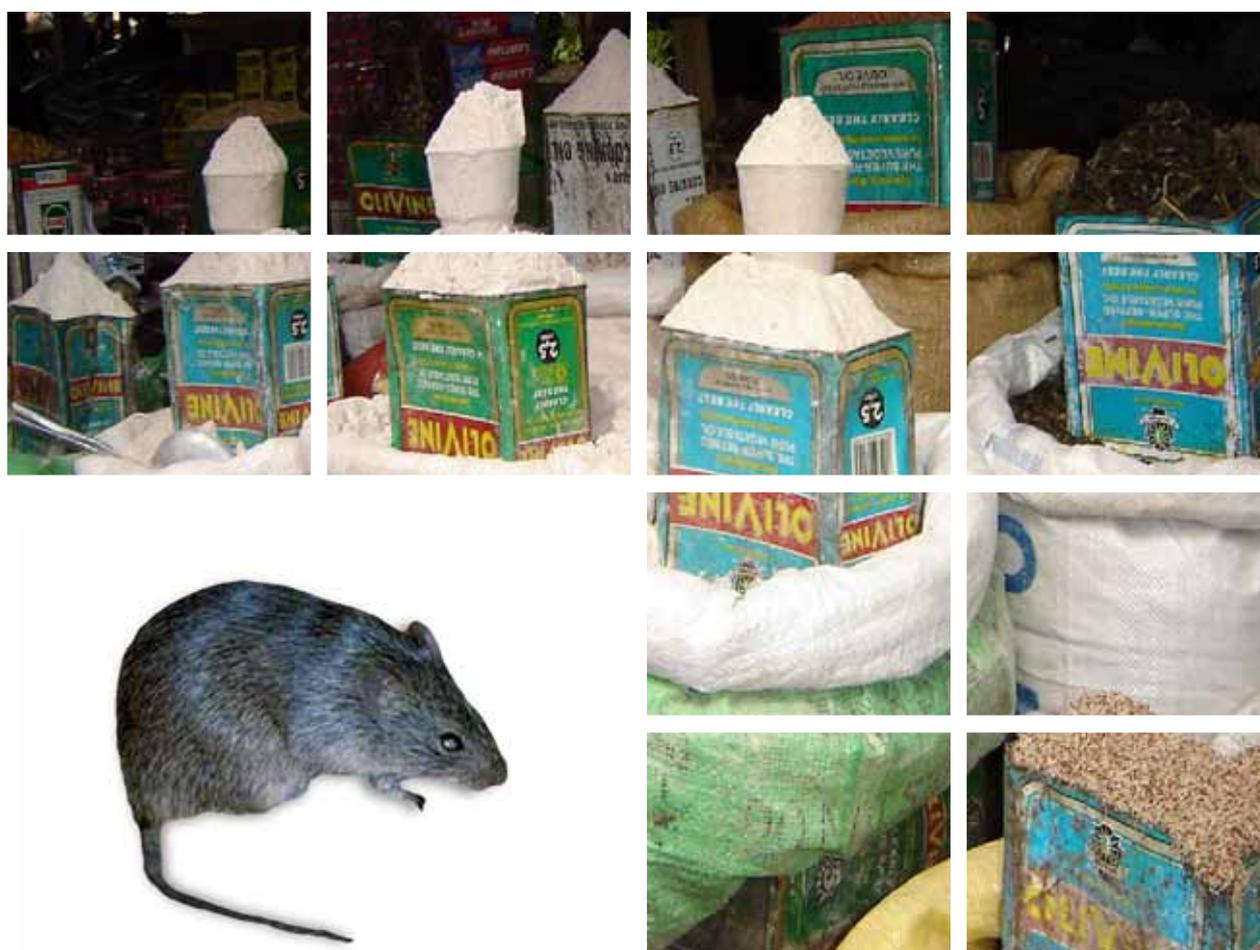


**The RATZOOMAN Project
Socio-Economic Study
NRI Report: 2782**

Socio-economic factors influencing the transmission of rodent-borne diseases in Southern Africa

January 2006



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Socio-economic factors influencing the transmission of rodent-borne diseases in Southern Africa

Based on data from field surveys in:

Mozambique	Maputo, Tete and Zambezia Provinces
South Africa	Mapate, Limpopo Province Cato Crest, KwaZulu Natal Province.
Tanzania	Lushoto District, Tanga Province. Morogoro District, Morogoro Province
Zimbabwe	Harare and Nkayi Districts.

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Executive summary

The rationale for the Project was based on concerns that rodent-borne diseases were on the increase among human populations and that this might be linked to the behaviour of rodents, for long seen as agricultural pests and threats to public health. Changes in climate, the growth of cities and increasing connectivity between cities and rural areas, were some of the factors that might be involved in this increase. The epidemiology of many rodent-borne diseases and the social contexts within which they spread are poorly understood. Management strategies, which have often been based on information gathered outside Africa, have met with little success.

The overall objective of the RATZOOMAN Project is to provide new insights into the risks to public health caused by rodents living in close proximity with humans, and apply this to the development of risk-management strategies. It was funded by the European Union, managed by the Natural Resources Institute and comprises work between leading European and Southern African Development Community (SADC) partners in the focus countries: Mozambique, Tanzania, South Africa and Zimbabwe.

An inter-disciplinary approach was adopted to examine disease prevalence and livelihood constraints. Social, economic, ecological and anthropogenic factors responsible for disease spread and transmission have been identified, measured and evaluated for three major diseases, plague, leptospirosis and toxoplasmosis. This report presents the approach, results and conclusions of the socio-economic component.

Socio-economic principles were applied to the rodent-borne diseases' context. Having identified the key social, economic and human and rodent behavioural issues, surveys were conducted to measure the variables associated with disease risk at household level with questions tested as suitable for interview. Those requiring a more sensitive and lengthy dialogue were put to a survey sub sample through the anthropological component. Nine surveys (654 respondents) were conducted in the four countries, in urban and rural locations reflecting the range of risk to disease, and also a market survey. Households were randomly selected at sites common to the technical research.

Household socio-economic status was measured through age, education, employment status, crop cultivation, animals/livestock keeping and practices, housing and rodent access to living accommodation and compound; the latter two, also by enumerator assessment. Behavioural variables measured included: source and storage practices for drinking and washing water; waste disposal; staple food store types and whether rodent-proof, and practices.

Household's rodent perceptions were measured by: where and frequency of observation; what problems they cause; views on disease; responses; have household members been bitten and are rats consumed. Data on plague and flea management was obtained from the sites where the disease occurs.

Mbare market surveyed is thought to typify urban and larger rural markets in much of Africa. Large volumes of goods and food are traded between large numbers of suppliers, intermediaries and end users. Waste, as a source of harbourage and food for rodents, and the rodents themselves, are much in evidence. The survey of stallholders

revealed concerns that included, in spite of the widespread use of control methods: increasing rat populations; rodents causing physical damage to stocks and the prevalence of a new breed of rodents. There is awareness that any attempts at management will require a communal effort.

Frequencies and associations were analysed for local, national and regional levels, revealing differences between and within sites for all social, economic, behavioural and rodent-related variables measured. The general economic status of the sample was moderate, characterised by dependency of families on household heads, intermediate quality of housing and medium levels of employment.

Human proximity and contact with rodents are high, offering the latter easy access to food, water and harbourage. Contact within the house with alternative (to humans) hosts for rodent diseases is limited apart from cats. The main perception of rodents is as a nuisance, destroying food and household goods. However, their disease role is widely recognised when this issue is specifically raised.

Socio-economic status has a major bearing on: exposure to rodents; household's vulnerability to rodent-borne diseases; their perceptions of rodents and subsequent decisions taken in respect of management or control. As socio-economic status improves so measurements of these characteristics increase. Improvement in the quality of house construction has a direct bearing on reducing rodent access.

Level of education is a key variable. Its increase is associated with: improved house rodent-proofing; a belief that rodents carry disease, undertaking rodent control and the frequency with which rodents are seen in the house. Although the latter appears to negate the association between years of education and house being rodent-proof, it may be that perception and awareness of rodents increases with education level.

Other positive indicators from the point of view of rodent management potential are: houses being increasingly rodent-proof associated with a reduction in rodent observation in the house, believing they carry disease and controlling them; the head of household having been bitten by rats is associated with heightened perception of the importance of rodents and the control response, and experiencing plague is associated with controlling rodents (although very few households recorded plague).

Factors which do not seem to have a bearing on the way people live in terms of rodents are: age (although the <25 age group are more likely to control), and there is no suppression of rodent numbers by keeping cats, indeed their presence is associated with increasing frequency of rodents observation in the house.

Although the analysis strongly underlines the positive relationship between wealth, and exposure to rodents, there are pointers towards reducing the risk of impact of rodent-borne diseases on poorer households. Education/training material combining the understanding generated by this research with technical information on rodents could be expected to make a significant contribution towards risk reduction.

Further research is proposed in management policy and a number of areas where the evidence presented is either inconclusive or requires further testing in other sites.

1. Introduction

About the Project

Rodents have a long history as pests in both agriculture and public health. They can cause extensive damage and loss to crops, both pre- and post-harvest, attacking grains and a wide range of high value fruit and nut crops as well as pulses and forestry plantations. Perhaps more importantly, rodents are vectors for many serious diseases of humans and livestock. Based on recent data, these diseases are on the increase among human populations. The epidemiology of many rodent-borne diseases is poorly understood, and management strategies, which have often been based on information gathered outside Africa, have met with little success.

Cities and rural areas are changing throughout the developing world, and connectivity between cities and rural areas is increasing. Cities continue to grow, and public hygiene is often deteriorating while urban rat populations are increasing. Climate change, deforestation, the introduction of new crops and livestock and the invasion of agriculture into new areas are all affecting the rural environment and resound major changes in rural ecology. Because of changes in rural ecology, previously rare diseases could become more common. Because of increasing connectivity between rural and urban areas, these diseases could reach cities. Because of deteriorating hygiene and increasing urban rodent pests, these diseases could easily spread and persist in cities.

The general objective of the RATZOOMAN Project is to provide new insights on the risks to public health caused by rodents living in close association with humans, and apply this information for the development of risk-management strategies.

The Project has adopted an inter-disciplinary approach through 13 work packages, which examine different aspects of disease prevalence and livelihood constraints. Social, economic, ecological and anthropogenic factors responsible for their spread and transmission have been identified, measured and evaluated for three major diseases, plague, leptospirosis and toxoplasmosis.

The Project was funded by the EU¹ and comprises work between leading European and Southern African Development Community (SADC) partners in the focus countries: Mozambique, Tanzania, South Africa and Zimbabwe.

For a more detailed description of the Project, refer to the website:
<http://www.nri.org/ratzooman>

Objectives

The objectives of the Socio-economic research (Work Package 6) were to identify, measure and assess socio-economic factors likely to impact through rodent-borne diseases on the health and nutrition of African communities

¹ Through the [European Commission Framework 5 Programme on International Cooperation](#), under the A4 objectives, *Research for Development*, specifically dealing with regional priorities about *systems research on natural capital and the human environment, including health* (part b)

Report structure

This is a consolidated report of activities and outcomes of research undertaken for the socio-economic component of the Project Work Package 6. The report is divided into 5 sections:

- Introduction
- Methodology; which sets out the methods used for gathering data.
- Analysis; explaining the analytical approach
- Results; which presents the basic data and analyses the relationships between social characteristics, human perceptions and activities that might influence their exposure to and management of rodent-borne diseases. The analysis covers the sub-site (9), country (4) and entire data set level and the market survey. The contribution of existing and additional data is reviewed in the context of the different sites.
- Conclusions; draws conclusions and the influence they might have on human exposure to rodents and the potential for improved management of rodent-borne diseases. Further research is proposed.

Together with supporting Annexes.

2. Methodology

General approach

The general approach has been to apply socio-economic principles to identifying the issues, determining and conducting the methodology and interpreting outcomes to the particular conditions pertaining to research into rodent-borne diseases, within an inter-disciplinary context.

From the outset, the intention was that the approach would involve the use of complementary methods with other disciplines, in particular with the anthropological, to encourage cost-effectiveness and synergy. Socio-economic surveys provide a broad overview, in this case, of a range of factors with potential to affect zoonosis² transmission, for a large number of households. Anthropological case studies provide detailed insights into a wider range of factors for a small number of households and on subjects requiring observation or detailed discussion, for which surveys are not appropriate.

Following on from intense consultation during early 2003, this research has benefited throughout from interaction with those working on other Project work packages.

Sample selection

Site selection

In order to facilitate cross-referencing with zoonosis data being generated by Project collaborators, the sites selected for the socio-economic survey were common with the zoological components. In turn, they provided the frame from which the sub-samples for the anthropological studies could be drawn.

About the sites

The following are all household survey sites except Mbare, the site of a market survey.

South Africa

Mapate: A rural (close to a major urban centre), low-density site in Limpopo Province in the northern highveld of South Africa³.

Cato Crest: An urban, high density, site in Durban, KwaZulu Natal Province, near the coast in eastern South Africa.

Tanzania

Lushoto: Three sub-sites; rural, low density, partly urban (small town), squatter.

There is an ongoing history of plague in one of the sites (Mlalo). Lushoto is a rural district situated in Tanga province in Tanzania's hilly northeast.

Morogoro: a mainly medium to high density urban site located predominantly in a valley. Morogoro District is the main town in Morogoro Province in the central-east.

² Refers to diseases that can be passed from animals, whether wild or domesticated, to humans.

³ Janowski, M and Matshidze, P. "Perceptions and practices relevant to the transmission of plague, leptospirosis and toxoplasmosis." RATZOOMAN Social Anthropological Study 1. NRI Report 2780; part of a series of reports on common sites.

Mozambique.

Tsalala is a peri-urban area in Maputo Province near the capital Maputo in the south. Mutarara village is in a rural area in Tete Province in the north-west of the country.

There is a history of plague in this area.

Morrumbala village is also in a rural area in Zambezia Province also situated in the north-west of the country. High prevalence rates have been found of Leptospirosis by other research programmes.

Zimbabwe.

The survey in Hatcliffe is in a peri-urban area in Harare Province in the centre-east of the country near the capital Harare. Nkayi is an urban/peri-urban site in north-west Matabeleland Province

The market survey was carried in Mbare a high-density urban area in Harare.

Table 1: Socio-Economic Component. Regional matrix: representativeness.

Criteria	Mozambique	South Africa	Tanzania	Zimbabwe	Comments
Plague history	✓		✓	✓	
Eat rodents	✓		✓	✓	
Leptospirosis	✓		✓		High prevalence rates have been found where work has been done in Mozambique and Tanzania.
S-economic survey					
Rural area	✓	✓ ¹	✓ ²	✓	¹ Mapate: 120 households, from 4 Blocks selected purposively for economic status and proximity to bush areas in one village. Households selected at random.
Peri-urban	✓		✓ ²	✓	² Lushoto: 102 households interviewed from 3 villages purposively selected on for their propensity to plague: (1) propensity to plague; (2) 'No' plague, (3) history but no plague since 1990. Households selected at random from each village.
Urban area		✓ ³	✓	✓	² Cato Crest, Durban, Kwazulu Natal province.
Market survey				✓	

Survey conduct and data management

A draft questionnaire was prepared by NRI and enumerators identified in consultation with in-country collaborators. The questionnaire was finalised together with enumerator guidelines and data-entry spreadsheets supplied by NRI. In-country collaborators finalised recruitment and trained the enumerators, conducted the survey and entered data on computer spreadsheets. The data was then checked and analysed in the UK. Draft/final reports were prepared in consultation with collaborators.

The questionnaires

The structure of the questionnaire was based on factors linked to rodents and diseases (see below), questions that householders could be expected to know and answer and a sequence progressing from the factual to the more sensitive. Although some fine-tuning was necessary to accommodate a few essential local differences, the basic structure of the questionnaire used in each survey was the same in order to facilitate comparisons across sites (See: Annex F).

Socio-economic factors with potential to affect zoonosis transmission in general

A number of factors were understood to have an important effect on the transmission of diseases from rodents to humans. These were⁴:

- gender and age
- wealth and education levels
- occupation - paddy fields, slaughter houses, animal husbandry, activities that may increase cuts to hands and feet
- density and quality of housing
- amount of rodent harbourage inside home - notably nesting in thatched roofs, burrows in mud walls, roof or wall voids, behind furniture
- source of drinking water
- source of washing water - bathing, clothes, kitchen utensils
- drinking water storage
- proximity to sewage
- proximity to open water
- proximity to agricultural land - vegetable or staple crops
- proximity to bush or fallow land
- amount of rodent harbourage outside relatively near home
- food preparation methods, eating uncooked fruits and vegetables
- food storage location and accessibility level, ranging from inside dwelling to rodent-proofed store
- eating rats, frequently handling rats
- general hygiene at household and community levels

Disease risks associated with human behaviour and contact with rodents

There are numerous ways in which human behaviour increases disease risk arising out of contact with rodents. The following notes⁵, provided as background information to enumerators in the Cato Crest and other surveys (See Annex F Appendix 3) provide some background into how some of the main risks arise.

Leptospirosis: contact with rat urine through any orifice or wound in the body including the nose, cuts, sores and through the mouth. Places where this could happen include along the sides of rivers, in small puddles of water near houses, through water stored in the house or near the house which rats can urinate in, through wet or damp foods including fruit and vegetables. Rats urinate wherever they go, to establish territory and just because they have to.

Toxoplasmosis: eating the meat of animals which are carrying toxoplasmosis without cooking it fully, and contact with cat faeces. All mammals can carry toxoplasmosis in their meat, but wild animals are more likely to carry it because they are in contact with cat faeces – these wild animals, including rats, are then eaten by cats which is where the cats get the disease in the first place.

Plague: contact with fleas from infected animals, and eating the meat of infected animals without cooking it fully. Plague hasn't been known in Cato Crest, but it could

⁴ Based on an unpublished communication from Belmain, S (April 2003). See also Annex I.

⁵ Based on unpublished material prepared by Janowski, M. for the associated anthropological research of this Project. Refer to http://www.nri.org/ratzooman/docs/cato_crest_final_anthropology_report.pdf

potentially be in some wild animals and there is the possibility of its transmission to humans in the future.

There are different kinds of rodents which live in Cato Crest – the main ones are called *Rattus norvegicus* (house rats) and *Mus musculus* (house mice). House rats are much larger than house mice. Both species are active at night.

For more information about these diseases, rodents and rodent vectored zoonosis, see Annex I or, refer to the website: <http://www.nri.org/ratzooman>

Household selection for survey

Villages were understood to be broadly representative of the socio-economic characteristics prevalent in areas previously selected for Project technical Work Programmes.

Household sampling lists were obtained through local politico-administrative structures or drawn up together with the village chairs, from which households were selected at random. Where household lists were not available, other methods were identified to ensure randomness. In a high density location, Cato Crest for example, the transect approach was used whereby transects were drawn through a map of the site and houses along those lines were visited at random; every 3rd house was systematically selected, with the starting point chosen at random. Contingency arrangements were made for the selection of a similar replacement in cases where a house was unoccupied at the time of the enumerator's visit.

Surveys were completed by interviewing the head, or a key informant, of each selected household.

Enumerators and Guidelines

See: Enumerator guidelines.

Sample source and size

The size of each survey sample was intended to be large enough to give sufficient data in the anticipated social sub-groups.

Table 2: Survey samples: Numbers of households
Household surveys

Country/site	Total sample size	Sub-sample households
South Africa:	210	
Mapate		120
Cato Crest		90
Tanzania:	210	
Lushoto, of which		102
Lushoto		45
Mlalo		31
Soni		26
Morogoro		108
Mozambique, of which	94	
Maputo		33
Tete		30
Zambezia		31
Zimbabwe, of which	140	
Hatcliffe		70
Nkayi		70
Total	654	

Market survey

Zimbabwe	
Mbare market	15

Table 3: Housing density⁶ and location of households interviewed
Numbers

Country/site	Housing density				Location	
	Squatter	Low	Medium	High	Valley	Hill
South Africa						
Mapate	25	74	19	-	39	79
Cato Crest	90	-	-	90	17	83
Tanzania						
Lushoto	23	54	21	2	29	73
Morogoro	5	3	25	75	80	28
Zimbabwe						
Hatcliffe	41		4	25		
Nkayi*		4		51		

* Query on Malindi ward – to be included



Photo 1: Low density improved housing survey site Hatfield, rodent access restricted to base of wall and open doorways.

⁶ The terms **squatter, low, medium and high density** are terms in common usage (for which no comprehensive reference was found). The following attempt at definition may help the reader distinguish between the terms.

Low, medium and high density housing are all likely to be constructed using conventional building materials and likely to have some surrounding land not built upon. The different densities refer to the concentration of houses per unit of land. As density increases, so do the number of houses and the likelihood that there will be less surrounding land not built upon. It is unusual for high-density housing be of more than one storey.

Squatter. Housing that derives its name from a person who lives in a building or on unused land, often with no legal title to the land occupied. Squatter housing might be constructed using conventional or recycled building materials and is likely to have very little surrounding land not built upon. Frequently such housing can be closely packed, allowing only alleyways for the movement of people, rainwater and even waste.

3. Analysis and presentation

Analysis

Analysis of the data has been undertaken in two stages. Firstly, descriptive statistics based on simple averages, and secondly, by investigating the relationships between household socio-economic variables and human behaviour, with particular reference to factors which may predispose to zoonosis transfer.

Analyses were run separately for each group of variables, i.e. livestock, housing, sanitation, storage of staples, rodents, etc., using XLSTAT 7.5. Either Pearson correlation coefficients or cross tabulations and the chi square test of association were found as appropriate.

Presentation

In the correlation and chi square tables only relationships which were significant at the 0.05 level are normally presented.

Each sub-section of text deals with a specific socio-economic issue potentially relevant to human vulnerability to rodent-borne diseases. At the end of key sections there is a short overview summary comparing the sites.

4. Results

A Socio-economic status

Biodata/social indicators.

The data are analysed for head of households whose contribution is seen as a key indicator of household socio-economic status.

Age and education

As heads of household are the most senior members of the family, the age structure would be expected, with the averages being between 42 and 47 for most sites (see following table). The exception is Lushoto, which is rural and in spite of the potential effect of plague, which is significantly higher averaging 51.8 years. However there are some notable differences between the villages for: Lushoto, higher average age; Lushoto, much lower levels of education; the relative importance of men as HoH, particularly in Zimbabwe and Lushoto and the h/holds headed by men and women were reciprocals in Mapate and Cato Crest.

Table 4: Age and education status of heads of households

Country/ Site	Age		Gender		Education
	Average	Range	Males %	Females %	Average years
South Africa					
Mapate	45.2	17 - 91	56	44	7.2
Cato Crest	42.0	20 - 75	57	43	7.3
Tanzania					
Lushoto	51.8	20 - 86	86	14	4.7
Morogoro	46.5	20 - 76	69	31	5.8
Zimbabwe					
Hatcliffe	42	19 - 85	100	0	7.4
Nkayi	43.5	24 - 87	92	8	7.7

Relationship between age and years of education

The relationship is examined in Table 5, where heads of household are grouped by age and education status. The **Age Groups** are:

- Young; Less than 25 years,
- 25 - 40 years,
- 41 - 60 years, and
- 61 years and over.

The **Years of education Groups** are:

- None,
- 1 – 3 Years, Early primary;
- 4 – 7 Years, Late primary
- 8 – 9 Years, Form V and VI, and
- More than 10 Years, College and beyond.

Table 5: Relationship between age and years of education

Frequency of observation

Age groups	Education groupings				
	None	Early primary	Late primary	Form V and VI	College plus
< 25 years	0	0	5	8	16
25 - 40	5	6	74	57	57
41 - 60	8	15	125	54	28
> 61 years	3	9	65	11	4

[Chi-square (observed value) is 83.602 and the One-tailed p-value is < 0.0001]

There is an association between age and years of education, with better access to education amongst the younger heads of households. None of those in the <25 years old group had no education, a characteristic entirely confined to the older groups. Also, it is much more likely that those in the younger groups will have proceeded further in their education than those in the older groups. Those who are 61 years and over are those least likely to have proceeded beyond 7 years education.

Employment status

The key member of the household for employment is usually the head of household. The highest levels of employment are in the rural Lushoto (93 per cent) where farming is a major source of employment. The predominantly urban sites Morogoro and Cato Crest have moderate to high employment levels above 50 per cent. For the remaining sites the level of employment is below 50 per cent,

Table 6: Employment status of head of household

Country/ Site	Employment status								Lives at home			
	Unemployed		Employed		Pensioner		Others		Yes		No	
	Nos.	%	Nos.	%	Nos.	%	Nos	%	Nos	%	Nos	%
South Africa												
Mapate	77	64	30	25	12	10			107	90	12	10
Cato Crest	15	23	58 ¹	66	13 ²	15	2 ³	2	84	93	6	7
Tanzania												
Lushoto	5	5	93	91	4	4			101	99	1	1
Morogoro	2	2	77	71	28 ⁴	26			107	99	1	1
Zimbabwe												
Hatcliffe	14	24	38	66	4	7	1	2	56	97	2	3
Nkayi	5	8	38	60	8	11	1	2	55	87	8	13

¹ Includes 24 classed as 'informal earning'² Includes those on grants and 1 classed as 'retired'³ Housewives.⁴ Many have small businesses.

A very high proportion, almost all in the case of the Tanzanian sites, of heads of households are 'Living at home'.

The employment status for the entire sample of Mapate is considered in the following table. Given the economic importance of the head of household, the average level of employment declines when the entire family spectrum is considered.

Table 7: Employment status of all household members: Mapate

Status	Numbers	%
Unemployed	416	83
Employed	66	13
Pensioner	19	4
Scholar	1	-

Overview of socio-economic status

Although there is variation within and between sites, the general economic status of the sample households was moderate; characterised by intermediate levels of employment and dependency on the head of household (HoH). Apart from Lushoto, where animals are an important asset, further indication of low economic status are the number of animals kept in Mapate and Cato Crest (although as a squatter area, this is to be expected), and the quality of housing. Area of land available for cultivation is an important indicator of wealth and income for Mapate, Lushoto, Hatcliffe and Nkayi.

Mapate and Lushoto are both rural locations and so provide a useful comparison. A major difference is that the Lushoto is far from an urban centre whereas Mapate is close to a major urban centre and is linked by cheap and readily available public transport.

There is a much higher level of employment amongst HoH in Lushoto than in Mapate, although this is partly explained by farming not being considered 'employment' in Mapate. The nature of employment also differs markedly, with a very high proportion of the employed HoHs staying at home in Lushoto; partly because they are mainly farming. It might also be because of the propensity to migrate in search of paid employment in South Africa.

This would appear to indicate a relatively high level of unemployment in Mapate, and that most HoHs remain at home. It is thought that those who don't stay at home are employed outside the village.

Land and cultivation.

Land. Large areas of land are only evident at the rural sites; particularly Nkayi, but also Mapate, Lushoto and Hatcliffe. 'Farm' size is small at the other sites and at Cato Crest there is virtually no land. (Note: Land can be a key indicator of wealth, but the surveys did not gather land ownership data).

Cultivation

Crops are important in most sites. The exceptions are Cato Crest, where there is very limited space available and the Tete and Zambezia sites in Mozambique (although this might be partly due to lack of data). Cropping is extremely important in Zimbabwe.

Maize is the most important crop, grown by most households in Zimbabwe and on a much larger scale than in other sites; all households in Mapate and Lushoto, where it is positively correlated with bean production. Vegetables are also important and fruit trees are grown by all farmers in Mapate. Cassava is also important in Mapate and Lushoto, where bananas are also grown. In Cato Crest the only crop is vegetables; grown by a few households.

Generally speaking, the areas of crops grown by survey households are fairly small. The households in the survey sites in Zimbabwe grow large areas of maize and vegetables, with a few households greatly exceeding the average figures.

It would appear likely that when in season, these crop areas provide a significant potential food source for rodents, and this is borne out by interviewee's responses to questions on the problems caused by rodents (see Section C, below).

Animals and livestock.

The survey sites are characterised by fairly low levels of animal-keeping (Annex A Table 28), with the exception of poultry (particularly chicken) which are kept by the majority of households. Household keeping differs markedly for each site. Those kept on any scale are (in order of importance):

- Cattle, at Lushoto, Morogoro, Nkayi and Tete and, with notably fewer animals than these sites; Mapate.
- Goats at Lushoto and, with notably fewer animals at the Mozambique sites and Mapate.
- Sheep at Lushoto only
- Cats at all sites with the notable exception of Hatcliffe.
- Dogs at all sites again with the notable exception of Hatcliffe.
- Pigs at all sites except Cato Crest, Lushoto and Hatcliffe.
- Chicken are kept by a large minority of households at Lushoto, Morogoro (where a few households have semi-commercial flocks) and Nkayi

Compared with the other sites, many more households keep animals in Lushoto. Cattle, sheep and goats are all important. Cats are markedly more important in Lushoto and Morogoro, dogs more so in Mapate. There are very few animals in Cato Crest and no farm livestock, apart from chickens. Chickens are important in Morogoro; 8 households keeping moderate to large number presumably for income-raising.

Animals sleeping in the house

Households were asked if animals sleep in the house. Animals are usually kept close to the house. Cats appear to move freely around compounds. In Morogoro, cats move freely between houses and it is not uncommon for cats from other house to stay overnight. In Cato Crest, almost half said that cats owned by others came into the house. Cats sleep in the house in almost ¼ of households in Lushoto and a few houses in Mapate and Cato Crest. The following tables give the responses. This question was modified at subsequent surveys to focus on human behaviour in respect of cats, so this table should be considered together with the subsequent tables.

A review of the data generated during the Mapate and Lushoto surveys indicated the need for more information in respect of cats, because of their importance as a primary host for toxoplasmosis. It was thought likely that not only the households' own cats might enter houses, particularly in urban areas. So other survey households were asked; 'Do other cats come into your house?' and specifically whether cats 'slept in the house'.

The custom of other's cats coming in the house is widespread and common at all sites, although somewhat less so for Hatcliffe. It is generally unusual for cats to sleep in the

house with the notable exception of the Mozambique sites and, to a lesser extent, Morogoro.

Housing

The experience generated during the earlier Mapate and Lushoto surveys indicated the need for more accurate information in respect of the access of rodents to houses and the areas surrounding. Status was still based on enumerator assessment, the refinements addressed the different components of houses and compounds. These refinements were made to the questionnaire for the Cato Crest survey and subsequent surveys.

The type of housing lived in by the interviewees is presented in the following table and provides an indication of economic status. The use of 'improved' materials might reduce rodent access.

Table 8: Type of housing
Percentages of respondents in each

Country/ site	Type of housing			
	Traditional	Improved	Brick and tile/sheet	Recycled materials
South Africa				
Mapate	13	41.8	44	
Cato Crest			53	47
Tanzania				
Lushoto	33	47	19	
Morogoro	17	26	85	
Mozambique				
Maputo			31	69
Tete			39	61
Zambezia			43	57
			13	87
Zimbabwe				
Hatcliffe			39	61
Nkayi	13 ¹		77	10

Blocked out cells signifies question not asked/relevant

¹ Pole and dagga.

Rodent access to housing

The experience generated during the Mapate and Lushoto surveys indicated the need for more accurate information in respect of the access of rodents to houses and the areas surrounding. In essence, although status was still based on enumerator assessment, the refinements (explained below) addressed the different components of houses and compounds. These refinements were made to the questionnaire after these surveys were completed in time for the Cato Crest, Morogoro, Mozambique and Zimbabwe surveys⁷.

⁷ A more detailed discussion about these changes can be found in the Project Meeting Report, Maputo, February 2004. <http://www.nri.org/ratzooman/docs/first%20year%20annual%20report.doc>

Table 8a: Is the house rodent-proof?

In percentages

Country/site	Parts of house that are rodent-proof		
	Doorways	Eaves	Walls
South Africa			
Cato Crest	35	30	50
Tanzania			
Morogoro	55	49	72
Mozambique	40	37	32
Maputo	58	52	52
Tete	37	37	26
Zambezia	23	19	16
Zimbabwe			
Hatcliffe	37	24	37
Nkayi	36	43	60

Assessment of property for ease of rodent access: living accommodation.

Enumerators assessed the interviewee's house where the family sleeps for how rodent-proof the house is; checking the walls, the roof and the doors (when closed) to see if rodents can gain access. One of the categories below was chosen for each household interviewed:

- 1, Very poor quality housing, provides very easy access for rodents.
- 2, Poor housing and worse than average. Access for rodents is relatively easy but not as bad as Category 1.
- 3, Better than average providing limited access for rodents. Not as good as Category 4.
- 4, Good housing, access for rodents is very difficult.

Housing quality across the survey sites is mainly concentrated in the two categories just above and just below average, with the remaining households more or less evenly distributed in the best and poorest categories.

Creation of indices for the rodent-proof status of houses

In order to allow examination of the relationships with other variables, a rodent-proof index (RPI) was created for houses that enumerators had assessed for this characteristic. The assessment during the later surveys was based on whether or not the eaves, walls and doorways were rodent-proof. This was combined with a quality of house index (QHI) for the earlier surveys, Mapate and Lushoto, based on whether the house was traditional, improved or brick and tile (and therefore increasingly likely to be rodent-proof). Four categories of RPI were created: high, medium, low and poor.

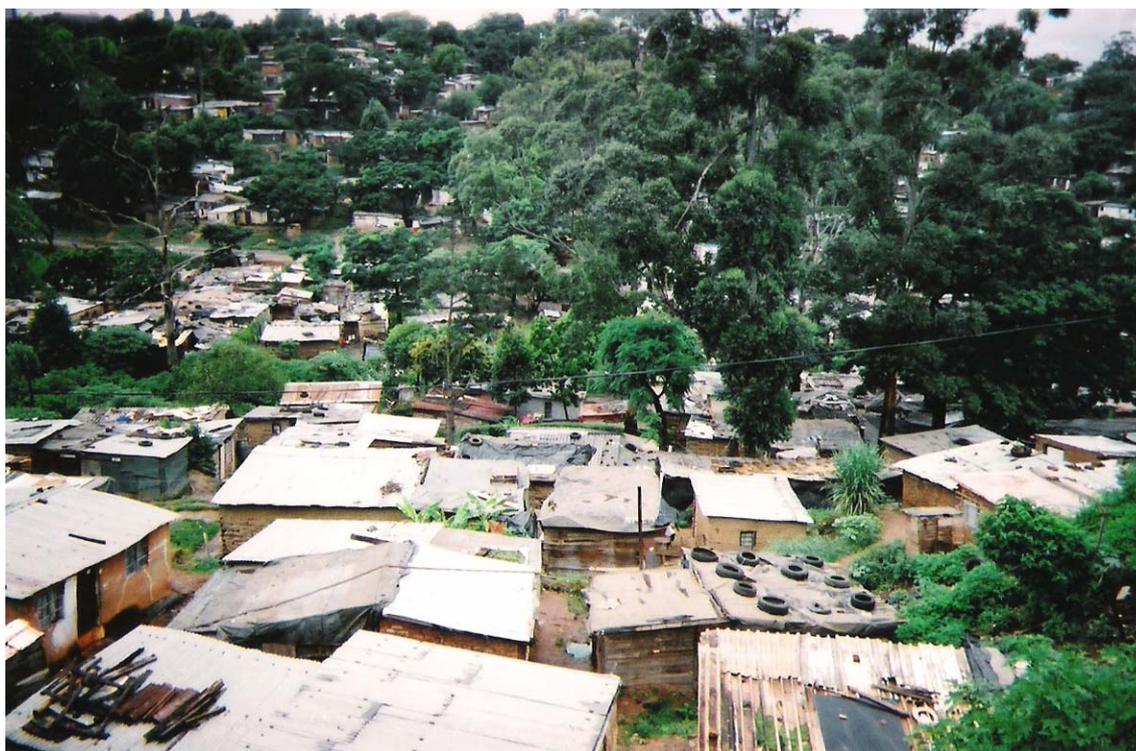


Photo 2. Squatter survey site Cato Crest; houses built of recycled material or brick and sheet in close proximity, harborage and ease of rodent access.

Relationship between education and quality of housing (access to rodents).

There is an association between years of education and the rodent-proof index (RPI); as the level of education increases so the degree to which houses are rodent-proof tends to increase.

Table 9: Relationship between years of education and Rodent-proof index

Years of education	Rodent-proof index				Total
	High	Medium	Low	Poor	
None	3	2	5	8	18
1 – 3 years	14	10	2	3	29
4 – 7 years	58	86	25	99	268
8 – 9 years	53	30	10	32	125
10 years or more	37	35	11	21	104
Total	165	163	53	163	544

Chi-square (observed value) 42.707. One-tailed p-value < 0.0001

House ownership and occupancy

The levels of home ownership vary substantially between the different sites, highest in Mozambique, 100 per cent in Zambezia, to a low of 34 per cent in Cato Crest. In most sites, ownership levels are around or in excess of 50 per cent. Occupancy varies from an average of 5.9 years (Hatcliffe) to a high of 13.4 years (Morogoro). This relative stability does not seem to be affected, positively or negatively, by the quality of housing.

Assessment of property for ease of rodent access: compound around the house.

Enumerators assessed how rodent-free the interviewee’s compound of the household is. After checking all buildings (kitchen, toilet, poultry houses, etc.) and possible sites

where rodents could hide (apart from the living accommodation) to see if rodents can gain access. One of the categories below was chosen for each household interviewed:

- 1, very easy access to rodents and extensive availability of harbourage and cover
- 2, could provide cover and harbourage for rodents. It is worse than average, but not as bad as Category 1.
- 3, some rodent cover, but better than average. Not as good as Category 4.
- 4, provides almost no cover/none for rodents and no evidence of rodents.

The quality of the rest of the household compound at survey sites is also (as for living accommodation) mainly concentrated in the intermediate categories, just above and just below average. The remaining households are more distributed in the poorest category than in the best. However, almost all sites have some houses in the best category, whereas not all sites have houses in the poorest category.

Owning a radio

Radio ownership was thought to be a good indication of household wealth. The data indicates that upwards of 2/3rds of households own radios at each site, with almost 100 per cent in Tete and Morogoro. This question was changed to 'television ownership' in Hatcliffe, as this was thought to be a better indicator of wealth; 40 per cent owning a television.

B. Human behaviour

Water

Drinking water sources. Rural sources are fairly evenly divided between piped and open (streams) and washing water comes mainly from open sources. Urban water sources are only piped.

Drinking water sources.

Rural sources are fairly evenly divided between piped and open (streams) and washing water comes mainly from open sources. Urban water sources are only piped. The source of water for families without their own piped water source is shown in the following table. The purchasing of water (thought to be important during pre-survey visits) only registers as being of minor importance at the Mozambique sites and Morogoro.

Some households get water from more than one source: local springs, rivers and boreholes. Families appear to take more care with their drinking water than their washing water; with a larger number obtaining water from a piped source. The piped water is metered and paid to the local municipality, whereas river and spring water are a free resource.

Table 10: Family water sources

In percentages

Country/ site	Drinking water source			Washing water source		
	Open	Piped	Purchased from a source outside the area	Open	Piped	Purchased from a source outside the area
South Africa						
Mapate	43	38		72	7	
Cato Crest		100			100	
Tanzania						
Lushoto	44	49		46	49	
Morogoro	5	84	11	5	83	12
Mozambique ¹	63	44	10	72	30	11
Maputo	58	42	12	58	42	6
Tete	73	33		93	7	3
Zambezia	58	55	16	68	39	23
Zimbabwe						
Hatcliffe	41	59		41	59	
Nkayi	21	79		21	79	

¹ Households use more than one source

Water storage

Storage is common for both drinking and washing water. Fewer households store in Cato Crest, where all water is piped. Covering water is commonplace with drinking water (up to 1/5th uncovered), less so for washing water. Boiling and filtering water is only practised in rural Lushoto where households have insufficient and have to purchase. In Mapate, drinking water is generally stored because is only available

during restricted periods, whereas washing water is carried in larger containers which act as a store until depleted. Storage practice varies widely. Again more care is taken with drinking water than washing water, although 18 per cent of households do not cover.

Covering of stored water

When asked when they cover, a much more varied picture emerges which suggests that:

- Some, particularly in Cato Crest, do indeed cover except when in use,
- Most households cover most of the time,
- A significant minority only cover occasionally or even, never.

More care is given to drinking water than to water for washing.

Sanitation

Type and location of toilet

A substantial majority of families at all sites have their own toilet.

Toilet construction.

In the rural sites the early surveys households are fairly evenly divided between traditional and 'improved', with the remainder as brick/tile/sheet. The usefulness of this data was limited and so it was abandoned in the later surveys.

Disposal of waste

Households use more than one method. Household practices are fairly evenly divided between burning waste and through ways such that it could remain a food source for rodents: discarded or in covered or uncovered pits. In Lushoto waste is mainly buried in a pit. In the urban site Cato Crest, almost all waste is collected by the council, thereby removing it as a possible food source for rodents. A substantial minority of households in Morogoro and Hatcliffe also have their waste collected.

Burning of waste is important in Maputo and Mapate, where around half of families burnt their waste, Morogoro and Hatcliffe and to a much lesser extent at other sites. Disposal by the majority of the remaining households is through ways such that it could remain a food source for rodents.

Staple food storage

For most of the households interviewed storage involved a range of receptacles; the majority store in sacks, although traditional storage structures and drums and tins are also widely used. Most households **store their staple foods**: Mapate, 86%; Cato Crest 84%, Lushoto 100%. Most use sacks or a traditional open type of store. In Cato Crest, **storage location**;30%, on the floor. **Sleeping in the room where staples are stored**, Mapate; 42% and Lushoto 90%.

Rat-proof

The views of the households were that almost none of the sacks were rodent-proof. Traditional and other methods of storage fare better although $< 1/3^{\text{rd}}$ of these are rodent-proof.

Table 11: Are stores rat-proof?

Numbers of households

Country/site	Type of store					
	Sacks		Traditional store (open)		Other	
	Yes	No	Yes	No	Yes	No
Tanzania						
Morogoro	2	64	1	15	2	1
Mozambique						
Maputo	0	10	9	9	13	3
Tete	1	14			1	14
Zambezia	0	10	1	1	0	22
Zimbabwe						
Hatcliffe						
Nkayi						
Totals	3	98	11	25	16	40

Storing food on or off the floor

Households across the survey countries were fairly evenly divided as to whether or not they store on or off the floor.

Families sleeping in the place where staple food is stored

For those storing staple food, less than half sleep in the same room as where staple food is stored and the majority do not. Usually, bags of maize are put in the corner of the room.

C. Rodents

The majority of h/holds in all sites, have **seen rats in the village**. Of these, it most likely they were seen in the **house** or the **bush/surrounding areas**. Being seen in **crops** was important in Hatcliffe, Lushoto, Nkayi and the Mozambique sites .

Table 12: Where rats were seen in village: All survey locations

Where observed	All locations	
	Total observations	%
In the house	522	43.8
In the bush	375	31.5
In crops	271	22.7
Elsewhere	24	2.0

There is a lot of variation in respect of **frequency of observation** (seldom, 1/month, 1/week, 1/day and >1/day) for the ‘Yes’ families:

Table 13: Frequency of seeing rats in village: All survey locations

Frequency	All locations	
	Total observations	%
Seldom	363	30.5
Once a month	86	7.2
Once a week	111	9.3
Once a day	167	14.0
More than once/day	465	39.0

A complete set of the data behind Tables 12 and 13 can be found in Annex C Table 35.

Rats Observed in the House Index (ROHI)

In order to be able to compare the frequency of rodent observation with other household characteristics, it was necessary to create an index of observations. The ‘observation of rats in the house’ was selected as the most appropriate for comparison with the other characteristics, e.g. house quality, perception of rodents, etc.

The other dimension of ROHI, is the frequency of observation. In order to have a manageable number of cells in cross-tabulation tables, it was necessary to reduce the number of observation categories. Because they stretch back further in time, it seemed reasonable to combine the ‘Seldom’ and ‘Once a month’ categories. Combining them in a ‘Once a month or less’ (OML) category was also supported by:

- These two categories have small counts for most survey locations, ∴ by reducing the number of categories also reduced the possibility of counts <5
- Tendency of these two categories to be mutually exclusive
- ‘Seldom’ was not qualified.

Rats as a problem

An attempt was made to translate these frequencies into importance. Interviewees were asked if rats are seen as a problem in their village. Rats are seen as a problem by

most h/h, except Lushoto (which is evenly divided), Tete (1/3rd) and Cato Crest (24 per cent).

The problems rats cause and what might be done

Those respondents in all the later surveys (excluding Mapate and Lushoto) who said that rats were a problem, were asked what problems they caused and what might be done to redeem the situation. The results are shown in the following two tables.

It is clear from the responses about eating or destroying food, clothes and property, noise, etc. that people were concerned with rodent's nuisance value and the associated financial loss rather than health-related concerns, which hardly appear at all. [This contrast with direct questions about disease in the next section]

Table 14: The problems rats cause

Numbers of responses

Problem rats cause	Country/site					Totals %
	Cato Crest	Morogoro	Mozambique	Zimbabwe		
				Hatcliffe	Nkayi	
Eat/destroy food	30	67	68	45	40	35.3
Eat/destroy clothes	21	56	32	14	13	19.2
Destroy property furniture/other/cables	6	3	2	14	28	7.5
Create noise/disturbing	4	7		2	10	3.2
Attract snakes, ticks, lice, etc.		2		16	2	2.8
Carry disease/cause infection			2	17 ¹		24.4
Attack/bite people		1	2	11	2	2.3
Eat young chicks, rabbits		3		4	6	1.8
Make mess/dirty/holes	6				3	1.3
Destroy everything/belongings	5				2	1.0
Bring flies/health problems/unhygienic	2	1	1		1	0.7
Pollute water sources		1				0.1
Don't know			2			0.3

¹ Of which , scabies (7), flu (2) and blisters (2) were mentioned.

The responses of those interviewed as to what might be done to redeem the situation are presented in the following table. Although a few respondents cited preventative action, the overwhelming view is rodents should be killed using a variety of different methods. The second largest sub-group are those who either believe that nothing can be done or, don't know what can be done.

Table 15: What can be done about problems do rats cause?

Numbers of responses

What can be done	Country/site					% of total
	Cato Crest	Morogoro	Mozambique	Zimbabwe		
				Hatcliffe	Nkayi	
Chemical means/poisoning/traps/kill them	17	61	35	27	47	52.7
Nothing	19	10	21	5		15.5
Traps (of different types)		15		4	5	6.8
Mechanical means		16		2	1	5.4
Don't know			11		1	3.4
Biological means		8			2	2.8
Keep yard cleaner	3		3			1.7
Get a cat			3	1	2	1.7
Chemicals are ineffective/need to be effective					6	1.7
Filtering ⁸				5		1.4
Cover/move food	1	2	2			1.4
Change behaviour/improve hygiene	1				3	1.1
Only possible if entire location is treated				3	1	1.1
Poisoning impossible because of the nature of houses/no solution				3		0.8
Needs a community approach				2	1	0.8
We don't have the resources				2		0.6
Keep clothes cleaner				2		0.6
Try new methods					1	0.3
City Council will come	1					0.3

Respondents views on whether rats carry disease

From the views on the problems with rodents expressed above, it could be concluded that concerns amongst interviewed families are less about disease than about other factors. In particular that families have concerns about food loss and nuisance value. However, as can be seen from the following table, when specifically asked about disease, there is clearly a widely held view that rats carry disease. At least 2/3rds of the respondents at each site, the overwhelming majority – 78 per cent - said this was the case. The notable exceptions were Mapate, Cato Crest and Morogoro where in excess of 50 per cent said rodents did not carry disease. This was in spite of the almost non-existence of respondents who included health/disease when asked previously what problems rats cause. This might signify their belief that although rats carry disease, this is not a problem. The sequence of questions was important here. Having been asked:

- Are rats a problem?
- What problems do they cause?
- What can be done about problems do rats cause?

Those who did not say disease was a problem were asked:

- Do rats carry disease?

⁸ Filtering – this is the literal translation for ‘spraying chemicals’. In Shona they say “kufirita” meaning to “spray”.

Table 16: Family views on rats carrying disease

In percentages

Country/site	Rats carry disease	
	Yes	No
South Africa		
Mapate	43	57
Cato Crest ¹	33	67
Tanzania		
Lushoto	64	36
Morogoro	49	51
Mozambique	71	29
Maputo	76	24
Tete	70	30
Zambezia	68	32
Zimbabwe		
Hatcliffe	86	14
Nkayi	69	20
Overall	78	22

¹ This question was only put to families not mentioning disease-related problems**Relationships between key socio-economic and rodent perception variables**

The overall picture of relationships between key socio-economic and rodent perception variables can be seen in Table 17, which draws on the entire data set. Only p-values <0.05 are shown in the table, thereby indicating a significant relationship. A blank cell indicates that the relation was not significant at the 5% level. A black cell indicates that a relationship was not valid or not attempted; in the case of plague because of the smallness of the sample (See section on Plague, below).

Table 17: Associations between key variables

Chi-squared associations: All Africa

	Education	See rodents	RPI ¹	ROHI	Rodents = Problem	Rodents = disease	Control Rodents
Age group	<0.0001						<0.0001
Education level			<0.0001	0.009		0.008	<0.0001
Keep cats		0.003					
RPI¹				<0.0001			
ROHI							<0.0001
Head/household bitten		0.038	<0.0001	<0.0001	0.014	<0.0001	0.004
Household members have had plague							0.042

¹ Including 'Quality of house index' for Mapate and Lushoto.

From this it can be seen that determinants of particular importance are:

1. The number of years of education received. Increasing numbers of years of education are associated with:
 - the house rodent-proof index,
 - the frequency with which rodents are seen in the house,
 - believing that rodents carry disease, and
 - undertaking rodent control.
2. Head of household bitten by rats. This is associated with:
 - the house rodent-proof index,

- the frequency with which rodents are seen in the house,
 - believing that rodents carry disease, and
 - undertaking rodent control.
3. The house rodent-proof index. Increasing house rodent-proofing is associated with:
- a reduced frequency with which rodents are seen in the house.

Relationship between age and perceptions of rodents.

There is no association between age group and the frequency with which rodents are observed in the house; one-tailed p-value 0.388.

There is an association between age group and undertaking control of rodents; with those aged less than 25 being more likely to control rodents than the older age groups; One-tailed p-value is 0.000. see Annex C, Table 63.

Relationship between quality of housing and rodent observation.

There is no association between the rodent-proof index (RPI), assessed by enumerators and general rodent observation by interviewees [Chi-square (observed value) is 5.206 and the One-tailed p-value is 0.157].

However, when compared with the frequency rodents are seen in the house, there is a close association. As the quality of the housing deteriorates, so both the likelihood that rodents are observed and the frequency of observation increase.

Table 18: Relationship between quality of housing and rodent observation

Observed frequencies:

Rodent-proof index	Frequency rodents are seen in the house					Total
	Not seen	1/month or less	Once a week	Once a day	More than 1/day	
High	55	44	21	11	34	165
Medium	31	62	12	12	46	163
Low	6	8	4	5	30	53
Poor	17	17	7	25	97	163
Total	109	131	44	53	207	544

Chi-square (observed value) 109.259 One-tailed p-value < 0.0001

There is a dip in the above table for the ‘Low’ category. This is as a result of the score imputed for ‘Improved’ housing for the data from the early Mapate and Lushoto surveys. As the scoring system is integer, it inevitably puts this data into either the Medium or the Low index, but not both.

Relationship between keeping cats and rodents

The relationship between keeping cats and observation of rodents is unclear.

In respect of the general observation of rodents, there is a strong association, with those families keeping cats having less likelihood of seeing rodents than those without cats. [Chi-square (observed value) is 7.668 and one-tailed p-value is 0.006]

However, there is no association between keeping cats and the frequency with which rodents are seen in the house. [Chi-square (observed value) is 2.627 and one-tailed p-value is 0.622]

It is possible this distinction arises because the 1st observation is general, whereas the 2nd observation specifically refers to a location; the house and to specific periods in time; more than once a day, etc.

Relationship between years of education and frequency rodents are seen in the house

As years of education increase, so does the frequency with which rodents are seen in the house [Chi-square (observed value) 32.173 and one-tailed p-value; 0.009].

Although at first sight this appears to contradict the association between years of education and house being rodent-proof, it might also indicate greater perception and awareness of rodents as education increases.

Perceptions of rats and diseases

Respondents views on whether rats carry disease

There is a widespread awareness that rats carry disease. When asked if rats carried disease, the overwhelming majority – 78 per cent - said ‘Yes’. This was in spite of the almost non-existence of respondents who included health/disease when asked previously what problems rats cause. This might signify their belief that although rats carry disease, this is not seen as a problem.

Relationship between years of education and rodents causing disease

There is also an association between years of education and whether respondents think rodents cause disease. As the number of years of education increase, respondents are more likely to think rodents cause disease.

Table 19: Relationship between years of education and rodents causing disease

Years of education	Do rodents cause disease?		Total
	Yes	No	
None	6	11	17
1 – 3 years	8	21	29
4 – 7 years	154	110	264
8 – 9 years	73	53	126
10 years or more	62	42	104
Total	303	237	540

Chi-square (observed value) is 13.792

One-tailed p-value is 0.008

Family members which have been bitten by rats

Rats are seen as a problem by most h/h, except Lushoto (which is evenly divided), Tete (1/3rd) and Cato Crest (24 per cent). When asked specifically if **family members were bitten by rats**, All sites reported some family members having been bitten by rats. A quarter or more of respondents said that family members had been bitten by rats in Zambezia, Tete, Hatcliffe and Morogoro. The members of the family most affected were: daughter, head of household and spouse. None of those bitten became infected. For more detail see Annex C, Tables 59 and 60.

The head of household having been bitten by rats is associated with: the house rodent-proof index, the frequency with which rodents are seen in the house, believing that

rodents carry disease, and undertaking rodent control. However, the number of observations in each cell are small, particularly in the cases where there are a large number of categories, such as the house rodent-proof index (shown in the following table) and the frequency with which rodents are seen in the house.

Table 20: Relationship between head of household being bitten by rats and House rodent-proof index

Head of household was bitten	House rodent-proof index			
	High	Medium	Low	Poor
Yes	2	5	4	24
No	163	158	49	139

Chi-square (observed value) 29.260 and One-tailed p-value < 0.0001

Rodent consumption

Do you eat rodents?

Families who said they ate rats (not asked in the Mapate or Lushoto surveys) in: Cato Crest, 2 families; Morogoro, 5 families, Mozambique 39 families, of which: Maputo 4 families.

A number of families in Hatcliffe and Nkayi also consume rodents, see the following table. Additional data was gathered which show that most families catch their own, although there is a small amount of trade in Hatcliffe.

Preparing rodents for eating

Although there is some variation in the methods of preparation, most families that consume rodents first remove the fur and intestines and then roast or boil them, some with the use of salt. In some cases they dry the rodents.

Rat control

The majority of families say they undertake rat control. Attributing this level of importance compares with the higher proportion of families which considered rats a problem.

Table 21: Families that undertake rat control

In percentages

Country/ site	Families that undertake rat control	
	Yes	No
South Africa		
Mapate	74	26
Cato Crest	21	79
Tanzania		
Lushoto	91	9
Morogoro	82	18
Mozambique	66	34
Maputo	70	30
Tete	47	53
Zambezia	68	32
Zimbabwe		
Hatcliffe	87	13
Nkayi	70	16

A range of methods are used to control rats; the most important being chemical, followed by mechanical, biological and other (Table 22). Because of the presence in Mapate village of another rodent-related project, we can expect some influence to have been exerted on these responses, particularly those assessing awareness.

Table 22: Control methods used by family members for rat control

In percentages

Country/site	Control methods used by family members for rat control			
	Mechanical means	Chemical means	Biological means	Other
South Africa				
Mapate	13	34	4	7
Cato Crest	11	52	8	-
Tanzania				
Lushoto	35	63	32	-
Morogoro	44	61	15	
Mozambique	26	22	24	2
Maputo	27	27	18	3
Tete	20	17	40	
Zambezia	29	23	16	3
Zimbabwe				
Hatcliffe	29	76	4	1
Nkayi	26	54	10	13

Households use more than one method.

Relationship between years of education and undertaking control of rodents

As might be expected, therefore, there is an association between years of education and undertaking control of rodents. Those who have received education are more likely to undertake control of rodents than those who have not. The 4 - 7 years education group are the most likely to undertake control. Why this group should have a higher propensity to control than those in the higher education groups is unclear. However, it may be explained by the large number of respondents that coincide in the 41 - 60 age group and the 4 - 7 years education group, and by the way these groups have been demarcated.

Table 23: Relationship between years of education and undertaking control of rodents

Years of education	Do you control rodents?		Total
	Yes	No	
None	6	12	18
1 – 3 years	20	10	30
4 – 7 years	223	42	265
8 – 9 years	90	33	123
10 years or more	56	48	104
Total	395	145	540

Chi-square (observed value) is 51.229 One-tailed p-value is < 0.0001

D. Plague

Questions on plague were added to the questionnaires for Lushoto and Nkayi, endemic plague areas.

Table 24: Households affected by plague: Lushoto and Nkayi

In percentages

Country/ site	Affected by plague	
	Yes	No
Tanzania		
Lushoto	5	95
Zimbabwe		
Nkayi	11	86

In Lushoto, household members **undertaking flea control**; Yes – 46%, No – 54%.

Methods used by households for **flea control** Plaster floor, 13 %; Put hot water on floor 15 %; Use insecticides, 13 %; Use traditional insecticides 8 % Other 1%.

For Lushoto there appears to be a strong association between families affected by plague with undertaking flea control (Table 24); as flea control is undertaken there is more likelihood of the family experiencing plague. However, because of the small number of families experiencing plague, this cannot be a firm conclusion.

For detailed responses to questions on plague, refer to Annex C Tables 64 - 67.

Table 24a: Relationship between experiencing plague and undertaking control of fleas

Observed frequencies

Family has experienced plague	Flea control	
	Yes	No
Yes	5	0
No	36	61

Chi-square (observed value) 7.822

One-tailed p-value 0.005

Similar remarks apply to the methods used for flea control. The only methods with an association with families experiencing plague:

- plastering the floor [Chi-square (observed value) 4.038, One-tailed p-value 0.044] and
- using insecticides [Chi-square observed value 6.871, One-tailed p-value 0.009]

are both associated with an increasing likelihood of families experiencing plague.

Relationship between having plague and perceptions/response to rodents

The number of households which said they had plague is very low (11 out of 654), so only a few cross-tabulations were tried (refer to Table 17 above). Of these, only for controlling rodents was there an association, see following table.

Table 25: Relationship between having plague and controlling rodents

	Control Rodents	Don't Control Rodents
Plague Yes	11	0
Plague No	384	145

Chi-square (observed value) 4.122 and One-tailed p-value 0.042

E. Market survey

This section is based on the market survey carried out and reported on by Nontokozi Nemarundwe as part of the research in Zimbabwe. Market stallholders were interviewed by questionnaire⁹.

Mbare is a high-density suburb, one of the oldest in the Zimbabwe capital Harare. The site of the survey was the open market which is at the centre of the suburb and next to a major bus station. Goods are traded every day of the week and include agricultural produce, supplied to the market from the eastern half of the country. The market comprises 3 distinct sections: farmers' enclosure, where farmers deliver; wholesale and retail.



Photo 3: Market survey site Mbare; abundant availability for rodents of food waste, standing water and harbourage.

There is plenty of food waste available for rodents to feed on. Traders are responsible for cleaning their stalls and the immediate surroundings, removing rubbish from their stalls and hiring garbage carriers to take the waste to dumping sites outside the market. The market is managed by a committee which "...is responsible for ensuring that minimum hygiene standards are maintained in the market. No fines are imposed on traders found to be not meeting set hygiene standards, with a mere reprimand as the only known severe punishment that can be imposed on a culprit. It is the role of the same committee to ensure that traders' merchandises are secure. Because the Mbare market committee is chosen along party lines, its effectiveness in discharging its duties is compromised as allegiance to set institutional arrangements tends to be

⁹ The full report; "Perceptions and practices relating to the transmission of plague, leptospirosis and toxoplasmosis in Zimbabwe", is at Annex E Appendix 1. The questionnaire is at Annex G Appendix 2.

influenced much by politics than anything else” (Nemarundwe). The area around the market is characterised by large areas of food waste (See photo, Annex E Appendix 1).

A large majority of the 15 stallholders interviewed said that their stalls (66.67%) provided an environment that is conducive to harbourage for rodents.

Table 26: Quality/Type of Stall at Mbare Market

Category	No. of Stalls	Percentage
1	6	40.00
2	4	26.67
3	3	20.00
4	2	13.33
Total	15	100.00

Waste including marketing waste, other rubbish, building rubble, timber and cardboard boxes are littered in different places all over the market. Rodents could be seen around the stalls searching for food and undisturbed by the physical presence of people. Untidy stalls (66.67%) are located in the part of the market where fresh vegetables and other foodstuffs are sold. This part of the market is damp most of the time from water that is used to wash and store vegetables so that they are clean and remain fresh for longer periods. Tidy stalls (13.33%) that are clean and provide no cover for rodents are located in that part of the market where metal ware, plastic ware and dried foods are sold.

Traders use more than one method; less than half of the traders (41.95%) reported that they dump their refuse in the open for council to collect later on and about 25% reported that they hire garbage collectors to carry their garbage for dumping at the dumping site from where the city council collects it. The open dumping sites were cited as one of the breeding grounds for rodents.

Respondents have seen an increase in rat population. This was attributed to a variety of reasons to: an increase in the number and volume of traders and stocks in the market (over crowding). Mrs. Sakabuya who has been a trader since the early 1970s thinks that the upsurge in rodents numbers coincided with the trading of fresh agricultural produce in the market such as groundnuts, bambara nuts etc. which was not common in the 1970s and 80s. Hygiene standards have also gone down over the last few years due to overcrowding and poor refuse/waste collection by the city council.

There were concerns that rodents cause physical damage to stocks thereby reducing the quality of the product on sale. Damaged products are sold at a reduced price, or thrown away. Mrs. Letis Johns reported that for every 1000 packets of pop corn she buys, at least 20 packets are destroyed by rodents and she throws them away losing a total of Z\$16 000 (US\$2.60). Rodents in Mbare market do not bite people because they are always awake and active.

To control rats, the majority of respondents use chemicals (61.11%), mechanical methods (22.22%) and biological methods (16.67%). There is no consensus among the traders at Mbare market with regard to what method to use to control the rodents.

However, the chairman of the traders claimed that the use of chemicals in the control of rodents in the market was not allowed as it could result in accidental poisoning of food. The main disadvantage of using mechanical methods is that very few rats are caught at a time.

Most stallholders who use chemicals use the black grainy rat killer (Chinese). While the efficacy of pesticides can readily be acknowledged, two problems were regularly cited:

- 1) that poisoned rodents can contaminate food and
- 2) that poisoned rodents can die in secluded places where they will rot and produce a stench smell. Locating such rotting rodents can be a real hassle and time consuming especially at overcrowded stalls. “Once I used rat killer and the next morning I found 24 rats dead. I had to turn the whole place up side down to find all the dead rats. After a few days more rats from my neighbours’ stalls had invaded my stall. It is useless to try and control rats when your neighbours are not doing anything”. Exclaimed Mrs. Sakabuya, who had a stall at the Mbare market during the interview on the 6th of March 2005.

Biological control

Respondents indicated that even though they themselves do not keep cats, some wild cats roam around the areas and are often seen catching rodents around the market. Also mentioned was that the rodents are so many that the cats can not reduce their population significantly because they are not that many. To illustrate how serious the problem of rodents was in the Mbare market, one trader poured some water on the floor of her stall and in less than one minute rats started to come out of junk material at the stall to drink water (see Photo 4 below, taken on this occasion). Use of personal cats at individual stalls poses a problem in that the cat will roam around the entire market instead of safeguarding its owner stall. Thus stall owners see no point in keeping cats.



Photo 4: Market survey site Mbare; rodents drinking water (Nemarundwe).

Mechanical means

The main problem cited for the use of traps is that traps can only catch a one rat at a time. Most rats are caught at night which means for the entire night only one rat will be caught. Sometimes you set traps and no rodents are caught. It's as if '*Makonzochacho anonyumwa zvekuti haabatwi* – the rodents now know that these are traps set to catch them' said the chairman of the Mbare market committee. Some traders now lock up their stocks in metal containers every night as a way to safe guard it from rodents.

Consumption of rodents

While historically, consumption of rodents such as mice may have contributed to the decline in the rodents' populations, the majority of respondents interviewed in all areas indicated that they do not eat rodents.

Conclusion

It is apparent that rodents are a major problem in all areas covered by the study. The general perception is that there has been an increase in the rodent population in the last three to four years and also that a new breed of rodents not seen previously is now prevalent. Similarly, most households do not keep cats that may contribute towards the biological control of rodents. Thus the prevalence of rodents.

The deterioration in the quality of housing, especially in the squatter camps and the compounds may also contribute to the increase in rodents' population as this type of housing provides good harbourage for rodents. There was also a general perception that rodents breed very quickly, especially in conditions that are conducive to rodents breeding, such as poor disposal of waste. The standards of living are generally going down, as a result of the overall poor performance of the macro-economy.

Efforts are being made by various individuals to control rodents through mechanical, biological, chemical and other means, yet the general perception was that the problem still persists. Suggestions were that there is a need to put concerted efforts together by different stakeholders including the health departments, housing departments and city and town councils responsible for waste disposal as well as the residents themselves. There is also a need for awareness raising on the hazards that are related to the prevalence of rodents as well as ensuring that rodents populations are eradicated or are under control.

F. Further research

Socio-economic status of other H/H members.

Considerable additional data has been gathered on the socio-economic status of all members of interviewed households: gender, age, education level and economic indicators. Further analyses of this data could be undertaken.

Comparisons of this socio-economic data set with other Project work packages.

- the importance of cats from the anthropological case studies

Research in non-Project areas

Because of the need to select sites for socio-economic survey that were also supporting Project zoonosis research, it could be argued that there may have been some influence on respondents' replies to questions. However, the data has provided an understanding of the relationships and the importance of rodents and human responses. Research in non-Project areas would provide a different perspective.

Cats

More comparative analysis of the socio-economic and technical data may throw more light on the relationship between cats and human health within the communities surveyed and the possible need for further research.

Management or control?

Gaps in the study

No specific interviews were conducted with health personnel. Where these were interviewed, it was a matter of coincidence that they fell in the sample, and so were only asked the same questions put to all respondents. The study would have benefited from key informant interviews with health personnel to get their views on people's perceptions about e.g. diseases caused by rodents as well as attempts to control such diseases.

Focus group discussion could also be facilitated to get people's views on possible solutions to rodent problems. This would also provide a platform for cross-pollination of ideas among the various stakeholders.

5 Conclusions

The data overall

The nine survey areas were drawn from sites common to the technical research of the project and yet also able to provide a representative picture of the urban, peri-urban and rural situation in the four countries. Through its analysis, data from the nine survey sites provide: an overview of the socio-economic context in which perceptions and decisions are taken in respect of rodents; what some of those perceptions and decisions are; the relationships between key variables; the likely impact of rodent-borne diseases on sustainable livelihoods; some pointers towards how rodent management might be improved and possible areas for further research.

The survey methodology was basically common throughout, permitting 'regional' analysis across the sites. However, some relatively minor adjustments were made over the course of the research as analysis revealed both the redundancy of some lines of enquiry and the need to add supplementary lines.

Because of the need for research cost-effectiveness, the sites selected for socio-economic survey were also supporting Project zoonosis research. It could be argued therefore that there may have been some influence biasing respondents' replies to questions. Similar remarks apply in respect of other external influences such as government programmes at sites, e.g. Lushoto where they are trying to help families deal with the effects of plague. A completely random approach might have provided a different picture. In support of the approach however the data are basically consistent. The breadth and depth of the data provides both a confirmation of aspects that were anticipated, and key insights into those about which little was known.

An overview of the socio-economic context

There are differences between and within sites for all social, economic, behavioural and rodent-related variables measured. The general economic status of the sample was moderate, characterised by medium levels of employment; dependency of families on household heads and few larger animals kept (except for Lushoto) and intermediate quality of housing. Area of land available for cultivation is a key indicator of wealth and income (and rodent food availability) for Mapate, Lushoto, Hatcliffe and Nkayi.

As might have been expected, socio-economic status has a major bearing on exposure to rodents, household's vulnerability to rodent-borne diseases, their perceptions of rodents and subsequent decisions taken in respect of management or control. As socio-economic status increases so measurements of these characteristics show improvement, and the converse.

Perceptions and decisions in respect of rodents

Although they also demonstrated important variation, in general the communities surveyed have a moderate to high exposure to rodents,:

- Food source availability for rodents is 'high'
- Rodent access to human buildings and land is 'high' and there is good availability of cover for rodents.
- Close contact with alternative (to humans) hosts for rodent diseases within the house is limited to cats.

- Rodent access to human drinking water is ‘moderate to high’ – by source, and whether or not stored water is covered.
- Rodent access to household waste is ‘moderate to high’
- Rodent access to stored food is ‘high’
- Frequency of observation of rats is ‘medium to high’. Awareness of the importance of rodents is ‘low’ although it becomes higher when questions on diseases are posed specifically.

Relationships between key variables

From the analysis of the entire survey sample combined, the following can be concluded.

The enumerators’ assessment of **how accessible the house is to rodents** and the derived **rodent proof index** (RPI) corresponds well with the householders’ observation of rodents in the house. From this it can be concluded that the quality of the house construction has a direct bearing on rodent access.

Respondents’ age does not seem to have a bearing on the way people live in terms of rodents with the exception of whether or not they control rodents. Those in the under-25 age group are more likely to control rodents.

The **level of education** is a key variable. It is associated with: improved house rodent-proofing; a belief that rodents carry disease and undertaking rodent control, all of which increase with education status.

As years of education increase, so does the frequency with which rodents are seen in the house. Although this would appear to contradict the association between years of education and house being rodent-proof, it may indicate greater perception and awareness of rodents as education increases.

Cats are important as a primary host for toxoplasmosis. However, there is no evidence that keeping cats suppresses rodent numbers, indeed their presence is associated with an increasing frequency of rodents observation in the house.

There is an association between increasing rodent-proof indices and a reduction in:

- Frequency of seeing rodents in the house
- Believing rodents are a problem
- Believing rodents carry disease
- Undertaking rodent control

The head of household having been **bitten** by rats is associated with: the house rodent-proof index, the frequency with which rodents are seen in the house, believing that rodents carry disease, and undertaking rodent control. However, the number of observations in each cell are small, particularly in the cases where there are a large number of categories, such as the house rodent-proof index (shown in the following table) and the frequency with which rodents are seen in the house.

Plague. There were very few households recording plague so few analyses were tried. Households experiencing plague with controlling rodents was the only association, and it appeared to be a strong one.

Pointers towards how rodent management or control might be improved.

Although the analysis strongly underlines the positive relationship between wealth, through quality of housing and less risky practices in respect of exposure to rodents, there are a number of ways the impact of rodent-borne diseases could be reduced on sustainable livelihoods in poorer households.

Overall, the positive effect of education status has an important potential bearing on the possibilities for improving management of rodents. Training and promotional material can be expected to have a positive effect.

Strengthening householder's views of the importance of rodent's ability to carry disease (with outputs from the technical work packages) would be expected to contribute positively to rodent management.

However, the socio-economic perspective can only help to describe the resources, constraints and perceptions of households in respect of rats. These questions therefore need to be addressed jointly with the technical work packages.

Possible areas for further research

Socio-economic status of other H/H members.

Considerable additional data has been gathered on the socio-economic status of other (in addition to the head of household) members of interviewed households: gender, age, education level and economic indicators. Further analyses of this data could be undertaken.

Comparisons of this socio-economic data set with other Project Work Packages.

- More comparative analysis of the socio-economic and technical data may throw more light on the relationship between cats and human health within the communities surveyed and the possible need for further research.
- The importance of cats as assessed by the anthropological case studies.
- Comparisons between household type and rodent catches.

Research in non-Project areas

Because of the need to select sites for socio-economic survey that were also supporting Project zoonosis research, it could be argued that there may have been some influence on respondents' replies to questions. However, the data has provided an understanding of the relationships and the importance of rodents and human responses. Research in non-Project areas would provide a different perspective.

Rodent management or control policy

Human exposure to rodents is widespread. There is considerable scope for changes in human behaviour to reduce the potentially adverse effects which can result from this exposure. These improvements are likely to involve long-term effort and managing rodent numbers and access to humans rather than eradication. Examination of the outputs from this research and from other work packages may reveal implications for rodent management policy.

Annexes

Annex A. Socio-economic status

Biodata/social indicators

Household heads in Mapate and Cato Crest (South Africa) were fairly evenly divided between men and women, whereas Lushoto (Tanzania) was dominated by men. Mapate and Cato Crest were fairly close in average age and years of education, whereas in Lushoto, average age was higher than in the other sites and education years notably lower.

Age is negatively correlated with education, presumably because education is now generally available to younger family members. In Lushoto, age is positively correlated with land area for the same reason.

Cultivation

Table 27: Crops grown, numbers of farmers growing and average areas

Square metres (except where noted)

Country/ site	What crops do you grow?											
	Vegetables		Fruit		Maize		Beans		Cassava		Bananas	
	Nos.	Area	Nos.	Area	Nos.	Area	Nos	Area	Nos	Area	Nos	Area
South Africa												
Mapate ¹	47	94	100	32	107	1632					3	1343
Cato Crest	4	2.5	9	2								
Tanzania												
Lushoto	66	0.7 ²	22	0.6 ²	100	2.0 ²	69	1.6 ²	57	0.9 ²	25	1.3 ²
Morogoro	46	2.9	24	1.2	31	1.3					14	1.00
Mozambique ³												
Maputo ⁴	18	20.1	3	17.7	9	22.3	10	na	15	25		
Tete	1	na			1	na						
Zambezia ⁵	1	5			1	25	9	na	5	na		
Zimbabwe												
Hatcliffe	49	33.1	3	14.3	47	831.7						
Nkayi	44	199.9	44	na ⁶	41	7682	2	na				

¹ Also grown are Irish potatoes (which would be well suited because of the altitude) by 30 farmers on an average of 1.6 acres.

² In acres

³ Also grown are groundnuts, sorghum and sugar cane

⁴ Also grown – sweet potato

⁵ Also grown are groundnuts and sorghum

⁶ Most (40) grow a few plants, 3 grow 10 sq metres and 1 grows 8,000 sq metres.

Generally speaking, the areas of crops grown by survey households are fairly small. The households in the survey sites in Zimbabwe grow large areas of maize and vegetables, with a few households greatly exceeding the average figures.

It would appear likely that when in season, these crop areas provide a significant potential food source for rodents, and this is borne out by interviewee's responses to questions on the problems caused by rodents.

Table 27a: Correlations between socio-economic indicators and crop areas: Lushoto

	Vegetables	Fruit	Maize	Beans	Cassava	Bananas	Irish potatoes
Age			0.387	0.293	0.277	0.269	
Education (yrs)		0.204			-0.225		
Land area	0.380		0.851	0.865	0.315	0.205	0.688
Vegetables				0.280			
Maize				0.616	0.348		0.478
Beans							0.658
Cassava							-0.201

Only correlations significant at the 5% level are shown.

Maize is positively correlated with bean production and Lushoto, where they tend to be intercropped.

The relationship between age and education could be complex; for example, younger farmers might have had more opportunities to stay longer in education. The positive correlations between age and: maize, beans, cassava and bananas suggests that these crops are grown increasingly with age. The correlations involving education are interesting: positively, with fruit, and negatively, with cassava. This might have been expected as awareness increases of the healthy benefits of fruit and that cassava is a 'poor man's crop'.

Land area is positively correlated with the growing of beans, maize, Irish potatoes, vegetables and cassava. Age of HoH is positively correlated with maize, beans, cassava and bananas.

Animals and livestock

The survey sites are characterised by fairly low levels of animal-keeping (Table ???), with the exception of poultry (particularly chicken) which are kept by the majority of households. Household keeping differs markedly for each site. Those kept on any scale are (in order of importance):

- Cattle, at Lushoto, Morogoro, Nkayi and Tete and, with notably fewer animals, Mapate.
- Goats at Lushoto and, with notably fewer animals at the Mozambique sites and Mapate.
- Sheep at Lushoto only
- Cats at all sites with the notable exception of Hatcliffe.
- Dogs at all sites again with the notable exception of Hatcliffe.
- Pigs at all sites except Cato Crest, Lushoto and Hatcliffe.
- Chicken are kept by a large minority of households at Lushoto, Morogoro (where a few households have semi-commercial flocks) and Nkayi

Table 28: Household animal keeping

Country/ site	What animals do you keep?											
	Cattle		Goats		Sheep		Pigs		Dogs		Cats	
	Nos.	/HH	Nos.	/HH	Nos.	/HH	Nos	H/H	Nos	/HH	Nos	/HH
South Africa												
Mapate ¹	4	2.5	4	6.3			4	2.8	39	2.8	2	2.5
Cato Crest ²									6	1.5	6	1.7
Tanzania												
Lushoto ³	59	2.2	34	3.1	37	2.9			12	1.6	23	1.6
Morogoro ⁴	6	20.7 ⁵					6	14.3	19	3.0	11	1.2
Mozambique ⁶	3	10.7	14	7			12	8.2	12	1.8	23	1.8
Maputo ²			2	2.5			2	1.5	3	1	7	1.4
Tete ²	3	10.7	7	7.3			6	12	5	1.6	9	2.4
Zambezia ²			5	10.4			4	5.8	4	2.5	7	1.4
Zimbabwe												
Hatcliffe ⁷												
Nkayi ⁸	5	23	8	12.3			1	6	16	1.6	6	1.3

Other animals were kept by:

¹ 12 HH have an average of 5.7 (donkeys, chickens and ducks).

² < ½ HH with < 10 chickens/HH.

³ 60 HH have an average of 4.7 chickens each.

⁴ 43 HH have an average of 72.3 chickens each and 9 HH have an average of 8 ducks each.

⁵ This average is mainly accounted for by 1 HH where there are 85 cattle.

⁶ 34 HH have an average of 6 chickens each.

⁷ 9 HH with 14.9 chickens/HH

⁸ 40 HH with 15.8 chickens/HH

Compared with the other sites, many more households keep animals in Lushoto. Cattle, sheep and goats are all important. Cats are markedly more important in Lushoto and Morogoro, dogs more so in Mapate. There are very few animals in Cato Crest and no farm livestock, apart from chickens. Chickens are important in Morogoro; 8 households keeping moderate to large number presumably for income-raising.

Animals sleeping in the house

Households were asked if animals sleep in the house. Animals are usually kept close to the house. Cats appear to move freely around compounds. In Morogoro, cats move freely between houses and it is not uncommon for cats from other house to stay overnight. In Cato Crest, almost half said that cats owned by others came into the house. Cats sleep in the house in almost ¼ of households in Lushoto and a few houses in Mapate and Cato Crest. The following tables give the responses. This question was modified at subsequent surveys to focus on human behaviour in respect of cats, so this table should be considered together with the subsequent tables.

Table 29: Animals sleeping in the house

Numbers of households

Country/ site	What animals sleep in the house?												
	Cattle		Goats		Sheep		Pigs		Dogs		Cats		
	Nos.	%	Nos.	%	Nos.	%	Nos	%	Nos	%	Nos	%	
South Africa													
Mapate												2	100
Tanzania													
Lushoto	59	100	33	97	35	95	-	-	12	100	23	100	
Morogoro											15 ¹		

¹ In Morogoro, cats from other houses stay overnight, so the number of houses recording cats sleeping exceeds the number of houses keeping cats.

This question was intended to find out which animals slept close to household members. These responses suggests that the question was interpreted differently; Lushoto responses refer to animals living **near** the house.

A review of the data generated during the Mapate and Lushoto surveys indicated the need for more information in respect of cats, because of their importance as a primary host for toxoplasmosis. It was thought likely that not only the households' own cats might enter houses, particularly in urban areas. So other survey households were asked; 'Do other cats come into your house?' and whether cats 'slept in the house'.¹⁰

The following table indicates that the custom of other's cats coming in the house is widespread and common, although somewhat less so for Hatcliffe. It is generally very uncommon for cats to sleep in the house with the notable exception of the Mozambique sites and to a lesser extent, Morogoro.

¹⁰ A summary of the relevant discussion can be found in the Project Meeting Report, Maputo, February 2004.

Table 30: Presence of cats

In percentages

Country/ site	Do other cats come into your house?		Do cats sleep in the house?	
	Yes	No	Yes	No
South Africa				
Cato Crest	40	50	4	86
Tanzania				
Morogoro	91	17	15	93
Mozambique				
Maputo	82	9	49	45
Tete	67	33	55	45
Zambezia	97	3	27	73
Zambezia	100	0	74	26
Zimbabwe				
Hatcliffe	24	76	1	99
Nkayi	69	31	1	99

Table 31: Correlations between socio-economic indicators and livestock

Location	Education (yrs)	Numbers of animals kept			
		Goats	Pigs	Dogs	Cats
Mapate					
Age	-0.531				
Cattle keeping		0.313		0.211	0.321
Dogs keeping			0.411		0.482
Lushoto					
Land area cultivated		0.198			
Cattle keeping		0.223			0.212
Dogs keeping		0.225			
Other animals		0.231			

In Mapate, cattle are positively correlated with: keeping cats, goats and dogs. In Lushoto, goats are positively correlated with: land area and keeping cattle, dogs and other animals.

Although there were also no strong positive correlations between ownership of different types of livestock in Mapate, households keeping cattle were more likely to also keep goats, dogs and cats. Because of the higher value of cattle, this may be an extension of economic well-being. There was also a positive correlation between households keeping pigs and dogs, and dogs and cats, although the reasons for this are not clear.

House ownership

Table 32: House ownership

Country/ site	House ownership			
	Do you own your own house?		How many years have you lived in this house?	
	Yes	%	Range	Average
South Africa Cato Crest	31	34	1 – 14	8.4
Tanzania Morogoro	66	61	0.08 - 55	13.4
Mozambique Maputo	89	96	1 - 55	8.9
Tete	30	91	1 - 55	11.4
Zambezia	28	93	1 - 20	7
Zimbabwe Hatcliffe	31	100	1 - 19	8.1
Nkayi	45	64	0.5 - 20	5.9
	54	46	0.3 - 87	8.2

Does not include non-responses.

Assessment by enumerator of property for ease of rodent access.

1. Living accommodation.

Enumerators assessed the interviewee's house where the family sleeps for how rodent-proof the house is; checking the walls, the roof and the doors (when closed) to see if rodents can gain access. One of the categories below was chosen for each household interviewed.

Category 1

Very poor quality housing (poor quality building materials, gaps between building materials - about as bad as housing can be. Provides very easy access for rodents.

Category 2

Poor housing and worse than average. Access for rodents is relatively easy but not as bad as Category 1.

Category 3

Better than average. Quite good housing that could only provide limited access for rodents. Not as good as Category 4.

Category 4

Good housing, access for rodents is very difficult.

Housing quality across the survey sites is mainly concentrated in the two categories just above and just below average, with the remaining households more or less evenly distributed in the best and poorest categories.

Table 33: Ease of rodent access: living accommodation

Country/site	Ease of rodent access category								
	1		2		3		4		
	Nos	%	Nos	%	Nos	%	Nos	%	
South Africa									
Cato Crest	9	24	12	32	15	39	2	5	
Tanzania									
Morogoro	11	10	36	34	45	42	14	13	
Mozambique									
Maputo	2	2	49	52	5	5	38	40	
Tete	1	3	16	53	10	33	3	10	
Zambezia	1	3	17	55	11	35	2	6	
Zimbabwe									
Hatcliffe	33	48	17	24	15	21	5	7	
Nkayi	1	1	30	43	26	34	11	16	

Does not include non-responses.

2. The rest of the household compound (excluding living accommodation)

Enumerators assessed how rodent-free the interviewee's compound of the household is. After checking all buildings (kitchen, toilet, poultry houses, etc.) and possible sites where rodents could hide (apart from the living accommodation) to see if rodents can gain access, one of the categories below was chosen for each household interviewed.

CATEGORY 1

There is very extensive availability of harbourage and cover (such as household waste, other rubbish, building rubble, timber stacks, etc.). Generally, there is very easy access to rodents to any buildings within the compound (poor quality building materials, gaps between building materials) and evidence of rodents (rodents' holes, etc.).

CATEGORY 2

The area could provide cover and harbourage for rodents. It is worse than average, but not as bad as Category 1.

CATEGORY 3

There is some cover but it is better than average. Not as good as Category 4.

CATEGORY 4

It is a very tidy and clean environment that provides almost no cover, or none, for rodents. Generally there is no access to rodents within the compound and no evidence of rodents

The quality of the rest of the household compound at survey sites is also (as for the living accommodation) mainly concentrated in the two categories just above and just below average. The remaining households are more distributed in the poorest category than in the best. However, almost all sites have some houses in the best category, whereas not all sites have houses in the poorest category.

Table 33a: Ease of rodent access: rest of the household compound

Country/site	Availability of rodent cover								
	1		2		3		4		
	Nos	%	Nos	%	Nos	%	Nos	%	
South Africa									
Cato Crest	9	24	18	47	9	24	2	5	
Mozambique			40	43	49	52	5	5	
Maputo			15	45	18	55			
Tete			13	43	13	43	4	13	
Zambezia			12	39	18	58	1	3	
Zimbabwe									
Hatcliffe	34	49	27	38	6	9	3	4	
Nkayi	2	3	28	40	32	46	8	11	

Does not include non-responses.

The availability of rodent cover data for Morogoro was collected in a slightly different format; according to the materials used in construction, as follows.

Table 34: Morogoro. Ease of rodent access: rest of the household compound

Country/site	Availability of rodent cover								
	Recycled		Traditional		Improved		Brick/sheet		
	Nos	%	Nos	%	Nos	%	Nos	%	
Tanzania									
Morogoro	13	13	15	14	33	32	43	41	

The closeness of houses to cultivated and uncultivated land (Table 11) confirms visual assessment; that cultivated land is quite close, and that most houses are quite close to bush areas. 'Bush' refers to uncultivated land full of trees, grass and other plant material, possible harbourage for rodents.

Table 35: Closeness of house to cultivated and uncultivated land

Average distances per household in metres.

Country/ site	Type of land					
	Land used to grow vegetables		Land used to grow maize		Uncultivated land (bush)	
	HH	Dist	HH	Dist	HH	Dist
South Africa						
Mapate		9		75		114
Cato Crest						
Tanzania						
Lushoto ¹	70		100		57	

Blocked out cells signifies question not asked/relevant

Other economic indicators**Table 36: Do you own a radio?**

Country/ site	Do you own a radio?	
	Yes	No
Tanzania		
Morogoro	99	9
Mozambique	75	19
Maputo	85	15
Tete	93	7
Zambezia	62	38
Zimbabwe		
Hatcliffe	40 ¹	60 ¹
Nkayi	64	36

¹ Television**Table 37: Correlations between socio-economic indicators and housing: Mapate**

Type of housing	Closeness of house to	
	Vegetables	Maize
Age		-0.211
Area land	0.302	0.228
Nos. Goats kept		0.548

Table 38: Correlations between socio-economic indicators and housing

	General condition	Closeness of house to		
		Vegetables	Maize	Bush
Lushoto				
Vegetables			0.203	
Mapate				
Age			-0.211	
Area of land	0.302	0.288		

Overview of socio-economic status as it relates to rodents

Although there were differences between sites, the general economic status of the sample households was low, characterised by low levels of employment and dependency on the head of household (HoH). Apart from Lushoto, where animals are an important asset, further indication of low economic status are the number of animals kept in Mapate and Cato Crest (although as a squatter area, this is to be expected), and the quality of housing.

Annex B. Human behaviour

Water storage and covering

Water storage

The situation for water storage is given in the following tables. Storage is common for both drinking and washing water. Fewer households store in Cato Crest, where all water is piped. Covering water is commonplace with drinking water (up to 1/5th uncovered), less so for washing water. Boiling and filtering water is only practised in rural Lushoto where households have insufficient and have to purchase. In Mapate, drinking water is generally stored because is only available during restricted periods, whereas washing water is carried in larger containers which act as store until depleted.

Table 39: Families storing their water

Percentages

Country/ site	Storing	
	Yes	No
South Africa		
Mapate		
Cato Crest	58	42
Tanzania		
Lushoto		
Morogoro	98	2
Mozambique		
Maputo	93	1
Tete	100	0
Zambezia	100	0
Zimbabwe		
Hatcliffe	97	3
Nkayi	20	80
	90	10

Storage practice varies widely. Again more care is taken with drinking water than washing water, although 18 per cent of households do not cover.

Although families store water, the periods it is covered varies. Approximately half of the households cover most of the time or except when in use, whereas half of the households only cover occasionally or never.

Table 40: Types of family water storage

Percentages

Types of water storage	Morogoro ¹		Mozambique		Drinking water	Washing water
	Drinking water	Washing water	Drinking water	Washing water		
Bucket	69	74	2			
Large Clay Pot	22	-	63	43		
Drum/barrel	8	36	15	16		
Can			18	17		

¹ Households use more than one source

Covering of stored water

Those that store water were asked if it was kept covered and when, for which the data is presented in the following tables. More care is given to drinking water than to water for washing.

Table 41: Covering of stored water

In percentages

Country/ site	Drinking water		Washing water	
	Covered	Not Covered	Covered	Not Covered
South Africa				
Mapate	78	18	23	65
Cato Crest	87	13	9	91
Tanzania				
Lushoto	99	1	56	44
Morogoro	98	2	70	30
Mozambique				
Maputo	92	2	37	63
Tete	94	6	85	15
Tete	100	0	10	90
Zambezia	100	0	10	0
Zimbabwe				
Hatcliffe	87	13	9	81
Nkayi	79	21	17	83

Although at first it appears that most families cover their water, this is not borne out by the responses to the more detailed question. When asked when they cover, a much more varied picture emerges which suggests that:

- Some, particularly in Cato Crest, do indeed cover except when in use,
- Most households cover most of the time,
- A significant minority only cover occasionally or even, never.

Table 42: Covering of stored water: frequency

In percentages

Country/ site	Stored water is kept covered			
	Except when in use	Mostly	Occasionally	Never
South Africa				
Mapate	17	35	28	20
Cato Crest	88		6	6
Tanzania				
Lushoto	33	65		1
Morogoro	59	24	16	2
Mozambique				
Maputo	1	91	1	5
Maputo	3	79	3	12
Tete		97		3
Zambezia		100		
Zimbabwe				
Hatcliffe ¹	17	44	4	1
Nkayi ¹	44	36	1	4

¹ Some missing data

Table 43: Families boiling and filtering drinking water

Country/ site	Boiling	Filtering
South Africa		
Mapate	3	1
Cato Crest		
Tanzania		
Lushoto	85	38

Blocked out cells signifies question not asked/relevant

Most people boil their drinking water in Lushoto and many also filter it. In Mapate very few families boiled or filtered drinking water, probably because it is treated.

The types of water storage used in the different sites were: bucket; large clay pot and drum.

Sanitation; toilets, waste

Type and location of toilet

A substantial majority of families at all sites have their own toilet.

Table 44: Does your family have its own toilet?

Country/ site	Own toilet	
	Yes	No
South Africa		
Mapate	100	19
Cato Crest	93	7
Tanzania		
Lushoto	95	3
Morogoro	95	5
Mozambique		
Maputo	83	11
Tete	31	2
Zambezia	83	17
	87	13
Zimbabwe		
Hatcliffe	67	33
Nkayi	76	24

Toilet construction.

Although further details of the type and location of toilets were collected in the early surveys, its usefulness was limited and so abandoned in the later ones.

In the rural sites Mapate and Lushoto, households are fairly evenly divided between traditional and 'improved', with the remainder as brick/tile/sheet. In Mapate, the majority have a toilet that is improved or brick with tile/sheet type and few families a traditional type (Table 28) and a few families have two toilets. Some families are thought to have flushing toilets, using outside latrines when there is insufficient water for flushing. In Lushoto, the majority have traditional toilets.

Table 45: Type of toilet

In percentages

Country/ site	Type of toilet		
	Traditional	Improved	Brick and tile/sheet
South Africa			
Mapate	14	49	34
Tanzania			
Lushoto	55	32	12

The closeness of the toilet to sites of possible rodent habitation is shown in Table 46.

Table 46: Closeness of the toilet to sites of possible rodent habitation: Mapate

In metres

Country/site	Closeness of the toilet to sites of possible rodent habitation							
	The house		Land used for vegetable growing		Land used for growing maize		Uncultivated land (bush)	
	Range	Average	Range	Average	Range	Average	Range	Average
South Africa								
Mapate	6 - 35	17	2 - 70	17	1 - 2500	29	1 - 800	117

Disposal of waste

Household practices are fairly evenly divided between burning waste and through ways such that it could remain a food source for rodents: discarded or in covered or uncovered pits (see: following table). In Lushoto waste is mainly buried in a pit. In the urban site Cato Crest, almost all waste is collected by the council, thereby removing it as a possible food source for rodents. A substantial minority of households in Morogoro and Hatcliffe also have their waste collected.

Burning of waste is important in Maputo and Mapate, where around half of families burnt their waste, Morogoro and Hatcliffe and to a much lesser extent at other sites. Disposal by the majority of the remaining households is through ways such that it could remain a food source for rodents.

Households use more than one method.

Table 47: Family disposal of waste

In percentages

Country/site	Method of disposal					
	Burnt	Thrown anywhere	Pit in garden and cover	Pit not covered	Collected by council	Other
South Africa						
Mapate	48	23	15	14	1	3 ¹
Cato Crest	-	-	-	-	94	3
Tanzania						
Lushoto	11		85			6
Morogoro ²	30		35		39	9 ³
Mozambique	24	52 ³	30		1	
Maputo	64		27		3	18 ⁴
Tete		63 ³	13	27		3
Zambezia	6	29 ³	55	13		
Zimbabwe						
Hatcliffe	31		44		41	3 ³
Nkayi	6	4	73		4	3 ⁴

¹ one place which is not covered, at the back of the house, as compost.² Using more than one method.³ Thrown in canals⁴, bush and garden.⁴ Used as manure

For Mapate, the correlation between occupation and distance from toilet to maize land is highly negative because many heads of households are farmers and the distances to the maize are far. The distance to the toilet from the house increases when it is not owned, so the correlation is highly negative.

There were no positive or negative correlations between socio-economic indicators and sanitation for Cato Crest.

Table 48: Correlations between livestock and sanitation: Lushoto

Livestock numbers	Closeness of toilet to			
	House	Vegetable land	Maize land	Bush
Goats				0.311
Dogs	0.340			0.275
Cats				
Other animals		0.331		

Correlations between livestock keeping and sanitation were:

Positive for Mapate:

- Goats with closeness of the toilet to vegetable areas

Positive for Lushoto:

- Numbers of dogs kept with closeness of the toilet to the house and with the bush.
- Goats with closeness of the toilet to the bush.

The reasons for a positive correlation between 'the toilet is near to vegetables' with goat-keeping, are not clear.

Food storage: types of store used for staples, practices

Family staple food storage behaviour, the types of stores used, whether they are rodent-proof and other practices, is shown in the following four tables.

Types of store used for staples

For most of the households interviewed storage involved a range of receptacles; the majority store in sacks, although traditional storage structures and drums and tins are also widely used.

Table 49: Types of store used for staples

In percentages

Country/site	Households storing	Type of store				
		Sacks	Traditional store (open)	Traditional store (closed)	Purchased store	Other
South Africa						
Mapate	86	62		2		2 ²
Cato Crest	84	14	84 ¹			
Tanzania						
Lushoto	100	98	12	88	7	-
Morogoro	69	62	15			3 ³
Mozambique	87	37	2	40 ³	1	30 ²
Maputo	76	30	27 ^{1,2}			3 ³
Tete	97	50				50 ³
Zambezia	94	32	6 ²			71 ³
Zimbabwe						
Hatcliffe	93	18	29 ^{1,2}			2
Nkayi	96	10	25 ^{1,2}			

¹ Drums

² Bucket and tins

³ Traditional granaries (*celeiro* in Mozambique)

As most households use sacks, tins or open stores, there is the potential for access by rodents.

Rat-proof

This would seem to be borne out by the views of the households, which considered that almost none of the sacks were rodent-proof. Traditional and other methods of storage fare better although less than 1/3rd of these are rodent-proof.

Storing food on or off the floor

Households across the survey countries were fairly evenly divided as to whether or not they store on or off the floor.

Table 50: Do you store food on or off the floor?

In percentages

Country/site	Store food	
	On the floor	Off the floor
South Africa		
Cato Crest	30	69
Tanzania		
Morogoro	43	26
Mozambique		
Maputo	36	54
Tete	58	21
Zambezia	33	63
Zambezia	16	81
Zimbabwe		
Hatcliffe	87	13
Nkayi	61	34

Families sleeping in the place where staple food is stored

For those storing staple food, less than half sleep in the same room as where staple food is stored and the majority do not (Table 36). Usually, bags of maize are put in the corner of the room.

Table 51: Families sleeping in the place where staple food is stored

In percentages

Country/site	Families sleeping where staple food is stored		Families sleeping in the house with stored food		Families sleeping in the same room as stored food	
	Yes	No	Yes	No	Yes	No
South Africa						
Mapate	42	58				
Cato Crest						
Tanzania						
Lushoto	90	10				
Morogoro			53	16	29	40
Mozambique			80	20	20	80
Maputo			64	36	36	64
Tete			93	7	13	87
Zambezia			87		10	
Zimbabwe						
Hatcliffe					50	50
Nkayi			47	49	33	51

Annex C. Rodents

Observation

Families were asked a number of questions dealing directly with rodents. The responses indicate that most people have seen rats in the village (Table 34).

The majority of h/holds in all sites have seen rats in the village.

Table 52: Families seeing rats in their village

In percentages

Country/ site	Families seeing rats in their area	
	Yes	No
South Africa		
Mapate	91	9
Cato Crest	86	14
Tanzania		
Lushoto	89	11
Morogoro	93	7
Mozambique		
Maputo	84	16
Tete	88	12
Zambezia	77	23
Zimbabwe		
Hatcliffe	87	13
Nkayi	97	3
	80	20

Of these, it most likely they were seen in the house or the bush/surrounding areas. Being seen in crops was important in Hatcliffe, Lushoto, Nkayi and the Mozambique sites. There is a lot of variation in respect of frequency of observation (seldom, 1/month, 1/week, 1/day and >1/day) for the 'Yes' families:

- Mapate; a decline in scores as the frequency of observation increases; the most common frequency being once a month, and the least common - more than once a day.
- Cato Crest; daily or more frequent observations account for the majority.
- Lushoto; would appear to be bimodal – observations either not at all or frequent (to be checked)

Frequency of observation.

Those seeing rats in their village indicated (Table 41). For Mapate there appears to be a decline in scores as the frequency of observation increases; the most common frequency being once a month, and the least common - more than once a day. The daily observations do appear to be an important factor, accounting for at least 15% of the 'Yes' families. For Lushoto, there appears to be a bimodal distribution with peaks of 'seldom seeing rats' and the more frequent observations. The locations where people see rats are fairly evenly distributed.

Where rodents were observed

Respondents were much more likely to see rodents **in the house** than in any other location. Where growing crops was an important part of the household economy

respondents were more likely to see rodents **in their crops**, the notable exception being Mapate.

Table 53: Location and frequency of seeing rats in their village

Frequency	Seldom	Once a month	Once a week	Once a day	> once a day	Total scores for this location
Where						
Mapate						
In the house	17	28	15	16	10	86
In crops	0	11	2	2	1	16
In the bush	34	24	13	1	6	78
Elsewhere	3	0	0	0	0	3
Total scores for this frequency	54	63	30	19	17	
Cato Crest						
In the house	9	7	9	20	19	64
In crops	0	0	0	1	0	1
In the bush	6	4	7	19	27	63
Elsewhere	0	0	0	0	0	0
Total scores for this frequency	15	11	16	40	46	
Lushoto						
In the house	52	2	4	7	18	82
In crops	38	1	13	20	9	81
In the bush	27	2	15	18	7	69
Elsewhere	-	-	-	-	-	
Total scores for this frequency	107	5	32	45	34	
Morogoro						
In the house	13	3	7	5	67	95
In crops	5	0	1	2	14	22
In the bush	6	0	1	2	26	35
Elsewhere	0	0	0	0	1	1
Total scores for this frequency	24	3	9	9	108	
All Mozambique						
In the house		1	4	17	55	77
In crops	5			8	23	36
In the bush	7	1	6	6	13	33
Elsewhere			1			1
Total scores for this frequency	12	2	11	31	91	
Maputo						
In the house			1	2	26	29
In crops	2				7	9
In the bush	4			1	4	9
Elsewhere						
Total scores for this frequency	6		1	3	37	
Tete						
In the house			3	10	10	23
In crops	2			5	4	11
In the bush	4		3	3	4	14
Elsewhere						
Total scores for this frequency	6		6	18	18	

Frequency	Seldom	Once a month	Once a week	Once a day	> once a day	Total scores for this location
Where						
Zambezia						
In the house		1		5	21	27
In crops				3	13	16
In the bush		1	3	2	5	11
Elsewhere			1			
Total scores for this frequency		2	4	10	39	
Hatcliffe						
In the house	6				55	61
In crops	27		1	5	30	63
In the bush	29	2	2	3	21	57
Elsewhere					6	6
Total scores for this frequency	62	2	3	5	112	
Nkayi						
In the house	10		3	7	34	54
In crops	30		5	5	12	52
In the bush	34		1	2	2	37
Elsewhere	5		1	1	6	13
Total scores for this frequency	79		10	15	54	

Mapate

There is an association between the quality of housing (QHI) and whether rats are a problem.

Table 54: Quality of housing and whether rats are a problem: Mapate.

Observed frequencies:

Quality of housing	Are rats a problem		Total
	Yes	No	
Poor	7	6	13
Medium	45	2	47
Good	44	8	52
Total	96	16	112

Chi-square (observed value) 14.695

One-tailed p-value 0.001

Relationship between quality of housing and rodent observation.

There is no association between the rodent-proof index (RPI), assessed by enumerators and general rodent observation by interviewees [Chi-square (observed value) is 5.206 and the One-tailed p-value is 0.157].

However, when compared with the frequency rodents are seen in the house, there is a close association. As the quality of the housing deteriorates, so both the likelihood that rodents are observed and the frequency of observation increase.

Rodents as a problem

Interviewees were asked if rats were seen as a problem in their village (Table 55).

Table 55: Rats are seen as a problem in their village

In percentages

Country/ site	Rats are seen as a problem in their village	
	Yes	No
South Africa		
Mapate	84	16
Cato Crest	76	24
Tanzania		
Lushoto	52	48
Morogoro	81	19
Mozambique	82	18
Maputo	91	9
Tete	67	33
Zambezia	87	13
Zimbabwe		
Hatcliffe	90	10
Nkayi	81	17

Other human: rodent perception relationships

Relationship between keeping cats and rodents

The relationship between keeping cats and observation of rodents is unclear, as the following two tables reveal.

The following table relates to the general observation of rodents, where there is a strong association, with those families keeping cats having less likelihood of seeing rodents than those without cats.

Table 56: Relationship between keeping cats and rodent observation

Cats	See rodents		Total
	Yes	No	
Keep cats	54	15	69
Don't keep cats	522	57	579
Total	576	72	648

Chi-square (observed value) is 7.668 One-tailed p-value is 0.006

However, there is no association between keeping cats and the frequency with which rodents are seen in the house.

Table 57: Relationship between cats and frequency rodents are seen in the house

Observed frequencies:

Cats	Frequency rodents are seen in the house					Total
	Not seen	1/month or less	Once a week	Once a day	More than 1/day	
Keep cats	17	11	7	7	27	69
Don't keep cats	111	125	43	64	242	585
Total	128	136	50	71	269	654

Chi-square (observed value) is 2.627 One-tailed p-value is 0.622

The most likely explanation for this apparent discrepancy is the weakness of the general question on observation (discussed elsewhere), providing information which is too general. It is therefore concluded that on the basis of the frequency rodents are observed, that there is no association between cats and rodent number in the house.

Relationship between years of education and frequency rodents are seen in the house

There is an association between years of education and the Rodent-proof index (RPI); as the level of education increases so the degree to which houses are rodent-proof tends to increase (see: following table).

Although this would appear to contradict the association between years of education and the house being rodent-proof, it may indicate greater perception and awareness of rodents as education increases.

Table 58: Relationship between years of education and Rodent-proof index

Years of education	Rodent-proof index				Total
	High	Medium	Low	Poor	
None	3	2	5	8	18
1 – 3 years	14	10	2	3	29
4 – 7 years	58	86	25	99	268
8 – 9 years	53	30	10	32	125
10 years or more	37	35	11	21	104
Total	165	163	53	163	544

Chi-square (observed value)42.707 One-tailed p-value < 0.0001

Perceptions of rats and diseases

Respondents views on whether rats carry disease

There is a widespread awareness that rats carry disease. When asked if rats carried disease, the overwhelming majority – 78 per cent - said ‘Yes’. This was in spite of the almost non-existence of respondents who included health/disease when asked previously what problems rats cause. This may signify their belief that although rats carry disease, this is not seen as a problem.

Family members which have been bitten by rats

All sites reported some family members having been bitten by rats. A quarter or more of respondents said that family members had been bitten by rats in Zambezia, Tete, Hatcliffe and Morogoro.

Table 59: Families in which members have been bitten by rats

In percentages

Country/ site	Families in which members have been bitten by rats	
	Yes	No
South Africa		
Mapate	5	95
Cato Crest	14	86
Tanzania		
Lushoto	7	93
Morogoro	25	75
Mozambique		
Maputo	27	73
Tete	9	91
Zambezia	27	73
Zambezia	45	55
Zimbabwe		
Hatcliffe	26	74
Nkayi	14	83

The members of the family most affected were: daughter, head of household and spouse. None of those people bitten became infected.

Table 60: Which family members have been bitten by rats

Numbers

Country/ site	Which family members have been bitten by rats									
	HH	Spouse	G/Mother	Son	Daughter	Brother	Sister	G/son	G/daughter	Other
South Africa										
Cato Crest	4	3	1	1	3					
Tanzania										
Morogoro	5	3		3	7	1	1	2	2	1

Rodent consumption

Do you eat rodents?

Families who said they ate rats (not asked in the Mapate or Lushoto surveys) in: Cato Crest, 2 families; Morogoro, 5 families, Mozambique 39 families, of which: Maputo 4 families.

A number of families in Hatcliffe and Nkayi also consume rodents, see the following table. Additional data was gathered which show that most families catch their own, although there is a small amount of trade in Hatcliffe.

Table 61: Family rodent trade and consumption

Percentages

Site	Buy rodents		Sell rodents		Eat rodents	
	Yes	No	Yes	No	Yes	No
Zimbabwe						
Hatcliffe	10	90	1	99	20	80
Nkayi		99		100	10	90

Preparing rodents for eating

The following table shows some variation in the methods of preparation, although most families that consume rodents remove the fur and intestines and then roast or boil them, some with the use of salt. In some cases they dry the rodents.

Table 62: Methods of preparing rodents for eating

Numbers of households

Methods	Hatcliffe	Nkayi
Remove fur and intestines, boil and salt - dry	5	
Burn (fur) and remove waste, wash and put salt and dry	1	
Burn fur, roast in oven until well done	1	
Burn fur, wash and roast till it dries	1	
Remove fur, boil, and dry	1	
Roast it well	1	
Roast them	1	
As others do	1	
Remove fur and roast		2
Remove fur, boil, salt, and leave to boil		1
Boil and dry them		1
Boil and roast		1
Remove fur and roast		1
Roasting		1

Relationship between age group and undertaking control of rodents

There is an association between age group and undertaking control of rodents; with those aged less than 25 being more likely to control rodents than the older age groups; One-tailed p-value is 0.000.

Table 63: Relationship between age group and undertaking control of rodents

Age group	Do you control rodents?		Total
	Yes	No	
Less than 25	11	18	29
25 -40	144	46	190
41 - 60	168	55	223
61 and over	65	23	88
Total	388	142	530

Chi-square (observed value) is 19.580 and the One-tailed p-value is 0.000

Further comments made during the interview

South Africa Cato Crest

Some families expressed concern about using chemicals to control rats because there are young children around.

Cats are not a control option for some families because of religion.

Some families have sent their children away because of the rat problem.

Some used to control with chemicals, but felt it was ineffective.

Others stopped using because they felt it had been effective.

Some used to eat rodents in their farm villages but not here in squatter conditions (for health reasons?)

When there are a lot of rats, people trap them, but when there are few they don't.

Tanzania Morogoro

A lot of bush and vegetation which can facilitate the existence of rats in the area.

Dirty environment which facilitate the presence of rats

Dirty environment which provide good environment for rats

No control measures thus facilitate the presence of rats in area

The environment is conducive for rodents because washing water is not stored.

The area is dirty which favours the presence of rats

The house is closer to the bush thus facilitate the presence of rats in the environment

Annex D Plague

Differences between households affected/not affected by plague

Table 64: Differences between your household and those affected by plague

Country/site	Reasons given	Number
Tanzania		
Lushoto	There are rats	5
	There are rats with fleas	2
	They are not following health directives from health officers	3
	Dirty environment	3
	Dirty environment, poor disposal of dead rat	2
	There is a presence of fleas that cause the disease	2
	They are surrounded by bushes	1
	They are surrounded by bushes and rats that carry plague	1
	Sleep on Dry banana leaves	1
	People sleep on the floor	1
	Not healthy	1
	Unclean	1
Zimbabwe		
Nkayi	Don't know	15
	No difference	10
	Houses with a lot of junk	2
	Don't keep the area clean	1

Table 65: Differences between your household and those NOT affected by plague

Zimbabwe		
Nkayi	Don't know	1
	No difference	1
Additional comments relating to plague		
Tanzania		
Lushoto	Lack of land	3
	The village has no plague cases	3
	No/ Few crops grown by respondent due to poor health	2
	Misuse of chemicals for rats control has caused some poisoning problems	1
	Rats might not be that many due to empty stores	1
Zimbabwe		
Nkayi	Big problem of rats in January	1
	Chemical control works better when used in tomatoes	1

Flea control

Table 66: Household undertaking flea control

In percentages

Country/ site	Household members undertaking flea control	
	Yes	No
Tanzania		
Lushoto	46	54

Table 67: Methods used for flea control

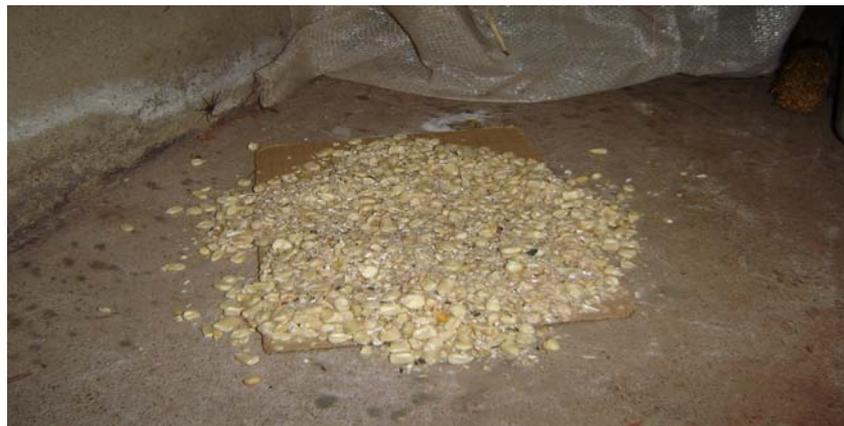
In percentages

Country/site	Methods used for flea control				
	Plaster floor	Put hot water on floor	Use insecticides	Use traditional insecticides	Other
Tanzania					
Lushoto	13	15	31	8	1

Households can use more than one method.

Annex E: Appendix 1

Perceptions and Practices relating to the Transmission of Plague, Leptospirosis and Toxoplasmosis in Zimbabwe



Case Studies from Mbare and Hatcliffe Suburbs in Harare and Nkayi District in North Western Zimbabwe

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April 2005

Introduction

This report presents findings of a socio-economic survey on perceptions and practices relating to human behaviour and rodent risks undertaken in urban and peri-urban areas in Zimbabwe. The main risky behaviour areas include *leptospirosis*, *toxoplasmosis* and *plague*. *Leptospirosis* refers to the contact with rat urine through any orifice or wound in the body including the nose, cuts, sores and through the mouth. Places where this could happen include along the sides of the rivers, in small puddles of water near houses, through water stored in the house or near the house which rats can urinate in, through wet or damp foods including fruit and vegetables. *Toxoplasmosis* refers to eating of the meat of animals which are carrying *toxoplasmosis* without cooking it fully, and contact with cat faeces. *Plague* involves contact with fleas from infected animals and eating the meat of infected animals without cooking it fully. This study was undertaken in March 2005 by the author and a total of five research assistants. Three study sites were covered by the study in Zimbabwe, namely, Mbare market and Hatcliffe in Harare and Nkayi district in Matebeleland North province. The sites were selected on the basis on previous reports on plague. The sites selected for the socio-economic studies were also chosen on the basis of some on-going biological studies being undertaken by Syngenta in those areas.

Methodology

Sampling procedure and data analysis

For the purposes of the study, Hatcliffe and Nkayi districts were further subdivided into smaller areas based on the quality of housing and general living conditions of each of the areas. Hatcliffe was divided into a) the Institute of Agricultural Engineering Compound; b) Hatcliffe Extension; c) Hatcliffe 1 and d) Hatcliffe Extension Sun Valley. In Hatcliffe, a total of 70 households were sampled from the four settlements, namely Compound (10 households), Hatcliffe 1 (20 households), Hatcliffe Extension (20 households), and Sun Valley (20 households).

Nkayi was divided into a) Peri-urban (Malindi ward); b) DA and ministry of Transport Compound – referred to in the report as the DA's Compound; c) Low density houses and d) Belmont high density area. A random sampling strategy was used for the study in each of the areas. Data entry and analysis was done using Microsoft Excel.

Challenges faced

Challenges experienced during the study include, lack of cooperation by some respondents in the beginning although after a long explanation they would agree to be interviewed. Other respondents complained that they are tired of people from different organizations who come and interview them but never give them feedback and no tangible benefit from the process. This was expressed more in Hatcliffe and Nkayi district. Other respondents were annoyed that we were wasting time talking about rodents yet there were more pressing issues such as the costs of living that have been sky rocketing, drought and food relief, deteriorating health services. In Hatcliffe extension and Sun Valley people indicated that we should be also be talking about poor housing conditions, poor sanitation and other social amenities. Some respondents demanded that, if we came back to interview them, we should bring chemicals to control rats if they are to provide information requested. In the squatter camps of Hatcliffe, some respondents expressed their hope that this study was not being

undertaken so as to evict them. While the research team faced these challenges, they were still able to conduct the survey after explaining the purpose of the study.

Background to the study sites

Mbare: The suburb and the market the place.

Mbare market is situated in Mbare high density suburb. Mbare is one of the oldest high density suburbs in Harare having been built by the white settlers as a dormitory mainly for male industrial workers. The suburb has grown since then, in terms of number of people domiciled in it. Many residential houses and social amenities have since been constructed over the years. While a number of people prefer to reside in the slum like and crime infested Mbare because they have social ties to the suburb (having grown there), others prefer to stay in the suburb because it is within walking distance to town and industrial sites. Rufaro stadium, the second biggest stadium in Harare is situated in Mbare suburb, so is the national studio for vernacular languages. Mbare bus terminus, located next to the market, is the road port for buses to almost all cities, towns, rural areas in the country and most suburbs in Harare. Also nested in the middle of Mbare suburb is the Mbare open market where people sell different items including second hand clothes.

Mbare market is the nodal marketing place for agricultural produce in Harare. At Mbare market goods are traded everyday of the week throughout the year except on national holidays. Business tends to take low ebb on weekends as some traders observe the Sabbath day on either of the two weekend days. Like any other market place, trading at Mbare involves bulk suppliers of goods (e.g. commercial farmers, out growers of food crops, cooperatives e.g. EU sponsored horticultural producers from Mutoko – about 150km away (Sithole, 1999) who sell their merchandise to middle traders who de-bulk the goods for sale to other buyers down the market chain, these buyers being consumers or middle traders. Suppliers come from as far as Chimanimani, about 400km away (e.g. fruit banana, avocado pears and naartjies suppliers), Karoi (about 300km away) e.g. potatoes or as well as from BeitBridge e.g. Mopane worm traders (Kozanayi and Frost, 2004).

Goods sold at the market include the above mentioned agricultural produce, plasticware, electronics, seed, packaging material, pre packed food e.g. pop corn, accessories for farm implements and for harnessing animals. As a result of the economic meltdown the country has been experiencing for the past 3 to 4 years, there has been an increase in the range of goods traded at Mbare market. For instance, some women illegally sell family planning tablets just outside the great market enclosure, while others sell whatever commodity is scarce in town. There is also production and sale of steel and wooden furniture just outside the market. A number of cottage ‘industries’ are dotted around the market e.g. women making and selling floor polish, welders busy with their metalware. That is how busy Mbare is. Until recently every TV news bulletin in the country would give an up date of agricultural produce at Mbare in terms of prices, availability and quality of the produce.

The Mbare market complex where this study was undertaken is divided into three distinct sections.

1. *Farmers’ enclosure*: this is where farmers from outside Harare deliver and trade their produce usually to wholesale buyers. The place is mainly busy in

the morning when wholesale trading is done. By late morning all the produce is bought and the place is empty.

2. *The wholesale section*: this is the section where wholesalers sell their stocks. The wholesalers can also de bulk their stocks and sell directly to consumers. Only agricultural produce is sold here, fruits (bananas, oranges, paw paws, mangoes, and guavas), leaf vegetables (rape, cabbages,), root crops (carrots, onions, yams, potatoes,), and fruit vegetables (tomatoes, egg plant, butter nuts). Substantial amounts of water is used e.g. to soak vegetables to increase their shelf life. As a result this place is generally wet. Traders own distinct stalls which are numbered and are generally well maintained.
3. *Retail section*: This is the enclosure where a diversity of merchandise is sold: electronics, agricultural produce, clothes, processed foods, accessories for agricultural implements (e.g. harnesses for cattle and donkeys), herbs, and packaging material. This section can further be divided into two sections based on the level of cleanliness, with level of cleanliness is closely linked to the type of goods being sold. Green vegetables are traded in the eastern half of this section. Like in the wholesale section, a substantial amount of water is used there to soak and wash fresh vegetables making the place damp. Because this end is the most accessible from the bus terminus, there is demand for stalls in this section, hence a number of shacks have been built around the designated stalls (i.e. sprouting of sub-stalls within the originally designated stalls). There is overcrowding as well in this section. The prevalence of rats is more in this section than in the western part of the retail section. During the questionnaire surveys, interviewers observed more rats loitering in this section than the western side of the retail section. In the western side of the retail market traders generally sell dried products e.g. dried vegetables, mealie-meal (traditional i.e. sorghum, pearl and finger millet mealie meal), electronics, clothes, pop corn, dried fish. This section is dry and less crowded.

Institutional setup in the Mbare market

There is a committee that is responsible for ensuring the smooth running of the market. From discussions with some of the respondents during the questionnaire survey, it emerged that the committee is made up of predominantly activists of the ruling party who want to maintain a grip on the running of the market. For a trader to retain their stall in the market they are expected to be a card carrying and active member of the ruling party i.e. making the required subscriptions. The interviewers had to seek permission to interview traders from the Mbare market committee. The first day the interviewers were forced to change their schedule because the committee commandeered all traders to a party rally and locked the market for that day. The committee is also responsible for ensuring that minimum hygiene standards are maintained in the market. No fines are imposed on traders found to be not meeting set hygiene standards, with a mere reprimand as the only known severe punishment that can be imposed on a culprit. It is the role of the same committee to ensure that traders' merchandises are secure. Because the Mbare market committee is chosen along party lines, its effectiveness in discharging its duties is compromised as allegiance to set institutional arrangements tends to be influenced much by politics than anything else.

Maintaining hygiene in the market

Traders are responsible for cleaning their stalls and the immediate surroundings. Every trader is responsible for removing garbage from their stall. Traders hire garbage

carriers to take the waste to dumping sites outside the market. Charges for ferrying away a bin of garbage ranges between Z\$1000-Z\$1500¹¹. Busy traders fill one bin of garbage per day while the less busy and bulk traders e.g. traders of electronics can fill one bin per week. In some cases traders use one bin and share the cost of ferrying away the bins.

Hatcliffe

As described under methodology, for the purposes of this study, the Hatcliffe area was divided into 4 areas based on the different setting of those areas and each of these areas is described below. These are:

- The Institute of Agricultural Engineering (IAE) Compound
- Hatcliffe 1
- Hatcliffe Extension and
- Sun Valley

The Institute of Agricultural Engineering (IAE) Compound

The compound is located in the IAE farm. Residents in the compound are employees of IAE. The problem of rodents was said to be much less in this area as compared to other areas studied in Hatcliffe. Rather people complained about the prevalence of snakes.

Hatcliffe 1

The study targeted households around the poly-clinic area. This area is located about 500m from the IAE. There is a road that runs between the two areas. This is a high density suburb with a more or less planned settlement unlike for Hatcliffe Extension.

Hatcliffe Extension

This area is more or less a squatter camp, although conditions here are better than for Sun Valley, which is also a squatter camp. Residents in this area were settled in 1990 by an aspiring ruling party candidate who wanted to gain votes in the area during the parliamentary elections. The squatter camp is located near the Zimbabwe Republic Police (ZRP) boarding school. The majority of the shelters are made from plastics and wooden cabins, which rodents can easily access. The majority of the cabins do not have concrete or cement floors, thus rodents easily access the room. Cases of people with rash/sores claiming they got these from rats lice/fleas were observed during the survey. Rubbish and litter is scattered all over the place. The area is characterized by tall grasses, poor infrastructure, poor sanitation, potholes, backyard gardening and field crops where the main crop grown is maize, which is the staple food. This environment is conducive to harbouring rodents and also serves as a breeding place for rodents that carry lice and fleas.

Sun Valley

This squatter camp is located about 2.5 km from the ZRP boarding school. The overcrowded and cabins are concentrated and clustered to an extent that the effect of rodents are much greater as compared to the other three areas studied. Problems of poor sanitation and living conditions are more or less similar to those experienced in Hatcliffe Extension, except that they differ in magnitude. The majority of dwelling

¹¹US\$1=Z\$6200 at the official exchange rate as of March 2005

structures are made from plastics and thatch grass, with very few wooden cabins. On the overall, the environment around this area provides a favourable breeding ground for rodents.

Nkayi District

Nkayi district is located in the Matabeleland North province and is drought prone. The district has a population of approximately 156 000 and is located 160 km north of Bulawayo, Zimbabwe's second largest city. The major sources of livelihood in the district is agricultural and livestock production, petty trading, gold panning, and remittances, especially in the rural areas. The major livelihood source in the urban area is employment within the civil service e.g. in government extension service departments, local government offices and in non-governmental organizations (NGOs). A brief description of the four sub-areas covered by the study is given below.

Malindi ward: this is a peri-urban area located within 10-15 km radius from the main business centre. Livelihood sources here include cropping and livestock production and some gold panning in the neighbouring Kwekwe district, especially by men. Only one of the households interviewed was not engaged in agricultural activities as a result of old age. Remittances are a key component of the livelihood sources in Malindi ward, with the younger generation engaged in wage employment outside the village. Eleven of the fifteen households interviewed own livestock. Forty percent of the households in Malindi are female headed and the average household size was 6.6 at the time of the study.

Belmont: this is the main high density suburb in Nkayi urban. The majority of residents here are civil servants. While this is an urban setting, approximately 77% of the respondents grow crops, mainly maize, which is the staple food. Thirty-eight percent keep animals, mainly dogs and chickens. Very few households keep cats but most households have cats come into their houses from elsewhere. Only 15% of the households in Belmont are female headed. The average household size for Belmont is 5.5.

The District Administrator (DA) and Ministry of Transport Compounds: These two areas have similar characteristics in terms of their setting and organization, thus they were combined for sampling purposes. Both areas are generally overcrowded. The Ministry of Transport compound is residence for employees of the Ministry of Transport who are mostly from outside the district. Some of the housing here is made from recycled materials or are log cabins. The DA's compound has more brick and cement houses and is residence for the low income groups working mostly under the DA's office which falls under the Ministry of Local Government. It was found that more than one family resides in the units designed for single families. Sixteen percent of the households are female headed. In addition to their formal jobs and in some cases, petty trading enterprises, households from these two compounds also grow crops.

The Low Density area: only four households were interviewed from this cluster. The inclusion of this area came as an afterthought. The reason of including this area was to see whether rodents are also a problem in the high income groups' area. People from the upper middle class reside in this area.

RESEARCH FINDINGS

Socio-economic status

Household structure (e.g. age, average household size)

In Hatcliffe, most households are male headed as only about 20% of the sampled households were female headed. The Sun Valley has the largest number of female headed households with 40% of the households being female headed. It is worth noting that this is an area considered poorest of the four Hatcliffe sub-areas covered by the survey. The population for the sampled households in Hatcliffe area is 377 giving an average of 5.4 persons per household for the whole area. Hatcliffe 1 has the highest population per household at 6.3 while Sun Valley has the least number at 4.6 people per household. The high population density in Hatcliffe 1 can be attributed to the availability of social amenities (electricity, piped water, shop) unlike the newly and haphazardly planned new settlement at Hatcliffe extension and Sun Valley.

In Nkayi four (4) areas were surveyed as described above: Malindi, Belmont, DA High density and Low Density. A total of 70 households were covered in Nkayi with a combined population of 377 people and an average of 5.4 people per family. The DA high density suburb has the lowest density of 4.3 people per family while the Low density has the highest density at 6.8 people per family. An average of 21.43% of the households in Nkayi is female headed, with Malindi having the highest number of female headed households at 40%.

Education status

Generally literacy levels are high in the entire Hatcliffe area, with close to 50% (162/377) of the population having attained form 4. Hatcliffe 1 has the highest number of people (50%) who have attained four years of secondary education (49.6% - i.e. 66/133), followed by the Sun Valley, 44.5% (41/92) and Compound 35.8% (19/53) respectively. A negligible number of residents in the study site 5.8% (22/377) have received some tertiary training, these being found only in the IAE Compound and Hatcliffe 1. Those who have attained elementary level of education, i.e. grade 7 accounts for 30.7% (116/377) of the population in Hatcliffe.

The level of education of people in Nkayi assumes a near bimodal shape with approximately 26.5% (100/377) and 44.5% (168/377) of the local population having attained at least seven years of primary and four years of secondary education respectively. A paltry 8.2% (31/377) attained tertiary education.

Type/Quality of Housing/Stalls

At the Mbare market, a large majority of stalls (66.67%) provide an environment that is conducive to harbourage for rodents (Table 1).

Category	No. of Stalls	Percent
1	6	40.00%
2	4	26.67%
3	3	20.00%
4	2	13.33%
Total	15	100.00%

Table 1: Quality/Type of Stall at Mbare Market

Rubble such as marketing waste, other rubbish, building rubble, timber and card board boxes is littered all over the place. Rodents could be seen roaming around the stall scrounging for food and undisturbed by the physical presence of people. Only 13.33% of the stalls are tidy and clean providing no cover for rodents. The untidy 66.67% stalls are located in the southern part of the market where fresh vegetables and other food stuffs are sold while the tidy 13.33% stalls are located in the northern part of the market where metal ware, plastic ware and dried foods are sold. The southern part of the market is damp most of the time from water that is used to wash and store vegetables so that they are clean and remain fresh for long periods.

Regarding the type/quality of housing in the residential areas, while the original questionnaire had two types of housing identified, i.e. made from recycled materials (where rats can easily access through walls and eaves) and brick and tile/sheet (where access for rats is not normally possible except when doors are left open), these categories were only applicable to the urban setting. For the peri-urban setting in Nkayi, the majority of houses were constructed from mud/dagga and pole with thatch grass. Thus a third category was added for Nkayi. Some houses with brick walls also had some openings between the walls and the roof, leaving room for rats to go through. In some cases, people used newspapers to close such eaves.

In the Hatcliffe area, except for the Hatcliffe Extension and Sun Valley sub-areas, in the other settlements almost all houses are modern brick and cement houses under asbestos or clay tiles. The percentages of brick and cement houses in Hatcliffe area are, Compound (100%), Hatcliffe 1 (95%), and pathetically low numbers for Sun Valley (5.00%) and Hatcliffe Extension (25%) – see Table 2. In Hatcliffe Extension and Sun Valley most houses, (78.95% and 95.00%) respectively are made from recycled materials (polythene and jute sacks). The Sun Valley and Hatcliffe Extension settlements are fairly new, having mushroomed after the government set up the Hatcliffe extension as a holding/temporary camp for people who had been evicted from Porta farm near Norton. People from Porta farm had earlier on been dumped on that farm in 1986 by the government as part of a window dressing exercise in preparation for the hosting of the Common Wealth Heads of Government Meeting (CHOGM). Other settlers were to join this first group of settlers from Churu farm, and Dzivarasekwa Extension (Mr. T. Gondo, Lecturer at RUP, UZ, Personal communication, March 2005). No social amenities have been provided by the government in both Hatcliffe Extension and Sun Valley. The furthest the government has ever gone is to make flowery promises towards elections, which have never been fulfilled.

	Compound		Hatcliffe 1		Hatcliffe Extension		Sun Valley	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Re-cycled materials	0	0.00%	1	5%	15	75%	19	95.00%
Brick/cement	10	100.00%	19	95%	5	25%	1	5.00%
Total	10	100.00%	20	100.00%	20	100.00%	20	100.00%

Table 2: Type of housing in Hatcliffe

Despite the fact that most of the houses in Hatcliffe 1 are brick and cement (52.63%) of those houses have openings through which rodents get into the houses. Overall, in terms of quality of houses in Hatcliffe area, on a scale of 1 to 4 (1 being poor), 71%

(50/70) of the houses fall on a scale of 1 and 2 (see Table 3). These are poor houses that provide harbourage and easy access to rodents. Partly this explains the high incidences of rodents found in homes in all the 4 settlements in Hatcliffe. Only 7% (5/70) of the houses are good housing which do not offer easy access to rodents.

Area	1	2	3	4	Total
Compound	0	2 (20%)	8 (80%)	0	10 (100%)
Hatcliffe 1	4(20%)	4 (20%)	7 (35%)	5 (25%)	20 (100%)
Hatcliffe Extension	18 (90%)	2 (10%)	0	0	20 (100%)
Sun Valley	11(55%)	9(45%)	0	0	20(100%)
Total	33 (48%)	17(24%)	15(21%)	5(7%)	70 (100%)

Table 3: Quality of Living Accommodation

Relative to other settlements, the Compound has better houses as 80% of the houses are better than average which do not offer easy access to rodents. All in all the majority of houses in Hatcliffe provide conducive environments for rodents breeding and habitation, more so if garbage is dumped near houses and is not collected in time. Similar to the quality of the living accommodation, the rest of the household, in the compound were also on the overall, poorly maintained as can be seen in Table 4.

Area	1	2	3	4	Total
Compound	0	8 (80%)	2 (20%)	0	10 (100%)
Hatcliffe 1	5 (25%)	8 (40%)	4 (20%)	3 (15%)	20 (100%)
Hatcliffe Extension	18 (90%)	2 (10%)	0	0	20 (100%)
Sun Valley	11 (55%)	9 (45%)	0	0	20 (100%)
Total	34 (49%)	27 (38%)	6 (9%)	3 (4%)	70 (100%)

Table 4: Quality of the rest of the household compound

In Nkayi, the type of housing varied depending on the location of the household as can be seen from Table 5.

Type	Malindi		Belmont		Low Density		DA's Compound	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Re-cycled materials	5	33.33%	0	0.00%	0	0.00%	2	8.00%
Brick/cement	1	6.67%	26	100.00%	4	100.00%	23	92.00%
Pole and dagga	9	60.00%	0	0.00%	0	0.00%	0	0.00%
Total	15	100.00%	26	100.00%	4	100.00%	25	100.00%

Table 5: Type of housing in Nkayi

In the peri-urban village, Malindi, the majority of the households (60%) are made from pole and dagga, which is typical of most rural housing in Zimbabwe. The urban houses are predominantly made from brick/cement (100% for Belmont and the low density area and 92% for the DA's /Ministry of transport compound). It was only in the Ministry of transport's compound where there was use of recycled materials for housing. It was observed during the interviews that there was overcrowding especially in the DA's compound where more than one family often use one house. Although cases of lodgers were noted in Belmont, this was not very prevalent. Although most housing in Nkayi urban were made from brick/cement, in Belmont 23% of the houses had brick walls with openings and 26% for the DA's compound. Two of the four

houses from the low density suburb covered in the survey had openings in the walls. These openings may be outlet through which rodents may go into the house. It was reported that often people use old newspapers or other materials to close the openings in the walls, especially between the wall and the roof. This in a way acts as a temporary measure to prevent rodents getting into the houses.

The quality of living conditions was much better in Nkayi district as compared to Hatcliffe and the stalls in the Mbare market. Approximately 38% of the housing fell under category 3 (Better than average - quite good housing that could only provide limited access for rodents, but not as good as Category 4) see Table 6. Approximately 43% fell under category 2 (Poor housing and worse than average. Access for rodents is relatively easy but not as bad as Category 1) and 16% under Category 4 (Good housing, access for rodents is very difficult).

Area	1	2	3	4	No data
Malindi	0	80% (12)	20% (3)	0	0
Belmont	0	23% (6)	42% (11)	30% (8)	1
Low Density	0	50% (2)	50% (2)	0	0
DA's Compound	1	40% (10)	40% (10)	12% (3)	1
Total	1.4% (1)	43% (30)	34% (26)	16% (11)	2

Table 6: Quality of living accommodation

Similar to the quality of living accommodation, the quality of household compound were much better in Nkayi as compared to Hatcliffe. Most households fell under categories 2 (40%) and 3 (46%) and 11% of the households falling under category 4. Very few (2.8%) households were classified under category 1 (see Table7).

Quality of household compound					
Area	1	2	3	4	Total
Malindi	0	11	4	0	15
Belmont	1	5	12	8	26
Low Density	0	3	1	0	4
DA's Compound	1	9	15	0	25
Total	(3%) 2	(40%) 28	(46%) 32	(11%) 8	70

Table 7: Quality of rest of household compound

Household income (economic status) and other livelihood strategies

The majority of people in Hatcliffe 93% (65/70) own a piece of land and grow at least one crop. Crops grown range from leaf and fruit vegetables e.g. tomatoes to maize depending on the size of the arable land. Animal rearing is not a common practice as only 17% (12 out of 70) of the respondents indicated that they keep animals at their homesteads. Close to half of the people in Hatcliffe who keep animals, rear largely chicken broilers. Broiler production is a key source of income even to people from the middle class. Most households depend on informal income generating activities such as petty trading activities for their livelihoods.

In Nkayi, crop production is a key livelihoods source especially in the peri-urban ward. Eighty percent of the total respondents (56/70) in Nkayi are involved in the growing of at least one crop. Fifty (50%) percent of the households in the area keep animals such as goats for the peri-urban and chickens and dogs for the urban

households. Sixty-nine (48/70) households are visited by non resident cats that help in the control of rodents.

Human behaviour

Sources of water, sanitation and food

Drinking Water sources: The majority (59%) of households (i.e. 41 out of 70) in the Hatcliffe megalopolis have access to piped water, with all the households in Hatcliffe 1 and Compound settlement having access to piped water, while 50% of the households in Sun Valley have access to piped water, the remaining 50% relying on open water sources. Almost all (18 of the 20 sample households) in Hatcliffe extension rely on open water sources. Only two households have access to piped water. None of the settlements constituting the Hatcliffe study area purchase water. Access to water (especially piped) is negotiated and granted through mutual understanding and in the spirit of reciprocity.

In Nkayi, 21.4% of the households use open water sources while 78.6% uses piped water. The open water source is mainly used by households in Malindi ward who get their water from the river. Only two households from Malindi ward indicated that they have access to piped water. The majority of households in the urban setting in Nkayi have access to piped water. There was no report on water being purchased in all the study areas.

Sources of washing water: Drinking water sources are also used for washing. Thus the above pattern of water use applies for washing in all the areas in Hatcliffe. Where laundry is done close to the water source, this gives rise to damp conditions around the water source with grass and shrubs growing around the water source. The bushy surroundings provide habitat for rodents. The pattern of sources for water used for washing was similar to that for drinking water in Nkayi districts. Most households use the same water sources for both washing and drinking water.

Storage of drinking water: In total 62 of the 70 (85.6%) sample households in Hatcliffe store water for two main reasons: convenience and strategic. Water storage is done as a mitigatory measure, just in case there is water cut off. Water is also stored for convenience purposes. Instead of collecting water from the water source each time one wants to cook or wash, it is convenient to store it in some container from which the water can then be taken for use at the appropriate time. Containers used include disused plastic 20 litre gallons and open metallic 20 litre tins. The 20 litre plastic gallons usually have small openings that are closed using a small screw-on lid. The metallic buckets are the one that are usually left open as they require big lids which may not be readily available. Despite the fact that Hatcliffe 1 and the compound section have access to piped water, 28 of the 30 households surveyed in these two settlements store water. The reason could be that Hatcliffe in general experiences recurrent periods of water cuts due to burst water supply pipes. Eighty-five percent (34 out of the 40) households who rely on open water sources (Hatcliffe Extension and Sun Valley) store water for use. In total 85.5% (53 of the 62) of the households who store water cover it while only 14.5% (9) do not cover their stored drinking water. Covering stored drinking water is done for hygienic purposes.

In Nkayi, a similar pattern was observed whereby drinking water stored was covered with only 8% of the households that store drinking water leaving it uncovered.

Ninety-two percent of the households who store drinking water keep it covered. The reason for storing water in the peri-urban area is related to distances that people walk to go to the river to fetch water while in the urban setting, people experience erratic water cuts, thus they have to store some water for emergency.

Storage of washing water: In Hatcliffe, very negligible fractions (10%) of those who store washing water (6 out of 62) cover the stored water. The main reason for not covering the stored water is that since the water is used for washing there is no need to cover it. As in the case of Hatcliffe, water stored for washing is often left uncovered although a few households (25%) indicated that they cover water for washing. Seventy-five percent of the households do not cover water for washing as they feel that it is not necessary since the water is not for human consumption.

Food storage: In both Hatcliffe and Nkayi districts, households store staple food, this is mainly unprocessed maize or maize meal. In Nkayi 30% of the respondents indicated that they store their food in rodent proof containers such as drums. The majority, 82% said they store their food in non-rodent proof containers and these were mainly sacks that can be broken by rodents. It is here worth noting that the percentage does not add up to one hundred because some respondents indicated that they store their food in more than one type of container and in some cases they had both rodent proof and non-rodent proof storage facilities. In the peri-urban Nkayi area, staple food is mostly stored in granaries and observations revealed that these were not very rodent proof.

Waste disposal

In the urban areas, the local authorities are responsible for waste collection and disposal. In both Harare and Nkayi urban, the waste disposal systems were said to have been weakened over the years for a variety of reasons. In the Mbare market in Harare, the city council is responsible for taking away the waste from the dump site used by traders. Traders reported that council hardly collects the garbage, resulting in some people taking their own initiative once in a while and burning the waste. Some of the waste at the open dump site can stay for months and it rots resulting in a stench smell emanating from the dump site. "The smell can be so strong that we can hardly eat food"-complained Mrs. Matimba, one of the traders. A visit to the dump site by the interviewers confirmed reports by the interviewees (see photo number below). The open dump sites were cited as one of the breeding grounds for rodents. In the market the city council is also responsible for cleaning toilets, yet this is done on very rare occasions.

Dumpsite at the Mbare market



In Mbare market, to dispose of garbage, traders use more than one method. Slightly less than half of the traders (41.95%) reported that they dump their refuse in the open for council to collect later on. About 25% reported that they hire garbage collectors to carry their garbage for dumping at the dump site from where the city council will collect the garbage. Traders are responsible for cleaning their stalls and the immediate surroundings. Every trader is responsible for removing garbage from their stall. Traders hire garbage carriers to take the waste to dumping sites outside the market. Charges for ferrying away a bin of garbage ranges between Z\$1000-Z\$1500. Busy traders fill one bin of garbage per day while the less busy and bulk traders e.g. traders of electronics can fill one bin per week. In some cases traders use one bin and share the cost of ferrying away the bins. The open dumpsites were cited as one of the breeding grounds for rodents. If the heap of rubbish becomes too big due to non collection by council, the traders sometimes burn it. The only problem with the burning option is that sometimes the garbage is wet and does not burn. In the market, the city council is responsible for cleaning the toilets and this service has also gone down over the years, to some extent contributing towards the prevalence of rodents.

In Hatcliffe, waste disposal is through dumping in rubbish pits, collection by council sanitary department, burning, and throwing in canals. The main methods of waste disposal are Pit (31), collection by council (29) and burning (22). Nearly all (31 out of the 40) households in Sun valley and Hatcliffe extension dump their waste in pits while the households in Hatcliffe 1 and the Compound reported that refuse is collected by council. Very few people throw their refuse in drains/ canals especially when they notice that council is not consistent with the collection of litter/ garbage. Council is inconsistent with the collection of garbage resulting in some households emptying their bins in open places and later burning the garbage before it emits

stinking smells. The heaped garbage provides habitat for rodents, especially when it is not burnt.

In Nkayi, the most common method of refuse disposal is dumping in pits, this accounting for 73% (51/70) of the total population using this method. At least 9% (6/70) of the people use other methods of refuse disposal other than burning. Only three of the 26 households interviewed in Belmont indicated that the town council collects waste from their houses while 65% of the households use pits that they dig on their own. Overall, 73% of the respondents indicated that they use pits for disposing their waste with 5% reporting that they burn their waste and 4% saying it gets collected by the town council and remainder use other methods such as open dumping sites. None of the respondents reported using canals for waste disposal.

Council efficiency in garbage collection

In Hatcliffe and Mbare market as well as Nkayi urban, the city and town councils are very inefficient in collecting garbage from the open dumping sites and in the bins provided for at residential areas. In Nkayi, most respondents have resorted to using pits rather than wait for the town council. In Mbare, respondents rated council's rate of garbage collection as not efficient at best (26.67%) and very inefficient at worst (73.33%). The prevalence of heaps of uncollected garbage in the open is true testimony of council's failure to collect the garbage often (see photo below of uncollected garbage).

Photo of uncollected garbage



Prevalence of rodents (frequency of observation)

In all the study sites, there is a general perception that there has been an increase in the population of rodents over the past three years. In all the study sites, rodent sightings were reported. It was also suggested that there is now a new breed of rodents that people had never seen prior to the outbreak that has occurred during the last three years. Indications were that the new breed is very big in size and black in colour. For instance in Nkayi, respondents from both the urban and peri-urban households indicated that the new breed even eats eggs and up to one week old chicks, something never heard of before. In Hatcliffe, respondents complained about the high prevalence of rodents as these destroy their food stuffs, fruits, vegetables, chicks, rabbits, clothes and in some cases furniture. Suggestions in Hatcliffe were that this new breed of rodents eats chicks, which, as in the case of Nkayi, was a new experience. Efforts to solicit reasons why there has been an outbreak of a new breed did not yield much information. One possibility of the changes in the sizes of the rodents could be linked to the low numbers of cats and dogs being kept by the respondents. Historically, most households in Zimbabwe kept dogs and cats, but due to recent shortages of food and economic hardships, few households appear to keep these animals. In Mbare market, rodents are a common sight at the marketing stalls, the number of rodents being sighted in over crowded stalls where the following merchandise is sold: fresh foods, fruits, seeds, cardboard boxes and where food is prepared and sold. Rodents can be seen roaming around the stalls and immediate surroundings during broad day light. Security personnel at the market revealed that during the night the rodents become more proactive than they are during the day. Despite the high number of rodents that roam around stalls there are few (20%) of reported cases of biting from rodents.

Using number of rodents seen as a proxy for the prevalence of rodents in Hatcliffe, it can be said the area is infested by rodents. In all the areas constituting Hatcliffe megalopolis, most respondents mentioned that they see a rodent/rodents more than once per day the majority of the rodents are seen in the house. The high prevalence of rodents in houses can be attributed to the fact that the rodents frequent houses in search of food and the warmth and dry conditions provided by houses. The highest number of rodents sighted in the house is in Hatcliffe extension where 95% (19 out of 20) respondents indicated that they see at least one rat in the house per day. The least number of rodents (70%) are sighted in the Compound. Hatcliffe 1 is second (85% - 17 out of 20) in terms of rodents seen in the house. The over crowding condition here (6.3 people per household) is one of the factors that gives rise to the high prevalence of rodents in the area. In the compound there is the least number of rodents seen per day in the house, rather respondents noted the prevalence of snakes in the compound. Rarely do respondents see rodents in the bush and crop fields. Partly this is because most of the respondents do not own fields while those who own the fields do not go to the fields every day. They only go there either for routine security checks or to carry out agronomic operations such as weeding. Overall, the highest number of rodents are seen in Hatcliffe extension (40) and Sun Valley (35). Chiefly this is due to the poor or no proper planning in terms of the location of infrastructure and the prevalence of crop fields and crop residues (which provides habitat for the rodents) in nearby crop fields in these two residential areas.

Increase in rat population was attributed to a variety of reasons. For instance, in the Mbare market, increase in rodents is attributed to an increase in the number and volume of traders and stocks in the market (over crowding). For instance Mrs.

Sakabuya who has been a trader since the early 1970s thinks that the upsurge in rodents outbreaks coincided with the trading of fresh agricultural produce in the market such as groundnuts, bambara nuts etc. which was not common in the 1970s and 80s. Hygiene standards have also gone down over the last few years due to overcrowding and poor refuse/waste collection by the city council. In Hatcliffe, the increase of rodents populations was also attributed to overcrowding, the emergence of the squatter camp in Sun Valley where there are poor sanitation conditions (most households have not toilets) and the increase in people growing maize. Respondents' perceptions were that there has been an increase in urban agriculture as a result of economic hardships and 'where there is a maize field, you are likely to find rats' – said one old man during the interview.

Incidents of rodents bites are generally low in Hatcliffe with less than half (29%) respondents indicating that some of their family members had been bitten by rodents. The highest number of victims of rodents biting is in Hatcliffe Extension where half of the respondents reported that they had had some of their family members bitten by rodents. Only 4 members from Hatcliffe 1 reported that their relatives who had been bitten by rodents had been infected by the rodents.

In Nkayi, most rodents are seen in crop fields and nearby bushes. The DA's compound recorded the highest number of rodents seen in fields and nearby bushes (100%). Prevalence of rodents in houses is very low as it ranges from 0-25%. Frequency of rodents' sightings is rare/seldom in the low density areas. In Nkayi, incidences of rodent biting are very rare, at 9/377. Most people (48/56%) believe that rodents carry diseases but reported that only one person was reported to have been infected by a rat after being bitten. Only one case of infection was reported in Nkayi (see Table 8).

Area	No. bitten	No. infected
Malindi	3	1
Belmont	3	0
DA's Compound	2	0
Low density	1	0
Total	9	1

Table 8: Family members bitten by rodents

During the interviews, some respondents expressed much shock at the new breed of rodents that bite people, especially at night when they are asleep. In one case, an old woman from Malindi indicated that she got very embarrassed at one time when a relative who was visiting woke up with her feet being chewed at by a big rat. She was relieved when the visitor expressed her understanding of the rodents problem, otherwise it may have raised some witch craft suspicions.

In all the study sites, concern was raised on the negative impacts of the presence of rodents. For instance, in Mbare market there was concern that rodents cause physical damage to stocks thereby reducing the quality of the product on sale. A damaged product sells at a reduced price, i.e. if a trader decides to sell the product but in the case of food any damaged food is thrown away for fear of food poisoning, although sometimes it is actually consumed so that it is not wasted. Mrs. Letis Johns, a trader at Mbare market reported that for every 1000 packets of pop corn she buys, at least 20 packets are destroyed by rodents and she throws them away losing a total of Z\$16 000 (US\$2.60 at the official exchange rate at the time of the study) in the process. Rodents

in Mbare market, unlike those in homes do not bite people. Possible reasons for this given included that at the market people are always awake and active, yet in homes, people are sometimes bitten at night when they are asleep.

Diseases caused/related to rodents

Generally informants believe that rodents carry diseases. For instance, in Hatcliffe, 87% (61 out of 70) respondents believed that rodents carry diseases while a mere 11% (8 out of 70) believe that rodents do not transmit any disease. Besides carrying diseases, rodents are said to be a visual nuisance, some people do not like the sight of rodents racing around the house. The rodents can also disturb the tranquillity of the night as they race in the ceiling, leading to lack of sleep. In the urban study sites, particularly Mbare market and Hatcliffe, it was indicated that rodents have fleas/lice (*nhata*) that sting people and produce an itchy feeling on the skin of the victim. Often some rash develops on the skin. In Hatcliffe, especially in the Sun Valley area, cases of people with skin rashes suggesting that this was a result of bites from the rodents' fleas were observed. Unfortunately, the team had not camera during these interviews, otherwise some photos would have been taken for illustrative purposes. The rash caused by the fleas sometimes develop into sores that later develop into black spots in both children and adults.

Unlike in all the study sites, respondents from the Sun Valley area in Hatcliffe believe that rodents are causing gastric and other stomach diseases. This could result from *toxoplasmosis* or *leptospirosis* because of poor food storage and hygienic conditions.

In Nkayi, there was a general perception that rodents carry diseases and these relates to skin rashes caused by biting from rodents. In Malindi, 73% indicated that rodents carry diseases, 62% in Belmont, 64% in the DA's compound and 75% in the low density area also had the same opinion. There was a general concern that some solutions should be derived to deal with the problems of rodents as it was on the increase. Otherwise there may be some plague outbreak.

Human response to rodents

While in the first instance people suggests that they have given up on attempts to control rodents because of their increase in population, in reality there are efforts made to control the further increase of the rodents in all three areas studied. It is more common to use chemical means and mechanical means as compared to biological means of control, but often more than one method is used to control rodents. The majority of respondents at the Mbare market (61.11%) use chemicals, while 22.22% use mechanical method. More people, 16.67% at Mbare market use biological methods to control rodents. There is no consensus among the traders at Mbare market with regard to what method to use to control the rodents. The chairman of the traders told the survey team that the use of chemicals in the control of rodents in the market was not allowed as it could result in accidental poisoning of food e.g. if a poisoned rodent ate food which a customer will buy and get infected later on. The chairman's statement proved to be wrong later on as most respondents confessed that they use chemicals to control rats in the market. The main disadvantage of using mechanical methods is that very few rats are caught at a time. Each of the initiatives to control rodents are discussed below.

Use of chemicals:

Most people who use chemicals use the black grainy rat killer from China). While the efficacy of pesticides can readily be acknowledged, two problems were regularly cited:

- 3) that poisoned rodents can contaminate food and
- 4) that poisoned rodents can die in secluded places where they will rot and produce a stench smell. Locating such rotting rodents can be a real hassle and time consuming especially at overcrowded stalls. “Once I used rat killer and the next morning I found 24 rats dead. I had to turn the whole place up side down to find all the dead rats. After a few days more rats from my neighbours’ stalls had invaded my stall. It is useless to try and control rats when your neighbours are not doing anything”. Exclaimed Mrs. Sakabuya, who has a stall at the Mbare market during the interview on the 6th of March 2005.

Biological control

In all the study areas, respondents indicated that even though they themselves do not keep cats, some wild cats roam around their areas. For instance in Mbare, wild cats are often seen roaming around the market place catching rodents. Informants mentioned that the rodents are so many that the cats can not reduce their population significantly because they are not that many. To illustrate how serious the problem of rodents was in the Mbare market, one trader poured some water on the floor of her stall and in less than one minute rats started to come out of junk material at the stall to drink water (see photo below taken on this occasion). Use of personal cats at individual stalls poses one problem to the traders that of ownership as the cat will roam around the entire market instead of safe guarding the stall of its owner. Thus stall owners see no point in keeping cats.

Photo with rodents drinking water at the Mbare market



Mechanical means

Traps can also be used to trap rodents. The main problem cited for the use of traps is that traps can only catch a one rat a time. Most rats are caught at night which means for the entire night only one rat will be caught. Sometimes you set traps and no rodents are caught. It's as if '*Makonzo acho anonyumwa zvekuti haabatwi* – the rodents now know that these are traps set to catch them' said the chairman of the Mbare market committee. Some traders now lock up their stocks in metal containers every night as a way to safe guard it from the marauding rodents.

Similar to Mbare, the commonly used methods of rodent control in Hatcliffe are chemical (53 – 76%), and mechanical (20 – 29%¹²) in that order. Chemicals used are usually locally manufactured pesticides (obtained over the counter in local shops) and cheap rat killer pesticide from China sold in streets by vendors. One disadvantage of using chemicals is that the rodents are quick to discover that food has been poisoned after the death of a few rodents. Mechanical method involves the use of metal traps that are used in collaboration with a bait to lure the rodents to the trap. The use of chemicals to control rats seems to be uniform in all the sites (Hatcliffe 1, 17), Hatcliffe extension (17), Sun Valley (16) while the Compound has the least number of people who use chemicals to control the rodents (only 3 out of 10). Very few (3 out of 70) people indicated that they use biological means to control the rodents. This involves the use of cats. A small fraction, 17 out of 70 reported that they have cats that frequent their homes to catch rodents. A negligible 1 out of 70 indicated that they have cats sleep in the house to control rodents. The major problem with cats is that in highly crowded areas cats are bound to roam or stray to neighbours' homestead where they can then control rodents instead of doing that at their owners' homestead. The other problem is that if cats eat a rat that has been poisoned, the cat can also die from the poison.

The main method of rodent control used in Nkayi is mechanical. Sixty-nine percent of the respondents suggested that they use mechanical methods for rodents' control. Fifty-four percent said the use chemical methods for rodents control while 10% use biological means and other methods added up to 11%. It is worth noting again that the percentages do not add up to one hundred because most respondents said the use more than one method of controlling rodents.

Conclusion

From the results presented in the report, it is apparent that rodents are a major problem in all areas covered by the study. General perceptions are that there has been an increase in rodents' population in the last three to four years and in addition, a new breed of rodents never seen before is now prevalent. While historically, consumption of rodents such as mice may have contributed to the decline in the rodents' populations, the majority of respondents interviewed in all areas indicated that they do not eat rodents. Similarly, most households do not keep cats that may contribute towards the biological control of rodents. Thus the prevalence of rodents.

The deterioration if the quality of housing, especially in the squatter camps and the compounds may also contribute to the increase in rodents' population as this type of housing provides good harbourage for rodents. There was also a general perception

¹² The percentages do not add up to 100 because respondents use more than one method of rodent control.

that rodents breed very fast, especially in conditions that are conducive to rodents breeding such as poor disposal of waste. The standards of living are generally going down, as a result of the overall poor performance of the macro-economy.

Efforts are being made by various individuals to control rodents through mechanical, biological, chemical and other means, yet the general perception was that the problem still persists. Suggestions were that there is need to put some concerted efforts together by different stakeholders including the health departments, housing departments and city and town councils responsible for waste disposal as well as the residents themselves. There is also need for awareness raising on the hazards that are related to the prevalence of rodents as well ways of ensuring that rodents populations are eradicated or are under control.

Gaps in the study

No specific interviews were conducted with the health personnel in all the study areas. Where these were interviewed, it was a matter of coincidence that they fell in the sample, but they were only asked similar questions to all the respondents. There should have been key informant interviews with health personnel in all the study areas to get their views on people's perceptions about e.g. diseases caused by rodents as well as attempts to control such diseases.

In future, focus group discussion could also be facilitated to get people's views on possible solutions to the rodents' problem. This would also provide a platform for cross-pollination of ideas among the various stakeholders.

References

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Annex F: Appendix 1

Location, enumerator, interviewee

Name of enumerator: _____ Date of interview: _____ GPS Code: _____

Location: Country South Africa Province: KwaZulu/Natal Urban: Durban/Cato Crest

Area/Block _____ Density: Squatter/High density

Site (Tick one) Valley: _____ Hill _____ Household number: _____

Name of Household Head _____ Who is interviewed if different _____

A. Socio-economic status

1. Biodata/social indicators

Code ↓	Household members occupation	Office use ↓					
* Write in the number code for these categories							
	Relation to family head	Age	Gender	*Years completed in school*	*Occupation *	*Stays at home*	
101							
102							
103							
104							
105							
106							
107							
108							
109							
110							
111							
112							

2. Cultivation

Do you grow any crops near the house? Yes No

If 'Yes', what crops do you grow?

		Square metres	
201	Vegetables		
202	Fruit		
203	Maize		
204	Other staples (specify)		

3. Animals

What animals or livestock do you keep? Yes No

		Numbers			Numbers	
301	Chickens		303	Dogs		
302	Pigs		304	Cats		
305	Other animals (specify)					

		Tick if 'Yes'	
310	Do other cats come into your house?		<input type="checkbox"/>
311	Do cats sleep in the house?		<input type="checkbox"/>

4. Housing

What type of house does the family live in?		Tick	
401	Recycled materials	Brick/cement walls and tile/sheet	<input type="checkbox"/>

Is the house rodent-proof?				
405	Doorways	Yes	No	<input type="checkbox"/>
406	Eaves	Yes	No	<input type="checkbox"/>
407	Walls	Yes	No	<input type="checkbox"/>

Assess the quality of the living accommodation

Refer to the categories and tick one of the following					
410	1	2	3	4	<input type="checkbox"/>

		Tick if 'Yes'	
420	Do you own your own house?		<input type="checkbox"/>
		No. of years	<input type="checkbox"/>
430	How many years have you lived in this house?		<input type="checkbox"/>

Assess the quality of the rest of the household compound (excluding accommodation)

Refer to the categories and tick one of the following					
440	1	2	3	4	<input type="checkbox"/>

B. Human behaviour

5. Water

		Tick	
Where does your family obtain its drinking water from?			
501	Open water source		<input type="checkbox"/>
502	Piped water source		<input type="checkbox"/>
503	Purchased from a source outside the area/village		<input type="checkbox"/>

Where does your family obtain its washing water from?			
504	Open water source		<input type="checkbox"/>
505	Piped water source		<input type="checkbox"/>
506	Purchased from a source outside the area/village		<input type="checkbox"/>

507	Does your family store its water?	Yes:	No:	<input type="checkbox"/>
-----	--	------	-----	--------------------------

Enumerator: if the answer if YES, go to Question 508, if NO, to Question 512

If Yes, in what does your family store its water? Specify / tick				
508	Drinking water	Type: _____		<input type="checkbox"/>
509		Covered? Yes: _____ No: _____		<input type="checkbox"/>
510	Washing water	Type: _____		<input type="checkbox"/>
511		Covered? Yes: _____ No: _____		<input type="checkbox"/>

	Is the stored water kept covered?	Tick	
512	Except when in use		
513	Mostly		
514	Occasionally		
515	Never		

6. Sanitation

Tick

601	Does your family have its own toilet?	Yes:	No:	
-----	--	------	-----	--

How do you dispose of waste:

If 'Yes,' tick

610	Pit in garden		
611	Collected by council		
612	Burnt		
613	Canals		
614	Other (specify)		

7. Staple food storage

Tick

701	Does your family store staple food?	Yes:	No:	
-----	--	------	-----	--

Enumerator: if the answer if YES, continue to Question 702, if NO, to Question 801

702 What **type of store** do you use? Is it **rat-proof?** **Tick** those applicable

Is it **rat-proof?**

		Used	Yes	No	
710	Sacks				
711	Drums				
712	Tins				
713	Other (specify) _____				

Where do you store food?

If 'Yes,' tick

720	On the floor		Off the floor		
721	Does the family sleep in the house with stored food?	Yes:	No:		
722	Does the family sleep in the same room as stored food?	Yes:	No:		

C. Rodents

8. Observation

Tick

801	Do you see rodents in your area?	Yes:	No:	
-----	---	------	-----	--

Enumerator: if the answer if YES, continue to Question 802, if NO, to Question 806

Where and how frequently do you see **rodents in your area?** Tick those applicable _____

	Frequency Where	Seldom	Once a month	Once a week	Once a day	More than once a day	
802	In the house						
803	In crops						
804	In the bush						
805	Specify						

806	Are rodents a problem in your area?	Yes:	No:	
807	If so, in what way (Specify)? _____			
808	If they are a problem, what can you do to overcome problems? _____			

If 'they carry disease' was not mentioned, please ask Question 809

809	Do rodents carry disease?	Yes:	No:	
-----	----------------------------------	------	-----	--

810	Have any of your family members been bitten by rodents during the past year?	Yes:	No:	
-----	---	------	-----	--

Enumerator: if the answer if YES, continue to Question 820, if NO, the questionnaire is complete

Which family members have been bitten by rodents? **One Tick for each member bitten**

Family members in questions 820 - 821 are the same as filled in for questions 101 - 112

	Relation to family head	Which family members been bitten by rodents? Tick	Were any family members infected by these bites? Tick		
			Yes	No	
820					
821					
822					
823					
824					
825					
826					
827					
828					
829					
830					
831					

840	Do you eat rodents?	Yes:	No:	
-----	----------------------------	------	-----	--

845	Do any family members undertake rodent control?	Yes:	No:	
-----	--	------	-----	--

	If yes, what do family members use to for rodent control?	Yes:	No:	
850	Mechanical means			
851	Chemical means			
852	Biological means			
853	Other (specify)			

Notes:

Any additional information relevant to the study which was observed, or took place during the interview.

Annex F: Appendix 2

Location, enumerator, interviewee

Name of enumerator: _____ Date of interview: _____ GPS Code: _____

Location: Country Zimbabwe Province: _____ Urban: _____

Market _____ Density: High ____ Medium ____ Low ____ Squatter ____

Name of stallholder: _____ Stallholder no: _____

Age of stallholder: _____ How many years at this market? _____

101 What products do you sell at this stall?

- | | |
|----------|-----------|
| 1. _____ | 2. _____ |
| 3. _____ | 4. _____ |
| 5. _____ | 6. _____ |
| 7. _____ | 8. _____ |
| 9. _____ | 10. _____ |

Assess the quality of the stall

Refer to the categories and tick one of the following

201	1	2	3	4	
-----	---	---	---	---	--

Tick if 'Yes'

301	Do you have cats at your stall?		
302	Do other cats come into your stall?		

Tick if 'Yes'

410	Do you own your own house?		
-----	----------------------------	--	--

How do you dispose of waste:

If 'Yes,'
tick

510	Piled up in market		
511	Collected by council		
512	Burnt		
513	Canals		
514	Other (specify)		

Enumerator: if the answer to Question 511 is YES, continue to Question 520, if NO, to Question 601

Assess the efficiency of the council

How efficient is the council in clearing rubbish from the site. Tick one of the following

		If 'Yes,' tick	
520	Very efficient – all waste is cleared away after the market		
521	Quite efficient – some waste remains for short periods		
522	Not efficient – some waste remains, some for long periods		

523	Inefficient – almost all waste remains for long periods.		
-----	--	--	--

524	Any other observations on efficiency_____		
-----	---	--	--

Rodents

9. Observation

Tick

601	Do you see rodents in your market area?	Yes:	No:	
-----	--	------	-----	--

Enumerator: if the answer if YES, continue to Question 602, if NO, to Question 606

Where and how frequently do you see **rodents in your area?** Tick those applicable

	Frequency Where	Seldom	Once a month	Once a week	Once a day	More than once a day	
602	In the stall						
603	Other, specify						

606	Are rodents a problem in your area?	Yes:	No:	
607	If so, in what way (Specify)? _____			
608	If they are a problem, what can you do to overcome problems? _____			

If 'they carry disease' was not mentioned, please ask Question 609

609	Do rodents carry disease?	Yes:	No:	
-----	----------------------------------	------	-----	--

610	Have any of your stallholders been bitten by rodents during the past year?	Yes:	No:	
-----	---	------	-----	--

640	Do you eat rodents?	Yes:	No:	
-----	----------------------------	------	-----	--

645	Do any of your stallholders undertake rodent control?	Yes:	No:	
-----	--	------	-----	--

	If yes, what do your stallholders use for rodent control?	Yes:	No:	
650	Mechanical means			
651	Chemical means			
652	Biological means			
653	Other (specify)			

Notes: Any additional information relevant to the study which was observed, or took place during the interview.

Annex F: Appendix 3

Guidance notes: Maputo Mozambique

These notes are intended to assist the enumerator to conduct the interview and fill in the questionnaire. Whenever relevant, they give further clarification about a question, and in some cases help explain why a question has been asked. When necessary, they can be referred to during an interview, for example in response to a question from the interviewee. Not all questions have been explained. If enumerators have any queries not answered here, they should check with the supervisor. There are also 3 Annexes which provide helpful background information and codes to be used during the interview.

Terminology

Key terminology used in these notes and the questionnaire:

- *enumerator*; the person (staff) asking the questions and filling in the questionnaire
- the *householder* or, *respondent*; or *interviewee*, the person answering the questions
- *rodents* are rats or mice in the context of this interview.

Resources required

- Duplicate copies of the questionnaire.
- A copy of these guidelines.
- Clipboard, pencil, sharpener and eraser. It is suggested that:
 - the questionnaire be completed in pencil
 - changes are made on the questionnaire using eraser and pencil, and that
 - pens and ball-points are only used on completed questionnaires in the office.

Selection

The survey will be carried out in the three villages; Tsalala, T3 and Mashekeni. Household lists can be obtained for the three areas and these can be used to make the selection.

Random number tables should be used to identify households for interview. The minimum sample for each village/area is given in the following table. It may be possible to collect larger samples from larger villages.

Village/area	Minimum sample
Tsalala	30
T3	30
Mashekeni	30

Procedures if it is impossible to interview one of these households:

1. As far as possible, the selected households should be interviewed because a change from this will affect the random nature of selection.

2. If no-one is available to be interviewed at a selected household, the Enumerator should plan to return at a more convenient time. In the meantime, continue with the next household interview.
3. If it is impossible to interview these households, the interview replacement households can be selected until the sample is complete.

The interview

1. Introduction to the respondent (the first step)

Introduce to participating householders:

- yourself;
- the organisation you are working for (INS),
- the reason for the visit, which is to collect information from householders in order to understand the situation in respect of rodents,
- that (apart from the 1st household) they have been selected at random for interview, and
- that we would like to spend a short time asking them questions.
- once the interview is completed, the GPS code can be measured and added to the questionnaire.

Note: 1. The GPS coding will be coordinated by Dr. Ricardo Thompson (INS).

2. Filling in the questionnaire

General:

- it is preferable to interview the householder/their family members separately from other householders;
- if this is not possible, and other people are present during the interview, take care to record the responses of the householder/their family;
- the questionnaire also contains guidance for the enumerator;
- these notes provide clarification for sections which may prove difficult to complete
- length of interview: it should be possible to complete each interview within 40 minutes.
- once the interview is complete, the GPS code can be measured and added to the questionnaire.

Note for enumerators:

- There may be occasions when you are uncertain that the respondent is providing the information we are asking for. Record your misgivings on the questionnaire next to the question concerned. This will help the analysts when dealing with the data. Space is also available for this at the end of the questionnaire.
- These Guidance notes, and those on analysis below, may help in some cases. If you understand what we need from the data, you may be able to re-frame the question to the householder.

Structure

The questionnaire structure three main parts:

- left hand column – question codes;
- central columns – question to the left and space for answers on the right, and
- right hand column – to be left for data entry in the office.

It is laid out as in the following diagram:

Code ↓	Enumerator: write answers in this area	Office use ↓
101	Question	Answer

Enumerators:

- write answers in the column or on the dotted lines provided;
- the left hand column of the questionnaire (↓**Code**) is for coding and the right hand column for **Office use ↓**, do **not** fill these columns;

There are three types of recorded answers:

- numbers
- written as words, some of which request you to specify
- ticks to indicate YES or NO

Questions

These questions have been divided into three sections

- Socio-economic status**; to identify age, education and income status of household members.
- Human behaviour**; as it relates to potential exposure to rats and the family's response.
- Rodents**; to measure exposure to rodents and perception of rodents as a problem.

For **location**, include the number of the Area/Block where the householder lives.

The questions relating to Household Head are intended to identify the household head or the person being interviewed, in case we need to follow-up again later. **If there is concern on the part of the person being interviewed about giving their name, record the code number for that person at the top of Page 1 of the questionnaire.**

Biodata/social indicators

These questions refer to anyone living in the household, even someone who is just sleeping there. The question is intended to help assess income levels; the relative importance of garden/farmstead income and other employment as a source of income to the family, and to identify dependents.

The table should be filled in using the Codes at **Annex 2**

The following example has been filled in with the data from a hypothetical family comprising: male head of household; spouse; daughter; father

	Relation to family head	Age	Gender	*Final grade/school completed*	*Occupation*	*Stays at home*	
101	<i>1</i>	<i>42</i>	<i>M</i>	<i>11</i>	<i>27</i>	<i>31</i>	
102	<i>2</i>	<i>40</i>	<i>F</i>	<i>11</i>	<i>21</i>	<i>30</i>	
103	<i>4</i>	<i>16</i>	<i>F</i>	<i>12</i>	<i>20</i>	<i>30</i>	
104	<i>7</i>	<i>70</i>	<i>M</i>	<i>14</i>	<i>26</i>	<i>30</i>	
105							
106							

Cultivation

Crops refers to any crops grown in the area around the house. Staples could be maize, cassava, millet, sorghum, potatoes, wheat, etc.

Include the **units used to measure land**, eg. Square metres.

Animals

- Pigs, Dogs and Cats can be important carriers of disease,
- Other animals (specify) may be important and so need to be listed.
- Question 310 is intended to find out if householders allow **cats they do not own** to come into their houses.

Housing

These questions provide an indication of household wealth and the possibility of entry by rodents.

Question 401. The enumerator should assess what type of house the interviewee has. The two categories are, either made of:

- Recycled materials; where rats can access through walls and eaves, and
- Brick and tile/sheet where access for rats is not normally possible, except when doors are left open.

Questions 402 - 407. These are to assess if the **doorways** (when closed), the **eaves** and the **walls** are accessible to rodents. If there are gaps where rodents could enter, tick 'No'.

Questions 410 and 440. Definitions of housing categories

Refer to the categories explained below and allocate a category for each interviewee for:

- 410 Living accommodation, and
- 440 The rest of the household compound.

Question 410: Living accommodation. To define the house where the family sleeps and assess how **rodent-proof the house** is use the categories below. **Check the walls, the roof and the doors** (when closed) to see if rodents can gain access. Choose one of these categories for each household interviewed.

- CATEGORY 1** Very poor quality housing (poor quality building materials, gaps between building materials - about as bad as housing can be. Provides very easy access for rodents.
- CATEGORY 2** Poor housing and worse than average. Access for rodents is relatively easy but not as bad as Category 1.
- CATEGORY 3** Better than average. Quite good housing that could only provide limited access for rodents. Not as good as Category 4.
- CATEGORY 4** Good housing, access for rodents is very difficult.

Question 440. Definitions of housing categories - the rest of the household compound

(excluding living accommodation)

To assess how **rodent-free the compound of the household** is, use the following categories. **Check all** buildings (kitchen, toilet, poultry houses, etc.) and possible sites where rodents could hide (apart from the living accommodation) to see if rodents can gain access. Choose one of these categories for each household interviewed.

- CATEGORY 1** Very extensive availability of harbourage and cover (such as household waste, other rubbish, building rubble, timber stacks, etc.). Generally very easy access to rodents to any buildings within the compound (poor quality building materials, gaps between building materials) and evidence of rodents (rodent's holes, etc.).
- CATEGORY 2** Area could provide cover and harbourage for rodents. Is worse than average, but not as bad as Category 1.
- CATEGORY 3** Some cover but better than average. Not as good as Category 4.
- CATEGORY 4** Very tidy and clean environment that provides almost no cover for rodents, or none. Generally no access to rodents within the compound and no evidence of rodents

Human behaviour

Water

Questions 501 – 503. Do households get their **drinking water** from either of these 3 sources?

Questions 504 – 506. Do households get their **washing water** from either of these 3 sources?

If possible, the enumerator should check the methods used to store water.

Staple food

The is question refers to the main food commodity which is often stored to meet regular need, and could be maize, cassava, millet, sorghum, potatoes, wheat, etc.

Is the type of staple food store used rat-proof?

For each type of food-store used, the enumerator should assess whether it is rodent-proof. At the time the enumerator inspects it, is it possible for rats to enter/is there evidence of rats having entered - rat-holes, etc. **Caution:** If the householder is using the store at the time of the interview, assess if it would otherwise have been rat-proof. Make a note 'being used at time of interview' on the questionnaire.

Where and how frequently do you see rats in your village?

Go through this table row by row. For each location: in the house, in crops, in the bush and if other locations are specified, offer the interviewee the choice of one from the following:

Seldom Once a month Once a week Once a day More than once a day.

Questions 820 – 831. Which family members have been bitten by rats?

Family members in questions 820 - 831 are the same as filled in for questions 101 - 112

The table should be filled in using the Codes at **Annex 2**

The following example has been filled in with the data from the same hypothetical family comprising: male head of household; spouse; daughter; father
as given for questions 101 - 112 above

	Relation to family head	Which family members been bitten by rats? Tick	Were any family members infected by these bites? Tick	
			Yes	No
810	4	✓		✓
811	7	✓	✓	
812				

Question 845. Do any family members undertake rodent control. This question should be asked without suggesting any types of control.

Question 850 - 853. If they practise rodent control, which methods do they use?
Examples:

- Mechanical means; traps, etc.

- Chemical means; poisons etc.
- Biological means; cats, etc.
- Others (specify)

Notes: Any additional information relevant to the study which was observed, or took place during the interview.

Enumerators should make a note of anything which:

- may have affected the interviewee's response; eg. Presence of other householders.
- observations which are at variance to the answers given. The enumerator can comment on this at the time of the question or when all other questions have been answered. If interviewees change their response, amend the questionnaire. Note the outcome on the questionnaire.

Data entry

For **Office use** ↓, **only** fill these boxes in if the data collected in the field is changed.

Analysis

The data will confirm or provide an insight into which types of households are exposed to rodents, if they respond to rodents, and what influences householder behaviour. The key areas of analysis will be:

- household structure
- economic status
- education status
- layout: proximity of house to water, sanitation and food
- availability of food for rodents
- availability of animals as alternative hosts
- potential for rat access to houses
- potential for water and food exposure to rats
- frequency of rat observation
- direct impact of rats
- human response to rats

Codes

Relationship to the head of the household

1. Head
2. Spouse
3. Son
4. Daughter
5. Brother
6. Sister
7. Father
8. Grandchild
9. Other youth
10. Other child

11. Friend
12. Tenant

Occupation

20. Student
21. Housewife
22. Unemployed
23. Informal earning
24. Retired
25. Pension/grant
26. Home farming
27. Employed

Stays at home

30. All the time
31. Comes home every week
32. Comes home weekly to monthly
33. Comes home every 2-3 months
34. Comes home less than every 3 months

Background information about rodents

The following notes should be referred to when explaining the reasons for the project.

Human behaviour and rodent risks

These are the main risky behaviour areas which you need to be aware of:

Leptospirosis: contact with rat urine through any orifice or wound in the body including the nose, cuts, sores and through the mouth. Places where this could happen include along the sides of rivers, in small puddles of water near houses, through water stored in the house or near the house which rats can urinate in, through wet or damp foods including fruit and vegetables. Rats urinate wherever they go, to establish territory and just because they have to!

Toxoplasmosis: eating the meat of animals which are carrying toxoplasmosis without cooking it fully, and contact with cat faeces (all mammals can carry toxoplasmosis in their meat, but wild animals are more likely to carry it because they are in contact with cat faeces – these wild animals, including rats, are then eaten by cats which is where the cats get the disease in the first place).

Plague: contact with fleas from infected animals, and eating the meat of infected animals without cooking it fully. (plague hasn't been known in Cato Crest, but it could potentially be in some wild animals and there is the possibility of its transmission to humans in the future).

There are different kinds of rodents which live in the villages – the main ones are called *Rattus norvegicus* (house rats) and *Mus musculus* (house mice). House rats are much larger than house mice. Both species are active at night.

Annex G

A brief summary of the rodent-borne diseases leptospirosis, plague and toxoplasmosis¹³

Leptospirosis

Leptospirosis is a bacterial disease caused by a number of pathogenic species of the genus *Leptospira*. Pathogenic leptospires live in the kidney of host animals and are excreted in the urine over a few days or for a long time up to lifelong. They may be irregularly shed in the urine as opposed to being continuously shed. Different serovars of leptospires are often associated with, or adapted to, different animal hosts. Adapted species may cause no or only minor clinical problems for the host. However, when the leptospires find their way into another animal species, they may cause severe disease. There are, therefore, a range of leptospires in the environment that range in clinical effects from benign to acute. Hence, leptospires that are harmful to humans may be benign to rodents. Other wild and domestic animals can contract and excrete leptospires and will suffer the same range of symptoms ranging from benign to acute depending on the species of leptospira infecting them. Some species of leptospira are known to be more harmful than others, and many of these harmful species are known to be adapted to rodent hosts.

The severity of the disease will be a factor of the person's general health and age and their extent of exposure to the bacteria as well as the species of leptospira they have contracted. As with many bacterial infections, the old and those in poor health or nutrition will be most susceptible. Leptospirosis in children is less frequently reported but that may at least partly be due to different clinical manifestations in children (meningitis has been mentioned as dominant clinical sign) leading to misdiagnosis. Symptoms in humans can range from benign, to a mild cold or flu, to severe febrile disorder, to kidney and/or liver failure, to internal haemorrhaging and death (5 to 20 % but fatalities of .50% have been reported). It is likely that many cases go unreported or are confused with other diseases such as malaria. Most people probably recover naturally, but even relatively mild cases may cause loss of income due to debilitation as the recovery period can be prolonged.

For survival outside the host, the bacteria require a warm, moisture and neutral, slightly alkaline environment. Under optimal circumstances they can survive up to several months. In a dry, too hot ($.40^{\circ}\text{C}$) or too cold ($< 10^{\circ}\text{C}$) and /or pH-hostile environment, leptospires are killed quickly (few hours.) Typically, they are transmitted through contaminated water. It is feasible that leptospirosis could be transmitted through exposure to contaminated moist soil, a water-borne aerosol or contaminated food. The bacteria enter the body in the ways that most bacteria do, through wounds, cuts, mouth, eye, nose. It is unknown which transmission route is most common, but this is likely to be a factor specific to the situation. Working or washing in potentially contaminated water will be a high risk factor as will collecting household water from poorly covered wells. Poor storage of water at the household level, proximity of open sewage, proximity of livestock and low levels of general household hygiene may all contribute to disease transmission. Leptospirosis infection

¹³ Based on an unpublished communication from Belmain, S., April 2003.

rates may be seasonal under some circumstances related to rainfall patterns and the amount of standing water available.

Plague

Plague is a bacterial disease caused by the organism *Yersinia pestis*. Although there is only one bacterial species, its life cycle and ecology are relatively complex. There is a good deal of information available about plague epidemiology, but it is far from a complete picture due to its complexity. In addition to a number of small mammals (not all rodents) acting as carriers and vectors of plague, there are a number of flea species that vector the disease. Normally an animal becomes infected through flea bites and fleas will be responsible for transmitting the disease among different animals and humans. Some species of flea and rodent are more likely to be involved in vectoring the disease and have become partially adapted to the disease, these animals do not become noticeably ill. Plague persists in the wild, circulating in certain species of fleas and animal without any noticeable effect or human cases occurring (quiescent plague). Outbreaks of plague appear to be related to interactions between different rodent species, particularly among those species that are tolerant and susceptible to plague. Commensal rodents (associated with man) such as *Rattus rattus* may pick up plague from interactions with wild rodents (or their fleas) and spread the disease in urban areas. Aspects of flea ecology will also be important, and flea species that confine themselves to rodent burrows may be the true 'reservoir' of the disease.

Plague is a blood-borne pathogen which manifests itself in two main ways, termed bubonic plague and pneumonic plague. Both types have high mortality rates if left untreated, but fortunately symptoms are quite distinct leading to proper identification and treatment. Bubonic plague is relatively more common than pneumonic plague. Bubonic plague results in a series of spots on the skin and the distinct swelling of the lymph glands. The disease progresses relatively slowly over a few days usually allowing treatment to occur in time. If left untreated, severe cases of infection can arise when the bacteria move to the lungs. This results in coughing out a fine aerosol of infected blood that can then be inhaled by others, resulting in the pneumonic form of plague transmission. Pneumonic plague is fortunately rare as its progress is rapid, leading to death in approximately 48 hours unless treatment is sought. Where plague is endemic, most people even in isolated areas will be aware of plague and its symptoms and treatment. What is not known fully is whether and to what extent sub-clinical or sub-lethal cases of plague occur and whether it is possible to build immunity to plague.

Besides the traditional route of disease transmission via flea bites, there will also be other ways in which plague transmission may occur. Plague bacteria can survive for relatively long periods of time in the environment (several days) and disease transmission has been known to occur through handling infected blankets or pelts of infected animals. Handling or eating rodents will increase the risk of exposure, and theoretically infection could occur through the normal entry points for bacteria (cuts or wounds in skin, mouth, eye, nose). There are recorded instances of pharyngeal plague, presumably contracted by eating poorly cooked infected meat.

Plague outbreaks appear to be strongly seasonal and cyclical. In the African context, plague outbreaks appear to be associated with the late dry season. This is probably

related to reduced food resources for rodents, their migration to urban areas in search of food and the subsequent mass mortality of starving rodents shedding their fleas in urban areas. The cyclical nature may be due to changes in the population dynamics of rodents with higher numbers of rodents in some years, but the reasons why some years are worse for plague than others is not really understood.

Toxoplasmosis

Toxoplasmosis is a protozoan disease caused by the organism *Toxoplasma gondii*. The main host is the domestic cat where the organism is able to sexually reproduce. Cysts are shed in cat faeces which are then consumed by other animals. When other animals eat them, the cysts do not enter a sexually reproductive stage but migrate around the body asexually dividing. These are eventually attacked by the animal's immune system and become encapsulated, meaning they are alive but dormant. The cycle is completed when another cat eats the animal with encapsulated cysts which then wake up and infect the cat where they can sexually reproduce. Humans and other animals can be exposed to the disease by eating infected animals (e.g. rodents, pigs) or food/water that has been contaminated by infected cat faeces. Research has shown that rodents with toxoplasmosis are more easily preyed upon by cats (so that the parasite completes its lifecycle). This is not surprising as many parasites affect the behaviour and physiology of their host to promote its survival. As with cysts of trichinosis, adequate cooking should readily kill any toxoplasmosis cysts in meat.

Many people contract toxoplasmosis without realising it. The worst case symptoms are usually similar to a very bad case of the flu. Severe cases would be debilitating for a few weeks, but cases of death are unheard of in normal healthy individuals as long as any associated dysentery is treated. Life-long immunity occurs after a single exposure so although no illness will derive from future exposure episodes, the cyst load may marginally increase with each subsequent exposure. If contracted during pregnancy for the first time, the disease will either cause miscarriage or severe congenital deformity. Immuno-compromised individuals (AIDS) that were previously exposed to toxoplasmosis can have cerebral re-activation where the dormant cysts in the body come alive again. As the immune system is unable to re-encapsulate the cysts, the person dies as the cysts continue to multiply and migrate around the brain and body.

The cysts are probably able to survive for quite long periods in the environment, but I'm not sure whether this has been evaluated. The disease is unlikely to persist in an area where there are no cats. It is likely that disease incidence is only minimally affected by climate, but it could be affected by the susceptibility of cysts to desiccation and periods of drought. Hygiene standards and eating rats will contribute to the prevalence rate.



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