwa — agricultural engineering

Charlotte Boyd (socio-economist, Overseas Development Institute) and Mark Galpin (agronomist, University of Reading) provided back-stopping support on PRA and PFM techniques respectively.

2.2 Survey Site

The survey site, of Vidcos D, E and F in Ward 21 of Chivi District, was selected in order to incorporate farmers participating in the monitoring of maize storage trials.

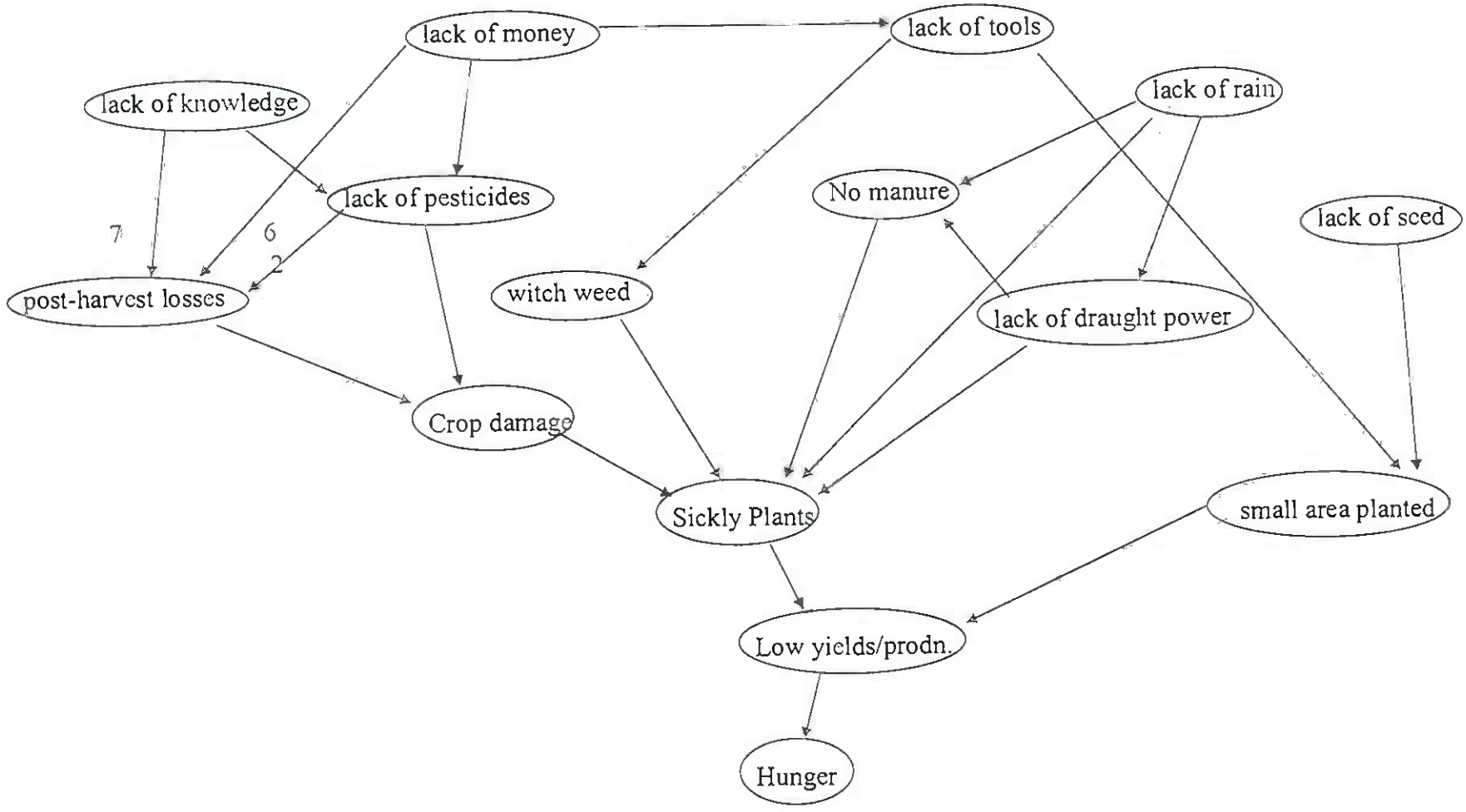
The survey site is predominantly Natural Region V (implying average annual rainfall of less than 500mm). Farmers categorised two main soil types: mishesha (sandy soils) and black soils (loams). This was corroborated by the transect walk which found a range of sandy soils with coarse stones, sandy soils with fine sand, and black loamy soils. The village-level map and transect are transcribed in Figures 2.2a and 2.2b respectively.

The site is some distance [details?] from the main trunk road between Harare and Beit Bridge on the South African border, and about [?] km from Chivi Town, the District's service centre.

Intermediate Technology Zimbabwe (ITZ) have been working with all the Vidcos in Chivi District since 1991, focusing on building the capacity of community groups to identify and solve their own food security problems (Mvumi, 1996), and their involvement was very apparent during the fieldwork.

[insert Figures 2.2a and 2.2b respectively]

Diagram 3. Causal Diagram of general agricultural problems, as identified by farmers



3. FARMING SYSTEM

3.1 Land

Allocation

The amount of arable land varies from one family to another as parents tend to redistribute the land to their children. If a stranger requires land to settle on, the kraal head is approached who will decide whether he can allocate land. This issue was controversial as land availability is apparently decreasing and farmers cannot grow as much as they would like, so they feel that the kraal head should not continue allocating land to new households. Lack of land not only limits total production, but was several times mentioned as a constraint on crop diversity.

Grazing land is communally owned, though every village has a specific grazing area during the crop-growing season. Off-season, cattle and donkeys graze anywhere. Disputes tend to arise when cattle graze in someone's field, but are usually settled between themselves.

Soil fertility

Farmers mainly depend on manure and anthill soil for improving soil fertility (for example, anthill soil and manure can enable maize to be grown in sandy soils). If artificial fertilisers are used, these are for top-dressing. Basal fertilisers are rarely used.

One woman lost all her livestock in the 1991/2 drought. She is therefore entirely dependent on anthill soil for improving soil fertility, as she cannot afford fertilisers.

Planting patterns

Farmers tend to grow a large number of crops in small proportions to spread the risk. Planting patterns reflect soil types: millets, sorghum tend to be grown on sandy soils, while maize and occasionally cotton are grown on black loamy soils. Farmers disagreed over whether it was worthwhile planting groundnuts on poor soils. One farmer commented that actual cropping patterns also reflect the stage of rotation. Gardens are located mainly on riverbanks with access to plenty of fresh water. Rice is also occasionally grown near water sources and along contours. Farm-level maps are transcribed in Figure 3.

[insert Figure 3]

3.2 Rainfall

There is a single rainy season, starting in November, peaking in December and again in March with a 'mini-drought' in January. The dry season starts in June. Table 3.2 below shows how farmers attributed rainfall over the year:

Table 3.2: Annual rainfall calendar

Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
7	10	7	12	14	5	3					

From January to August, there is plenty of water. September-November it is very difficult, except for those close to the Runde or Save Rivers. Many farmers are considering buying pumps.

In discussions as part of a general causal diagram (see Diagram 3), the major problem identified by farmers was 'lack of rain'. They considered that this problem resulted in the death of livestock and therefore 'lack of draught power'. 'Lack of rain' also resulted in a lack of fodder resulting in 'no manure'. 'No manure' led to poor plants, and 'lack of draught power' resulted in late planting and weeding causing low yields.

3.3 Labour

Planting

The main planting season is October to December, with a significant peak in November. Sorghum may be dry planted in October, but most is planted in November (SV1 and SV2). The planting time of sorghum depends mostly on whether long season or short season varieties are chosen.

Harvesting

Harvesting peaks in April, although some is harvested in March, and harvesting continues into May. Sweet potatoes are harvested in June through August.

There are severe labour shortages at planting and harvesting times, with implications for the timeliness of activities. Table 3.3 below therefore presents a labour calendar for planting and harvesting of the main crops.

Table 3.3: Annual labour calendar

	Planting					Harvesting						
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
sorghum	2	10					10	2				
finger millet	10						10	2				
groundnuts		10				10	2					
maize		10	2				4	8				
bambara		10	2				7	5				
sweet pot.		12							2	6	4	
pearl millet		8	4		2	10						

Labour constraints

Lack of draught power, following the 1991/2 drought, has led to labour bottlenecks particular during land preparation and weeding. Farmers without access to draught power prepare the land in ridges with hoes and hand plant which is time consuming and laborious. Animal-drawn cultivators are also an important means of relieving labour constraints during weeding.

The labour budget was undertaken to determine the labour requirements for different activities associated with the production, harvesting and processing of pearl millet and to determine how activities are separated by age and gender (see below for details on labour differentiation).

Size of family and access to draught power are the two key factors influencing labour availability. Field activities such as land preparation and weeding are much more labour intensive for families without draught power (D.P), however group labour is often used for field activities if there is no access to draught power. In the case studies, group labour was used for the second weeding by the household without access to draught power. Weeding is often not completed even by those with access to draught power, as many other crops require labour at this time. Completion of weeding is a particular problem for small families, however it does coincide with school holidays therefore children are available to assist in the fields. Bird scaring in March and April is very time consuming and children are not available to do this work as they are at school.

Harvesting, involving the cutting of the pearl millet heads, is a labour intensive activity and often labour groups are used. Threshing is also very labour intensive and labour groups are again often utilised. Draught animals are used for treading out the grain if they are available to the group, but groups with no access to draught animals do this work by hand using flails. Winnowing takes place at the same time if group

labour is used and then the grain is transported to the permanent granaries. Transport is easier for those with access to draught power.

A comparison of maize and pearl millet labour requirements for families with access to draught power (case-studies 1 & 3) shows that maize has a lower labour demand than pearl millet. The main differences being that no bird scaring is required with maize. Harvesting and threshing of pearl millet also takes longer and is much more labour intensive than de-husking and shelling of maize. Group labour is also used for the de-husking of maize. The major difference in post-harvest processing between the two crops is the very high labour requirement involved in threshing of millet, as compared to maize shelling. Shortages in labour can result in a delay in threshing of a crop, with the crop spending more time in the temporary store, unthreshed. An example of this is short-term sorghum varieties (e.g.SV2) which have a much shorter growth period than pearl millet, and are normally harvested in February. Sorghum is stored from February to July unthreshed and then threshed together with pearl millet. This occurs as there is a labour bottle-neck in February as many other activities also occur at this time. This has important implications if more losses occur in temporary storage than in permanent storage, as suggested later in this report.

The primary source of labour is from immediate family members resident in the home. Hiring of labour is only common amongst the better-off farmers. Labour groups are a important source of labour for the majority of farmers.

3.4 Capital inputs

Productive assets

In the wealth-ranking, ownership or access to productive assets, such as draught power, ploughs, cultivators and scotch carts are closely associated with high yields, indicating the important role that these play within the farming system.

Cattle numbers were decimated by the 1991/2 drought, and numbers have not yet recovered. The average household now owns 8 head, compared to about 30 in 1970. Veterinary attention and knowledge is limited, and the farmers require advice on and cattle diseases, especially lumpy skin diseases, and how to remedy them. (Researchers noted that there has been a general shift towards donkeys which, as browsers, are more drought tolerant).

Many households therefore no longer own to draught power. Some households can access draught power through kinship relations or through ploughing clubs. Others must use hoes for land preparation, which is a particular constraint for field crops, such as maize, finger millet and sorghum. Yields have declined substantially since the 1991/2 drought, which is attributed to lack of draught power and the consequent delay in critical operations, and lack of manure to improve soil fertility. Lack of livestock is also a constraint during threshing as crops may be prepared by having animals driven over them.

Diagram 3.3. Production and post-production activities and related labour requirements for pearl millet (with and without Draft Power) and Maize (with draft power)

OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
Activities Pearl Millet Dry planting	Planting and weeding (thinning)	Weeding		2nd weeding	Bird scaring,	Bird scaring' Harvesting	Harvesting (winter ploughing)	tsapi (temporary granary)	threshing, permanent storage, brewing	Threshing, permanent storage, Beer brewing	Threshing, permanent storage, Beer brewing
Family 1 (with DP) 3 days 2 people (5)	thinning 5 days 2 people (10)	Cultivation (2 days) Hand weeding 6 days 5 people (30)	(0)	second weeding 2 people 10 days (20)	bird scaring 2 people 30 days (60)	bird scaring 2 people 30 days (60)	Harvesting 2 people 15 days (30)	harvesting and transport 2 people, 15 days (30)	Threshing (group labour) 20 people 1 day (to granary)	(threshing) Brewing	 Brewing 1 person 4 days (4) (per brew)
family 2 (no DP) Dry pl. 3 people 30 days (90)	 Dry pl. 3 people, 15 days (45)	Weeding 3 people 30 days (part of the day) (90)		2nd weeding 20 people 1 day (group) (20)	bird scaring 2 people 30 days (60)	bird scaring 2 people 30 days (60)	harvesting 20 people 1 day (group) 2 people 1 day (finish off) (22)		Threshing 2 people 3 days (6) Winnow 3*2 = (6) Transport to granary (2*1 = 2) (14)	Brewing	Brewing
Maize with DP.	planting behind plough 3 people 2 days (6)	cultiv. & weeding 3 people 2 d weed 2 d cult (12)	Weeding 3 people 3 days (9)			Harvest, cutting and stooking 3 p * 4 d (12)	dehusking (group) 10p*1d (10) Transport 3p*1d (3) (13)			Shelling and storage 2 days * 4 people (8)	

Figures in brackets (9) represent approximate man-days calculated by multiplying no. of people by no. of days. This was done by researchers after completion of the labour budget.

In discussion as part of the general causal diagram (see Diagram 3), 'lack of tools' was considered responsible for 'witch weed' (*Striga spps.*) and hence the poor condition of plants, as winter ploughing and cultivation was said to control witch-weed infestation. However, it was not considered a major problem as it only occurred in a few fields and affected a few crops. 'Lack of tools' also resulted in a small area being planted and was caused by 'lack of money'.

Purchased inputs

In semi-structured interviews, most farmers said they used seed saved from the previous season, with the general exception of maize for those who can afford it. Few farmers acknowledged using fertilisers or chemical pesticides. Many farmers would like to grow cotton, but feel constrained by the high requirements for purchased inputs.

3.5 Enterprise ranking

A pair-wise ranking of on-farm enterprise/activities together with employment is presented in Table 3.5 below. Activities were ranked in terms of the 'most enviable' occupation.

Table 3.5: Enterprise ranking

	employ-ment	small livestock	large livestock	pulses	cash crops	horti-culture	field crops
field crops	field crops	field crops	field crops	field crops	cash crops	field crops	
horticulture	employ-ment	small livestock	large livestock	pulses	cash crops		
cash crops	cash crops	cash crops	cash crops	cash crops			
pulses	employ-ment	pulses	large livestock				
large livestock	large livestock	large livestock					
small livestock	employ-ment						
SCORE	3	1	4	2	6	0	5
RANKING	4	6	3	5	1	7	2

The single cash crop under discussion was cotton. Most farmers do not grow cotton, but have noted that those who do are well off. One cotton bale is valued higher than goats or chickens or even an ox. Farmers would prefer to shift into cotton, but are limited by lack of cash for inputs, poor soil-types and low rainfall. Within existing

constraints, field crops were therefore considered the most valued enterprise. Farmers felt that livestock ownership was preferable to employment, as those with livestock could sell it for the earnings of the employed. Pulses were considered more important than goats, and poultry. In the previous season, people benefited most from sales of pulses and sorghum. Small livestock was not considered an enviable enterprise. Horticulture was only a worthwhile project in the past, but now almost everyone in the Ward is involved and so there is no market.

4. IMPORTANT CROPS

4.1 Crop-Ranking

In the past, the main crops were pearl millet, sorghum and finger millet grown for subsistence. Maize was grown only on anthills and consumed as green mealies. A small amount of groundnuts were also grown for peanut butter. Cowpeas were also grown.

At present, farmers continue to grow pearl millet, sorghum and finger millet on a yearly basis in case of drought. There has been a shift towards cash crops such as increased production of ground nuts and cotton.

Crop-rankings were undertaken at various stages in the survey against a range of criteria. Table 4.1a below presents a general matrix-ranking of importance against farmer-identified criteria.

Table 4.1a: Crop-ranking by importance

	sadza	beer	drought tolerance	pest tolerance	cash	snack food	score	RANK
pearl millet	5	4	5	4	3		21	1
finger millet	3	5	4	5	1		18	2
sorghum	4	3	4	1	2	3	17	3
ground-nuts			2	2	5	4	13	4
bambara nuts			1	3	4	5	13	4

In a separate ranking exercise, the main crops used for sadza were ranked in terms of the quality of sadza produced, with the following results:

Table 4.1b: Preference for sadza

Rank	Crop	Comments
1	pearl millet	quite filling - sustains a man all day long
2	finger millet	especially with meat
3	sorghum	quite filling
4	maize	relatively tasty, but not at all filling

Crops used for brewing were also separately ranked in terms of the quality of beer produced, as follows:

1. finger millet;
2. Sorghum (SV2) combined with finger millet;
3. pearl millet combined with finger millet;
4. pearl millet.

4.2 Pearl millet

In general terms, pearl millet was ranked highly for food security as it is a drought-resistant staple with long storability, but it has limited commercial value. Its main use is for sadza, but it is also used for beer-brewing and as a poultry food (as it encourages egg-laying).

Production of pearl millet has not changed much over the years: farmers only grow sufficient for food security purposes. It is generally a low-yielding crop: the greater part of the field is allocated to traditional varieties, because although these are low-yielding they have better weevil-resistance. Modern varieties (short-season) are high-yielding, but are extremely susceptible to weevil infestation, therefore only small amounts are grown. Bird damage is a serious constraint, and one farmer interviewed had abandoned some portions of her fields because almost all the ears had been eaten prior to harvest. Other limits to increased production include lack of land, drought in some years, or water-logging in others (e.g. 1996/7).

Table 4.2 below presents a seasonal calendar for pearl millet, focusing on post-harvest activities.

Table 4.2: Seasonal calendar: pearl millet

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Plant-ing	10	2	2	2								
Weed-ing		12	16	19	3							
Harvest-ing					4	12	7					
Thresh-ing/ storage									10	21	14	3
Market-ing				8	4							

Pearl millet is harvested by cutting the heads, then stored unthreshed in a temporary store (tsapi) close to the fields or threshing site. Threshing is done collectively through clubs, in 3 hour, 7 hour and 8 hour sessions. The husks are skin-irritants.

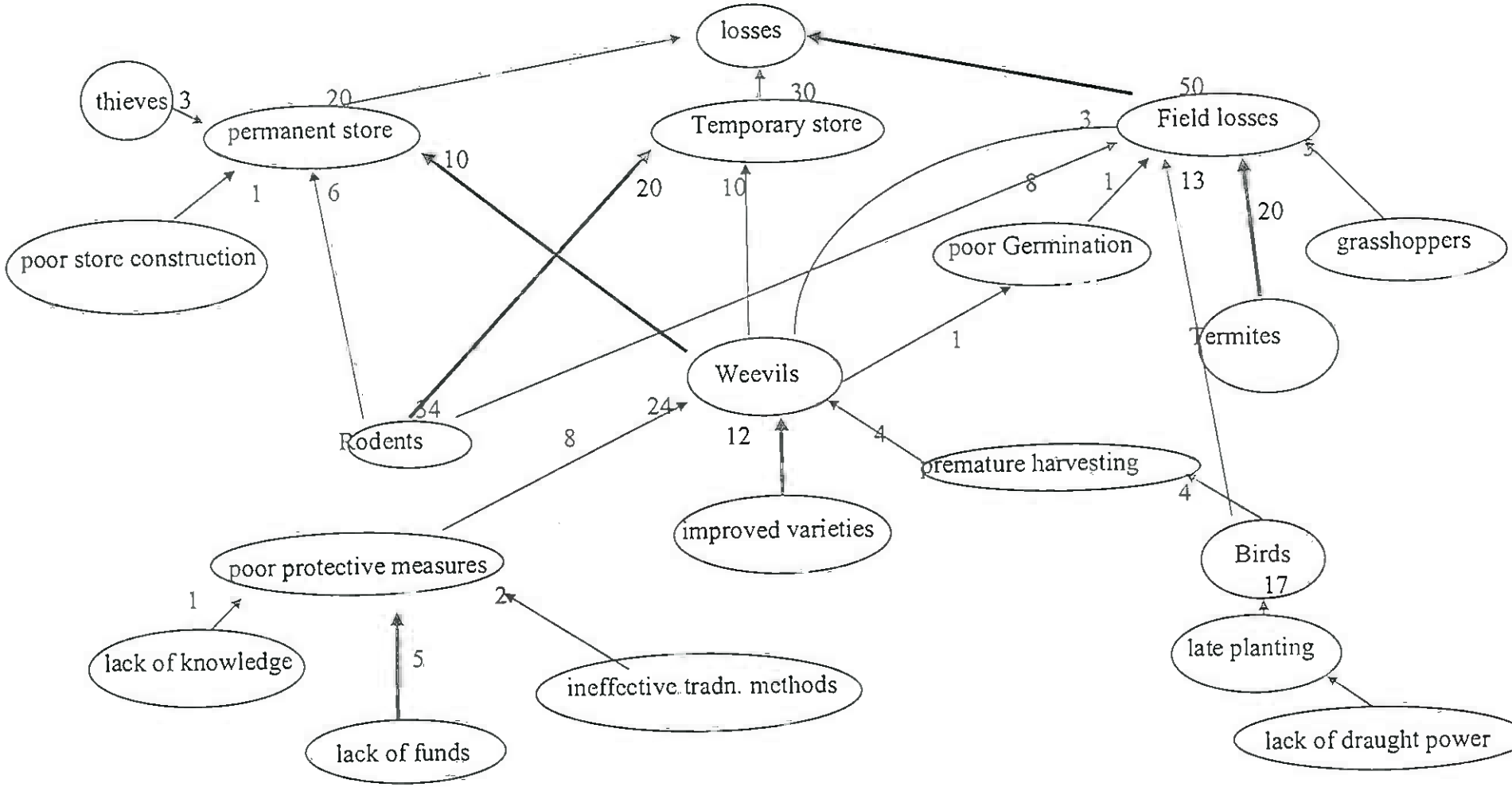
Once threshed, the grain is placed in the permanent store in the homestead. Pearl millet can be stored for up to 6 or 7 years, although modern varieties are more susceptible to weevils. No protective measures are used to prevent weevils in the granary. It is extremely hard to pound it into mealie meal.

Marketing is not considered a problem as it is mainly kept for home consumption or beer brewing, which is marketed locally. Limited marketing takes place in the hungry season of January and February to those who would starve otherwise. (January disease: people haven't got money because of school fees and input costs, so they are forced to sell most of their stored grain.) There is no known market outside the community.

A specific causal diagram was drawn for pearl millet. Crop losses after maturity of the crop were divided into losses which occurred in the field, in the temporary store and in the permanent store. Field losses (50)were considered to be the most important, then losses in the temporary store (30) and finally losses in the permanent store (20) as least important. It is interesting that this group were in agreement that most losses occur in the field, however they felt that more losses occurred in the temporary store than the permanent store. It may be that this is explained by pearl millet being more resistant to weevils than maize and legume crops which where also considered in the general post-harvest constraints causal diagram. The major cause of field losses is through pests in the following order of importance; termites (20), birds (13), Rodents (8), grasshoppers (5), and weevils (3). All these pests damage the crop once it is harvested and piled in the field. Weevils also cause indirect field losses by reducing seed germination. Temporary store losses are caused primarily by rodents (20), but also by weevils (10). Weevils are the major cause of loss from permanent stores (10), with rodents being less important (6). Thieves (3)

Diagram 4.2: Causal diagram for post-maturity problems in pearl millet and sorghum

.NB. The higher the score the more important the problem



and poor store construction (1) were also seen as causing losses from permanent storage. Poor construction involved poor siting and poor construction of the roof resulting in losses from moisture. However farmers felt that the primary cause of poor construction was laziness and that if the farmer wanted to overcome these construction problems he could easily do so. Lack of knowledge was not considered to be a constraint resulting in poor store construction. Losses also occurred during the transporting of the harvest from the field to the temporary store, and during threshing.

Pearl Millet is used as a staple food as well as for brewing beer. The quality of the staple food (sadza) and the beer significantly deteriorates through the season with an increase in pest infestation. Eventually, the quality of the grain is so poor that it does not germinate when placed in water to make malt, and so cannot be used for brewing.

Rodents

Rodents cause major losses from the temporary storage structures (20) and the field (8), with less important loss from permanent stores (6). Reasons given for this were that permanent stores are of better construction and close to the homestead, where cats are often kept to control rodents. Temporary storage structures are far from the homestead, and often built on rocky outcrops where a lot of rodents are present. When the crop is in the field there is no protection against rodent damage. There are apparently no traditional methods of rodent control.

Weevils

Weevils cause damage at all three stages of the storage process and particularly in the permanent and temporary store, with less damage occurring in the field. The major cause of the high damage caused by weevils is given as the susceptibility of 'improved varieties'(12) to weevil damage. Ineffective traditional methods (2) and the cost of chemical treatments (5) resulting in a lack of protective measures being taken. Lack of knowledge (1) is also given as a minor cause of the lack of protective measures taken. Weevil damage is exacerbated if premature harvesting occurs. Early harvesting is carried out to avoid bird damage. During discussion of the importance of weevil damage, some farmers felt that weevil damage once the crop was in the granary was not important as they could still eat the grain even if it was damaged. This highlights the problem of farmers perception of post-harvest problems. Often the problem may be more serious than the farmer realises. If this is the case then trials done with farmers to assess weight loss during storage etc. can be very useful in assessing, together with the farmer, the seriousness of the problems.

Adding-up and comparing the total scores for weevils and rodents, rodents appeared to be the most important problem primarily due to their major effect on temporary storage losses. However when farmers were asked for clarification on this point, there was some dispute with a number of farmers saying that weevils were in fact more important than rodents.

Seed storage and selection

Weevil damage was identified as a cause for poor germination in the field. This resulted in a brief discussion of seed selection and storage. Some farmers select seed after storage of the crop prior to planting. When this is done problems of germination occur. However, most farmers grade the crop in the field and select seed heads for size and maturity. Seed heads are then stored in the roof of the kitchen unthreshed. For groundnuts, seed selection occurs once the crop is shelled just before planting, however farmers stressed the importance of keeping the crop away from rodents e.g. by storing in sealed earthenware pots.

4.3 Finger millet

Finger millet is one of the major crops grown, mainly for beer-brewing. It is also grown as a food security crop, but cannot be used for sadza on a daily basis due to its constipating effect.

The red heads are harvested by cutting, using locally-made knives. This is time-consuming, but not a very hard job. The heads are left in a pile for about three days, to allow them all to ripen. They are dried on bare rocks of cowdung-polished yards, then stored in the temporary holding store (tsapi). Threshing requires hard labour but produces no skin irritation. There are no weevil problems, but rodents may be a problem. As it brews the best-tasting beer, there is a ready local market for cash. Brewing is a woman's task and cash sales form an important part of women's income.

4.4 Sorghum

Sorghum production was boosted in the early 1980s with the donation of SV2 by the Government and the formation of sorghum societies. Limits to increased production of sorghum include lack of land, lack of draught power, drought in some years or water-logging in others (e.g. 1996/7), and markets. For example, one farmer stated that he only produces that which he is sure the household will need as otherwise the crop will be lost to weevils. Bird damage occurs only on the outside of heads, but the inside of compact heads remains undamaged. Termite damage occurs either prior to harvest or at harvest.

The main variety grown is SV2, which is valued for its drought tolerance, early maturity and high yields, and is good for beer-brewing. However, it is the most prone to bird damage and vulnerable to weevils. SV1 is good for sadza, and easier to process than Tsveta, which is a red sorghum and therefore has a higher tannin content. Production of tsveta (the traditional red sorghum cultivar) is decreasing, because of its late maturity and because it is less tasty and harder to process. If Dhedlani is planted early, it can be harvested before the birds come. It is also the most pest-resistant variety, but needs more moisture during the growing season.

Table 4.4 below presents a seasonal calendar for sorghum.

Table 4.4: Seasonal calendar: sorghum

	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Plant-ing	10	17	5									
Weed-ing		8	12	15	4							
Harvest-ing					5	10	15	12				
Thresh-ing									10	12	8	
Storage										7	10	5
Amount in store	7	6	4	2						10	12	14
Weevil infest-ation	25	30							5	10	15	20
Market-ing		5	12	15								

Problems occur when the rains start before harvesting is complete. Weevil infestation starts even in the holding crib, well before threshing. The sorghum is cut and dried on a bare rock or dung-smeared surface. It is stored temporarily in the tsapi prior to threshing. Long sticks are used for threshing, preferably after animals have been driven over the crop.

After threshing, sorghum is transferred to permanent storage. SV2 and SV1 and other short season varieties has poor storage properties. Weevils are worse in the threshed than unthreshed crop.

Sorghum is not usually sold but retained for home consumption or beer-brewing. Households try to ensure that the granaries will be full in January. Beer-brewing is a lucrative form of income generation for women.

The decision to sell is based on agreement between husband and wife. Red sorghum is marketed to Chibuku Breweries, sometimes on contract. (According to AGRITEX's Provincial Crop Specialist, farmers must register with Chibuku, Chibuku prefers seed to be bought from them, advance payment is offered to commercial farmers, but not to small-scale farmers). National breweries buys red sorghum and also takes white sorghum, collecting from farmers at a central collecting point. National Breweries encourages farmers to form groups and establish production levels then buys everything. White sorghum is much harder to market. Buyers determine when to buy, and insist that sorghum is stored according to variety. Marketing groups also sell as a group, ensuring fairly good prices, and arrange transport.

Farmers felt that the causal diagram drawn specifically for Pearl Millet was also relevant for Sorghum which has similar post-harvest problems to Pearl Millet. However it was noted that Sorghum is more prone to weevil infestation than Pearl Millet. There is also a type of moth which is more often present in Sorghum than pearl millet. This is possibly the larvae of *Euphestia* or *plodia spps.* as the 'worm' was said to cause a lot of webbing.

4.5 Maize

Maize is produced mainly for consumption, with little surplus produced for sale. Few farmers grow local varieties of maize, most buying hybrids. Limitations to maize production include poor soils, low rainfall, and the labour-intensity of weeding.

Maize is harvested by cutting, using hoes and stacked until dry. It is then dehusked and placed in the drying stand (*chitata*) for further drying. Taste is improved if the grain is wetted by rain and then dried. It is dehulled and winnowed before being stored in the *dura*.

There was some controversy over maize storability: some say maize keeps well, others that it is easily infested. One woman commented that there were no infestation problems for the first six months. Maize storability is increased by sun-drying it prior to storage to deter pests and storing it on the cob. Traditional protectants (see below for further details) are also used. 6 months there are no infestation problems.

Maize marketing is limited as yields are low, prices are not conducive, and transport costs are too high. In years of plenty, surplus is sold locally to those without. At other times, farmers only sell as they are desperate for cash to pay for school fees. The parastatal Grain Marketing Board (GMB), the main marketing enterprise for maize, does not send any collecting vehicles, as it assumes no crops are produced in this area. GMB is, and maize is therefore not marketed. Some farmers market maize to the GMB depot in Masvingo, but are discouraged by transport problems. Private traders can be found at the local business centres. They grade through visual assessment.

4.6 Groundnuts

Groundnuts are regarded as a woman's crop. Production is limited by land availability, but generally production meets demand. Groundnuts are primarily a cash crop, although some is retained for next year's seed.

Groundnuts are harvested by pulling and stacking within the field until dry. Too much rain during picking leads to germination and moulding. Mice are the only problem within the stacks. Ideally, stacks would be located at homesteads, but lack of containers and transport impede this. Residues are used for composting. Plucking/picking is carried out in the field, followed by winnowing and packing into bags. Groundnuts are stored unshelled, and shelled

by hand immediately prior to consumption. Mice are a minor problem during storage. Weevil damage is negligible. No treatment is applied. Women are aware of processing options such as peanut-butter machines. Groundnuts are easy to market, but the prices are very low, at about $50 per 20kg. Groundnuts are sold to GMB, Seedco and National Foods. Farmers' committees source buyers who move between the villages, and negotiate and agree prices. These private buyers grade in terms of variety and colour by a visual assessment. They provide transport and cash on delivery, and then sell to GMB for a small profit. Groundnuts are also bartered with Zimbabwean traders who sell in South Africa.

4.7 Bambara Nuts

Bambara nuts are a woman's crop, grown mainly as a snack food. A relatively low hectarage is planted, as it is a high-yielding crop, but hard to market, so if more land is allocated, farmers are left with a stockpile. Production responds to prices in previous year. High prices in 1995/6 led to high production in 1996/7. As prices in 1996/7 are low and there is no lucrative market, forecast production for 1997/8 is low.

The main production constraints are premature defoliation and senescence, striga infestation without means of control, white rot (*Sclerotium rolfsii*) which forces an early harvest, and bucks which eat the mature crop. There is low incidence of insect pests.

Bambara nuts are harvested by pulling by hand, or digging using hoes if dry. Too much rain during harvest leads to mouldy crops. The nuts are dried on a bare rock and winnowed to get rid of the leaves and other debris. The moisture level is critical, as it the nuts become too dry they lose weight. It is preferred to retain a high moisture content for marketing purposes. The nuts are kept in the shell for up to three years, and are only shelled immediately prior to use. Dust formulation is a problem. Shelling is done by light pounding in a mortar, followed by winnowing. In marketing, farmers' committees source buyers who move between the villages, and negotiate and agree prices. However, the buyers determine when to buy, and demand uniform colour. Poor markets are a constraint.

4.8 Cowpeas

The main production constraints for cowpeas are white rot, and bucks which eat the crop in the fields.

Cowpeas are harvested by pulling/digging. They are then picked/plucked and dried on a bare rock. If it rains before drying, they crack and/or rot, so must be kept out of the rain until the weather clears. Post-harvest pests include rodents, weevils and reptiles [gheckos?].

Cowpeas are considered very difficult to market, and at the moment, granaries are still laden with cowpeas. Prior to marketing, cowpeas are shelled and sorted, and the quality is checked

by buyers. There are many private traders at various business centres, but the 1996/7 price is very low and better markets would be preferred.

4.9 Sweet Potato

Old storage practices for sweet potato have been abandoned. Now tubers are left in the beds or ridges, and only harvested as required.

4.10 Cotton

Cotton production is considered an enviable enterprise, and has increased since 1990 when only a few farmers were involved. However, it is largely limited to areas categorised as NR IV, and most farmers feel constrained by lack knowledge and the high cost of chemical inputs. Cotton is also very labour-intensive.

In terms of post-harvest activities, there are problems with transport to take the seed cotton to the cotton gin. Cotton may be marketed to Cotco or Cotpro, a private trading company which provides transport to farmers.

4.11 Sunflower

Farmers reported variously that sunflower was bought by local businessmen, and that there is no decent market for sunflower, and is usually bartered for sugar and flour. Enough seed is left for next season's planting.

4.12 Rice

Rice is occasionally grown close to water sources and along contours. It is reserved for home consumption, and never sold.

4.13 Horticulture

Gardening for home consumption was introduced in the 1980s. In the 1990s, gardening cooperatives were formed, and started to sell produce within the community. Awareness of the value of gardens has increased as a result of action groups, interaction with other groups, and Independence. Before Independence, people thought vegetables were for whites only, but now they are more aware of their palatability.

There is a cooperative Garden Club, and some individual gardens. For example, one woman with access to a vlei where she grows maize for green mealies from November to April, and cabbage, tomatoes, sweet potato from May to October.

Horticultural diversity has also increased, and now includes rape, cabbage, spinach, lettuce, cauliflower, chomollier, tomatoes, onions, eggplant, peas, beetroot, broccoli, and carrots.

As more people have become involved, horticultural produce has become less easy to market. Gardens located mainly on riverbanks with plenty of fresh water. Main markets far away from rivers where insufficient water for gardening. (For further details see horticultural report.)

5. POST-HARVEST CONSTRAINTS

5.1 Ranking of constraints

It was apparent that the farmers' primary concern were production constraints rather than post-harvest constraints. Discussion indicated that post-harvest constraints are fairly serious, but farmers were aware that the researchers were working on post-harvest issues.

In the general causal diagram (see Diagram 3), farmers indicated that 'post harvest losses' were caused by three factors; ' lack of pesticides', 'lack of knowledge' and 'lack of money'. Scoring of these three causes (out of 15) resulted in 'lack of knowledge'(7) being considered the major problem, then 'lack of money'(6) as this resulted in problems of purchasing pesticides and other items , with 'lack of pesticides'(2) relating to the availability of pesticides, being given a low score. Two areas where knowledge was lacking were identified by farmers. Lack of knowledge on store design and construction, and lack of knowledge resulting in the incorrect use of pesticides. It is likely that farmers were again influenced by their perception of the researchers area of interest. On-going work being carried out in the area involves investigations into store construction and related losses, and members of the group were aware of this and therefore may well have given more emphasis to the problem than they would have normally.

From this exercise it was apparent that farmers were aware of post-harvest issues, but did not consider them as important as problems relating to the initial production of crops. This is emphasised by the scoring of problems in which post-harvest losses received the lowest score. It is likely that post-harvest losses were mentioned as the farmers were aware of this as an area of interest to the researchers. This was also the case for 'lack of knowledge' being given as the most important cause of post-harvest problems, though the identification of two areas where knowledge is lacking is interesting. The lack of financial resources (money) also appears to be a significant constraint to farmers, resulting in post-harvest losses. It is worth noting that marketing problems were raised as a problem but were not included by farmers in the diagram. These problems included the unavailability of markets and transport to the market.

In a causal diagram focusing on post-harvest constraints, farmers indicated that the most significant losses that occur after crop maturity, occur in the field and in the permanent store. Field losses include losses after maturity but prior to harvest, and losses incurred after harvest but prior to the crop being stored e.g. while it is still in the field. These losses are exacerbated by the problem of transporting the crop from the field to the temporary store i.e. lack of scotch-carts and containers in which to transport the crop.

A matrix-ranking of post-harvest constraints is presented in Table 5.1 below.

Table 5.1: Matrix-Ranking of Post-Harvest Constraints

	Pearl millet	Maize	Ground-nuts	Finger millet	Sorghum	Bambara	Cowpeas
Harvesting	7	1	3	6	2	5	4
Threshing/ winnowing	5	1	4	7	6	3	2
Permanent storage	4	7	3	1	6	2	5
Marketing	1	5	3	2	4	6	7
Score	17	14	13	16	18	16	18
RANK	3	6	7	4	1	4	1

5.2 Harvesting

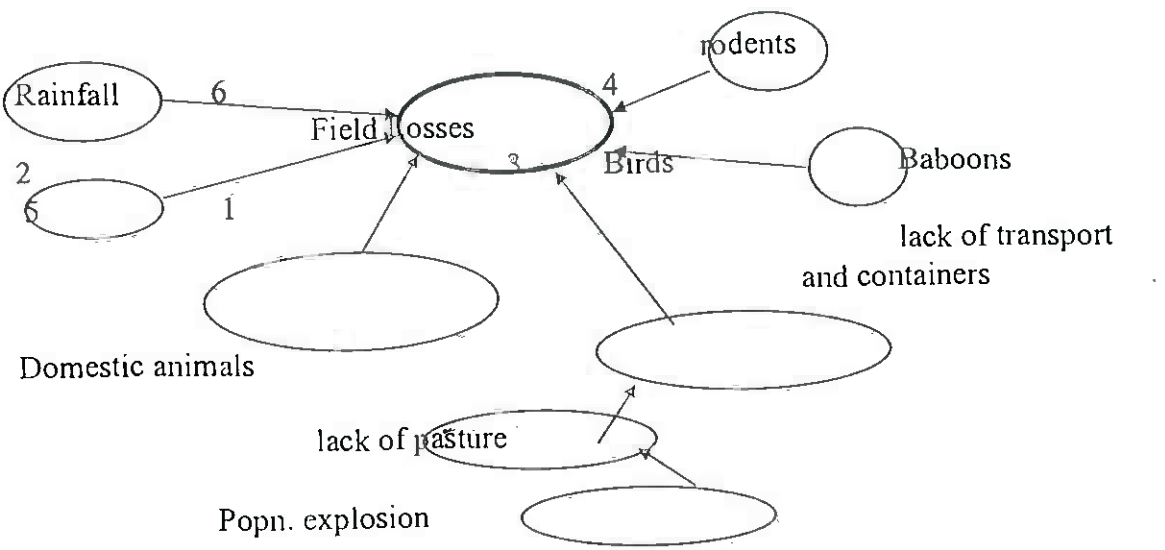
Harvesting is a problem for pearl millet, finger millet and bambara nuts because of labour-intensity. Finger millet is very labour intensive to harvest, and can take up to a month. Maize on the other hand can be harvested even by old ladies. Pearl millet was considered hardest to harvest because of bird damage.

As part of a causal diagram, farmers identified the major cause of loss in the field as rainfall occurring at or prior to, harvest. This results in the rotting of the crop. However the scale of this problem may have been accentuated due to heavy rains the previous year and may not be representative of an average year in this area. Rodents, birds and baboons also cause field losses, in that order of severity. Losses from pests are greatest once the crop has been harvested and is piled or stooked in the field, as the crop is concentrated in one place and is more accessible to pests.

A minor cause of loss is damage by domestic animals. This occurs if harvesting is delayed either due to late planting or labour shortages. It is the headman's responsibility to decide when domestic animals no longer need to be herded but can be left to graze freely. This

results in animals entering fields and causing damage to late crops which have not been harvested. Lack of pasture was given as the cause of this loss, as once available pasture is exhausted and animals become weak, there is pressure on the headman to release the animals early on in the season. Furthermore, the labour involved in herding them is very high. Lack of pasture was given as being the result of a 'population explosion', resulting in pressure on land and reduced area and quality of grazing.

Diagram 5.2: Causal diagram for field losses



5.3 Threshing

Threshing is a problem for finger millet, sorghum and pearl millet. Finger millet, in particular, is very labour intensive.

Transport from the field to the homestead is a constraint for those who do not own scotch carts and must hire instead or use a wheelbarrow. One woman said that she either hires a scotch cart and pays in fowls, or uses bags.

5.4 Storage

Farmers felt that grain losses in store are not a major problem, as it is more important to produce the grain in the first place. For example, in the general causal diagram (see Diagram 3), the distinction was made between field and post harvest losses caused by pests, and there was some discussion amongst the group as to whether post-harvest problems were important enough to be included.

During mapping exercises, two types of storage structures were identified:

1. tsapi for primary storage, mainly located in or near fields on bare flat rock;
2. dura for secondary storage, mainly located in the homestead.

Temporary stores are used for storing the crop between harvesting and threshing. Pearl millet presents a temporary storage problem because it is usually the first crop to be harvested (to avoid bird damage), and it is necessary to prepare the store well beforehand.

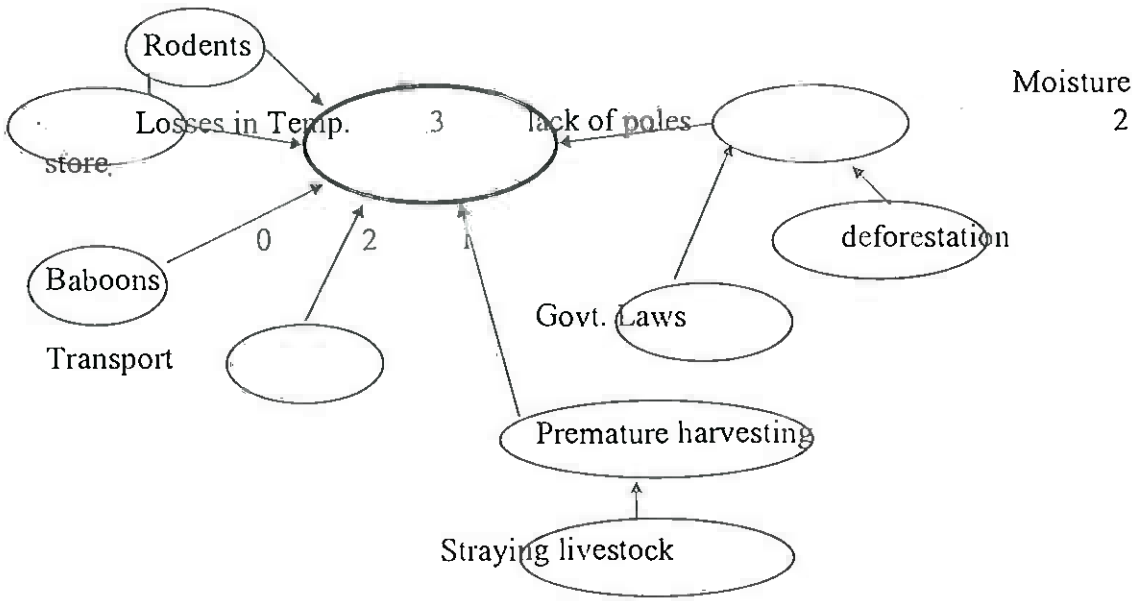
In a causal diagram of post-harvest constraints, losses in temporary store were considered minor compared with those in the field and permanent store. Of the causes of losses sustained while the crop is actually in the store, moisture is the most important factor. This occurs primarily from water running over the surface of the rocks that the stores are built on, and into the bottom of the granaries. This can be avoided by 'damp-proof coursing' the granary. Rodents are also considered a problem in temporary stores, and baboons also cause losses.

Premature harvesting, caused by the release of livestock, as explained above also results in losses in storage as this increases the susceptibility of the grain to insects.

However, the most serious constraint related to temporary storage structures is the lack of poles for store construction. If temporary stores cannot be built, the crops remain in the field for a longer period of time and are more susceptible to damage as they are exposed to rain and pests. Lack of poles results from a shortage of trees due to deforestation and resulting Government legislation prohibiting the cutting down of trees.

Temporary stores are built close to the fields, often on or near to rock surfaces on which threshing of millet and sorghum can be done. Following threshing, the crop is transferred to the permanent store. Transport of the crop from the temporary store to the homestead is also a problem. Delays in transporting the crop can increase losses.

Diagram 5.4a: Temporary storage losses



The permanent granary is also divided into short-term and long-term storage, as it is not wise to keep opening and treading on crops, such maize, in the granary as this predisposes it to weevils. The key to successful long-term storage is not to disturb the granary. Maize was considered the hardest to store as it is vulnerable to weevil infestation. Similarly sorghum is difficult because birds force farmers to harvest early which encourages weevil infestation. Modern varieties of pearl millet are susceptible to weevils. Groundnuts are attacked by mice. Bambara nuts can be stored for up to three years, and rodent damage is negligible. Finger millet is the easiest to store. Cowpeas, groundnuts are usually stored unshelled.

New granaries are built in good years, such as 1996/7, to store surplus production. Farmers appealed for new technology to improve storage structures. As the weather is now unpredictable, long-term storage has become more important. The need for storage is also related to marketing.

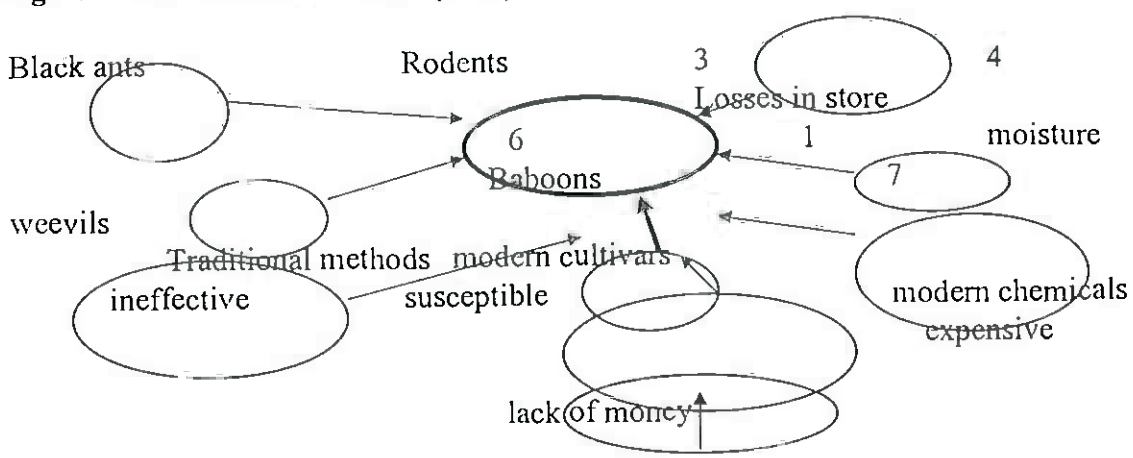
In the causal diagram of post-harvest constraints, losses in the permanent store (dura) are considered as important as losses in the field. The most significant cause of loss in the permanent store is considered to be weevils. This weevil damage occurs as traditional methods of protecting stored products, including the use of eucalyptus leaves, finger millet husks, and leaves from an indigenous tree species, 'mutovhoti' (*Spirostachys spps*), are not very effective, combined with the fact that modern cultivars are more susceptible to weevil damage than traditional varieties (see below for further details). Farmers do not use modern chemicals as they are too expensive.

In the past, weevils were considered to be less of a problem. The explanation given for this by one farmer was that cereals used to be (it is not clear when exactly) dry planted very early and germinated with the rains and therefore by the time the previous crop was infested by weevils

the new crop was ready for harvest. Therefore weevil damage was not considered to be important, as by the time it occurred they already had the new crop. This may have been the case, though it would seem more likely that traditional landraces were more resistant to weevil damage than modern varieties and therefore lasted longer.

Baboons were considered the next most important cause of losses in the permanent store, though this problem is only pronounced during drought years when there is a lack of wild foods for them. Black ants (not termites) were the third most important cause of losses in permanent storage. Although their occurrence was not very common, when they did occur , all the contents in the granary could be destroyed. Rodents also cause losses in store, and moisture was considered to be a minor cause of crop damage in the store and associated with poor design and / or construction.

Diagram 5.4b: Permanent store (*dura*) losses



Pest Control during Storage

The main storage pests cited were weevils. Farmers were not clear where they come from, but said that some come from wood. They distinguished between dark ones and light ones which fly. There is no difference in weevil infestation between old and new granaries.

Good storage practice involves lining the granary with traditional storage treatments or using modern chemicals. A pairwise ranking was conducted of natural methods of pest control, as presented in Table 5.4 below.

Table 5.4: Ranking of natural methods of pest control

	Mutovhoti	Eucalyptus	Finger millet chaff	RANK
Finger millet chaff	finger millet chaff	finger millet chaff		1
Eucalyptus	mutovhoti			3
Mutovhoti				2

Finger millet chaff:
The chaff from finger millet causes suffocation, and acts like a fumigant.

Mutovhoti (Spirostaclys africana):
For mutovhoti, farmers take the tree and cut it into small pieces which they later put inside the granary. The smell, which deters pests, does not in any way affect the grain. Mutovhoti can also be used for doorframes and roofing to scare away termites. It is also used to scare away evil spirits. It has a slow growth rate, and is never used for firewood. A milky substance exudes from the tree, which gives a pungent smell. Farmers burn it and collect the ash for aphid control in the garden.

Eucalyptus leaves:
The smell of gumtree leaves is also a deterrent. Fresh leaves are placed in the storage area. It is not very effective especially as the leaves dry-up. It is necessary to keep on putting in fresh leaves.

Chemical protectants:
Modern chemical treatments have recently been introduced, but farmers still depend largely on traditional methods. Of the purchased chemicals, Shumba is considered good but expensive, whereas Ingwe smells bad, especially if the grain is stored for some time.

5.5 Marketing

Most marketing takes place immediately after harvest, and crops marketed at this time are usually classified as Grade A. Grading by middlemen is usually informal and by visual assessment only. There was some controversy over whether cowpea or bambara were the hardest to market. Farmers argued that there was no market at all for cowpea, whereas the price for bambara was derisory. The price of maize is also very low. For sorghum, only red sorghum is sold. The price for groundnuts is also low. For finger millet, the beer-brewing price is good. Pearl millet is not sold, but kept for beer brewing.

Few trucks are available for transport, and these are both unreliable and expensive, so that profits realised by farmers on transported produce are insignificant. It is also difficult to source/buy containers, and hessian bags are expensive.

6. SOCIO-ECONOMIC DIFFERENTIATION

6.1 Labour Allocation in Post-Harvest Activities

While post-harvest activities are generally considered the woman's domain, all members of the family may participate in the more labour-intensive activities, such as harvesting and threshing. Labour constrained households may also arrange for collective labour.

For example, finger millet threshing is usually done collectively. It involves more women than men, and includes children of ten years and upwards, as follows:

- women 75%
- men 13%
- boys 4%
- girls 3%

Threshing of sorghum is done by the family. If labour is insufficient then collective labour is organised through the clubs or a party is held. Men, women, boys and girls participate. Normally threshing is done at the weekends so that children can help. It is easiest if animals from various households are first driven over the crop. Groundnuts and bambara nuts are women's crops, so men are rarely involved.

The labour budget provides further details on the differentiation of labour (see Diagram 3.3). Threshing is generally done through the use of labour groups incorporating both sexes. Men participate more in group threshing accompanied by beer drinking, than in group work without beer. Winnowing is done by women, and men are responsible for the transport of the grain to the granary. Men are responsible for the construction of the main frame of both the permanent and temporary storage facilities with women being responsible for the plastering and subsequent annual re-plastering. The repairs, mainly involving roofing are done by men while the women manage the day to day up-keep of the granary and the grain. Beer brewing is the women's responsibility, and a major source of income for women. Maize de-husking and shelling is generally the responsibility of women and children.

Children do not play as important a role as might be expected as they are only available during the school holidays and in the late afternoon after school. Therefore, activities such as bird-scaring which would have been done in the past by children, are now done by adults. However, they are involved in field and post-harvest activities when available. Activities involving the use of draught power, for example ploughing and cultivation are carried out by both men and women but men are responsible for the draught animals.

6.2 Wealth

Wealth-ranking of four kraals indicated the strong interrelationship between ownership/ access to productive assets and perceived wealth. Wealth is also closely linked to high yields, and the ability to grow sufficient food for the household or even a surplus. There is limited reference to off-farm occupations, such as being a businessman or nyanga, or to remittance income. Widows were frequently identified as being among the poorest.

Table 6.2 below presents interviewees characterisations of wealth groups from left to right. Columns are not labelled as the groups do not necessarily correspond precisely with each other.

Box 6.2: Aspects of wealth

One widow interviewed had no cattle, goats or donkeys and only two fowls. She used hoes instead of draught power and relies on collective labour. Her main crops were maize, groundnuts, cowpeas and sorghum. Crop diversity is restricted by land constraints. Her husband died elsewhere, and the widow returned to her parents and had a small plot of land allocated to her. She does not use fertiliser and relies on anthill soil. Her annual yields are mainly governed by rainfall.

At the other end of the scale, a wealthy farmer owns three cows, three donkeys, eight goats and twelve chickens. He grows maize, groundnuts, finger millet, sorghum (SV2), bambara, sunflower, cowpea and sweet potato. He is also involved in gardening through the cooperative.

Table 6.2: Characterisation of wealth groups

Wealthier — Poorer

Surplus grain to market. Draught animal power.	Enough grain - food secure. Have access to draught animals.	Few draught animals. Work in groups.	Not enough food. No draught power.	Very poor. Widows. Not much external support.
Cattle/ donkey owners or have access to draught animals. High yields. Most have implements and can afford agricultural inputs.	Enough yields. Some have access to draught power. Have relatives working in urban areas.	Widows. Most do not have draught power.	No draught power. Poor yields.	
At least enough draught power and implements, such as ploughs, cultivators and scotch carts.	Enough draught power (cattle, donkeys, goats), but not enough implements (e.g. only plough, no cart).	Insufficient draught power (two cows), plus a plough.	No animals nor implements. Rely on group work for land preparation and throughout the year.	
They work and have houses. They grow enough for their families and have implements and draught animals.	They do not work, but grow enough. They have implements and draught animals.	A few do not have draught power, but they grow more than the poorest group.	They do not have draught power. Most are widows. They do not have much.	
They work and have good jobs. One businessman. They have money, enough food, clothes and good housing.	They grow enough for their families and to sell. They have houses, implements and draught animals.	They do not work, or grow enough. They cannot explain how they get money to be what they are.	They do not grow enough even for their families. No clothes. They have to work in other farmers' fields for them to survive. No draught power or any livestock, even chickens.	
Workers and widows. Cattle, donkeys, goats etc. Some do not work but have plenty of livestock.	Work but no livestock. Some have reasonable numbers of cattle, but no donkeys.	Also work. Some are good farmers and often sell. One is a nyanga and has patients who pay.	Have few donkeys. Have good farming knowledge. No recognisable livestock, even goats.	Poor, but are not bad farmers.	Extremely poor and are very poor farmers.

6.3

6.4 Local Institutions

[insert social mapping]

Project Committee

The Project Committee was established in September 1996. Courses were initiated which were very beneficial. Now the society has blacksmiths and carpenters etc. The emancipation of women is also now appreciable. Women can now freely air their views in public, and participate in and contribute to various projects.

The Project Committee has generated much interest, so there are a series of projects scheduled for 1996/7. These are financed by donors. The Committee nominates who will attend particular courses.

7. CONCLUSIONS AND RECOMMENDATIONS.

7.1 Summary of Constraints

Despite the many post-harvest constraints facing farmers in Chivi Ward 21, post-harvest problems are apparently not a priority area for farmers in the area. Farmers are more concerned about production constraints, however they are aware of the causes of losses after crop maturity and harvest. Overcoming some of the post-harvest problems that are facing them, could have a significant beneficial impact on farmer's livelihoods. Although farmers perception of post-harvest losses are that they are minor, it may be that they are more important than farmers realise.

The most severe post-maturity crop losses occur in the field prior to storage. These losses occur prior to harvesting and while the crop is stored in the field. Causes of losses include exposure to rain resulting in rotting, insect pests (particularly termites), rodents and birds. These losses are exacerbated by the lack of scotchcarts and draught power to transport the crops from the field, and also by the shortage of building materials, particularly poles for the construction of temporary granaries.

The primary cause of losses in temporary storage structures are from rodents and insect damage. Poor construction can result in moisture damage. The major losses in permanent storage are due to weevils. Losses from weevils are more serious than in the past, as modern varieties are more susceptible to weevil damage than traditional landraces and the traditional protectants used are not effective. Chemical treatments are not generally used as they are too expensive. Poor construction and design of permanent granaries was not considered to be a major problem.

The major use of labour in post-harvest activities involves the threshing of small grains.

Often labour groups are utilised for this activity. Delays in threshing result in crops spending more time in the temporary storage structures where high losses can occur.

This study has focused on the causes of grain damage and loss, rather than problems relating to the marketing and processing aspects of the post-harvest process. However the marketing constraints facing farmers in the area should not be overlooked.

7.2 Areas for Further Research

The following areas of research would be of value in further assessing and overcoming farmers post-harvest constraints:

- quantification of the losses sustained at different stages of the storage process to verify farmers perceptions;
- assessment of the effectiveness of traditional protectants, particularly 'mutovhoti' tree (*Spirostachys spps.*), in comparison with chemical treatments and possible new natural protectants e.g. *Azidirachta indica* (vs insects), *Gliricidia sepium* (vs rodents);
- assessment of the suitability of *Azidirachta indica* (Neem), and *Gliricidia sepium* species to the relevant agro-ecological zone;
- basic improvements in the design and construction of temporary stores;
- design of a simple 'thresher' to reduce labour involved in threshing of millets and sorghums, and assessment of the effect of introducing this technology on traditional labour groups;
- investigate varietal susceptibility of crops to birds (for small grains) and storage insect pests (for maize and small grains).

7.3 Developmental recommendations

A number of the post-harvest constraints facing farmers in this area could be overcome by developmental activities rather than research. Possible areas of activity could include:

- improvements to temporary storage structures including rodent proofing;
- community forestry projects to provide timber for store construction. This could be combined with introducing new natural pesticides such as neem (*Azidirachta indica)* and Gliricidia (*Gliricidia sepium*) for the control of insects and rodents respectively;
- increasing availability of low cost transport devices e.g. carts, for transport of crops from the field;
- improving access to chemical protectants and advice through extension and credit programmes;
- extension on seed selection and storage methods to increase quality of home stored non-hybrid seed.