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**VALIDATION OF PARTICIPATORY APPRAISAL FOR USE IN
ANIMAL HEALTH INFORMATION SYSTEMS IN AFRICA**

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For Suzan, Fred and Joe

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ABSTRACT

Participatory appraisal (PA) is a methodology for problem description and analysis that has been widely used in less developed countries (LDCs) since the 1980s. The use of PA by veterinarians in LDCs has been restricted to mainly small-scale community-based animal health projects. Adoption of PA by veterinarians, particularly those working for government, was limited because of concerns about the reliability and validity of the methods.

Three studies were conducted with pastoralist and agropastoralist communities in East Africa to validate PA, by comparison of data derived from PA with conventional veterinary investigation and epidemiological information. In southern Sudan, research was conducted on a chronic wasting syndrome in adult cattle in Dinka and Nuer communities; in Kenya, research was conducted on bovine trypanosomiasis in Orma communities; and in Tanzania research was conducted on possible association between a chronic heat intolerance syndrome (HI) and foot and mouth disease (FMD).

Participatory appraisal methods, called matrix scoring, seasonal calendars and proportional piling, were standardised and repeated to generate quantitative data. The level of agreement between informant groups was assessed using the Kendal coefficient of concordance (κ). Matrix scoring was adapted for use by veterinarians to enable comparison of veterinarian's perceptions of disease signs and causes, with those of pastoralist informants. The data were compared using direct visual assessment, hierarchical cluster analysis and multidimensional scaling. Matrix scoring, seasonal calendars and proportional piling were judged to have good validity and reliability.

In Tanzania, adaptation of proportional piling enabled calculation of the relative risk of HI cases being observed in cattle herds with previous history of FMD, and demonstrated significant association between HI and FMD. This finding was confirmed by detection of antibody to non-structural proteins to FMD in herds with and without HI.

It was concluded that PA methods were reliable and valid methods for veterinary epidemiology when used by trained PA practitioners in agropastoral and pastoral settings. The methods were valuable for data collection and analysis, and for enabling greater involvement of livestock keepers in veterinary service development and research. Participatory appraisal could be further adapted to improve the design of primary veterinary services and disease surveillance systems. In veterinary research, PA was considered to be particularly useful during the exploratory phase of research and for generating research hypotheses. It was also concluded that institutional changes were required for the widespread adoption of PA by veterinarians in Africa.

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LIST OF ABBREVIATIONS

AEA	Agroecosystem analysis
AU/IBAR	African Union/Interafrican Bureau for Animal Resources
CAHW	Community-based animal health worker
CI	Confidence interval
CRS	Catholic Relief Services
DFID	Department for International Development, United Kingdom
ELISA	Enzyme-linked immunosorbent-assay
FEWS	Famine Early Warning System
FMD	Foot and mouth disease
FSR	Farming Systems Research
HCA	Hierarchical cluster analysis
IIED	International Institute for Environment and Development
ITK	Indigenous technical knowledge
KETRI	Kenya Trypanosomiasis Research Institute
LDC	Less developed country
MHCT	Microhaematocrit centrifugation technique
MDS	Multidimensional scaling
NGO	Non governmental organisation
OLS	Operation Lifeline Sudan (Southern Sector) Programme
PA	Participatory Appraisal
PACE	Pan African Programme for the Control of Epizootics
PARC	Pan African Rinderpest Campaign
PGE	Parasitic gastroenteritis
PLA	Participatory learning and action
PR	Participatory research
PRA	Participatory rural appraisal
R	Relative risk
RAP	Rapid assessment procedures
REA	Rapid ethnographic assessment and Rapid epidemiologic assessment
RRA	Rapid rural appraisal
RPK	Rural people's knowledge
sd	Standard deviation
SPSS	Statistical Package for the Social Sciences
USAID	United States Agency for International Development
<i>W</i>	Kendal coefficient of concordance

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Chapter 1

INTRODUCTION

1.1 Participatory Appraisal

Participatory appraisal (PA) is a generic term for a set of learning approaches and methods that have been used most commonly in less-developed countries (LDCs). This thesis investigates veterinary applications of PA and focuses on existing and potential uses in dryland areas of the Horn of Africa occupied by pastoralist communities.

To a large extent, PA methods originated from the social sciences and were characterised by interviewing and visualisation tools that produced qualitative data in a relatively short time. Among the factors influencing PA development were dissatisfaction with conventional research methods, particularly questionnaire surveys, when used in remote rural areas of LDCs. When using PA the aim was not to generate detailed information on specific topics, but rather to identify key issues and problems from the local perspective and to consider what action needed to be taken to improve a situation. Participatory appraisal methods were not fixed and could be adapted by researchers in the field according to what worked well and local systems of communication. These methods were usually qualitative and statistical analysis of data was avoided. Despite the informality of PA it was soon widely used by development professionals in sectors such as human health, agriculture, education, water supply and natural resource management (Pretty, 1995). In line with the flexible and adaptive philosophy behind PA, sector-specific modifications of participatory approaches and methods began to emerge. Some workers started to combine PA with formal data collection methods while others adapted PA tools in order to produce more quantitative data suitable for statistical analysis.

The emergence of PA was influenced by a diverse group of experiences including field-level project implementation in various technical sectors, social science methods, agricultural research, ecological theory and systems analysis (Chambers, 1994a). Prior to and during its development, PA was also influenced by wider social and political ideologies concerning issues of power, equity, social organisation and poverty alleviation in institutions ranging from non-governmental organisations (NGOs) to agencies such as the United Nations and World Bank. Consequently, development contexts and institutional aims and behaviour have been important in determining how and why methods such as PA have

evolved (Biggs and Smith, 1998; Rifkin *et al.*, 1998). Many workers see the advent of PA as a response to unsuccessful development initiatives in LDCs over more than two decades. The technology transfer development paradigm in the 1960s and 1970s did not deliver long-term benefits to poor rural people and the notion that western science *per se* could solve the problems of LDCs was found to be seriously flawed. Poor results in livestock development were one group of negative experiences that led to a reassessment of technology and expert-led approaches in LDCs (sometimes called 'top-down' development) and prompted discussion on alternative, more people-centred ways of working.

1.2 Pastoralism and Veterinary Services in the Horn of Africa

Pastoralist communities in the Horn of Africa are characterised by a strong economic and cultural reliance on livestock, and political and geographical isolation. Historically, governments have tended to regard pastoralists as a problem, as people occupying the remote margins of countries who wander around, keep too many animals and avoid modernisation and education (Silkin and Kasirye, 2002). Although pastoralist communities own substantial numbers of livestock, the protection and development of this resource has attracted relatively little interest. When livestock development programmes have been implemented, technology-driven approaches have resulted in dramatic and costly failures. As Chambers (1997) noted, '*A history of pastoral 'development' in the drier areas of sub-Saharan Africa would read like the afflictions of Job. Few domains can claim such consistent failure*'.

The development of animal health services in pastoralist areas mirrors this general situation. For many years government veterinary departments struggled to extend service provision beyond a few urban centres, and fixed-point delivery systems prevailed. Following the introduction of structural adjustment programmes, veterinary services in many pastoral areas reached a state of virtual collapse as state funding declined and the private sector failed to fill the gaps (Bonfiglioli, 1992; Silkin and Kasirye, 2002). In general, disease surveillance systems were non functional and researchers preferred the relatively easy option of studying livestock in more sedentary, accessible and secure settings. As a result, very limited epidemiological information was available on livestock diseases in pastoralist herds (Catley *et al.*, 1998).

In the late 1980s non governmental organisations (NGOs) began to apply the principles of community participation to the development of primary veterinary services in Africa.

Central to the philosophy of participation was recognition of indigenous knowledge on livestock health and husbandry. Participatory methods evolved as part of the new participatory approach, and community-based delivery systems started to be recognised as appropriate and cost effective means to improve primary animal health care. However, most NGO projects operated in isolation of official disease surveillance systems or research institutes. Recognition of community participation was greatly enhanced when the Pan African Rinderpest Campaign (PARC) successfully used community-based animal health workers (CAHWs) to eradicate rinderpest from the Afar region of Ethiopia (Mariner, 1996) and substantially reduce rinderpest outbreaks in southern Sudan (Leyland, 1996). However, surveillance systems and research activities were still poorly developed in pastoralist areas.

In the late 1990s, the World Trade Organization's Agreement on the Application of Sanitary and Phytosanitary Measures (the 'SPS Agreement') required countries to demonstrate their animal health status by means of 'scientifically-based surveillance efforts' (Zepeda, 2000). In the absence of reliable animal health information from throughout their territories, countries were less likely to benefit from formal international trade opportunities. Although NGOs and some workers in PARC were using participatory approaches and methods to design successful animal health interventions in pastoralist areas, uptake by government veterinary services and research institutes was extremely low.

1.3 Research Aims and Thesis Outline

The research presented in this thesis aimed to investigate some of the specific concerns of epidemiologists regarding PA and in particular, issues of reliability and validity.

Chapter 2 of the thesis is a literature review that describes the origins of PA, constraints to the use of conventional epidemiological methods in pastoralist areas of Africa and current uses of PA by veterinarians. Chapter 3 presents the materials and methods of the research, focussing on methodological details common to three field studies.

Chapter 4 to Chapter 8 describe three field studies in different countries and with different ethnic pastoralist groups. All three studies assessed the reliability and validity of PA methods by comparison of information derived from PA with data produced by conventional veterinary investigation and epidemiological methods. In these studies, the specific disease problems investigated were identified as priorities by livestock keepers and were not predetermined by the author.

Chapters 4 and 5 are an account of a participatory investigation of a chronic wasting disease in adult cattle in Nuer and Dinka communities in southern Sudan. Chapter 4 describes how a PA method called matrix scoring was adapted and repeated to understand livestock keepers' perceptions of the signs and causes of diseases. Results were compared with data produced by clinical and post mortem examinations, and a survey to estimate parasite prevalences. Chapter 5 describes how PA methods such as seasonal calendars and participatory mapping were used to triangulate information derived from matrix scoring.

In Chapters 6 and 7 research on bovine trypanosomiasis with Orma communities in Kenya is presented. This research also used an adapted matrix scoring method to understand local perceptions of disease signs and causes, and compared the results with descriptions of disease in standard textbooks (Chapter 6). A PA method called proportional piling was used as an indirect method for estimating disease incidence. Chapter 7 describes the use of seasonal calendars and participatory mapping to understand temporal and spatial aspects of bovine trypanosomiasis, including contact with tsetse flies. This chapter also describes how ranking and scoring methods were used to analyse existing and potential options for trypanosomiasis control.

Chapter 8 describes how matrix scoring and proportional piling methods were further adapted to investigate the possible association between a heat intolerance (HI) syndrome in cattle and previous foot and mouth disease (FMD). This work was conducted with Maasai and Sukuma communities in Tanzania. Results were compared with FMD serology data, including detection of antibody to non-structural proteins of FMD as a measure of previous clinical disease.

Chapter 9 of the thesis explains how matrix scoring was developed for use with veterinarians to enable comparison of the opinions of livestock keepers and professional workers. Three methods for comparing data derived from livestock keepers and veterinarians are described.

Chapter 10 is a general discussion that highlights common experiences and findings from the three field studies, and discusses future applications of PA in veterinary epidemiology. The final section of this chapter reviews experiences in institutionalising PA in government veterinary services and research institutions.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This chapter describes the development of PA and its applications in animal health services and research. The review focuses on experiences in Africa and, in particular arid and semi-arid areas inhabited by pastoralist and agropastoralist communities. The review also outlines the development of veterinary epidemiology in Africa and discusses constraints in pastoral areas facing the application of epidemiological approaches that are commonly used in industrialised countries.

Looking specifically at animal health service delivery in dryland areas of Africa, most experience with PA probably resides with NGO field staff who see livestock keepers daily. These workers have relatively few incentives or opportunities for publishing their experiences in professional journals, academic theses or other formal literature. Geographical isolation, poor communications and postal services and limited access to libraries are some constraints faced by veterinary personnel in remote areas. Hence, an important weakness of a veterinary-orientated literature review on a subject such as PA is that it reflects only that which is written rather than the much wider direct experience of local veterinary professionals or other workers. Although there is a growing and influential body of literature concerning participatory methods and approaches, accounts of their application in veterinary medicine are still relatively few.

2.2 Concepts of Participation in Development

The role of people in developing society has been a feature of the literature since Aristotle analysed Greek city-states in order to define those factors that contributed towards human happiness and 'the good life' (Cohen and Uphoff, 1980)¹. However, in the 20th century the critical period influencing theoretical constructs of community participation was immediately following the Second World War (Rifkin *et al.*, 1998). In the late 1940s and 1950s industrialised countries associated underdevelopment with lack of technology (Cohen

¹ In Aristotle's time, people participated by voting, paying taxes, holding office, attending meetings and defending the state. Citizenship required members to contribute towards the public realm which in turn, provided benefits to citizens.

and Uphoff, 1980). Hence, in the early history of the provision of aid to poorer countries, development theory was based on a western perception of a technology gap and the notion that poor people would become more developed by adopting new technologies. Later, a resource gap was also identified as a major constraint to development. This theory dealt with disparities between government income and expenditure, imports and exports, and savings and investments. In the technology transfer and resource-based theories of development, people were expected to either improve their lives by adopting new technology or make contributions to the national good in the form of taxes, production of items for export and through savings and investment. Up to the late 1960s, both of these theories underpinned international aid. They implied a passive role for the majority of people in poor countries, who would have technological innovations delivered to them or be compelled by government to contribute to national development. These processes were controlled by a relatively small number of highly trained technicians or resource managers.

In the 1950s and 1960s an important approach to rural development was introduced: community development. Community development had its origins in Theodore Roosevelt's Country Life Commission, which aimed to improve the livelihoods of rural Americans by enabling deprived communities to develop their own resources and become self-reliant (Christensen and Robinson, 1980). According to Rifkin *et al.* (1998), community development was popularised by the United Nations in 1950s and early 1960s as decolonisation spread in LDCs. At this time community development was linked to government policy and was associated with five main principles:

1. integrated development involving community plans and cooperation with all technical sectors;
2. planning based on a community's 'felt needs' rather than those of technical experts;
3. emphasis of self-help efforts;
4. concern for identifying and training local leadership;
5. technical assistance from industrialised nations.

In practice, community development was largely an educational approach to development, which aimed to remove the stigma of charity and involve local people in decision-making. However, the approach suffered from a number of serious flaws. For example, it was assumed that communities were homogenous rather than complex entities, and that everyone wanted the same things at the same time. While community development was based on consensus over local needs, it failed to recognise the practical difficulties in reaching consensus. For these and other reasons, community development lost credibility as

a development approach (Rifkin *et al.*, 1998). Relating community development to thinking on community participation Cohen and Uphoff (1980) judged it to have a narrow view of participation and was often ineffective in transforming rural communities. Essentially, participation within community development was a process defined by experts who felt that they had the answers to solving the problems of the poor.

In the late 1960s, two decades of experience with the technology gap and resource gap theories was revised and an 'organisational gap' was identified in relation to LDCs. In this latest theory, underdevelopment was related to inappropriate relationships between centralised, powerful bodies and poor rural communities that, to a large extent, had arisen due to previous development theories. The new theory advocated greater, more active involvement of people in development and called for decentralised local approaches and appropriate technology. The phrases 'popular participation' and 'people participation' began to appear in the strategies of international donors such as the United States Agency for International Development (USAID) as early as 1966, although were not given much attention (Cohen and Uphoff, 1980).

Concepts of participation began to feature more prominently in overseas development in the 1970s. Participation began to appear in the language of aid organisations such as the World Bank (1975), Overseas Development Administration (1975) and United Nations (1975), all of which called for participation to be a feature of national development strategies, and variously referred to 'popular participation' and 'active participation' of citizens in the development process. Early publications discussing participation included articles in the journal *Rural Development Participation Review* produced by Cornell University (e.g. Korten, 1981) and the book *Putting People First* (Cernea, 1985). Cohen and Uphoff (1980) sought to clarify the meaning of participation and suggested that the process required people's involvement in decision-making, programme implementation, sharing the benefits of development programmes and evaluating programmes.

Other workers advocated more in-depth participation characterised by greater political control of development by rural communities. In this type of participation, communities developed new skills and confidence, which enabled them to initiate their own projects and make claims on governments and donors (Oakley, 1991). This process was viewed as an end in itself rather than a means to achieve more relevant or efficient programme implementation. Definitions of participation continue to be discussed in the literature to the present day and are now so varied and open to misinterpretation that the concept requires

clarification each time it is used or mentioned (Pretty, 1994; 1995). The different meanings of participation are discussed in more detail in section 2.2.2.

Since the emergence of PA there has been a notable increase in the use of the approach by development and research bodies in both developing and industrialised nations. Although originally conceived and promoted by a small number of NGOs and academic institutes, terms such as PRA and community participation soon became commonplace in development, academic and political institutions worldwide (Chambers, 1997). However, the growth of participatory approaches and methods did not coincide with a common understanding of community participation or capacity within development agencies to use PA. These and other concerns regarding the growth of PA and community participation are discussed in section 2.3.3.5.

2.2.1 Meanings of 'community'

One of the key themes in the literature on PA and the concept of community participation is different definitions of community and community participation according to varying technical, institutional and project preferences and levels of understanding (Pretty, 1994; 1995; Rifkin *et al.*, 1998; Biggs and Smith, 1998). This diversity is a reflection of the rapid growth in participatory approaches and methods during the last 20 years but often leads to confusion when comparing experiences within or between sectors. Working in primary human health care, Rifkin *et al.* (1998) cited three definitions of community according to geography, degree of shared interest and levels of risk to health problems. While epidemiologists tended to regard communities as specific populations defined by geographical or risk variables, health planners were interested in groups with shared interests who might, for example, be willing to support a particular health intervention. In a more involved analysis of meanings of community, Jewkes and Murcott (1996) suggested that a community had a distinct geographical location, shared economic, socio-cultural and political interests, and shared problems and needs.

2.2.2 Meanings of 'community participation'

Community participation and similar terms were also subject to mixed interpretations and uses. Although a typical dictionary definition of participation usually referred to some level of involvement of people in an activity or process, this definition was too vague when used

in connection with development. Many of the attempts to define participation have identified different types of involvement of people in development processes. An early example was the eight levels of citizen control over initiatives or the 'ladder of participation' described by Arnstein (1969) in the United States. Some years later, four types of participation were described in relation to agricultural research. These were based on the nature of the relationship between researchers and farmers, and were described as contractual, consultative, collaborative and supporting farmers' research (Biggs, 1989). Other workers in agriculture have also used a four-tier definition of participation but related different types of participation to the power and scope of interaction between different players (Farrington and Bebbington, 1993).

More recently, other attempts to characterise types of participation in agriculture have included Pretty's seven levels of community participation ranging from manipulation to mobilisation, as summarised in Table 2.1 (Pretty, 1995). The underlying theme behind these definitions related to the balance in control of decision-making, information and resources between outsiders and the community, with more involved types of participation requiring local people to take ownership of development activities. Moving from 'Manipulative participation' to 'Self-mobilisation' (Table 2.1), people's participation became less passive and more active. As people participated more actively, they had the option of seeking technical assistance according to their own perception of need rather than according to external assessment.

Commonly, development workers linked interactive participation and self-mobilisation to the concepts of local empowerment and decentralisation. Pretty (1995) based his analysis of community participation on a review of both successful and unsuccessful projects conducted over more than 15 years and concluded that development benefits in agriculture were more likely to be sustainable when community participation reached interactive participation (co-learning) and mobilisation (collective action). In common with Chambers (1994b), the capacity of external agents such as professionals, government or aid personnel to empower communities was related to changes in professional behaviour based on learning with rural people and moves towards a more holistic rather than sector-specific understanding.

Table 2.1

Seven types of community participation (adapted from Pretty, 1994 and Cornwall, 1996)

Type of participation	Description
1. Manipulative participation (Co-optation)	Community participation is simply a pretence, with people's representatives on official boards who are unelected and have no power.
2. Passive participation (Compliance)	Communities participate by being told what has been decided or already happened. Involves unilateral announcements by an administration or project management without listening to people's responses. The information belongs only to external professionals.
3. Participation by consultation	Communities participate by being consulted or by answering questions. External agents define problems and information gathering processes, and so control analysis. Such a consultative process does not concede any share in decision-making, and professionals are under no obligation to take on board people's views.
4. Participation for material incentives	Communities participate by contributing resources such as labour, in return for material incentives (e.g. food, cash). It is very common to see this called participation, yet people have no stake in prolonging practices when the incentives end.
5. Functional participation (Cooperation)	Community participation is seen by external agencies as a means to achieve project goals. People participate by forming groups to meet predetermined project objectives; they may be involved in making decisions, but only after major decisions have already been made by external agents.
6. Interactive participation (Co-learning)	People participate in joint analysis, development of action plans and formation or strengthening of local institutions. Participation is seen as a right, not just the means to achieve project goals. The process involves interdisciplinary methodologies that seek multiple perspectives and make use of systemic and structured learning processes. As groups take control over local decisions and determine how available resources are used, so they have a stake in maintaining structures or practices.
7. Self-mobilisation (Collective action).	People participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice that they need, but retain control over how resources are used. Self-mobilisation can spread if governments and NGOs provide an enabling framework of support. Such self-initiated mobilisation may or may not challenge existing distributions of wealth and power.

When discussing the use of participatory research in human health, seven levels of participation were identified by Cornwall (1996) and these have been incorporated into Table 2.1. In the literature on primary health services the meaning and uses of participation have been discussed at length in journals such as *Social Science and Medicine* and *Health Policy and Planning*. For example, current debate on the use of community participation in primary human health care gives some insight into the various interpretations that appeared since the World Health Organization's strategy *Health for All by the Year 2000* developed in 1978. Although this strategy focussed on public participation in health services, 20 years later it was evident that health professionals still lacked a common framework for describing, analysing or measuring participation in service delivery (Zakus and Lysack, 1998).

Analysing concepts of community participation in health in some detail, Rifkin (1996) noted that health planners had taken two distinct and diametrically opposed approaches to community participation. In the first approach, health professionals had determined programme objectives and then attempted to convince communities to accept these objectives and collaborate with the programme. In some cases, community involvement was expected to include financial or other contributions. Professionals controlled the resources allocated to this type of programme, and success was usually determined according to technical, quantifiable health indicators. Community participation in this 'target-orientated' and 'top-down' approach was viewed by professionals as a means to an end. The second approach to community participation used by health planners aimed to counteract inequalities in programme design and resource allocation by encouraging communities to become more involved in decision-making. In this 'empowering' and 'bottom-up' approach, local people set priorities and sought advice from professionals. Participation was viewed as a process through which communities, and particularly poor people, gained access to information and resources in order to take more control of their lives. Consequently, community participation was the end rather than the means, and professionals acted as facilitators rather than controllers of change.

One of the main reasons for attempting to define participation has been lack of clarity over what participation actually means. Cohen and Uphoff (1980) noted the ambiguity of participation in the 1970s and suggested that it was basically a descriptive term encompassing various different activities and situations. While participation was widely supported by development agencies there was:

'Also a real danger that with growing faddism and a lot of lip service, participation could become drained of substance and its relevance to development programmes disputable.'

Pretty (1995) noted the ubiquitous use of community participation by development organisations in more than 130 countries and suggested that interpretations and applications of the term varied widely according to different institutional aims and operational styles. For example, participation was used to justify contradictory objectives such as the extension of state control and the promotion of local institutions and self-reliance. In summary, although discussion on the meaning of participation has been a feature of the development literature for many years, agreement on a definition is not yet evident.

Articles on the meanings of participation are now so numerous that other workers have reviewed different typologies in order to identify weaknesses and common features. Discussing typologies of participation in relation to agricultural research and development, Guijt and van Veldhuizen (1998) suggested various limitations. For example, there was the problem of classifying projects as static entities with respect to participation although changes occurred during the course of projects and different people participated in different ways at different points in time. Also, the much-used distinction between 'community' and 'outsider' failed to recognise differences in types of participation within these two groups. Many typologies assumed that projects should automatically aim for a *'state of absolute and enduring local participation'* although the feasibility and desirability of 100% local participation was thought to be questionable. These workers also argued that the use of distinct levels of participation tended to over-simplify complex interactive processes into a 'participation thermometer' might encourage prescriptive use of typologies and hinder innovation.

2.3 The Development of Participatory Appraisal

The development of PA was influenced by negative and positive experiences. Negative experiences included decades of poor success in rural development in LDCs and the widespread failure of aid programmes to improve the lives of poor people (Chambers, 1983). Associated with these failings was criticism of formal research and survey methods which often produced large quantities of unusable data at high cost. Despite the lack of quality information arising from this approach, development workers continued to seek descriptions of complex problems in rural communities according to western scientific principles and the development paradigm of top-down technology transfer persisted. One of

the underlying but unwritten principles behind technology transfer was that relative to developing nations, western perceptions, systems and views were superior.

Positive experiences that contributed towards PA development included lessons from Freirian-style adult education in Latin America (Freire, 1968); the methods of agroecosystem analysis developed at the University of Chiang Mai in Thailand (Conway, 1985); experiences from applied social anthropology such as the value of indigenous knowledge (IDS, 1979; Brokensha *et al.*, 1980) and informal survey methods (Rhoades, 1982); contributions from field research on farming systems such as recognition of the complexity of farming systems and the capacity of farmers to conduct their own research and analyses (Farrington and Martin, 1988; Chambers *et al.*, 1989); and the methods of Rapid Rural Appraisal (KKU, 1987; Beebe, 1987; Gibbs, 1987; Grandstaff and Grandstaff, 1987). Although PA evolved from a diverse group of disciplines and professional experiences, the main influences were drawn from the social sciences and novel systems approaches in agricultural and ecological research. It comprised a mixture of old, rediscovered and new methods together with researchers' attitudes, which recognised that local people were best placed to describe and analyse problems in their own environments. This review uses the term participatory appraisal (PA) to encompass Participatory Rural Appraisal (PRA), Participatory Learning and Action (PLA) and similar approaches and methods.

2.3.1 Negative experiences influencing the development of participatory appraisal

2.3.1.1 *The failings of top-down technology transfer*

As outlined in section 2.2 the 1960s and early 1970s saw the widespread application of the technology transfer mode of development in LDCs. In the agricultural sector, technology transfer involved the use of more intensive farming systems that were developed in temperate regions of western countries and required the use of seeds, fertiliser, pesticides, machinery and other inputs. Often, industrialised countries supplied these inputs. The resulting increases in rice and wheat yields in countries such as India, the Philippines and Mexico became known as the Green Revolution and were considered by many to be a technological success (Ruttan, 1977; DeWalt, 1985). However, the limitations of this form of technology transfer were also noted (Simmonds, 1985).

It was evident that the benefits derived from the new technologies were restricted to farms in areas with more favourable agro-climatic conditions (i.e. areas for which the technologies had been originally designed) and uptake by farmers in more marginalised areas was low. According to Chambers and Ghildyal (1985) only resource-rich farmers with commercially orientated, often monocropped systems benefited from the farming systems that were introduced during the Green Revolution. Even in high potential areas, farmers were rarely able to match the yields reported by agricultural research stations, and problems such as increasing pest populations and diseases, and reduced soil quality began to appear. In order to purchase the improved seeds, fertiliser or other inputs, farmers entered into credit arrangements but were unable to pay off their debts when production failed to meet expected targets.

These negative ecological and socio-economic effects raised serious concerns over the sustainability and value of western-style agricultural systems in poorer areas of developing countries and led to calls for more holistic, systems-orientated approaches to agriculture research. While experiences in agricultural production were probably the most dramatic and widely documented problems associated with top-down technology transfer, comparable mistakes had also been made in livestock development (Livestock in Development, 1998).

2.3.1.4 Farming Systems Research

In response to the limitations of conventional agricultural research methods and technology transfer, a research approach called Farming Systems Research (FSR) was developed in the 1970s (Kearle, 1976). The FSR model was based on recognition that farmers possessed valuable knowledge and, due to the complexity of farming systems, holistic and multi-disciplinary research was required (Kassorla, 1977). Farming Systems Research used a four-stage framework comprising problem description followed by the design, validation and promotion of alternative technologies (Simmonds, 1985). While both problems and solutions were based on the perceptions of the researchers, the resulting technology 'packages' were aimed at the poor farmers who had not benefited from previous technology transfer initiatives. With hindsight, this aspect of FSR proved to be one of its major weaknesses because the research agenda was set by scientists in research institutes, governments or donor agencies rather than by the end-users of the new technologies (Biggs, 1980; Okali and Knipscheer, 1985). Another problem with FSR was the management of multi-disciplinary teams. Rather than agreeing on research findings and presenting an holistic view of a system, teams became divided according to the technical backgrounds of

the team members. This often led to hierarchic and bureaucratic leadership of research teams which, as a result, were less able to work with poor farmers (Biggs and Gibbon, 1986; Chambers and Jiggins, 1986).

Farming Systems Research was also criticised because although researchers experimented with farmers, they did so using formal survey methods. Hence FSR researchers produced large quantities of data that could only be managed and analysed using computers (Conway, 1985). In some cases, scientific publications rather than practical solutions to farmers' problems were viewed as the most desirable research output (Biggs and Farrington, 1990). Many workers argued that this approach reduced the farmer's role to that of labourer rather than equal research partner (Baker *et al.*, 1988) and in general, farmers' participation in FSR was thought to be unacceptably low (Chambers and Jiggins, 1986; Chambers, 1990; Baker, 1991).

Although FSR was often ponderous and controlled by scientists, some useful rapid (Hildebrand, 1982) and informal (Rhoades, 1985) survey methods were associated with the approach and later influenced the development of PA methods.

2.3.1.3 The use of formal surveys in rural development

In the early 1970s development professionals working in agriculture and rural development became increasingly critical of the use of formal data collection methods in LDCs (Bulmar and Warwick, 1983; Chambers, 1983). In particular, the widespread use of the questionnaire as a survey tool was reviewed in the light of methodological constraints, the practical value of the data that was produced, and financial and time considerations.

According to Chambers (1983) the popularity of questionnaires in rural development surveys was linked to the scientific background of researchers and a misguided belief that rigorous, formal investigation was required before development projects could be designed and implemented. Consequently, questionnaires were widely used because the results could be easily quantified and findings from small samples could be extrapolated to large populations. Variables could be measured and relationships between variables assessed using statistical methods. The advent of user-friendly computer hardware and software allowed more rapid and sophisticated data handling, statistical analysis and presentation of numerical data and therefore made questionnaire surveys easier to conduct.

Social scientists have been discussing the strengths and weaknesses of formal surveys in developing countries for many years. For example, the limitations of questionnaire surveys have been described (Zarkovich, 1966; Moris, 1970; Zeller and Carmines, 1980) and in particular, the use of a western research tool in a foreign setting had attracted considerable criticism for reasons of cultural insensitivity (O'Barr *et al.*, 1973; Chen and Murray, 1976). Chambers (1983) argued that in rural areas of LDCs questionnaire surveys were difficult to design and administer, time-consuming and expensive to implement, and often produced results that were either wrong or that could only be confirmed by more research. When data analysis took place in an office or laboratory it became difficult to cross-check information or follow up interesting results because of the physical problem of relocating respondents in remote areas with poor roads and telecommunications. Furthermore, investigators had their own professional interests and consequently, they designed questionnaires according to their own technical background and information requirements. This situation was a reflection of the top-down development paradigm in which the views of scientists, professionals and academics were sacrosanct.

It was also noted that researchers tended to use formal systems of inquiry because of peer pressure and career development incentives. The all-pervading 'publish-or-perish' culture in academic institutions was a powerful influence on scientists from a wide range of disciplines². Typically, on returning from overseas missions researchers were expected to publish their findings in scientific journals and, almost inevitably, this required the presentation of numerical data and statistical analysis. Despite this professional focus on western scientific, quantitative methods it was also argued that many studies based on questionnaires failed to discuss important non-sampling errors³ such as enumerator bias.

² Although academics are partly evaluated according to the number of papers they publish, there are reports of substantial under-utilisation of research results e.g. Guba and Lincoln (1981). When assessing the use and relevance of papers indexed by the Institute for Scientific Information between 1981 and 1985, Hamilton (1990) reported that 55% of papers received no citations in the first five years after publication. A later review showed that for papers published between 1981 and 1997, 47% were never referred to again in the scientific literature, even by the researchers who conducted the original work (Anon, 1998a).

³ According to Nichols (1991), non-sampling errors are due to factors other than random variation between samples. Non-contacts, interview error, poor form design and errors in data processing all contribute to non-sampling error. Interviewer error could lead to misunderstandings between the interviewer and respondent. Although non-sampling errors are difficult to quantify, their effect on statistical analyses is understood and can be substantial. Non-sampling error (D) is the mean bias (the mean systematic error) between the survey measurements and the intended 'true' value. The total error (ξ) of a survey is the sum of the sampling error (SE) squared and the non-sampling error (D) squared (Zarkovich, 1966) i.e. $\xi = (SE)^2 + D^2$. Therefore, small increases in non-sampling error have a large impact on total error.

The problems of non-sampling errors in questionnaire surveys was highlighted in a study in Nepal which cross-checked the results of a human fertility questionnaire survey based on the knowledge, attitudes and practices approach (Stone and Campbell, 1984). The fertility survey had been conducted throughout Nepal under the Ministry of Health's Family Planning and Maternal and Child Health project and focussed on awareness and attitudes towards different methods of contraception. The cross-checking methods used by the researchers included repetition of the original questionnaire followed by informal interviews and conversation with questionnaire respondents, and tests on the intelligibility of the language used in the questionnaire. The results indicated that the original questionnaire survey had seriously underestimated the villagers' knowledge of family planning methods. For example, the official fertility survey had found that only 4.8% of respondents had heard of condoms whereas on cross-checking, 95.0% of respondents had heard of this method of contraception. Linguistic testing of the questionnaire indicated that when the questions were read out as written they were fully or partially unintelligible to 80% of the respondents sampled.

Negative experiences with health surveys in LDCs were not restricted to Nepal. When reviewing health interview surveys generally in developing countries Kroeger (1983) concluded that epidemiologists,

'... have often failed to take notice of basic anthropological tools geared to establish cross-cultural contact, and communication is a precondition for avoiding severe interview biases.'

2.3.1.4 The biases of rural development tourism

The term 'rural development tourism' was coined by Chambers (1983) when describing a series of anti-poverty biases that limited the capacity of researchers to understand the needs of the poorest people in LDCs (Table 2.2). It was argued that a typical survey often involved short visits to rural locations by 'outsiders' such as foreigners, professionals or government officials. These workers often failed to recognise and meet people who were the poorest and most in need of assistance. Consequently, during assessments of needs and project design, the perceptions of the poor were overlooked. The biases of rural development tourism include spatial, behavioural and logistical factors, which all limited the capacity of well educated, more wealthy and urban-based researchers to understand complex rural communities.

Recognition of rural development tourism biases was to be an important factor in the development of rapid rural appraisal (RRA) because in part, RRA was designed to offset these biases and ensure that outsiders met poor people and incorporated their perceptions and needs into development projects.

Table 2.2
The biases of rural development tourism (adapted from Chambers, 1983)

Type of bias	Key features
Spatial	Most learning by outsiders about rural communities and conditions takes place near to urban centres or in the proximity of tarmac roads. These areas tend to be better serviced and more prosperous than those where the poorest people live. When outsiders visit rural communities, the poorest households are located at the periphery of a village and are overlooked.
Project	Outsiders who wish to learn about rural conditions are directed towards villages where successful projects are in progress or have taken place. These villages are visited repeatedly, while other sites are ignored.
Person	Outsiders seeking contact with rural communities work through and are influenced by intermediaries who are biased against the poor. Such intermediaries can 'hide' the poor, limit access to the poor or inhibit open discussion when the poor are present. <i>Elite bias</i> - outsiders meet first and foremost with a local elite comprising elders, village headmen, traders, religious leaders, progressive farmers or professionals. <i>Male bias</i> - the groups of local elite mentioned above are nearly always dominated by men. <i>User bias</i> - when assessing a service or facility, outsiders meet those people who use the service or facility rather than those who do not. <i>Active, present and living bias</i> - outsiders tend to meet the healthy, active and wealthy rather than the sick, immobile and poor. The poor can be removed from the scene through migration or death.
Temporal	The tendency for outsiders to visit rural areas in the dry season(s) when access is easier but when conditions can be markedly different than in the wet season(s).
Diplomatic	In order to avoid embarrassment, to either themselves or local officials, outsiders avoid contact with the poor.
Professional	Professionally trained outsiders are drawn to the better educated, more progressive and less poor. Professionals tend to have narrow, technical interests, which limit their capacity or willingness to take the wider perspective required to understand poverty.

2.3.2 Positive experiences influencing the development of participatory appraisal

When discussing the origins of participatory approaches and methods Chambers (1994a) identified five bodies of experience that contributed towards the development of PRA, as summarised in Table 2.3.

2.3.2.1 *Adult education, participatory research and participatory action research*

Experiences from the field of adult education in Latin America, Asia and Africa were among the most important influences on the development of PA. The basis of these experiences was often cited as Paulo Friere's book *Pedagogy of the Oppressed* (Friere, 1968), which critiqued conventional approaches to education and described how typical practices failed to teach poor people to challenge the inequalities and power relationships which affected their lives. Friere argued that without understanding and questioning their place in society, people were less able to take action to improve their situation. An alternative form of education was proposed in which learners were encouraged to take control over their own learning, and the acquisition of knowledge was closely linked to action. This approach required educators to recognise that poor people were able to conduct their own investigations and analysis, and that they were well placed to design and plan initiatives, and act. In Friere's approach to adult education, the role of the conventional educator shifted towards facilitation of research, learning and thinking among co-learners. Hence, educators needed to modify their behaviour and attitudes towards poor people and had to be willing to enter into mutual research and learning processes.

In the mid 1970s the term 'participatory research' (PR) appeared in the literature on adult education and this was closely related to the Frierian themes of empowerment, research and learning systems linked to action, and appropriate researcher attitude (Fernandes and Tandon, 1981; Hall, 1981). The International Council for Adult Education promoted participatory research (Tandon, 1988) and regional workshops were organised in Africa in 1979 (Kassam and Mustafa, 1982) and Asia in 1982 (SPR in Asia, 1982). 'Participatory action research' (PAR) developed along similar lines to PR but placed greater emphasis on 'acting' as a basis for learning and critical reflection (Fals-Borda, 1985; Fals-Borda and Rahman, 1991). In both PR and PAR the process of learning was as, if not more important than the research products. According to Cornwall (1996),

Table 2.3

Influences on the development of participatory rural appraisal (adapted from Chambers, 1994a; 1997)

Discipline/system of inquiry	Key aspects which contributed to PA	References
Applied anthropology	<ul style="list-style-type: none"> ▪ promotion of indigenous skills and knowledge ▪ attention to flexible methods of learning ▪ researcher attitudes and behaviour ▪ self-critical awareness ▪ informal survey methods 	IDS (1979); Brokensha <i>et al.</i> (1980); Rhoades (1982).
Agroecosystem analysis	<ul style="list-style-type: none"> ▪ multi-disciplinary analysis ▪ attention to research team management ▪ avoidance of mathematical models ▪ pattern analysis of time, space, flows and decisions ▪ visualisation methods to describe systems e.g. maps, calendars, flow diagrams and Venn diagrams ▪ identification and use of key system features rather than comprehensive analysis of all system features 	Gypmantarsi <i>et al.</i> (1980); Conway, (1985).
Participatory activist research	<ul style="list-style-type: none"> ▪ recognition of poor people as able investigators, analysts and planners ▪ critical self assessment by professionals ▪ the facilitating role of outsiders ▪ empowerment of the poor, weak, marginalised 	Freire (1968); Cornwall and Jewkes (1995).
Research on farming systems	<ul style="list-style-type: none"> ▪ promotion of farmers as knowledgeable, analytical experimenters who behave rationally ▪ use of informal surveys ▪ recognition of farming complexity and risk 	Biggs (1980); Farrington and Martin (1988); Chambers <i>et al.</i> (1989).
Rapid rural appraisal	<ul style="list-style-type: none"> ▪ promotion of rural people's knowledge ▪ offsetting the biases of rural development tourism ▪ attitudes and behaviour of outsiders ▪ interdisciplinary approaches; pluralism ▪ informal interviewing and visualisation methods ▪ triangulation to cross-check information ▪ concept of optimum ignorance 	Chambers (1980); Carruthers and Chambers (1981); Beebe (1987); Gibbs (1987); Grandstaff and Grandstaff (1987); KGU (1987).

'PR aims to substitute a cyclical, ongoing process of research, reflection and action for the conventional linear model of research, recommendation, implementation and evaluation. Research becomes one mode of a continuing process of learning. Doing is reflected upon, raising more questions which in turn create further possibilities for action.'

The adoption of PR and PAR was not restricted to education but included use in the agriculture and industry sectors (Whyte, 1991), primary health care (de Koning and Martin, 1996) and other areas. As a measure of the scope of PAR in the 1990s, Selener (1997) reviewed more than 1000 references and characterised four major approaches and areas of development of PAR according to its application in community development, research in organisations, research in schools and farmer participatory research.

2.3.2.2 Agroecosystem analysis

Agroecosystem analysis (AEA) was developed in Thailand in between 1980 and 1985 at the universities of Chiang Mai and Khon Kaen. The method was designed to overcome the shortcomings of FSR and in particular, moved away from specialised data handling and analysis towards non-mathematical descriptions of systems. According to Conway (1985), the avoidance of conventional, quantitative analysis was intended to encourage the involvement of a wide range of individuals, particularly local researchers, in the analytical process rather than depending on a small number of highly skilled (often expatriate) operators.

Agroecosystem analysis applied multi-disciplinary and systems-based analysis to agroecosystems⁴ that were described according to four main system properties called productivity, stability, sustainability and equitability (Table 2.4). Drawing on ideas from systems analysis (Checkland, 1981) AEA also recognised the need to identify levels of hierarchy within systems and understand the behaviour of each hierarchical level. In addition to using system properties as indicators of system behaviour, AEA also used these four properties to assess change and measure agricultural development. During this process, four important assumptions were made (Conway, 1985):

⁴ Conway (1985) defined a system as an assemblage of elements contained within a boundary that had strong functional relationships with each other but weak or no relationships with elements in other assemblages. The strong functional relationships between elements were such that a system had a distinctive behaviour and tended to respond to stimuli as a whole, even when the stimuli was applied to only one part of the system. In agroecosystems, a hierarchical relationship existed between for example, field-level, farm-level, village-level, watershed-level and regional-level systems and each level of hierarchy was studied in its own right.

1. it was not necessary to know every detail of an agroecosystem in order to generate a useful and realistic analysis;
2. knowledge of a few key functional relationships enabled understanding of the behaviour and properties of the system as a whole;
3. within the system, a few key management changes could produce significant improvements in performance;
4. the recognition and understanding of key linkages and decisions could be based on a limited number of questions and answers.

Table 2.4
The four system properties of agroecosystem analysis (from Conway, 1985)

System property	Description and measurement of system property
Productivity	The yield or net income per unit of resource.
Stability	The effect of relatively small, normal fluctuations in environmental variables such as climate; measured as the reciprocal of the coefficient of variation in yield or income.
Sustainability	The ability of a system to maintain productivity in the event of stress or perturbation. Stresses were regular, relatively small and predictable disturbances to the system e.g. soil salinity. Perturbations were large, unpredictable disturbances e.g. a rare drought or disease epidemic. No satisfactory methods of measuring sustainability were available.
Equitability	The distribution of products from an ecosystem among its human beneficiaries; measured using statistical distribution parameters.

Therefore, AEA did not aim to describe every aspect of a farming system but sought to identify key features that could be altered to improve the whole system. This aspect of AEA was similar to the notion of 'optimal ignorance' which was to become an important concept in PA (see section 2.3.2.5f). The methods used in AEA included visualisation tools such as maps and transects to describe spatial patterns, graphs to describe changes over time, flow diagrams to illustrate movements of resources, and decision trees and Venn diagrams to show decision-making processes and power relationships between different players in the system. These visualisation methods were also incorporated into PA.

2.3.3.2 Applied anthropology and rural people's knowledge

From the early 19th century well into the 20th century, social scientists and others had described non-western societies as primitive, savage and ignorant (Warren, 1989). This stereotypical image persisted well into the post-colonial era and to some extent, influenced the top-down development paradigm based on technology transfer. Development theorists regarded traditional practices as inefficient, inferior and an obstacle to development (Agrawal, 1995).

In general, social anthropology has been a discipline of description. Typical research methods included participant observation with detailed accounting of social structure, events and behaviour with minimal influence over these events by the researcher. According to Chambers (1994a), social anthropologists began to take on a more applied role in the 1980s when work with other professionals in aid agencies, agricultural research centres and human health services was highly influential. In particular, anthropologists highlighted the distinction between the perspective, views and knowledge of outsiders (e.g. foreigners, professionals) and the perspective, views and knowledge of rural people. Better understanding and acceptance of different world views influenced changes in the methods that were used by development workers and their attitudes towards rural communities. These developments can be summarised as greater attention to rural people's knowledge, uptake of specific social anthropological approaches and methods, and the emergence of rapid data collection.

a. Rural people's knowledge

Social anthropologists played an important role in showing other professionals that rural people had their own, complex knowledge which had developed over many years according to local environmental and socio-cultural conditions. Rather than seeing rural people as resistant to change and irrational because they rejected the interventions of technology transfer, research on local knowledge and skills demonstrated that these resources were valuable and could contribute towards development (IDS, 1979; Brokensha *et al.*, 1980). Renewed recognition of age-old indigenous crop and livestock production methods also showed how farmers were active experimenters and were constantly adapting to new opportunities and external pressures (Thrupp, 1989).

Much of the early development-orientated work on local knowledge regarded this attribute as essentially technical in nature. Hence, the initial focus was on practical skills and know-how that could be understood by scientists by reference to their own technical training. Accounts of indigenous crop production methods, animal husbandry or local tool-making are among the many descriptions of what became known as 'indigenous technical knowledge' (ITK) (e.g. Farrington and Martin, 1988; Howes, 1979; Swift, 1979). While attention to ITK became a core component of much participatory research and was promoted by many academic institutions and NGOs, there was also concern that western scientists were appropriating ITK. In agroforestry, Thrupp (1989) noted how researchers had extracted ITK from rural farmers, modified and repackaged the information, and then transmitted the new 'improved' information back to farmers. In addition, there was growing debate on intellectual property rights and the exploitation of local technical knowledge by western scientists, pharmaceutical companies and multinational biotechnology corporations (Agrawal, 1995).

Other workers took a more holistic view of ITK and argued that people managed resources within their own reality of the natural world and within a system encompassing social and cultural norms, and important political and power relationships (Scoones and Thompson, 1993). Hence the term 'rural people's knowledge' (RPK) was used in an attempt to recognise the complex cultural, economic and political factors which influence how knowledge arises, how it is disseminated and used, and who benefits. Central to the concept and application of RPK was a need to:

'... account for the social and political forces at play in the interaction of contrasting, sometimes conflicting, knowledge systems' (Scoones and Thompson, 1993).

Also referring to power relationships, Agrawal (1995) argued that the practical use of indigenous knowledge required recognition that indigenous knowledge in LDCs and western scientific knowledge were not distinct entities and their treatment as such led to increasing control of indigenous knowledge by outsiders.

b. Approaches and methods from social anthropology

Among the most important contributions from social anthropology to the development of PA was the use of informal research approaches and methods which initially, were adopted by FSR researchers (Hildebrand, 1982; Rhoades, 1982; Collinson, 1981). Interviewing

skills, use of open rather than closed questions, personal attitudes and behaviour, and recognition of other people's body language and behaviour were inherent in social anthropological research methods. Analysis was based on the connections and differences revealed in the accounts of informants, all of which were considered to be important when presenting an holistic view. Informal surveys became an important tool in FSR (Rhoades, 1982) and later, semi-structured interviews were widely adopted as a central key method in PA.

c. *Medical anthropology and rapid procedures in human health and nutrition*

In addition to the use of social anthropological methods in agricultural research in LDCs, anthropologists also began to influence research methods and service planning in the human health sector. A distinct discipline called medical anthropology emerged as health care planners began to realise that programmes were more effective when tailored towards people's cultural beliefs and practices (Pelto and Pelto, 1992). According to Foster (1975) medical anthropology evolved from conventional ethnography, the cultural and personality movement of the late 1930s and 1940s (with its collaboration between psychiatrists and anthropologists) and the international public health movement after the Second World War.

At least two distinct methodologies were heavily influenced by medical anthropologists *viz.* rapid assessment procedures (RAP) and rapid ethnographic assessment (REA). In RAP anthropological methods such as interviews, conversation, observation and focus groups were used to assess community views of health, disease and both traditional and modern health interventions. The methodology evolved from earlier research on people's preferences for different health service providers ('health-seeking behaviour') in Central America (Scrimshaw and Hurtado, 1984) and led to general primary health care (Scrimshaw and Hurtado, 1987) and disease-specific RAP guidelines and manuals.

Closely related to and influenced by RAP, was REA. The main difference between these two methods was that REA focused on a single disease problem or group of related problems e.g. diarrhoea (Bentley *et al.*, 1988). Both RAP and REA were reviewed in detail by Manderson and Aaby (1992) who concluded that:

'The development of rapid assessment procedures of various kinds have provided techniques to ensure that a community voice and cultural understandings are reflected in health policies and programmes.'

These authors also advocated the wider use of qualitative research methods and noted that RAP could help health workers to identify the basic research questions that needed to be asked. Similarly, Annett and Rifkin (1995) mentioned the role of RAP and REA in addressing the problems of communities, particularly poor communities rather than individuals, and related these methods to action rather than research⁵.

2.3.2.4 Lessons from research on farming systems

Section 2.3.1.2 described negative experiences from FSR that influenced the development of PA while section 2.3.2.3b noted how FSR adopted important methods from social anthropology, such as informal surveys. In addition to the specific discipline of FSR, other workers were conducting on-farm research that did not fit into the typical FSR mode. For example, farmers' well developed skills and capabilities were described as 'informal research and development' by Biggs (1980), and Richards (1985) and Bunch (1985) showed how farmers were rational and adaptive researchers in their own right. Other workers developed these ideas, and farmers' participation in agricultural research was widely promoted (Farrington and Martin, 1988; Chambers, Pacey and Thrupp, 1989).

2.3.2.5 Rapid Rural Appraisal: its origins and key features

In the late 1970s various methods and ideas from adult education, AEA, applied anthropology and FSR were transferred between professionals who were becoming increasingly frustrated with formal survey methods and development approaches. Experimentation began with informal survey tools and experience of RPK began to merge with the field testing of informal interviewing, visualisation and other methods (Chambers, 1994a). This learning process involved many individuals and institutions, and culminated in a landmark conference on Rapid Rural Appraisal (RRA) at the University of Khon Kaen, Thailand in 1985 (KKU, 1987; Chambers, 1994a). This conference and the resulting publications established RRA as a practical and useful methodology with a sound

⁵ Experiences from RAP and REA were later combined with the less extractive and more holistic aspects of PRA to develop 'rapid participatory appraisal' for use in health needs assessment, planning and implementation of services (Annett and Rifkin, 1995; Rifkin *et al.*, 1998). RAP and REA were also incorporated into 'Rapid Epidemiologic Assessment' (Smith, 1989; Vlassof and Tanner, 1992).

theoretical basis (Beebe, 1987; Gibbs, 1987). Some key features of RRA are outlined below according to the training manual of McCracken *et al.* (1988).

a. Attitudes and behaviour of RRA practitioners

Practitioners of RRA were required to assess their own professional and cultural biases. Essentially, they needed to be genuinely willing to learn from local people, not lecture but listen actively and patiently. This required respect for local knowledge and culture, and a degree of humility.

b. The RRA toolkit: informal interviews, visualization and ranking and scoring

Rapid Rural Appraisal methods included a wide range of interviewing, scoring and ranking, and visualisation methods. Of these, interviews were the most important group of methods because they were used alone but also complemented and formed the basis for other tools. Slim and Thomson (1994) discussed interview techniques at some length and advised that:

'As well as patience, concentration, and a genuine commitment to listen and respect the views of others, a crucial interviewing skill is that of putting questions and guiding discussion. Interviews should not be straight-jackets which force narrators into unnatural and passive roles as objects of the process. Instead they should be semi-structured but guided encounters. Interviewers should be aware of their own body language, too: they should make eye contact and make culturally appropriate gestures to indicate agreement, enjoyment, sympathy, understanding or encouragement. The ability to keep an open mind and respond quickly to the unexpected and spot interesting and unusual avenues for further questions is a vital ingredient of good interviewing. Thus a good interview is semi-structured and improvisational'.

Central to good interviewing technique in RRA was the use of open and probing questions.

The visualisation methods used in RRA were many and varied. They included mapping (natural resource maps, social maps, service maps), seasonal calendars, time-lines, transects, Venn diagrams and flow diagrams. Noting the frequent misconception among professionals that illiterate farmers were incapable of constructing or understanding diagrams, the advantages of diagrams were stated as follows:

1. they were open-ended methods. The general subject matter was predetermined but precise details were added by informants, according to their own perceptions;

2. certain types of information could not easily be expressed verbally or in writing (e.g. the boundary of a geographical area or elevation of a landscape); diagrams could acquire and present information that was less precise or clear when written down, and this clarity eased analysis of the information;
3. diagrams were shared information that could easily be cross-checked by informants, discussed and amended.

Ranking and scoring tools in RRA were used to understand people's preferences for different items or services, or relate items key to each other. Whereas ranking required informants to place items in order of importance (1st, 2nd, 3rd etc.), scoring tools usually involved counters such as stones or seeds.

c. *Managing groups in RRA*

The RRA training curriculum for researchers included managing group interviews and exercises. Attention to group dynamics was used to identify those people who were talking and those who were not; various methods could be used to encourage less willing participants to contribute their views. RRA researchers were also taught how to handle dominant talkers in groups, that is, those people who talked to such an extent that other people were excluded from the discussion.

d. *The use of key informants in RRA*

Within communities, certain people were recognised as possessing particular knowledge or skills. These local experts were identified by asking people to identify others who knew most about a certain topic and then noting the names that were mentioned repeatedly by different informants. Key informants were used to provide very detailed information on specialised areas such as specific aspects of crop production, animal husbandry or human health.

e. *Triangulation in RRA*

Triangulation was a way of cross-checking information by taking the results of one method and comparing them with the results of a different method or existing data. These data could have arisen from different informants or groups of informants. Triangulation was an important mechanism for ensuring the validity of findings in RRA surveys.

f. Optimal ignorance in RRA

The concept of optimal ignorance in RRA was based on the notion that it is not necessary to know everything about a problem in order to decide how that problem should be solved. Rather, a description of the main features of a problem is usually sufficient for people to decide how to act. This aspect of RRA was designed to overcome the problem of excessive data collection in conventional surveys and a tendency to seek information that had limited practical value.

In summary, RRA was designed to use farmers' knowledge and skills when planning development projects and aimed to identify 'best-bet' interventions. The system used a 'toolkit' of interviewing, diagramming, ranking and mapping exercises with different social groups within communities and was characterised by its informality, field-level triangulation, flexibility and low-cost. Although RRA surveys tended to avoid quantification or statistical analysis of data, this omission did not hinder the planning of priority inputs for development projects (Moris and Copestake, 1993). Coinciding with the growth in RRA usage was the development of networks of practitioners and the publication of the informal journal *RRA Notes* in 1988 by the International Institute for Environment and Development (IIED). Consequently, experiences in RRA were widely disseminated in both industrialised countries and LDCs (Chambers, 1994a).

2.2.3.3 From Rapid to Participatory Rural Appraisal

While the use of RRA grew rapidly and new tools and ideas appeared in *RRA Notes*, its users were also aware of the limitations of the methods. Despite the intention to promote greater involvement of farmers in research, RRA was often viewed as a process that was controlled by outsiders with the primary aim of data collection and analysis. In terms of the development of PRA, seven types of RRA had been outlined at the 1985 conference at Khon Kaen University and one type had been called 'participatory RRA' (KKU, 1987). This term was later used in IIED's four classes of RRA methodologies together with exploratory RRA, topical RRA and monitoring RRA (McCracken *et al.*, 1988). Although not mentioned in relation to RRA, discussion on community participation began to feature more regularly in other literature (e.g. Korten, 1981; Cernea, 1985).

At field level various organisations became interested in participatory RRA and the use of researchers as facilitators who encouraged local analysis and ownership of information,

leading to community action plans. Experiences in Kenya (Kabutha and Ford, 1988) and India (McCracken, 1988) were reported as 'participatory rural appraisal' and 'participatory rapid rural appraisal' respectively and prompted considerable interest. In India, numerous training courses in PRA were conducted (e.g. Ramachandran, 1990) and IIED organised 30 field-level workshops in 15 countries, published papers about PRA in *RRA Notes* and produced guides and training manuals (e.g. McCracken *et al.*, 1988; Gueye and Freudenberg, 1990, 1991; Theis and Grady, 1991).

As experiences with PRA developed, the distinctions between RRA and PRA became more obvious. In relation to RRA, PRA was characterised by greater facilitation rather than investigation by outsiders, more local analysis, ownership and use of information, and ultimately, local capacity to plan and take action (Chambers, 1997). The actual methods used in PRA were similar to those used in RRA, although RRA has tended to use more interviewing methods, secondary data and observation whereas PRA has focused on visualisation methods and scoring and ranking exercises (Cornwall *et al.*, 1993).

2.3.3 Alternative learning paradigms: Participatory Learning and Action

Some of the most recent conceptual and methodological issues arising from participatory approaches and methods have focused on aspects of human knowledge, the control and use of knowledge, and the methods by which knowledge is acquired and validated (Pretty, 1994, 1995; Scoones and Thompson, 1993; Agrawal, 1995). In the literature on these topics one of the most prominent points of discussion has been the role of western science in human development and the limitations of positivist theories⁶ and methods in agricultural development in the late 20th century. Central to this theme has been the failure of positivism and conventional science methods to provide sustainable benefits to an increasing number of impoverished people in rural areas of the developing world. Although different kinds of knowledge influence the way human beings behave and act *viz.* instrumental knowledge, interactive knowledge and critical knowledge, it is instrumental knowledge derived largely from conventional, western controlled systems that dominates development policy and processes (Habermas, 1972; Park 1989).

⁶ Positivist theory dictates that every rationally justifiable assertion can be scientifically verified or is capable of logical or mathematical proof.

2.3.3.1 *Positivism, instrumental knowledge and 'good science'*

According to Pretty (1994, 1995) science in the 1990s was automatically equated with objective descriptions of reality. The Cartesian paradigm based on the discovery and control of nature was ubiquitous in the powerful institutions of industrialised countries. This positivist and reductionist paradigm assumed that the world could be described by reference to facts and laws that arose from methodologies based on a strict separation of the object of inquiry from the investigating subject. This process required a complex world to be compartmentalised into manageable units that were suitable for controlled manipulation and investigation. Perhaps due to the many successes of this approach and the obvious advances in technology and medicine that occurred in the 20th century, highly controlled and context-free investigation was considered to be 'good science' and the only rational way to determine how human development should proceed. In this paradigm, instrumental knowledge overrode other forms of knowledge and positivism dominated scientific method.

Although the positivist influence on scientific method was extremely powerful, many workers noted that it was only one way of describing and trying to change the world (Kuhn, 1962; Feyerabend, 1975; Habermas, 1987; Giddens, 1987; Uphoff, 1992). In addition to instrumental knowledge, Habermas (1972) described interactive knowledge and critical knowledge. People acquired interactive knowledge by living with other human beings and experiencing basic human interactions. This knowledge did not depend on the analysis of numerical data about other people but from sharing a life and world together, speaking with one another and exchanging actions against the background of common experience, tradition, history and culture. Interactive knowledge made human community possible as it enabled social solidarity through mutual support and common action. Critical knowledge was described as knowledge that derives from reflection and action, which makes it possible to deliberate questions of what is right and just i.e. human value judgements.

Although western science provided people with facts, the possession of interactive and critical knowledge meant that people interpreted and used these facts according to their perception of the world and what they wished to achieve as self-reliant and self-determining social beings (Park, 1989). Essentially the,

'... process of knowing should be seen as interactive, value-bound and context determined, rather than detached, value free and independent of context' (and

therefore) *interpretation, translation and representation are social acts that cannot be assumed to be neutral and objective*' (Scoones and Thompson, 1993).

According to Pretty (1994; 1995) the positivist paradigm failed to recognise that all data are constructed within specific social and professional contexts, and results are open to different interpretations according to the perceptions, social and economic interests of different interest groups and individuals. In agriculture, the dichotomy between western scientific facts and the limited uptake of new technology by poor farmers has been apparent since the 'Green Revolution'. In those areas where technology was not a perfect fit to local systems or where farmers were not highly controlled, agricultural modernisation was not adopted by rural people.

Various bodies of knowledge and methodology development suggest that alternative systems of inquiry and learning might provide more holistic and yet context-specific analysis and problem solving (Pretty, 1994; Chambers, 1997). Hence disciplines and theories such as chaos theory (Gleick, 1988), constructivist theory (Lincoln and Guba, 1985), soft systems methodology (Checkland, 1981) and even business management (Chambers, 1997; Peters, 1989; 1992) share similarities and, to varying degrees, have emerged in parallel to participatory approaches and methods.

2.3.3.2 *The principles of Participatory Learning and Action*

By the mid-1990s a diverse range of participatory approaches and methods had evolved. Pretty *et al.* (1995) listed 32 participatory systems of inquiry⁷ and suggested that these and other systems shared a number of important common principles. These principles were

⁷ Including Agroecosystem Analysis (AEA), Beneficiary Assessment (BA), Development Education Leadership Teams (DELTA), Diagnosis and Design (D&D), Diagnostico Rural Participativo (DRP), Farmer Participatory Research (FPR), Groupe de recherche et d'appui pour l'auto-promotion paysanne (GRAAP), Methode Accelere de Recherche Participative (MARP), Participatory Analysis and Learning Methods (PALM), Participatory Action Research (PAR), Process Documentation (PD), Participatory Learning and Action (PLA), Participatory Rural Appraisal (PRA), Participatory Rural Appraisal and Planning (PRAP), Participatory Research Methods (PRM), Participatory Technology Development (PTD), Rapid Appraisal (RA), Rapid Assessment of Agricultural Knowledge Systems (RAAKS), Rapid Assessment Procedures (RAP), Rapid Assessment Techniques (RAT), Rapid Catchment Analysis (RCA), Rapid Ethnographic Assessment (REA), Rapid Food Security Assessment (RFSA), Rapid Multi-perspective Appraisal (RMA), Rapid Organisational Assessment (ROA), Rapid Rural Appraisal (RRA), Samuhik Brahman (Joint trek), Soft Systems Methodology (SSM), Training for Transformation and Visualisation in Participatory Programmes (VIPP).

brought together using the rubric term Participatory Learning and Action (PLA) (Pretty, 1994, 1995) and were summarised as follows.

1. A defined methodology and systemic learning process

The focus was on cumulative learning by all participants, which included both professional trainees and local people. Given the focus of these approaches as systems of joint analysis and interaction, their use had to be participative.

2. Multiple perspectives

A core objective of PLA was to seek diversity rather than simplify complexity. It recognised that different individuals and groups made different evaluations of situations, leading to different actions. These multiple perspectives were important.

3. Group learning process

Group learning was based on the recognition that the complex nature of the world was best revealed through group analysis and interaction. Three possible mixes of investigators were suggested: those from different disciplines, those from different sectors and from the outside (professionals) and inside (local people). Within each of these combinations, there were other types of mix (e.g. not all local people in a community were the same).

4. Context specific

The approaches had to be flexible enough to adapt to each new set of conditions and people involved, and so there were multiple variants. Invention of new methods was encouraged.

5. Facilitating experts and stakeholders

Professional and outside 'experts' should act as facilitators and assist local people to conduct their own study in order to achieve something according to their own perception of need.

6. Leading to change

The participatory process led to debate about change. In turn, debate changed the perceptions of the people involved and their readiness to contemplate action. The process of joint analysis and dialogue helped to define changes that would result in improvement and motivate people to take action. This action included local institution building or strengthening, so increasing the capacity of local people to initiate action independently of outsiders.

This review uses the terms participatory appraisal (PA) to encompass philosophical and methodological aspects of RRA, PRA and PLA. Participatory appraisal acknowledges that participatory approaches are not always rapid, conducted in rural situations or used by institutions that are likely to shift their orientation towards involved levels of community participation in the near future. The appearance of PLA as a distinctive but broad group of learning and facilitation approaches was accompanied by renewed debate on the validity of information produced by participatory methods.

2.3.3.3 . The validity of participatory appraisal

a. Qualitative versus quantitative research

For many years systems of inquiry based on qualitative methods have attracted criticism, particularly from researchers who rely on quantitative approaches (Maxwell, 1992). Whereas quantitative and experimental research used well-defined measures of data quality such as internal and external validity, reliability and objectivity⁸, qualitative research was thought to lack a standard system for assuring the trustworthiness of data. Consequently, qualitative methods were associated with poor quality, second-rate work and informal methods were interpreted as highly subjective and undisciplined (Moris and Copestake, 1993). Qualitative researchers have responded to these criticisms in various ways but the main points of discussion have focused on fundamental differences in the nature of qualitative and quantitative research and alternative means to validate qualitative research methods.

⁸ Internal validity concerns the quality of findings relative to the population under study, whereas external validity concerns the extrapolation of findings to other populations. Reliability is a measure of the repeatability of findings, and objectivity assumes that the opinions or feelings of the researcher(s) do not influence the research (Tome *et al.*, 1999).

In quantitative research issues of validity and reliability are usually addressed at the design stage of the research. Techniques such as random sampling, selection of appropriate sample sizes and use of controls help to ensure that findings can be extrapolated to large populations (Maxwell, 1992). However, qualitative research conducted by anthropologists (and other social scientists) often aims to understand particulars in specific contexts rather than extrapolate findings to a general population with similar characteristics to the research sample. The process of understanding in this type of qualitative research requires methods that are more inductive and therefore, sources of error cannot always be predicted at the onset of the research. Hence, qualitative researchers tend to respond to validity problems as they arise during the course of the research. In part, the validity of findings in this situation is dependent on the skill of the researcher and their capacity to cross-check data as it emerges and confirm or refute previous findings. In terms of the types of knowledge described in section 2.3.3.1, qualitative research often aims to understand interactive or critical knowledge which is derived from very different processes to those which produce instrumental knowledge. Consequently, it has often been argued that validity measures for instrumental knowledge should not be applied to other types of knowledge (Park, 1989).

b. Comparing participatory and formal data to assess validity

In the literature on participatory approaches and methods, the question of validity has often been discussed. In justifying RRA methods in comparison with questionnaire surveys, Chambers (1997) cited five examples in which the results and use of RRA surveys compared favourably with questionnaires and in some cases, were considered to be more accurate than the questionnaires. In all cases, RRA was more rapid and less time-consuming and costly. Participatory maps were also found to compare well with official maps (three examples) and census data collected using participatory methods was found to be more accurate than questionnaire results (seven examples).

c. A framework for judging trustworthiness in participatory inquiry

Participatory research was holistic and encompassed aspects of instrumental, interactive and critical knowledge. As participation formed the basis for this research approach, it was suggested that the assessment of validity in participatory research should also be participatory in nature i.e. participatory evaluation (Fernandes and Tandon, 1981). An initial attempt to design a system for validating alternative systems of inquiry, specifically naturalistic inquiry, identified four 'trustworthiness criteria' called credibility,

transferability, dependability and confirmability (Guba, 1981). However, these criteria were considered by other researchers to be too closely linked to the conventional measures of internal validity, external validity, reliability and objectivity respectively used in conventional science, and hence additional 'authenticity criteria' were proposed (Lincoln, 1990). Drawing on these criteria together with the 'goodness criteria' of Marshall (1990) and Smith (1990), workers at IIED developed a framework for judging trustworthiness comprising 12 criteria as detailed below (Pretty, 1994).

1. Prolonged and/or intense engagement between the various (groups of) people

For building trust and rapport, learning the particulars of the context, and to keep the investigator open to multiple influences.

2. Persistent and parallel observation

For understanding both a phenomenon and its context.

3. Triangulation by multiple sources, methods and investigators

For cross-checking information and increasing the range of different peoples' realities encountered, including multiple copies of sources of information, comparing the results from a range of methods and having teams with a diversity of personal, professional and disciplinary backgrounds.

4. Expression and analysis of difference

For ensuring that a wide range of different actors are involved in the analysis, and that their perspectives and realities are accurately represented, including differences according to gender, age, ethnicity, religion and class.

5. Negative case analysis

For sequential revision of hypotheses as insight grows, until one hypothesis accounts for all known cases without exception.

6. Peer or colleague checking

Periodical review meetings with peers or colleagues not directly involved in the learning process, so as to expose investigators to searching questions.

7. Participant checking

For testing the data, interpretations and conclusions with people with whom the original information was constructed and analysed. Without participant checks, investigators can make no claims that they are representing participants' views.

8. Reports with working hypotheses, contextual descriptions and visualisations

These are descriptions of complex reality, with working hypotheses, visualisations and quotations capturing people's personal perspectives and experiences.

9. Parallel investigations and team communications

If sub-groups of the same team proceed with investigations in parallel using the same approach, and produce the same or similar findings, then these findings are more trustworthy.

10. Reflexive journals

These are diaries that individuals keep on a daily basis to record a variety of information about themselves.

11. Inquiry audit

The inquiry team should be able to provide sufficient information for an external person to examine the processes and product in such a way as to confirm that the findings are not a figment of their imagination.

12. Impact on stakeholders' capacity to know and act

For demonstrating that the investigation or study has had an impact, for example if participants were more aware of their own realities, as well as those of other people. The report itself could also prompt action on the part of readers who have not been directly involved.

Pretty (1994) suggested that the criteria in this framework could be used to judge the quality of participatory inquiry. It was proposed that although the absolute certainty of the data could only be verified by reference to objective measures of validity, the framework was sufficient to enable independent observers to understand how the process of information gathering had taken place and identify whether important elements of the process had been omitted. People could then make judgements on whether or not they trusted the data.

2.3.3.4 Complementary methods

In general the literature on the relative values of quantitative and qualitative research methods is characterised by workers who seek to defend their own approach rather than learn from other disciplines. The tendency has been towards a dichotomy in methodological development with criticism of quantitative methods by qualitative researchers and vice versa. For example, 'hard science' researchers have described qualitative research methods as unethical (Maxwell, 1992), whereas qualitative researchers have bemoaned the widely held view that true knowledge or good science is only associated with positivist theories and methods (Park, 1989; Pretty, 1994).

As PA evolved, various researchers considered options for combining PA with formal methodologies (Abbot and Guijt, 1997). This interest in mixing methods recognised that participatory investigation was not suitable for all purposes. For example, while PLA often yielded useful data about a small, specific location, this scale of information was not always relevant to policy makers. The question arose as to whether combined methods might produce information that described local concerns in the context of broader regional or national situations. Various examples of combined formal-participatory methodologies were presented in volume 28 of *PLA Notes* in 1997. Different sequencing of methods were reported such as the use of a questionnaire survey followed by PRA (Leach and Kamangira, 1997), and an opposite approach in which an initial participatory survey was used to guide

the design of a questionnaire (Davis, 1997). Both combinations were thought to be useful by the researchers involved.

A recent project entitled 'Methodological Framework for Integrating Qualitative and Quantitative Approaches for Socio-Economic Survey Work' summarised different combinations of methods and reviewed Guba's four tests of trustworthiness (Anon, 1998b). One group of mixed methods included swapping tools and attitudes from informal to formal and vice versa. This approach considered options for incorporating informal methods such as semi-structured interviews or longer PRA sessions into conventional, structured questionnaires leading to the concept of 'participatory questionnaires'. Other ideas were to use participatory methods such as mapping (a type of visualisation method) to create sampling frames for social surveys and to use qualitative insights to inform the choice of cluster variables in cluster analysis.

Regarding options for the use of formal methods in informal surveys, the researchers noted the limitations of participatory surveys in terms of extrapolation of findings to larger populations and suggested that probability-based sampling was required⁹. This need was related to the apparent weakness of Guba's test of validity called transferability (equivalent to external validity in formal methods). It was also proposed that statistical analysis could be conducted on binary, categorical and ranked data sets using analysis of variance and multi-level models.

During the early development of PA it was proposed that the collection of large quantities of data and detailed analysis was often unnecessary in order to make rational decisions about local problems and formulate plans in response to these problems. Typically, the presentation of data from PA surveys was informal. This approach meant that reports could be collated rapidly and decisions on action could be made without too much delay. The accuracy of results was determined by triangulation and community meetings, in which the final results were presented, discussed and amended as necessary.

However, with time PA practitioners began to consider the statistical analysis of data produced by PA tools. The informal journal *PLA Notes* published guidance on the use of ranks as statistics (Fielding *et al.*, 1998). This paper suggested ways to collect ranks and

⁹ Also see section 2.4.2.4 for discussion of sampling procedures in animal health questionnaire surveys in LDCs and in particular, describes the limited use of random sampling due to logistical and other constraints. Hence, even in formal surveys, random sampling is not always used.

analyse the results using tests such as the Kendall coefficient of concordance and Friedman's test.

2.3.3.5 The rapid growth of participatory approaches and methods: conceptual, methodological and other concerns

The rapid growth of participatory approaches and methods was associated with different interpretations and uses of community participation by development agencies and others. An editorial in *PLA Notes* (Anon, 1995) outlined real or potential problems with the practice of PRA and these ideas were later expanded by Guijt and Cornwall (1995), as summarised in Table 2.5.

Table 2.5

Concerns over the use of participatory approaches and methods (source: Guijt and Cornwall, 1995)

Concerns
<ul style="list-style-type: none">▪ The assumption that using PRA methods and/or approach in itself brings about positive change.▪ There is a lack of conceptual clarity, transparency and accountability.▪ Emphasis has been placed on information extraction with the rhetoric of political correctness.▪ Assumptions about community harmony have been unchallenged.▪ A lack of in-depth analysis has obscured awareness of political realities within communities.▪ There has been one-off training with no follow-up by trainers of institutions.▪ PRA has been poorly integrated into project planning and implementation.▪ The reasons for using PRA are not always clear.▪ Agendas have been driven from outside the community, not from within.▪ Co-option of the PRA acronym, making it a label without substance.

Definitions of PRA varied from an approach or process to a narrow set of data collection tools. The need to produce a single definition of PRA was questioned in view of the flexible, adaptive and learning nature of PRA and attempts by practitioners to move away from established, often dogmatic practice. While some workers recognised the creative and innovative aspects of PRA, others preferred to associate PRA with pre-defined, even prescriptive methods. Related to confused definitions was a lack of clear objectives.

Whereas RRA tended towards data collection controlled by outsiders' agendas, PRA was intended to enable people to set their own agendas according to local priorities. However, in some cases a conventional research approach was modified by the use of RRA methods and wrongly called 'participatory'.

The production of numerous method-focused PRA training manuals tended to reinforce perceptions of PRA as a toolkit rather than a learning process. While the methods were often novel and easy to learn, PRA also required changes in professional and personal attitudes and behaviour. When researchers concentrated on method, reports became the main output of PRA, and contextual and interactive features were overlooked. It was difficult to train people to view social interactions and context as crucial in PRA.

Another key cause for concern in PRA was raised expectations within communities when they were visited by outsiders, who were perceived to control resources. During such visits, community members sometimes assumed that because they had taken time to discuss particular issues, assistance from a government agency, research centre or NGO was guaranteed. This problem was most evident when the objectives of PRA were not clearly explained to community members.

Perhaps the most fundamental concern regarding the use of participation and PRA was the issue of power relationships, either between 'outsiders' and 'insiders', or between different groups or individuals within communities. For example, Mosse (1995) felt that PRA was not very useful for understanding the social dynamics of communities or the reasons why marginalised groups might be excluded from decision-making or project benefits. It was also noted how community leaders could direct PRA towards their own aims or attempt to undermine activities that had no obvious benefit to themselves. In terms of outsider control over participatory development, Pottier (1997) claimed that,

'Whatever the PRA pundits say about relaxed settings, participatory workshops are structured encounters marked by hidden agendas and strategic manoeuvres'.

Similarly, when discussing experiences in community health in Kenya, Nyamwaya (1997) described the rhetorical use of participation and how local people had only a limited role in prioritising health needs. In this case,

'Development is still effected in a top-down manner, and there is always the implicit assumption that communities can only develop once they have assimilated specialized technical and material inputs from the outside' and "while in theory communities are supposed to play a leading role in the health development process, the process is still largely controlled by government and NGO development 'experts' who do not allow communities to play major roles'.

To some extent, misunderstanding and misuse of participation was linked to the expansion of PA from small, often field-level situations to large-scale, sometimes politically motivated institutions. By the late 1990s, the 'scaling-up' or institutionalisation of participatory approaches and related power dynamics between development agencies and rural people was becoming a prominent theme in the development literature (e.g. Thompson, 1995; Blackburn and Holland, 1998).

2.4 Conventional Approaches to Veterinary Epidemiology: Experiences from Pastoral Areas of Africa

2.4.1 The need for veterinary services in pastoral areas

Due to the high dependence of pastoral communities on livestock, there is a particular need to develop effective veterinary services and livestock disease control programmes in pastoral areas. Pastoralists and agropastoralists inhabit arid and semi-arid areas¹⁰, and they own approximately 50% of Africa's livestock, or 225 million animals (de Leeuw *et al.*, 1995). The number of pastoralists in sub-Saharan Africa has been estimated at more than 50 million people (Coughenour *et al.*, 1985).

Typically, pastoralists derive at least 50% of their food and income from livestock (Swift, 1988). Milk, milk products and cereals are particularly important and milk alone can account for up to 75% of daily energy needs. For example, in northern Kenya milk provided 75%, 66% and 62% of the daily energy needs of the Rendille (Field and Simkin, 1985), Ariaal (Fratkin, 1991) and Turkana (Galvin, 1985) respectively. Pastoralists often acquire cereals by selling or exchanging livestock or livestock products, and meat and blood may also be consumed. In addition to food and income, skins can be used for clothing, to make household implements or the house itself; dung is used as fuel or burnt to repel flies; donkeys and camels are important for transportation of both materials and people, including

¹⁰ Rainfall in semi-arid regions is between 300-600mm/year and in arid regions < 300mm/year.

the carrying of goods to markets for sale. When crops are grown, oxen, camels or donkeys can be used for ploughing.

In addition to their more obvious use as food and income providers, livestock also play major social and cultural roles in pastoral communities in Africa. Livestock ownership affects wealth, status and decision-making power and social events such as births, marriages and deaths often involve ceremonies which require livestock. The close links between livestock, wealth and social interaction outlined above are reflected in the strong social support mechanisms that are a feature of pastoral communities. These systems are often complex and involve gifts or loans of animals or animal products to poorer members of the community. In many cases, the recipient has close kinship ties to the provider as described for the Maasai (Muir, 1994), Dinka and Nuer (Iles, 1994a; Catley, 1999a) and Somali (Ahmed Aden and Catley, 1993; Catley, 1999b).

Important livestock diseases in pastoral areas included trypanosomiasis, helminthiasis, CBPP, FMD, anthrax and clostridial diseases (RWA International/Vetwork UK, 2000). Depending on environmental conditions, fascioliasis and tick-associated health problems were also important in some areas. Although usually described as epidemic (or epizootic) diseases in Africa as a whole, CBPP and FMD are endemic in many pastoral areas. This situation reflected the general lack of veterinary services and disease control programmes. It was also noticeable that the last foci of rinderpest in Africa in the late 1990s were in pastoral and agropastoral areas of the Somali ecosystem and southern Sudan (RWA International/Vetwork UK, 2000).

2.4.2 Constraints to veterinary service provision in pastoral areas

While veterinary service provision to pastoralists has been a cause of concern for some time (Swift *et al.*, 1990), recent reports from Ethiopia (Godana, 1993; Catley *et al.*, 1997), Eritrea (FAO, 1994), Uganda (Catley, 1997a), Kenya (Tambi *et al.*, 1997; CONSORTIUM/BCEOM/SATEC, 1998) and Somalia (Catley, 1999c) indicated very limited if any progress in the development of conventional veterinary services in pastoral areas during the last twenty years or so. Constraints to service provision were numerous and included logistical, political and resource problems, often compounded by chronic armed conflict and inhospitable, hot environments.

Logistical constraints were associated with the remoteness of pastoral areas, relatively small

but mobile human populations and very poorly developed infrastructure and communications. Table 2.6 shows that Horn of Africa countries had approximately 100 times fewer paved roads and 145 times fewer telephones than a developed country such as the United States of America. Within Horn of Africa countries, infrastructure and communications facilities are concentrated in urban centres and so the figures in Table 2.6 do not fully show the infrastructural constraints in pastoral areas.

Table 2.6
People, land, infrastructure and communications in the United States of America and Horn of Africa
(adapted from Central Intelligence Agency, 2003)

Indicator	United States of America	Horn of Africa
Human population	272.6 million	157.2 million
Geographical area	9.62 million km ²	5.21 million km ²
Population density	28.27/km ²	30.17/km ²
Roads - total	1.50/km ²	0.03/km ²
Roads - paved	0.41/km ²	0.004/km ²
Telephones/1000 people	626	4.3

Limited development in pastoral areas has often been attributed to the political marginalisation of pastoral groups as typically, they have been viewed by government as backward and troublesome (Swift *et al.*, 1990; Toulmin and Moorehead, 1993). In some countries this situation was due to historical events that handed political power to sedentary ethnic groups, with the aim of developing these groups into an educated elite. Negative perceptions of pastoralism have contributed towards low investment by government and an unwillingness on the part of veterinarians to work in pastoral areas (Catley *et al.*, 1998). From the 1970s, the introduction of structural reform programmes led to dwindling resource allocation to veterinary services (Leonard, 1993) and pastoral areas were badly affected. For example, in the Karamojong region of northern Uganda:

'Government livestock-related services in Kotido District and Dodoth County are currently paralysed through lack of equipment, funds, transport, direction and supervision. There have been no large-scale vaccination campaigns in the county for ten years and most cattle herds have not been immunised. There are no vehicles, refrigerators, syringes, needles, drugs, microscopes, sprayers or diagnostic equipment in working order. There is little incentive to work: staff are under-paid, under-supervised and under-encouraged' (Sandford, 1988).

Veterinarians have also been unwilling to work in pastoral areas because of conflict.

Pastoralists also have a long history of competing with neighbouring groups for access to

grazing resources or theft of livestock by raiding (Ocan, 1994; Blench, 1996; Hendrickson *et al.*, 1998). However, civil war in the Horn of Africa and increased access to modern weaponry has exacerbated the scale and duration of conflict in pastoral areas. For example, the Somali-occupied areas of the Horn have been in a '*virtually continual state of conflict*' since the late 1970s (Bradbury, 1993). The war in Sudan is the longest-running civil conflict in Africa (only 11 years of peace since independence in 1956) and southern Sudan is often described by aid agencies as a 'chronic, complex emergency situation' (Operation Lifeline Sudan, 1994). Despite the cessation of the 27-year Ethiopian civil war in 1991, fighting between Ethiopia and Eritrea resumed between 1998 and 2000.

2.4.3 Animal health information systems in pastoral areas

The need to collect information on animal health is largely related to disease control measures. Priority diseases needed to be identified, characterised and controlled using interventions which were economically feasible and advantageous at national and sometimes international levels (Putt *et al.*, 1988). Veterinary epidemiology has been defined as:

'The investigation of disease, other health-related events, and production in animal populations and the making of inferences from the investigation in an attempt to improve the health and productivity of populations' (Thrusfield, 1995).

Consequently, the design and use of animal health information systems is one aspect of veterinary epidemiology because these systems provide data on the disease situation in animal populations. Thrusfield (1995) summarised the main components of veterinary epidemiology and it was evident that all components were related to, if not dependent on data collection.

2.4.3.1 Technology transfer and veterinary epidemiology

Support to building the epidemiological capacity of government veterinary services in Africa became a common feature of bilateral and multilateral aid programmes in the 1980s and 1990s. Typically, these programmes involved postgraduate training for veterinarians in western universities and technical assistance to design and manage central animal health data systems. Relatively little attention was directed at field-level data collection or how relatively poor quality or quantity of field data might limit the functionality of central epidemiology units. According to Broadbent (1979) and Pfeiffer (1996), the development of

sophisticated data processing techniques in veterinary epidemiology was not accompanied by similar developments in field-level data collection methods in LDCs.

By the late 1990s, official animal health reporting systems in pastoral areas of Kenya, Uganda, Tanzania, Ethiopia and Eritrea were based on information from field-level government clinics or smaller facilities, sometimes called sub-clinics or outposts. These clinics were often poorly resourced with minimal diagnostic equipment, medicines or vehicles. Typically, the clinics used a daybook to record activities such as examination and treatment of livestock, sale of medicines or vaccinations. Each month the entries in the daybook were summarised on to a reporting form which detailed numbers of different species of livestock treated or vaccinated, often by type of drug or vaccine. Animals receiving antibiotic would be grouped into a category such as 'infectious diseases' or 'use of antibiotic'. This report would then pass through various administrative levels until eventually the data reached a central point. At each administrative level, the original report might be compiled with other reports. This type of system produced the information that was the official view of livestock diseases in pastoral areas.

The weaknesses of these systems are summarised below.

1. Excessive filtering of information from the daybooks so that data on variables such as the location of diseases, seasonality of diseases and age groups of animals affected were collected locally but never analysed centrally.
2. Incorrect reporting of disease events due to lack of diagnostic facilities and or misunderstanding between livestock keepers and veterinary staff, particularly when the latter did not understand local disease names. In some cases, reports of clinical signs were reported as specific diseases. For example, sudden death cases were reported as anthrax, diarrhoea became helminthiasis or coccidiosis, and coughing became pasteurellosis. Lack of diagnostic facilities meant that confirmation of disease diagnosis was rare.
3. Limited geographical coverage of the clinics. Without transport veterinary staff could probably reach an area of around 10km radius from the clinic and so huge areas remained unserved. This problem was compounded by irregular and insufficient supplies of drugs so that the timing of treatments and vaccinations was subject to factors other than the timing of disease events. When drug and vaccine supplies were unreliable, livestock keepers were less inclined to risk long journeys to clinics only to find that no service was available.

4. Limited accurate information on livestock population and so numbers of cases seen or reported and numbers of animals treated or vaccinated were not compared with populations.

In addition to these problems, a general decline in funding and morale led to reduced frequency of reporting from field level to central level. This problem was exacerbated in some countries by decentralisation of veterinary services and loss of central control of disease surveillance¹¹. Looking at animal health information generally in pastoral areas, Bourn and Blench (1999) noted that,

'Information on the occurrence, epidemiology and economic importance of most of the diseases common to wildlife and domestic livestock in the rangelands of east Africa is fragmentary and of limited value (and in view of this) prioritising diseases for research or control will continue to be dependent largely on limited information and informed guesswork'.

Although more detailed information was available on specific diseases such as rinderpest, the persistence of this disease in parts of eastern Africa was a measure of the limitations of conventional approaches to veterinary epidemiology and service delivery in pastoral areas (Leyland, 1996; Mariner, 1996). The re-emergence of rinderpest in Kenya in 1994 and confusion over the source of the outbreak highlighted the weakness of official information systems used by veterinary services in pastoral areas. When describing the epidemiological features of the outbreak, Barrett *et al.* (1998) concluded that,

'There is major concern over how such a notoriously severe disease can have remained undetected for over 30 years.'

Similarly, numerous disease control and research programmes were implemented in Africa in the 1980s and 1990s using modern epidemiological approaches. Again, the literature points to the limitations of technology-led solutions and the need for greater involvement of livestock keepers. When suggesting new approaches to solving animal health problems Davies (1985) recalled the past application of simple but successful control measures to eradicate major epidemic diseases. Drawing on experience from East Africa it was advised that,

'The lesson for 1985 is that technical aids are not enough; disease occurs in animals that exist in husbandry systems that are susceptible to economic and social

¹¹ In a workshop in Arusha in July 2002 to consider ways of improving livestock disease reporting in Tanzania, central epidemiologists blamed decentralization for a monthly reporting rate from District Veterinary Officers of less than 10%.

pressures, and unless these pressures are conducive to disease control then even the most sophisticated array of technical aids will be of no avail...The difficulty we face is that research and development in infectious disease control, and probably in other areas of veterinary medicine, has been technology-led rather than problem-led. In other words we are concentrating on developing new scientific tools and only later considering how they might be used in controlling disease, rather than considering the fundamentals of the disease problems facing us and developing an approach that embraces the social and economic systems in which farm animals exist.'

According to Huhn and Baumann (1996) the constraints facing veterinary research in sub-Saharan Africa were insufficient applied research to solve field problems contributing to development and poor working relations between research centres and farmers. When discussing constraints facing government veterinary services generally in sub-Saharan Africa the same workers noted a,

'...negligence of farmers' needs, interests, priorities, resources and capabilities (and) little or no efforts to achieve the active participation of farmers in disease control.'

As a relatively new science, veterinary epidemiology has a history of borrowing methods from other disciplines and sciences. Experiences from the social sciences, mathematics, economics and astronomy have influenced epidemiological approaches and methods (Schwabe, 1982; Davies, 1985). Araujo *et al.*, (1975) described an early collaboration between veterinarians and anthropologists, and calls for similar partnerships have come from veterinarians working in developing countries generally (Waltner-Toews, 1988) and in pastoral areas of Africa (Sollod *et al.*, 1984). However, much of this transfer of ideas and practices has occurred within the positivist paradigm. Meek (1993) noted that although scientific methods had been preferred in the physical and life sciences, more blending of qualitative and quantitative methods might improve the 'society relevancy' of veterinary epidemiology.

2.4.3.2 Pastoralists' indigenous knowledge on animal health

One of the characteristics of the technology transfer style of development was that indigenous knowledge was often overlooked. Regarding knowledge on animal health among pastoralists, veterinarians had long known that pastoralists possessed detailed knowledge of animal-health matters and had good diagnostic skills. The use of herders as vetscouts and vaccinators during the colonial period (West, 1961; 1973) was a reflection of local capacity to carry out important veterinary duties. Accounts from northern Somalia (Mares, 1951,

1954a, 1954b), Sudan (Schwabe and Kuoajok, 1981) and Turkana (Ohta, 1984) were examples of literature which detailed a rich, local veterinary terminology and the use of indigenous practices (including traditional vaccination, use of medicinal plants, avoidance of parasites and surgical procedures). In northern Somalia, herders' ability to diagnose trypanosomiasis in camels compared favourably with laboratory tests (Edelsten, 1995) and in Maasailand, it was herders who first suggested that wildebeest were associated with the epidemiology of malignant catarrhal fever (Barnard *et al.*, 1994). Detailed information on indigenous veterinary knowledge throughout Africa was compiled by McCorkle and Mathias-Mundy (1992) and Bizimana (1994).

2.4.3.3 Animal health data collection methods in pastoral areas: experiences with questionnaires

a. General principles for the use of questionnaires

An important factor in the development of PA was dissatisfaction with questionnaire surveys in rural development settings (section 2.3.1.3). In veterinary medicine, questionnaire surveys have been very widely used to collect information from informants such as livestock owners and veterinary workers (Edwards, 1990; Vaillancourt *et al.*, 1991; Thrusfield, 1995).

Drawing on experiences from medical epidemiology, social science and market research, advice on the correct design and implementation of questionnaire surveys has featured in the veterinary literature for more than 15 years (Waltner-Toews, 1983; Edwards, 1990; Vaillancourt *et al.*, 1991; Thrusfield, 1995) and specific aspects of using questionnaire interviews in developing countries have also been described (Perry and McCauley, 1984; Putt *et al.*, 1988; Pfeiffer, 1996). The important issues to consider when using questionnaires could be summarised as determination of sample size; sampling methods; questionnaire design; questionnaire administration; quality control (including pre-testing and assessment of reliability and validity).

Despite an ample literature on questionnaire methods and their application in veterinary epidemiology, a number of workers noted methodological weaknesses when questionnaires were actually used. For example, when discussing types of error in questionnaire surveys Waltner-Toews (1983) wrote that,

'There is at present so little standardisation and measurement of reliability in veterinary questionnaires that comparison of results from different surveys must remain at the most informal, impressionistic level'.

Edwards (1990) and Vaillancourt *et al.*, (1991) were also critical of questionnaire surveys used by veterinary researchers and considered surveys to be poorly designed and biased, even in developed countries. The latter paper described an analysis of 120 articles in six peer reviewed veterinary journals¹² that referred to questionnaire data. In these articles, 18.3% failed to mention sampling methods; only 15.8% mentioned some or all of the questions used; only 8.3% mentioned pre-testing of questionnaires; only 11.2% described validation procedures; and in those articles in which non-respondents were reported, only 5.7% attempted to explain the non-response figures. Questionnaire practice by workers in industrialised countries seemed to have improved since these reviews, as papers in some journals now include details of sampling methods and pre-testing, and provide a copy of the questionnaire (or guidance on where a copy of the questionnaire can be obtained).

b. Use of questionnaires with pastoralists and other livestock keepers in Africa

In pastoral areas of Africa however, the conditions that enable the use of questionnaires in developed countries rarely apply. Logistical problems can prevent effective questionnaire administration including poor postal, telephone and transport services in rural areas. Illiteracy levels prevent livestock keepers from completing a written questionnaire and therefore, direct owner interviews are required. Pre-testing is difficult if informants are in remote locations, and limited baseline data, inaccessibility and conflict hinders random sampling. Therefore, convenience sampling is common and researchers tend to work in areas where they expect reasonable cooperation from livestock keepers (e.g. Nuru and Dennis, 1976). In other cases, the aim was simply to involve as many informants as possible (e.g. McCauley *et al.*, 1983a).

When discussing the use of questionnaires in Africa, Perry and McCauley (1984) noted the importance of the direct interview with livestock owners or keepers as a means to obtain information on animal health matters. Drawing on their experiences in southern Sudan (McCauley *et al.*, 1983a) and Zambia (Perry *et al.*, 1984) guidelines for conducting

¹² The six journals reviewed were the Australian Veterinary Journal, the Journal of the American Veterinary Medical Association, the Canadian Veterinary Journal, the Journal of Preventive Veterinary Medicine, the Veterinary Record and the New Zealand Veterinary Journal.

interviews were proposed which included standardisation of the interview technique by the use of a single interviewer; recognition of local concepts of time; avoidance of rushed interviews; use of a local interviewer familiar with cultural norms; ordering of questions so that sensitive subjects were discussed late in the interview; use of questions related to specific and recent time periods in order to reduce recall bias. These workers also noted the limitations of random sampling procedures in LDCs and in common with Broadbent (1976) mentioned that in some areas an absolute lack of data inhibited the use of random sampling methods.

During the preparation of this review, only one example of a survey in a pastoralist area was found in which the researchers justified their sampling method according to their understanding of social structure and livestock management (McDermott *et al.*, 1987). This was a survey of CBPP and bovine brucellosis in southern Sudan. The researchers acknowledged the shortcomings of their convenience sampling but also explained how logistical, resource and other constraints prevented the use of a more rigorous survey design. The authors provided a detailed description of the sampling method and related the method to the context in which they were working¹³. The potential for recall bias was also discussed. The prevalence of brucellosis and CBPP was reported according to different age groups of cattle in the study and hence the ability of herd owners to accurately remember the age of specific animals was important during the analysis of results. However, the researchers judged respondents to possess good historical knowledge of the animals in their herds.

Regarding the validity of livestock owners' views on the prevalence of CBPP, a significant correlation between owner diagnosis and laboratory diagnosis was reported for cattle less than four years of age ($p=0.0041$)¹⁴. In the survey area CBPP cases did not show typical

¹³ Using their knowledge of the social organisation of the local Dinka community and the structure of temporary cattle holding areas called cattle camps (*wut*), the researchers were able to convenience sample three out of the seven court areas that made up Kongor Rural Council. Each court area contained a number of cattle camps and each cattle camp contained 20 to 100 family herds (*gol*). According to ease of access, two cattle camps were selected in each of the three court areas. Within each of the sampled cattle camps, family herds were selected according to their location in the camp (e.g. the third *gol* from the east). Finally, the interviewers selected 25 cattle within the *gol* using their knowledge of herd structures and strata according to age and sex.

¹⁴ The correlation was not evident in all ages of cattle. This finding was attributed to the use of the complement fixation test for CBPP serology and its limited capacity to detect either early or chronic cases. Data on owner diagnosis was not reported in the paper and the statistical test used to measure correlation between owner and laboratory diagnosis was not described.

textbook signs of disease but rather vague signs such as occasional coughing. Hence, although the clinical appearance of CBPP was not dramatic, livestock owners were able to accurately diagnose the disease. No information was provided on owner's recollection of abortion in their animals and the prevalence of brucellosis. The authors described the limitations of serological tests to determine the prevalence of CBPP and brucellosis¹⁵.

A review of non-sampling errors in surveys in LDCs and some of the best-practice advice on questionnaires indicated that attention to local customs and language were important during livestock owner interviews (section 2.3.1.3). However, in general the veterinary literature contains very little information on methods and behaviour for communicating effectively with people from different cultures, ethnic groups or backgrounds to the researchers. Although some workers mention the importance of non-verbal communication during interviews (e.g. Waltner-Toews, 1983) the precise details of appropriate behaviour and attitude of interviewers were not discussed, nor were ways of determining whether interviewers were hindering or promoting constructive, open dialogue. Perry and McCauley (1984) suggest that a local veterinary worker might be used as an interviewer but did not discuss how such a person might misinterpret or misreport the views of livestock keepers due to their own technical training or other reasons. Therefore, these workers assumed that the use of local interviewers would automatically overcome cultural and language barriers.

When discussing research methods in development settings, Pratt and Loizoz (1992) noted the limitations of personal interviews for collecting information on sensitive or private topics unless time was taken to build a trusting relationship with informants. This issue has been mentioned generally in relation to animal health surveys in LDCs (Pfeiffer, 1996) and specifically in connection with questions on numbers of livestock owned (Perry and McCauley, 1984). However, specific advice on how to create good rapport with livestock owners is absent in the veterinary literature on questionnaire methods. Although the need for training of interviewers is mentioned by various workers, the precise topics to be covered during training are not mentioned and it is unclear whether veterinarians themselves possess the skills required to train interviewers.

Further considerations affecting the use of questionnaires in pastoral areas of Africa are cultural and professional biases affecting veterinary workers. Typically, veterinarians who

¹⁵ Antibody to CBPP was detected using the complement fixation test (CFT); Brucella antibody was detected using the Rose-Bengal plate test and CFT.

are posted to these areas are not from pastoral ethnic groups and they have different moral and social values, religion and language. In many African countries, the notion of pastoralists as irrational, uncooperative and uneducated still prevails and in veterinary medicine, is reinforced by veterinary undergraduate training which focuses on intensive farming (Catley *et al.*, 1998). With these limitations in mind, the view of Stone and Campbell (1984) that non-sampling errors are often ignored in formal surveys in LDCs also applies to many questionnaire surveys on animal health topics.

Regarding validity of survey findings, measures of validity have usually been subjective with veterinarians making qualitative judgements on survey findings and assumptions regarding livestock keepers' ability to diagnose disease. For example, in a questionnaire survey of cattle health problems in Zambia, the researchers appeared to make a number of associations between a single clinical sign of disease and a specific disease (Perry *et al.*, 1984). A high grading of subcutaneous oedema by farmers in one area was described by researchers as '*probably a manifestation of principally haemorrhagic septicaemia*' because all ages of cattle were affected. However, in another area, the same clinical sign was '*probably a manifestation of fascioliasis*' because only adult animals were affected. Another highly graded sign 'sudden death' was '*probably a manifestation of haemorrhagic septicaemia or fatal theileriosis*'. In each of these cases no additional information, such as clinical examination of cattle or laboratory confirmation of disease by age group, was provided to support the association between the clinical sign and the disease.

In the previously mentioned schistosomiasis survey in southern Sudan involving an assessment of the ability of livestock keepers to diagnose the disease, no laboratory confirmation of diseases diagnosed by informants was conducted (McCauley *et al.*, 1983a). Also in southern Sudan, McDermott *et al.*, (1987) were able to compare the opinions of livestock keepers with serological findings and noted agreement between owner diagnosis and presence of CBPP antibody in some age groups of cattle. However, the limitations of CBPP and brucellosis serological tests were also discussed.

Overall, the use of formal data collection methods seems to reinforce the top-down research and development approach, with researchers setting the agenda and deciding which questions to ask. In only one of the above examples (McDermott *et al.*, 1987) did the researchers respond to a problem that seemed to be prioritised locally by livestock keepers. In other examples it was noted how informants had little interest in the research topic (e.g. Nuru and Denis, 1976). In livestock development, the problem of researcher-driven topics and methods was discussed by Leyland (1991). It was noted how questionnaires sometimes

made livestock owners seem ignorant simply because researchers asked the wrong questions about the wrong subjects. When these problems are considered together with problems of questionnaire design and the logistical difficulties of pre-testing and administering questionnaires in remote areas, the need for alternative methods becomes apparent.

2.4.3.4 International trade and the need for improving animal health information systems in pastoral areas

Increasingly, countries wishing to export livestock are required to demonstrate their animal health status. International standards are set by the Office International des Epizooties (OIE) according to the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) of the World Trade Organisation. To comply with the SPS Agreement, a veterinary service in a developing country must be able to:

- demonstrate national animal health status by means of scientifically-based surveillance efforts;
- draft regulations based on international standards and develop transparent means to divulge them to the public and international community;
- develop risk analysis capabilities;
- recognise and apply the concept of regionalisation;
- develop control, inspection and approval methods that are transparent, non-discriminatory and scientifically-based (Zepeda, 2000).

For many LDCs these conditions are major challenges. In particular, the special constraints and limited veterinary activities in pastoral areas of the Horn of Africa raise profound problems for countries wishing to enter international livestock markets.

Although it was widely recognised that livestock owners possess detailed information on animal health matters (section 2.4.2.3) it seems that this resource has been under-utilised in official animal disease reporting systems. Novel approaches such as the use of animal health workers to act as disease monitors have been used successfully in Niger (Sollod and Stem, 1991), Somalia (Baumann, 1990) and southern Sudan (Jones *et al.*, 1998).

2.5 Veterinary Applications of Participatory Appraisal

Veterinarians and livestock workers have used a wide range of PA methods to investigate animal health topics (Cornwall, 1992; Kirsopp-Reed, 1994; Waters-Bayer and Bayer, 1994). These reports together with other literature describing the use of PA methods in animal

health are listed in Table 2.7 and specific PA methods according to information needs are summarised in Table 2.8.

2.5.1 Animal health surveys, needs assessments and action plans

The earliest accounts of the use of PA methods to investigate animal health topics appeared in general participatory needs assessments which collected and analysed information on human livelihood strategies, work patterns, environment and agricultural practices. In these surveys, livestock problems were assessed in relation to other problems experienced by local people such as lack of water, human disease or poor education, and the approach was intended to identify preferred solutions¹⁶ with communities. The agencies responsible for initiating this work then tried to respond to key problems and used technical staff to follow-up the main areas of concern. Examples of this type of needs assessment include surveys in Ethiopia in which information on animal health was analysed in the field in comparison with other problems that were identified by local people (IIED and Farm Africa, 1991). Using various tools, data on patterns of livestock ownership, reasons for keeping different types of animals, relative importance of different livestock species and problems associated with keeping livestock were recorded. A similar integrated approach was used more recently by the Kenya Agriculture Research Institute in southwest Kenya (Rees *et al.*, 1998).

As participatory methods began to be used more widely, more detailed information on livestock production and health began to emerge from surveys conducted by NGOs such as ITDG and FARM Africa. This work was usually a component of community-based animal health projects. Participatory appraisal methods were first used by ITDG in 1986 when a base-line survey in Kamujini, Kenya included the use of methods such as wealth ranking, progeny histories, ethnoveterinary question lists and informal interviews (Maranga, 1992). Over the next few years other methods such as transect walks, mapping, and ranking exercises were also used. Maranga (1992) described how ITDG used wealth ranking, disease ranking and success ranking in projects in Zimbabwe and Kenya. In these projects, PA was used during the initial needs assessment or feasibility surveys and was intended to provide a rapid overview of key issues, relationships and services in communities, and locally-prioritised livestock diseases. Information gathered was used in the design of community-based animal health worker (CAHW) projects.

¹⁶ Often termed 'best-bet' solutions in the development literature.

Table 2.7
Literature on the use of participatory appraisal in animal health services

Country	Notes	References
Ethiopia	Included as an early example of animal health issues featuring in a general needs assessment.	Scoones and McCracken (1989).
Various	Thesis discussing the potential applications of RRA and PRA in livestock development.	Leyland (1991).
Kenya, Zimbabwe	Use of wealth ranking and disease ranking in ITDG projects.	Maranga (1992); Young (1992).
Ethiopia	Report which includes a method for 'interviewing cows'.	IIED and ActionAid Ethiopia (1992)
Afghanistan	Use of wealth ranking, disease ranking, fodder ranking and seasonal calendars during the design of an animal health project.	Leyland (1992).
Nigeria	Use of RRA to study constraints and solutions facing poultry farmers; comparison of RRA with questionnaire method.	Sonaiya (1992).
Zambia, Ethiopia, Guinea	Describes a methodology for rapid appraisal, including the use of livestock disease calendars and transect walks.	Ghirotti (1993).
Somaliland	Seasonal calendar showing variations in disease incidence; herders' calendars showing seasonal movements of livestock.	Hadrill and Yusuf (1994a; 1994b).
Kenya	Describes the progeny history method.	Iles (1994b).
Kenya	Ethnoveterinary question list	Grandin and Young (1994).
Mongolia	Use of labour calendars by gender; illustrates division of labour for livestock tasks.	Cooper and Gelezhamstin (1994).
India	Use of maps, interviews, seasonal calendars and livelihood analyses during an evaluation of a dairy buffalo project.	Devavaram (1994).
Nepal	Use of maps, progeny histories, rankings and interviews during an evaluation of a village animal health worker project.	Young <i>et al.</i> (1994).
Mozambique	Use of Venn diagrams to understand institutional links between communities and agencies involved in livestock.	Braganca (1994).
Indonesia	Outlines the use of progeny histories in a study of economic aspects of malignant catarrhal fever in buffaloes and cattle.	Nurhadi <i>et al.</i> (1994).
Somaliland	Use of participatory scoring tools including 'before and after' scoring for programme review/evaluation.	ActionAid Somaliland (1994).
Southern Sudan	Outlines the use of participatory animal health surveys from 1993 in the UNICEF Operation Lifeline Sudan Livestock Programme.	Leyland (1996).

Table 2.7 continued

Country	Notes	References
Somalia	Use of PA methods to conduct preliminary investigations on rinderpest in a remote area.	Mariner and Flanagan, 1996
Somaliland	Use of seasonal calendars and scoring tools to investigate tick ecology and tick-associated disease.	Catley and Ahmed Aden (1996).
Somaliland	Detailed account of a livestock disease scoring tool; discussion on reliability and validity.	Catley and Mohammed (1996).
South Africa	Outlines the use of RRA within a systems approach to animal health needs assessments.	McCrindle <i>et al.</i> (1996).
Non-specific	Summary of PA tools and training needs for veterinary epidemiology.	Catley (1997b).
Ethiopia	Stakeholder analysis of animal health services based on the use of PA tools, particularly proportional piling.	Save the Children UK (1997).
South Africa	Use of rapid appraisal with stakeholders to assess community veterinary needs.	McCrindle (1998).
Trinidad and Tobago	Use of school essay method and group interviews as part of an ethnoveterinary study.	Lans and Brown (1998a; 1998b).

Table 2.8

Participatory appraisal tools for use in veterinary epidemiology and economics (adapted from Catley, 1997b).

Information required	PA tools and methods ^a
System boundary	Natural resource maps, social maps.
Social organisation	Social mapping, Venn diagram
Wealth groups	Wealth ranking
Relative livestock ownership	Proportional piling
Role of livestock in household economy	Livelihood analysis
Preferred types of livestock reared	Livestock species scoring
Income from livestock	Proportional piling
Marketing structure	Flow diagrams, service maps
Veterinary services	Service map, Venn diagrams, ranking and scoring
Animal husbandry	Seasonal calendars ^b , mobility maps ^c transects
Resources available to rear livestock	Natural resource maps, transects.
History of livestock diseases	Timelines
Priority livestock diseases	Livestock disease scoring
Seasonal variations in livestock disease	Seasonal calendars
Relative mortality rates	Proportional piling
Livestock productivity	Progeny history

^aSemi-structured interviews can provide information on all topics

^bParticularly useful for showing breeding management and feeding management

^cTo show livestock movements in pastoral and agropastoral systems

The first comprehensive review of participatory approaches and methods and their potential applications in livestock development was conducted by Leyland (1991). This research described the conceptual basis for community participation in livestock development in relation to conventional development activities, and outlined PA tools for use in surveys and community-based livestock programmes. The ideas put forward in the review were applied in an animal health project in Daye Chopan district in southeast Afghanistan from 1991 to 1992. Participatory appraisal methods used in this project included group and key informant interviews, livestock movement maps, transects, seasonal calendars, pair-wise ranking, direct matrix ranking, progeny histories and wealth ranking (Leyland, 1992; 1993). In common with ITDG's work in Kenya, this project was community-based and aimed to involve local people in the analysis of problems and design of a service using basic veterinary workers. A similar approach to service delivery was used soon afterwards in a large-scale animal health programme coordinated by UNICEF in southern Sudan (Leyland, 1996). In the late 1990s, a number of NGOs in Kenya, Uganda, Ethiopia, southern Sudan and Somalia were using PA routinely in animal health projects¹⁷.

2.5.2 Monitoring and evaluation

Although PA has been widely used during the initial stages of project implementation, its use in project monitoring and evaluation has been less extensive. Participatory appraisal methods were used during evaluations of the United Mission to Nepal's Paravet Project (Young *et al.*, 1994) and ActionAid Somaliland CAHW project (ActionAid-Somaliland, 1994, 1998). Reviews of community-based animal health project in Karamoja, Uganda (Catley, 1997a) and southern Sudan (Catley, 2000a) also used PA methods, and scoring tools were incorporated into a questionnaire-based assessment of Oxfam UK/Ireland's project in Wajir, Kenya in 1998 (Odhiambo *et al.*, 1998). Participatory approaches to project monitoring were also introduced to the Dutch Committee for Afghanistan's veterinary projects (Blakeway, 1998).

2.5.3 Ethnoveterinary data collection

An integral feature of the development of participatory approaches and methods has been acknowledgement of local knowledge systems (section 2.3.3.2a). In community-based animal health services, rural people's knowledge including both technical knowledge and

¹⁷ These included ITDG, Oxfam UK/Ireland, Save the Children UK, ActionAid Somaliland, ActionAid Kenya, FARM Africa and others.

knowledge of social values and organisation, was used extensively to design and implement services. Participatory appraisal assisted local analysis of animal health problems, existing services and resources, and opportunities for improving services. When implementing projects, activities such as the selection of people for training as CAHWs and means to supervise these workers at community-level was based on local knowledge of community structures and decision-making processes (Catley *et al.*, 1998). In these situations, it can be noted that PA methods were used because they automatically evoked rural people's knowledge, and the approach recognised that local technical knowledge was intrinsically linked to other types of knowledge and social norms and behaviour.

Coinciding with the increasing use of community-based approaches to animal health service delivery was the emergence of 'ethnoveterinary medicine' as a distinct discipline based on the research and development of indigenous animal health knowledge and skills (McCorkle, 1986). This discipline attracted considerable interest from veterinary and other workers during the late 1980s and 1990s, and detailed accounts of ethnoveterinary medicine became available (Mathias-Mundy and McCorkle, 1989). Experiences and information from Africa were collated by McCorkle and Mathias-Mundy (1992) and Bizimana (1994).

As its name implied, ethnoveterinary medicine focussed on technical local knowledge, descriptions on indigenous language and practices, and to a lesser extent, validation of knowledge using western scientific principles. In comparison with the various PA methods used to understand rural people's knowledge during the development of community-based services, ethnoveterinary data collection tended to use a narrow range of interviewing methods. Often these methods were more formal than informal, with questionnaires and structured owner interviews forming the basis for data collection (e.g. Heffernan *et al.*, 1996; Delehanty, 1996). Although local ownership and analysis of information was evident in some ethnoveterinary studies (e.g. Wanyama, 1997), in some cases ethnoveterinary research and development was characterised by the collection and validation of knowledge by outsiders with a view to delivering proven, valid technology back to rural people.

In other situations, ethnoveterinary research was conducted in an attempt to promote new technology. For example, ethnoveterinary data collection in coastal areas of Kenya was driven by the idea that extension materials could be made more effective if local disease terminology was understood by researchers and extension agents. The need to develop extension materials arose from the development of a new vaccine for controlling theileriosis (Delehanty, 1996). Hence, a technology had been developed without much attention to how

it might be received by farmers or delivered to them. Arguably, the use of formal methods in ethnoveterinary investigation reflected a western, technical focus.

In human health, medical anthropologists have conducted numerous studies on the role of traditional healers, and users' preferences for different types of basic health service provider (Foster, 1975; Helander, 1990). In animal health, very few comparable studies have been conducted. Therefore, very limited information is available on people's preferences for different types of animal health service in different situations and hence, the application of validated indigenous knowledge remains open to question. As noted by Mathias and Perezgrovaz (1997), ethnoveterinary research and practical initiatives to improve veterinary services were often '*separated from each other*'.

2.5.4 Complementary methods

Participatory appraisal methods have been used in various combinations with conventional methods in veterinary research. Sonaiya (1992) used RRA and a questionnaire to study poultry problems in Nigeria, Nurhadi *et al.*, (1994) conducted an economic assessment of losses due to malignant catarrhal fever in Indonesia using an abattoir survey followed by PRA. In southern Africa, PA methods were used as a component of a methodology to assess community animal health requirements. This methodology was termed 'Veterinary Needs Analysis' and comprised conventional questionnaire methods and RRA (McCrinkle *et al.*, 1996).

In 1996 the term 'participatory epidemiology' was used in relation to field-level investigation and searching for rinderpest in Africa (Mariner, 1996). The use of PRA methods specifically to collect information from pastoralists on rinderpest was viewed as a key adjunct to laboratory-based epidemiology, particularly as serological surveys were difficult to conduct and interpret in remote pastoral areas. The main PA method used was semi-structured interviews (based on checklists of questions related to rinderpest) and timelines to build a historical picture of a rinderpest outbreak in a given area (Mariner and Flanagan, 1996). The methodology was described in greater detail by Mariner (2000).

2.5.5 Limitations to the use of participatory appraisal by veterinarians

In 1998 a survey of veterinarians working in Africa indicated that PA was most widely used by NGO workers (Catley, 2000b). In government veterinary services, reasons cited for not

using PA included negative attitudes of colleagues and ‘generates qualitative data’. Qualitative data was associated with difficulties in summarising and presenting the data, and concerns about data validity and reliability. This survey also noted that the number of veterinarians using PA exceeded the number who had been trained in the approach.

In participatory approaches and methods, the trustworthiness of data was dependent on factors such as the ability and behaviour of the facilitators, and the use of triangulation to cross-check information. An example of triangulation from an animal health project is detailed in Table 2.9. When using PA methods with herders in Somaliland in 1993 a disease called *humbul* was often cited as an important problem (Catley and Ahmed Aden, 1996). Information about this problem was triangulated by comparing data from livestock disease scoring, matrix scoring of ticks and health problems and formal identification of tick species with secondary, published data.

Table 2.9
An example of triangulation: Was *humbul* the same as Nairobi sheep disease?

Type of data	Methods and results
Primary	<p><u>PA method: Livestock disease scoring</u> The disease called <i>humbul</i> was associated with poverty, high mortality in sheep, transmission by ticks, bloody diarrhoea, coughing and congested carcasses. By reference to the secondary data, these findings were suggestive of Nairobi sheep disease.</p>
	<p><u>PA method: Matrix scoring of ticks and health problems</u> A strong association between the tick called <i>garabcad</i> and the disease <i>humbul</i> was indicated. This finding matched the results from the livestock disease scoring.</p>
	<p><u>Formal identification of ticks</u> Numerous samples of the tick <i>garabcad</i> were identified as <i>Rhipicephalus pulchellus</i>. Secondary data indicated that this tick transmitted Nairobi sheep disease in northern Somalia.</p>
Secondary	<p><u>Review of literature</u> Nairobi sheep disease had been confirmed in sheep in northern Somalia by a British veterinary team working between 1970 and 1972. Mortality reached 80% in affected flocks and at post mortem examination the disease was characterised by haemorrhagic septicaemia and pneumonia. The tick <i>Rhipicephalus pulchellus</i> was considered to be the main vector of the disease (Edelsten, 1975). Nairobi sheep disease was described as ‘<i>the most pathogenic virus infection of sheep and goats in eastern Africa, with mortality rates in naive sheep of up to 90%</i>’ (Scott, 1990).</p>

In this example, it should be noted the livestock disease scoring and matrix scoring methods were not used specifically to investigate the subject of the triangulation. Hence, at the time when the methods were used, the investigator was not purposely seeking information on Nairobi sheep disease and therefore it seemed unlikely that informants' responses and scorings were intended to please the investigator by providing information on this topic. The triangulation process started as the information began to emerge, and was partly informed by previous knowledge of the literature. Although this example shows how information arising from different sources, methods and informants could be triangulated in PA, this level of detail was rarely, if ever, provided in reports of participatory animal health surveys or research. In these reports, it was usually impossible for readers to ascertain how a specific survey finding or conclusion was based on cross-checking information from multiple sources or methods.

Regarding the affect of training in PA on an investigator's ability to use the approach and methods properly, the literature indicates that while it was straightforward to train people how to use PA methods, it was far more difficult for people to acquire communication and facilitation skills (Guijt and Cornwall, 1995). Other workers noted that inappropriate training was one cause of low quality PRA work (Anon, 1995). However, in terms of the presentation of PA findings and their interpretation by readers with a mainly technical interest in the information, the problem of demonstrating triangulation in PA reports has not been discussed. The assumption seems to have been that if a variety of PA tools were used, perhaps with different informants, then the process of triangulation automatically took place.

In epidemiology, issues of validity and reliability of PA methods have not been addressed. This lack of attention to the scientific value of PA seems to have arisen for four main reasons.

1. During the early development of PA, researchers avoided quantification and statistical analysis because this was deemed unnecessary with respect to understanding key problems and formulating action plans. The concept of optimal ignorance was applied together with the belief that local problems required local solutions. The need to make probability statements about large populations based on the characteristics of sample populations was not considered to be a priority.

2. Despite the informal, qualitative nature of PA, veterinarians at field-level recognised the value of the approach when supporting community-based projects (Catley 2000b). The impact of these projects, as assessed by donors (Livestock in Development, 1998), was an indication that PA did produce useful information for project planning, regardless of its value in a strictly scientific sense. Hence the need to validate PA was not a priority.
3. Participatory appraisal was most commonly used by NGOs in marginalised areas. Typically, NGOs were not well resourced, and, in some cases, funding was erratic and short-term. In this situation, investments in validation studies were not a priority.
4. The holistic and context-specific aspects of PA were more typical of qualitative rather than quantitative systems of inquiry. Hence, it was argued that the tests of validity and reliability that were used in quantitative, hard science approaches did not apply to PA methods.

2.6 Summary

The development of sophisticated data processing techniques in veterinary epidemiology has not been accompanied by similar developments in field-level data collection methods in LDCs. This disparity raises fundamental questions regarding the trustworthiness of animal health information in LDCs. Veterinary epidemiologists and researchers in LDCs relied heavily on questionnaires that were often poorly designed and administered. Data from questionnaires was fed into computer-supported quantitative epidemiological analysis, including risk analysis, disease modelling, geographic information systems and decision support systems. Ultimately these potentially valuable methods will be of little relevance unless information collected at field-level is accurate and timely. Experience from rinderpest control programmes indicated that eradicable livestock diseases persisted in pastoral herds partly because government veterinary services had limited understanding of the epidemiology of these diseases in remote areas. In part, limited information was associated with inappropriate methods.

A review of veterinary applications of PA indicates that the methods can be adapted at field-level to suit particular circumstances and information needs. When researchers have the correct approach, good rapport with livestock herders can be achieved, leading to action to

solve problems as they are identified. At present, the key constraints to the wider use of PA in animal health information systems seem to be the qualitative nature of PA and lack of formal validation of the methods. Therefore, assessment of the validity and reliability of PA methods for field-level veterinary use are required. In terms of the potential uptake of new methods, existing animal health institutions such as government veterinary services could adopt validated PA methods with relatively minor or no changes in institutional behaviour and approach.

An alternative approach to testing and adapting PA to fit existing paradigms in veterinary epidemiology would be to use PA to develop new paradigms. This review has argued that although veterinary epidemiological theory requires attention to complex relationships and holistic learning, to date much of this learning has focussed on the acquisition of instrumental knowledge. In veterinary epidemiology, reality is mostly described using methods based on positivism and a need to transform qualities into quantities before relationships can be analysed and understood. Although quantitative data processing and analysis have become more sophisticated, these developments *per se* do not necessarily result in improved human or animal welfare, and have had limited if any impact on veterinary services in more marginalised areas of developing countries. Veterinarians have already recognised the limitations of positivism.

Therefore, when borrowing PA methods from the participatory learning and action approach, veterinary epidemiology should also consider the framework that has been proposed for ensuring the trustworthiness of participatory data. This type of transfer, of both methods and tests of validity, avoids concerns over attempts to validate a qualitative approach and methodology using a quantitative value system and worldview. It also acknowledges that human knowledge and behaviour, and hence the development of better veterinary services, is dependent on instrumental, critical and interactive knowledge. In terms of the potential uptake of alternative approaches, existing animal health institutions would probably require major changes in institutional aims and behaviour in order to incorporate new learning and action paradigms.

Chapter 3

MATERIALS AND METHODS

This chapter provides an overview of the methodologies used in the research and describes methodological features of the research common to all field studies, with a focus on the PA methods used.

3.1 Research Design: General Principles

3.1.1 Within-study repetition of standardised methods

The general research design for assessing the reliability and validity of PA methods was to develop standardised PA methods, to use these methods repeatedly in the field, and then compare the data with data derived from conventional methods. Therefore, at the onset the research was not restricted to specific disease problems but was responsive to needs expressed by communities. It was anticipated that this approach would enable the research to be conducted in a participatory manner compared with conventional research, because disease problems considered to be important by local people would be studied. Also, it was assumed that local identification of problems would increase the likelihood that livestock keepers would be willing to spend time discussing the disease or diseases in question. Regarding the assessment of reliability and validity, it was assumed that a reliable method was more likely to produce valid results than an unreliable method (Scholl *et al.*, 1994; Thrusfield, 1995). It was also realised that good reliability *per se* did not guarantee good validity (Thrusfield, 1995).

3.1.2 Repetition of similar methods in diverse communities and locations

A further aim in terms of research design was the repetition of similar methods in at least three different ethnic groups who were separated geographically and linguistically. Characteristics of communities involved in the research are summarised in Table 3.1 and their geographical distribution is shown in Figure 3.1.

Table 3.1
Ethnic groups involved in the research

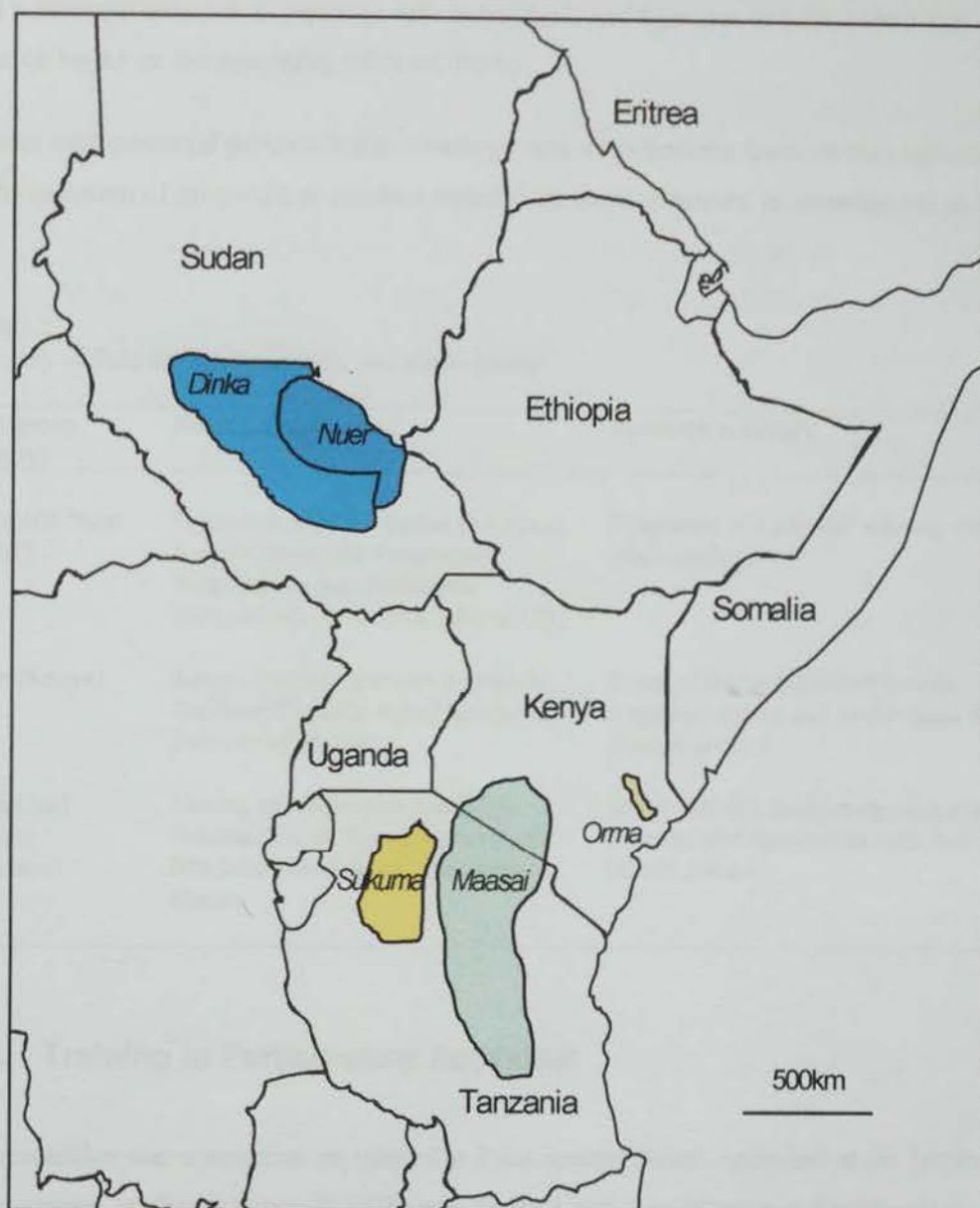
Ethnic group	Language group	Features
Dinka and Nuer	Western Nilotic	The Dinka and Nuer are closely related. They are the main cattle-keeping peoples of southern Sudan and occupy the low-lying grasslands and swamps of the Nile delta.
Orma	Eastern Cushitic	Closely related to the Oromo-speaking peoples, particularly the large Borana group of northern Kenya and southern Ethiopia, the Orma occupy territory along the Tana River in Kenya. They are a relatively small and isolated group who keep mixed herds but focus on cattle rearing.
Maasai	Plains Nilotic	Together with the Samburu, Karamojong and Turkana, the Maasai comprise the distinctive Plain Nilotes group. The main territory of the Maasai is now the Rift Valley in Kenya and Tanzania, although some groups are found in southeast Kenya, and east and central Tanzania. Cattle are viewed as the most important livestock species reared by the Maasai.
Sukuma	Bantu	A large Bantu group occupying Mwanza and Shinyanga Regions of Tanzania. They are primarily agriculturalists who also keep cattle.

3.2 Selection of Research Partners and Topics

The selection of research partners and topics was based on the following criteria:

1. Evidence that pastoralist or agropastoralist livestock keepers had requested assistance to solve a particular livestock disease problem, including previously undiagnosed diseases. Such requests might be articulated through government or nongovernmental agencies.
2. The presence of a well-established and functional animal health service at field level, with good links to communities.
3. Capacity for research partners to share research costs.
4. Geographical separation and ethnic diversity of communities, with a view to selecting at least three different study locations.

Figure 3.1
Approximate geographical distribution of ethnic groups



With these criteria in mind, the researcher approached government veterinary services, research institutes, veterinary schools and non-governmental organizations in the Horn of Africa region. Contact with potential partners was facilitated by a general collaboration with the Participatory Community-based Animal Health and Vaccination Project (PARC-VAC) of the Organization of African Unity/Interafrican Bureau of Animal Resources (OAU/IBAR). The PARC-VAC project specialised in community-based animal healthcare systems in pastoralist areas of the Horn of Africa, and, during the preceding five years, had

established various links with governmental agencies and NGOs. The researcher had also been working in the region for approximately five years before the start of the research, and used a personal network of contacts with individuals and agencies to solicit ideas for research based on the principles outlined above.

Contact with potential partners led to meetings with veterinarians from various agencies and the formulation of proposals to conduct research in three countries, as summarised in Table 3.2.

Table 3.2
Summary of field studies by country and ethnic group

Ethic group (country)	Research partners	Research summary
Dinka and Nuer (Sudan)	Operation Lifeline Sudan (Southern Sector) Livestock Programme; Veterinaries sans frontieres-Switzerland; Save the Children UK.	Diagnosis of a chronic wasting disease in adult cattle.
Orma (Kenya)	Kenya Trypanosomiasis Research Institute; Catholic Relief Services; Diocese of Malindi	Local characterisation of bovine trypanosomiasis and preferences for disease control.
Maasai and Sukuma (Tanzania)	Faculty of Veterinary Medicine, Sokoine University of Agriculture; Mwanza Veterinary Investigation Centre	Diagnosis of a heat intolerance syndrome in cattle and association with foot and mouth disease

3.3 Training in Participatory Appraisal

The researcher was a veterinarian trained in Participatory Rural Appraisal at the Institute of Development Studies, University of Sussex in 1991 and also training in Participative Training Techniques at the Agricultural Training Board, National Agriculture Centre, Stoneleigh, United Kingdom in 1991. The researcher had regularly practiced PRA in pastoralist areas of Africa during a seven-year period preceding the research and had trained veterinary workers in PRA. The researcher had also received specialist postgraduate training in animal disease diagnosis in the tropics, and had regularly practiced post mortem examinations and laboratory diagnosis of disease prior to the research.

In each field study location, training and planning sessions were conducted with teams of local research assistants and translators. The researcher designed and facilitated these

sessions, which included development and pre-testing of PA methods in the field to suit particular research needs.

3.4 Participatory Appraisal Methods

3.4.1 Selection of PA methods for standardisation

Participatory appraisal methods were categorized as interviewing methods, scoring and ranking methods, and visualization methods. Considering the need to assess the reliability and validity of methods, the research focused on those methods that produced numerical data at an early stage in the method. Therefore, scoring methods such as matrix scoring and proportional piling were prioritized with regards to methodological standardization and

Table 3.3
Repetition of standardised PA methods and assessment of reliability and validity

PA method	Repetitions		Assessment of reliability (Number of ethnic groups /countries)	Assessment of validity (Number of ethnic groups /countries)
	Within study	Ethnic groups (Countries)		
Matrix scoring of disease signs	7 to 12	5(3)	Kendal coefficient of concordance ^a <i>W</i> (5/3)	Comparison with: 1. Post mortem examinations (2/1) 2. Professional opinion using multidimensional scaling and hierarchical cluster analysis (3/3) 3. Veterinary literature (5/3)
Matrix scoring of disease causes	7 to 12	3(2)	Kendal coefficient of concordance <i>W</i> (3/2)	Comparison with: 1. Post mortem examinations (2/1) 2. Vector identification (3/2) 3. Prevalence estimates (2/1) 4. Veterinary literature (3/2)
Seasonal calendars	4 to 10	2 (2)	Kendal coefficient of concordance <i>W</i> (2/2)	Comparison with: 1. Measures of rainfall (1/1) 2. Veterinary literature (2/2)
Proportional piling	50 to 73	3 (2)	-	Comparison with: 1. Prevalence estimates (3/2) 2. Veterinary literature (3/2) 3. Measures of association (2/1)

^a As explained in section 3.6.1.2.

repetition (Table 3.3). Similarly, visualization methods such as seasonal calendars were adapted and standardized into methods that were both visual and numerical to enable assessment of reliability.

Matrix scoring involved the creation of a matrix with diseases positioned along the *x*-axis of the matrix and disease signs, disease vectors or other indicators placed along the *y*-axis. Relationships between diseases and indicators were quantified using piles of counters such as stones. Detailed explanations of the matrix scoring methods used during the research are provided in relevant chapters of the thesis.

Proportional piling was used to estimate the incidence and mortality of diseases. The method required informants to divide a pile of 100 stones to show the relative incidence or mortality of diseases. Detailed explanations of the proportional piling methods used during the research are provided in relevant chapters of the thesis.

3.4.2 Sequencing of PA methods

In all field studies, matrix scoring was used at an early stage in the research process to understand local characterisation of diseases and determine linkages between local and modern disease terminology. This approach was intended to enable the researcher to judge local ability to diagnose the disease under investigation. It was assumed that unless informants had a reasonably specific perception of, and name (or names) for, a particular disease problem, the value of applying other PA methods to understand other aspects of the disease would be limited.

3.4.3 Progressive development of PA methods during the research

As the research progressed, PA methods were further adapted to test the limits of the methods with regards the capacity of informants to understand the method and provide the information required. For example, in Kenya a proportional piling method was used to estimate the incidence of five cattle diseases by cattle age group (Chapter 7). In the following study in Tanzania, this method was expanded to include estimates of mortality (Chapter 8). Similarly, in southern Sudan and Kenya matrix scoring was used to understand local perceptions of disease signs (Chapters 5 and 7), whereas in Tanzania the method was

further developed to consider acute and chronic signs of disease, and association between acute and chronic clinical observations (Chapter 8).

3.5 Procedures for Avoiding Bias

Training courses in PA include sessions on communication skills that are intended to reduce bias during interaction with an informant or group of informants. Trainees receive instruction on topics such as appropriate behaviour during interviews, use of open and probing questions, and listening and prompting skills. Techniques for managing groups are also important, including methods for encouraging contributions from all group members and ways to handle dominant talkers.

In addition to the use of these communication skills, the research sought to reduce bias associated with expectations within communities and exaggerated responses to questions about livestock diseases.

3.5.1 Expectations of free treatments for livestock

In rural communities in developing countries, visits by unknown outsiders can raise expectations of assistance from government or aid agencies. In the researcher's experience in pastoralist areas, communities often expect free treatment of animals from visiting veterinarians or researchers. To overcome this, the research was based on disease problems that were identified by communities themselves (section 3.2.1) and in areas with functioning animal health services. In these areas, people were already accustomed to paying for veterinary services. In each research location, general introductory meetings were conducted with community representatives, livestock keepers, local administrators, NGO staff and local livestock workers to explain that animals would not be treated as part of the research. However, as CAHWs or other veterinary workers often assisted the researcher they were available to treat sick animals according to the usual charging system in operation in a particular area.

3.5.2 Exaggerated responses to a particular disease problem

When discussing livestock health issues in pastoralist communities it is common, in the researcher's experience, for some people to exaggerate a particular disease problem. This is

related to expectations of free treatments or vaccination and occurs most frequently when the visitors are associated with a specific disease. To reduce exaggeration, in the introductory meetings the researcher's interest was explained as a general interest in livestock diseases rather than a specific interest in a single disease. This apparent interest was incorporated into PA methods such as matrix scoring, seasonal calendars and proportional piling by requesting informants to consider and compare five different, locally important diseases and sometimes, a category called 'other diseases'. As each study progressed, the researcher would gradually focus questions on the specific disease under investigation but only after a comparative approach had indicated the relative importance of the disease. In some studies, importance was judged according to incidence and mortality estimates.

3.6 Selection of Statistical Tests

The literature review in Chapter 2 indicated very limited statistical analysis of data produced by PA methods by veterinarians or workers in other fields, and therefore limited published information was available to inform the selection of statistical tests.

3.6.1 Statistical procedures for data produced by standardised matrix scoring and seasonal calendars

3.6.1.1 Summarising the data

Standardised matrix scoring and seasonal calendars (section 3.4.1) involved allocation of 20 discrete counters to indicators. For these methods it was assumed that data was ordinal and therefore nonparametric statistical tests were used. These tests included summarising data using the median and range (SPPS 1999, 2001) and 95% confidence interval (95% CI) for the median (Gardner *et al.*, 1992).

3.6.1.2 Reliability

Reproducibility of the matrix scoring and seasonal calendar methods was assessed using the Kendal coefficient of concordance (W) (Siegal and Castellan, 1988). According to the description of this statistic provided by Siegal and Castellan (1988), evidence of agreement between informant groups was categorized by the researcher as 'weak', 'moderate' and

'strong' according to p-values assigned to W by SPSS software. Therefore, agreement was termed weak for $p > 0.05$, moderate for $p < 0.05$, and strong for $p < 0.01$. Reproducibility was assumed to be a measure of the reliability of the methods (Thrusfield, 1995).

Measures of reproducibility were applied to variables such as signs and causes of disease, and seasonal variations in disease incidence and contact with disease vectors. It was assumed that knowledge of these variables would be similar between individuals within communities due to the everyday discussions about disease and related events that take place within pastoralist groups (see Chapter 2). It was also assumed that the clinical expression of disease, as observed by livestock keepers, would be similar between herds.

3.6.1.3 Comparison of data

Chapter 9 describes the comparison of matrix scoring data produced by livestock keepers and veterinarians. The statistical procedures used were multidimensional scaling (MDS) and hierarchical cluster analysis (HCA) (Table 3.3). These tests were specific for this component of the research and are described in Chapter 9.

3.6.2 Statistical procedures for data produced by proportional piling

3.6.2.1 Summarising the data

The proportional piling method involved division of 100 counters to show the relative incidence or mortality of different diseases in a herd (Chapters 6 and 8). The frequency distribution of the data for each variable was defined using plots of cumulative expected proportion versus cumulative observed proportion, and comparison with a Normal distribution plot (SPSS, 1999; 2001). If cases were plotted around the Normal distribution plot, the data was judged to be Normally distributed. In both studies in which the method was used data produced by proportional piling was judged to be Normally distributed and therefore data was summarised using the mean and 95% CI for the mean (SPSS, 1999; 2001). Correlation between age and incidence or mortality was assessed using the Pearson correlation coefficient (SPSS, 1999).

3.6.2.2 Reliability

The reliability of a method can be assessed by reference to either the repeatability or the reproducibility of a method. Repeatability is defined as the level of agreement between sets of observations made on the same animals by the same observer. Reproducibility is defined as the level of agreement between sets of observations made on the same animals by different observers (Thrusfield, 1995). The proportional piling method recorded observations of disease incidence or mortality in different herds by the respective herd owner or carer. It was assumed that these variables would differ from herd to herd and therefore, neither repeatability nor reproducibility could be measured. This contrasts with the assessment of reproducibility of the matrix scoring and seasonal calendar methods where it was assumed that common knowledge existed regarding signs and causes of disease, and seasonal factors.

It might be argued that in pastoral herds many diseases are endemic and therefore, disease incidence and mortality would be similar between herds. However, the limited information available in the literature on diseases in pastoralist areas provides evidence of wide herd-to-herd variation in disease prevalence. In southern Sudan, the prevalence of brucellosis in 35 herds was estimated at 20.2% (s.d. = 14.3%) and the prevalence of CBPP in 31 herds was estimated at 8.1% (s.d. = 9.6%) (McDermott *et al.*, 1987). While noting the high contact rate between Dinka herds in southern Sudan and frequent exchange of cattle between herds, Zessin *et al.*, (1985) also reported only 41% of herds (n= 400) as positive for CBPP. In these situations, a reliable proportional piling method would produce varying estimates of disease incidence or mortality according to the observations made by herd owners on their own herds.

3.6.2.3 Validity

Statistical tests to assess the validity of proportional piling were used in only one study designed to investigate association between a heat intolerance syndrome and FMD. These tests are described in Chapter 8.

3.7 Sample Sizes and Sampling Methods

When using PA methods, sampling was purposive (Barnett, 1991) and based on the advice of local veterinary workers during planning meetings in the field. Their judgement was used to select sample locations that were representative of the population. Although all field studies were conducted in areas with poor or no roads, the research was not restricted to communities that were accessible by road. For example, in southern Sudan some communities were reached on foot whereas in Kenya river crossings by boat were required.

Limited information was available in the literature to guide the selection of sample sizes for PA methods or analysis of data using nonparametric tests. Resource and logistical constraints limited sample sizes for the matrix scoring and seasonal calendar methods to between seven and 12 informants groups. Reference to Siegal and Castellon (1988) indicated that nonparametric statistical tests could be applied to assessments involving between six and 25 raters or judges.

The proportional piling method was conducted with individual informants and sample size was also determined by resource and logistical factors. The method required approximately one hour with each informant plus travel time to and from the herd in question. Sample sizes varied from 50 to 73 informants for the proportional piling method.

Chapter 4

PARTICIPATORY INVESTIGATION OF A CHRONIC WASTING DISEASE IN CATTLE IN NUER AND DINKA COMMUNITIES, SOUTHERN SUDAN: DISEASE DIAGNOSIS

4.1 Introduction

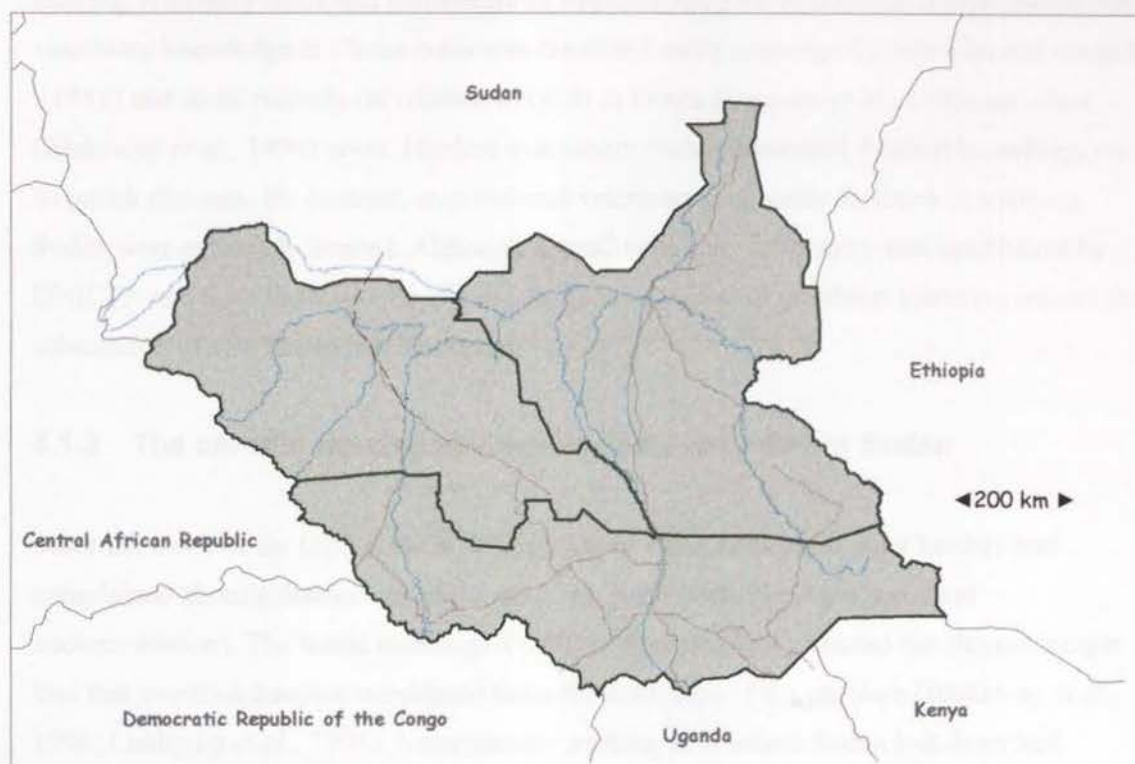
This chapter describes the first of a series of studies to assess the reliability and validity of PA methods, by comparison of results derived from participatory and conventional methods.

4.1.1 Background

Southern Sudan is an isolated area of approximately 650,000 km² that is bordered by Chad, Central Africa Republic, Congo, Uganda, Kenya and Ethiopia (Figure 4.1). The two largest ethnic groups are the Dinka and Nuer. These people are agropastoralists who rely heavily on cattle and other livestock for their social and economic well being in the low-lying areas of southern Sudan (flat grassland and woodland, and transected by substantial river systems that flow into the White Nile). Both Nuer and Dinka communities tend to follow seasonal movements between permanent settlements and dry-season grazing areas in the seasonal flood plains. The cattle population of southern Sudan is 5.8 million animals (Jones *et al.*, 1998).

Aid agencies often describe southern Sudan as 'a chronic, complex emergency situation'. The war in Sudan is the longest-running civil conflict in Africa (only 11 years of peace since independence in 1956). Although the human population of southern Sudan is ~ 6.7 million people, it is also estimated that over a million people have been killed and 2.5 million people displaced due to conflict (Amnesty International, 1997). The people of southern Sudan have experienced repeated famine and the collapse of trade and marketing systems in many areas. Most services are provided by NGOs, some of which are coordinated by the United Nations Children's Fund within the Operation Lifeline Sudan (Southern Sector) Programme (OLS) (based in Lokichokio, northern Kenya). Operational constraints in southern Sudan include insecurity, climatic extremes and a vast geographical area with very limited modern infrastructure.

Figure 4.1
Map of southern Sudan



4.1.2 The Operation Lifeline Sudan (Southern Sector) Livestock Programme

The OLS Livestock Programme aimed to improve the food security of people in southern Sudan by developing primary-level animal-health services. The programme involved a consortium of eleven NGOs and UNICEF. In 1993, OLS began to develop community-based animal-health activities in which communities identified priority animal-health problems and worked with programme staff to select people for training as community-based animal health workers (CAHWs). Although an important aspect of the programme was rinderpest vaccination using a heat-stable vaccine delivered by CAHWs, the programme also provided a basic diagnostic, preventive and curative service for problems such as blackleg, haemorrhagic septicaemia, trypanosomiasis, gastrointestinal helminthiasis and fascioliasis. The success of the community-based approach was demonstrated by a 10.6-fold increase in rinderpest-vaccination figures following the introduction of CAHWs in 1993 (Leyland, 1996). By 1998, the programme had trained 700 CAHWs and was covering approximately 80% of the agropastoral areas of southern Sudan (Jones *et al.*, 1998).

An important feature of community-based animal-health systems was the recognition of the existing veterinary skills and knowledge of livestock keepers. In southern Sudan, traditional veterinary knowledge in Dinka areas was discussed some years ago by Schwabe and Kuoajok (1981) and more recently (in relation to OLS) in Dinka (Linguist *et al.*, 1996) and Nuer (Blakeway *et al.*, 1996) areas. Herders in southern Sudan possessed detailed knowledge on livestock diseases. By contrast, conventional veterinary diagnostic facilities in southern Sudan were extremely limited. Although a small veterinary laboratory was established by UNICEF and Save the Children UK in Lokichokio, logistical problems tended to restrict the submission of samples to this laboratory.

4.1.3 The chronic wasting problem in cattle in southern Sudan

Since the onset of the OLS CAHW programme in 1993, Dinka and Nuer herders had complained about a disease called *liei* affecting adult cattle (Leyland, personal communication). The literal meaning of *liei* ('to steal slowly') reflected the chronic weight loss that livestock keepers considered to be the main sign of the problem (Blakeway *et al.*, 1996; Lindquist *et al.*, 1996). Veterinarians working in southern Sudan had described various diseases that caused chronic weight loss in adult cattle, including trypanosomiasis (Mefit-Babtie, 1983; Fison, 1993), fascioliasis (Schwabe and Kuoajok, 1981; Mefit-Babtie, 1983; Majok *et al.*, 1993; Fison, 1993) and schistosomiasis (Mefit-Babtie, 1983). Bovine schistosomiasis was studied extensively in White Nile province, adjacent to southern Sudan (Dargie, 1980; McCauley *et al.*, 1983a, 1983b). These diseases are characterised by non-specific clinical signs (Table 4.1) and require laboratory tests to confirm the diagnosis.

Reference to the literature indicated that the problem of 'thin cows' was not new to southern Sudan. More than sixty years ago the anthropologist Evans-Pritchard (1940) reported a '*mysterious wasting disease of cattle*' in Nuer areas that occurred despite the presence of good grazing and water, and was associated with biting flies such as Tabanids, Stomoxys and *tharkwac*. Karib (1962) noted the similarity of the clinical signs of fascioliasis and trypanosomiasis, and advised that '*cattle may be suffering from two diseases at the same time*'. In the Jonglei Canal area, Mefit-Babtie (1983) conducted post examinations on debilitated Dinka cattle and showed various mixed infections with *F.gigantica* (11/11 cases), schistosoma (11/11 cases), paramphistoma (11/11 cases), *H.contortus* (6/11 cases), trypanosomes (1/11 cases) and other parasites. It was suggested that '*This loss of condition is probably caused by a combination of factors*'. Ten years later, Fison (1993) examined 385 sick cattle in Bahr el Ghazal and Upper Nile and of these 166 (43%) were '*thin cows*,

variously accompanied by staring coat, hair loss from the tail, diarrhoea, general weakness'. In Eastern and Western Upper Nile, thin and thick blood smears revealed trypanosomiasis prevalence between 3.7% (n=27) and 22.2% (n=45) respectively.

Table 4.1

A textbook description of some chronic forms of diseases affecting adult cattle (adapted from Radostits *et al.*, 1994)

Signs	Diseases			
	Trypanosomiasis	Fascioliasis	Parasitic gastroenteritis	Schistosomiasis
Clinical signs	<ul style="list-style-type: none"> ▪ intermittent fever ▪ dullness ▪ poor appetite ▪ eye discharge ▪ loss of body condition ▪ emaciation ▪ enlarged lymph nodes ▪ pale mucus membranes ▪ some diarrhoea ▪ lacklustre coat 	<ul style="list-style-type: none"> ▪ weight loss ▪ reduced milk yield ▪ pale mucus membranes ▪ chronic diarrhoea ▪ wasting 	<ul style="list-style-type: none"> ▪ intermittent diarrhoea ▪ wasting ▪ pale mucus membranes 	<ul style="list-style-type: none"> ▪ most infections asymptomatic ▪ poor growth or weight loss
Post mortem signs	<ul style="list-style-type: none"> ▪ non-specific ▪ pale carcass ▪ emaciation ▪ serous atrophy of fat ▪ enlarged lymph nodes ▪ enlarged liver ▪ enlarged spleen ▪ corneal opacity 	<ul style="list-style-type: none"> ▪ flukes in liver ▪ bile duct thickening ▪ hepatic fibrosis ▪ hepatic calcification ▪ pale carcass ▪ oedematous carcass ▪ emaciation 	<ul style="list-style-type: none"> ▪ worms in gastrointestinal tract ▪ pale carcass ▪ oedematous carcass ▪ gelatinous fat 	<ul style="list-style-type: none"> ▪ worms in mesenteric blood vessels ▪ fibrosis of mesenteric blood vessels

In Ler and Nasir, Fison (1993) also conducted post mortem examinations and demonstrated *F.gigantica* in 66% (n=18) and 100% (n=5) of cases, *S.bovis* in 93% (n=14) and 80% (n=5) of cases and *H.contortus* in 50% (n=16) and 100% (n=5) of cases respectively. Local names for thin cows included *liei* (Bhar el Ghazal and Western Upper Nile) and *anoi* (Eastern Upper Nile). A typical case of *liei* was described as a combined infection of trypanosomiasis and fascioliasis.

For a community-based, primary-level programme with minimal laboratory facilities, the presence of *liei* posed an important diagnostic and therapeutic challenge. Although CAHWs in the programme were trained to use trypanocides and anthelmintics, programme staff were concerned that the use of these drugs was not informed by confirmation of the diagnosis of *liei*. Also, the possibility of mixed infections raised questions about the role of combined treatments and the capacity of livestock keepers to pay for these treatments in a programme that provided veterinary medicines on a cost-recovery basis.

With these issues in mind, meeting between the researcher and OLS veterinary staff led to the identification of the following two research objectives:

1. To characterise local perceptions of chronic wasting in cattle in southern Sudan and confirm the diagnosis of the disease from a scientific viewpoint.
2. To identify options for further action that was required to develop better control strategies for *liei* within the existing community-based animal health programme.

In addition, the researcher aimed to compare the indigenous and scientific information generated under objective 1 in order to assess the reliability and validity of PA methods used in the study.

4.1 Materials and Methods

The methods used were PA methods and conventional veterinary investigation methods. Secondary data for informing the choice and design of PA methods was obtained by a literature review of trypanosomiasis, fascioliasis, parasitic gastroenteritis and schistosomiasis in cattle in southern Sudan, as summarised in section 4.1.3 above. The PA methods used in this study were not pre-defined, but were selected and developed by the researcher according to conditions observed on arriving at field locations.

4.2.1 Research sites and timing

The research was conducted in two locations (Nyal and Thiet) in southern Sudan. Nyal was a Nuer area situated in Western Upper Nile (latitude 30°04', longitude 07°06'). Fieldwork in Nyal was conducted over a four-week period at the beginning of the main wet season (May and June, 1999). Thiet was a Dinka area situated in Bahr el Ghazal (latitude 28°09', longitude 07°06'). Fieldwork in Thiet was conducted over a four-week period during the dry season (January and February, 2000).

The most important factor when selecting Nyal and Thiet as research sites was the presence of a well-established animal health programme and the willingness and capacity of agencies to allocate resources and time to the research. Therefore, research sites were selected where field-level partners had been implementing community-based animal-health work for at least five years and had developed good relationships with communities and local administrations. During the implementation and monitoring of animal-health activities, the chronic-wasting problem was identified by livestock keepers as an important problem in both locations. To compare perceptions of the main cattle-rearing communities in southern Sudan, research was conducted in both Nuer and Dinka areas. A final consideration was that the two research sites were similar in terms of environmental and ecological conditions (as summarised in section 4.1.1).

4.2.2 Participatory methods

All participatory methods were conducted by the researcher using local translators. In Nyal, a Nuer stockperson¹ was trained by the researcher and various PA methods were practiced with individuals and groups of livestock keepers in and around the compound in Nyal where the researcher was based. In Thiet, a Dinka community liaison officer working for UNICEF was used as a translator and was trained in PA.

4.2.2.1 *Semi-structured interviews*

Semi-structured interviews (SSI) were conducted using mental checklists of open and closed questions concerning the signs and causes of livestock diseases, and the names and relevance of internal parasites, external parasites and biting flies (Appendix 4.1). The literature review informed the development of the checklists. Specimens of biting flies, gastrointestinal nematodes and trematodes preserved in 70% alcohol in clear glass bottles were used to facilitate interviews. During interviews these bottles would be handed to informants for them to view the specimens. Smaller specimens were removed from the bottles so that informants could see them clearly. Also, the presence of livestock keepers during post mortem examinations provided an opportunity to use semi-structured interviews to question people about specific lesions and the names and relevance of parasites observed in carcasses. Semi-structured interviews also were used to cross-check information provided during matrix scoring.

¹ A stockperson was a trained veterinary worker within the OLS Livestock Programme who originally was a CAHW but received additional training of up to 12 months in a recognized training institute.

4.2.2.2 **Matrix scoring**

In Nyal, a matrix scoring method was developed according to the method for livestock-disease scoring described by Catley and Mohammed (1996). By reference to the literature mentioned in section 4.1.3 and an ethnoveterinary report by Blakeway *et al.* (1996), the researcher identified three Nuer diseases that appeared to be associated with chronic wasting in cattle. These diseases were *liei*, *macueny*, and *maguar*. Also based on the ethnoveterinary report, the researcher selected two more Nuer cattle diseases called *dat* and *doop*. However, these last two diseases had already been characterised by the OLS Livestock Programme as FMD and CBPP respectively. These two diseases were included in the matrix on the assumption that they would act as control diseases that could be used to confirm whether informants understood the matrix scoring procedure. Therefore, a total of five Nuer diseases were used in the matrix.

To identify locally perceived indicators of chronic wasting in cattle, pair-wise comparison of the five Nuer diseases was conducted according to the method described by Catley and Mohammed (1996). The comparison was conducted with a group of 12 chiefs and cattle camp leaders and produced a list of 20 indicators. These indicators were categorised by the researcher into 11 'disease signs' and nine 'disease causes/sources'. Therefore, two matrices were developed to investigate disease signs and disease causes/sources respectively.

To construct the disease signs matrix, the researcher referred to a traditional Nuer game called *yied*. This game used two parallel rows of shallow holes in the ground and involved the movement of seeds or stones between holes by the players. Local familiarity with this arrangement was adapted to form the disease signs matrix by making five columns and 11 rows of shallow holes in the earth. The five columns were labelled using common objects to represent the five diseases, and the 11 rows were labeled using simple illustrations drawn onto pieces of card to represent the disease signs. (For example, a diagram of a thin cow was used to represent the indicator 'chronic weight loss'). The arrangement of the matrix and each illustration was explained to the informants.

For each disease sign, informants were asked to score the five diseases by dividing a pile of 20 seeds. The more important a particular disease sign for that disease, the greater the quantity of seeds assigned to it. After each disease sign had been scored, the researcher prompted the informants to check their scores and confirm that as a group, they agreed. When all the disease signs had been scored, the results were recorded in a notebook and the

researcher asked additional questions to cross-check and probe the scores. The questions asked were open-ended questions designed to elicit additional information and to follow up interesting scores. In particular, open questions were used to probe local ways of distinguishing between diseases with similar (as evident from the matrix scoring) clinical signs. The physical presence of the matrix and piles of seeds on the ground facilitated this type of questioning because the researcher could point to the piles of seeds, and usually, the informants would do likewise when responding.

When the additional questioning about disease signs was completed, the card illustrations of disease signs were removed and replaced by illustrations of disease causes/sources. Some of the disease causes/signs produced by the pair-wise comparison included local names for parasites. To relate these names to western scientific names, information was cross-checked during post mortem examination of cattle. Informants were asked to name specific parasites that were identified during the post mortem; and the researcher then related local names to actual specimens. The illustrations were supported by samples of parasites that had been collected during post mortem examinations of typical cases of *liei*. The parasites were passed among the informants to check the identity and local name of the parasite. A similar scoring and questioning procedure was used as for the disease signs matrix.

In Nyal, the disease signs matrix and disease causes/scores matrix was repeated with 12 independent groups of informants (each comprising four to nine individuals). Informants were interviewed at each of the cattle camps visited by the researcher during sampling of cattle (Table 4.2). The Kendall coefficient of concordance W was used to assess agreement between informant groups. Calculations were performed manually in the field using the formula provided by Siegel and Castellan (1988) and results were cross-checked using SPSS version 9.0 software (SPSS, 1999). 95% confidence limits for the median scores were calculated using Confidence Interval Analysis software (Gardner *et al.*, 1992).

In Thiet, matrix scoring methods for disease signs and disease causes/sources were developed in a similar manner to those described above. The literature review indicated that three Dinka cattle diseases called *liei*, *jong acom* and *jul* were related to chronic wasting. The researcher identified two other Dinka cattle diseases called *about pou* and *cual* that were reported to be CBPP and brucellosis, respectively. These two diseases were used as controls in the matrices. Pair-wise comparison of the five Dinka diseases produced 20 indicators that were grouped into 12 disease signs and eight disease causes/sources. These indicators were scored against the five diseases using 20 seeds per indicator. The matrix scoring was

conducted with seven independent groups of informants in cattle camps (table 4.2) visited during sampling of cattle, and informant group sizes varied from four to 11 individuals.

Table 4.2

Location and number of informant groups completing the matrix scoring in Nyal and Thiet

Area	Exact location of informant group	Number of informant groups
Nyal	Nyal village	3
	Kan Gat's cattle camp	1
	Lwali cattle camp	1
	Garang fishing camp	1
	Geaf tach	2
	Nyamet cattle camp	3
	Pasil cattle camp	1
	Total	12
Thiet	Cuie-cek cattle camp	3
	Diang cattle camp	2
	Madhol cattle camp	2
	Total	7

4.2.3 Conventional veterinary investigation methods

4.2.3.1 *Post mortem examinations*

Thirteen cases of chronic wasting in adult cattle were selected for post mortem examination (10 in Nyal and three in Thiet). The cases were selected by the researcher according to the case history, the name of the disease provided by the cattle owner, and a clinical examination of the animal by the researcher. Eight animals were rejected for post mortem because the history or clinical appearance was judged not to be typical of chronic wasting.

The researcher conducted all the post mortem examinations. Tissue samples were preserved in 10% formol saline for histopathology. Thin smears and buffy-coat smears were prepared from blood samples taken immediately before slaughter and the smears were stained with Giemsa (Anon, 1988). Lymph node smears from the prescapular lymph node were prepared soon after slaughter and stained with Giemsa.

Serum was harvested and frozen. Trypanosome antibody was detected using the enzyme-linked immunosorbent-assay (ELISA) method described by Luckins and Mehlitz (1978). The ELISA was performed by the Kenya Trypanosomiasis Research Institute (KETRI), near

Nairobi, Kenya. Parasites collected during the post-mortem examination were preserved in 70% alcohol. Fresh faeces was collected and placed in cold storage. These samples were transported to Lokichokio, northern Kenya, where worm egg counts were performed using a standard salt-flotation method, and fluke eggs were detected using a sedimentation method (Hammond *et al.*, 1991).

4.2.3.2 *Sampling to estimate the prevalence of trypanosomes, Fasciola and parasitic gastrointestinal nematodes*

Blood and faecal samples were collected from cattle to estimate the prevalence of infection with trypanosomes, *Fasciola* and parasitic gastrointestinal nematodes. In both Nyal and Thiet, a purposive sampling method was used (Barnett, 1991). During discussions with local veterinary workers, cattle herds and cattle camps were identified that were considered to represent the agropastoral management practices of the area. Due to the limited development in southern Sudan and civil war, livestock rearing systems other than traditional systems were absent. Cattle herds comprised cattle that were located in and around permanent homesteads (as is usual during the wet season in southern Sudan). Cattle camps were organised congregations of cattle herds that occupied dry season grazing areas.

In Nyal, 511 cattle were sampled. These cattle comprised 132 cattle in 9 herds in and around Nyal village, and 379 cattle in 13 herds in cattle camps within four hours walk of Nyal village (Table 4.3). The research team travelled to each cattle camp on foot and all supplies, equipment and samples were carried by the research team assisted by porters. In Thiet, the sampling team travelled by vehicle and 633 cattle were sampled in 30 herds in four cattle camps (Table 4.3). These cattle camps were located within 30km of Thiet village.

In Nyal, blood samples were collected in plain Vacutainers[®] by CAHWs. Thin smears were prepared immediately following sampling, stained with Giemsa and examined for the presence of trypanosomes. Serum was harvested and frozen. Trypanosome antibody tests were conducted by KETRI using ELISA, as for samples collected from post mortem cases. In Thiet, blood samples were collected and handled using similar methods to those used in Nyal. However, the microhaematocrit centrifugation technique (MHCT) was used to detect trypanosomes (Anon, 1988). Wet buffy coats were examined using dark-field microscopy. Thin smears were prepared from positive buffy coat cases and stained with Giemsa for trypanosome speciation.

In both Nyal and Thiet, faecal samples were collected by CAHWs and tests were conducted in Lokichokio as described for the faecal samples collected during post-mortem examination.

Table 4.3
Numbers and locations of cattle sampled for estimation of parasite prevalence

Location	Number of herds sampled	Mean number of cattle sampled	Range of cattle sampled	Total number cattle sampled
<u>Nyal</u>				
Nyal village	9	14.7	6-45	132
Kan Gat's cattle camp	3	14.0	12-18	42
Lwali cattle camp	6	21.7	9-37	130
Pasil cattle camp	4	51.8	39-66	207
Total	22	23.2	6-66	511
<u>Thiet</u>				
Cuie-cek cattle camp	26	4.3	1-10	111
Diang cattle camp	31	4.8	2-16	150
Madhol cattle camp	20	8.7	2-28	174
Maker cattle camp	33	6.0	1-16	198
Total	110	5.8	1-28	633






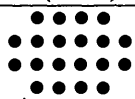

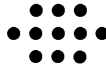


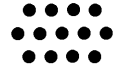


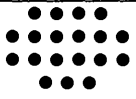
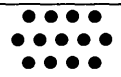

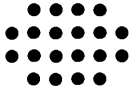





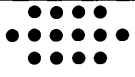


4.3 Results

4.3.1 Signs of disease

Despite the apparent complexity of the disease signs matrices and the use of five columns for diseases and 11 rows for disease-signs, the 12 groups of livestock keepers in Nyal were able to complete the matrices without difficulty. Typically, each matrix was completed in 45 minutes to one hour.

Analysis of the disease signs matrix scores demonstrated evidence of strong agreement between the 12 informant groups for nine out of 11 disease-signs (Figure 4.2). The two disease signs for which there was disagreement among informants were 'disease causes death' ($W=0.14$) and 'disease causes shivering' ($W=0.18$) (because of these disagreements, these disease signs are not included in Figure 4.2). 'Tearing' was used to describe serous eye discharge from one or both eyes that resulted in tear stains on an animal's face.

Figure 4.2
Matrix scoring of disease signs for diseases of adult cattle in Nyal†

Signs	Diseases				
	<i>Liei</i>	<i>Dat</i> (FMD)	<i>Maguar</i>	<i>Doop</i> (CBPP)	<i>Macueny</i>
Chronic weight loss ($W=0.51^{***}$)	 10 (6.0-16)	 1 (0-2.5)	 3 (0-3.0)	 1 (0-2.5)	 1 (0-2.0)
Animal seeks shade ($W=0.88^{***}$)	0 (0)	 20 (17-20)	0 (0)	0 (0-3.0)	0 (0)
Diarrhoea ($W=0.52^{***}$)	 4 (0-8.5)	0 (0)	 11 (6.0-16)	0(0)	 4 (0-7.5)
Reduced milk yield ($W=0.51^{***}$)	 2 (0-4.0)	 13 (7.0-20)	 3 (0-9.0)	 1 (0-2.5)	0 (0-1.0)
Coughing ($W=0.76^{***}$)	0 (0-0.5)	0 (0-0.5)	0 (0-2.0)	 19 (16.5-20)	0 (0-0.5)
Reduced appetite ($W=0.54^{***}$)	0 (0)	 13 (7.0-20)	0 (0)	 5 (0-10)	0 (0)
Loss of tail hair ($W=0.89^{***}$)	 20 (16.5-20)	0 (0)	0 (0-3.5)	0 (0)	0 (0)
Tearing ($W=0.28^*$)	 6 (3.0-13)	 2 (0-6.5)	 4 (0-8.5)	0 (0-1.5)	 3 (0-8.0)
Salivation ($W=0.50^{***}$)	 2 (0-3.0)	 14 (7.0-20)	 3 (0-6.5)	 1 (0-2.0)	0 (0-0.5)

† Number of informant groups = 12; W = Kendall coefficient of concordance ($*p<0.05$; $**p<0.01$; $***p<0.001$). Medians are presented in each cell and the 95% CI for the medians are shown in parentheses.

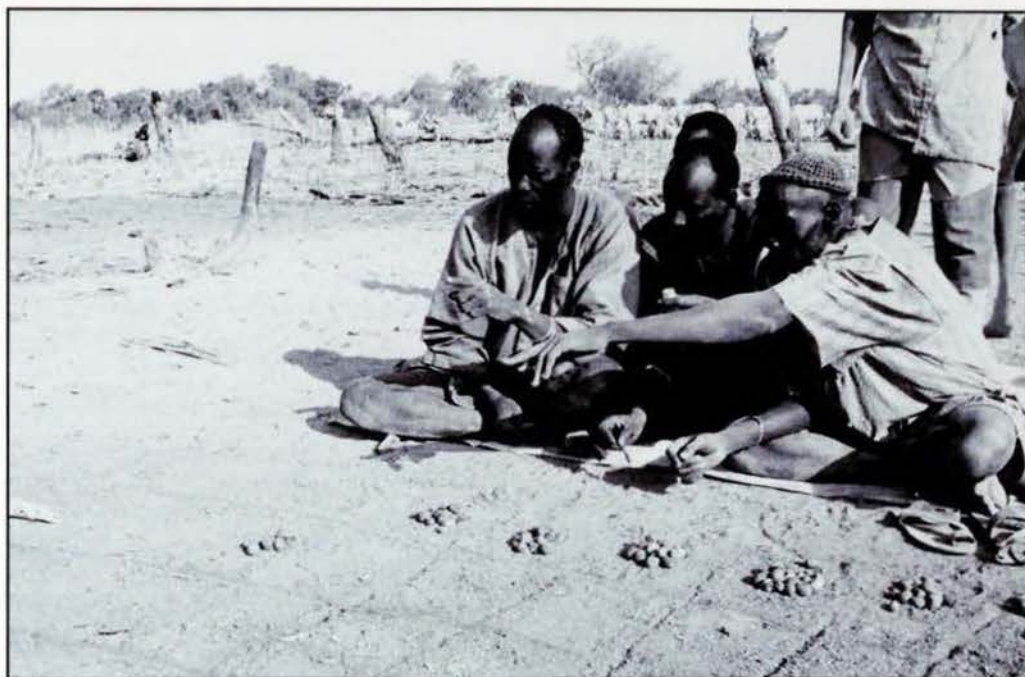


Plate 4.1
Dinka informants discussing the placing of stones during matrix scoring of disease signs near Thiet



Plate 4.2
Dinka herders examining samples of flies near Thiet



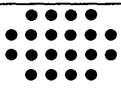


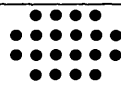


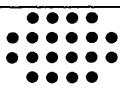

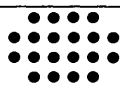
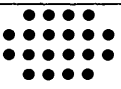
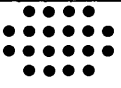


On completion of the scoring, informants provided further information on the signs of *dat* (FMD) and frequently mentioned lameness and mouth lesions. For *doop* (CBPP), a high score was assigned to 'coughing'.

The disease *liei* was associated with chronic weight loss, loss of tail hair. The other disease most clearly linked to chronic weight loss was *maguar* (also associated with diarrhoea). During SSI following the scoring of indicators, informants explained that *maguar* had a shorter duration than *liei* and that some cattle that did not recover from *maguar* developed *liei*. *Macueny* did not receive high scores for any disease sign relative to the other diseases. Specific comments about *macueny* were 'This disease is only known when a big, hard and white liver is seen in a dead cow' and '*macueny* is in the same family of diseases as *liei*'.

In Thiet, there was evidence of strong agreement between informant groups for 9 of 12 disease signs, and moderate agreement for two of 12 disease signs (Figure 4.3). Informant groups disagreed over the scoring of the disease-sign 'animal seeks sun' ($W=0.12$). In common with the matrix scoring in Nyal, CBPP received high scores for coughing, reduced appetite and shade-seeking behaviour. *Cual* (brucellosis) was strongly associated with abortion and swollen joints.

Liei and *jong acom* were both associated with chronic weight loss and diarrhoea by informants in Thiet, whereas only *liei* was associated with loss of tail hair. The scoring patterns for *liei* among Nuer informants in Nyal (Figure 4.2) and Dinka informants in Thiet were similar for the disease signs chronic weight loss, tearing, diarrhoea and loss of tail hair. The disease called *jul* was included in the matrix scoring because during initial interviews in Thiet, it was commonly cited as one cause of 'thin cows'. Discussions about *jul* after the completion of the matrices indicated that the disease always followed the illness called *dat* (FMD). It affected adult cattle and these animals never returned to normal health after the signs of *dat* had subsided. Also, the course of *jul* was prolonged and cattle developed a thick, woolly coat (Plate 4.3). Affected cows became less fertile and produced less milk than normal cows. A further sign of *jul* was 'difficult breathing', particularly, when the animal was grazing.

Figure 4.3
Matrix scoring of disease signs for diseases of adult cattle in Thiet†

Signs	Diseases				
	<i>Liei</i>	<i>Abuot pou</i> (CBPP)	<i>Jul</i>	<i>Jong achom</i>	<i>Cual</i> (Brucellosis)
Chronic weight loss ($W=0.67^{**}$)	 12 (4.0-20)	0(0)	0 (0)	 8 (0-16.0)	0 (0)
Seeks shade ($W=0.88^{***}$)	0 (0-1.0)	0 (0-3.0)	 20 (15-20)	0 (0)	0 (0)
Diarrhoea ($W=0.67^{**}$)	 5 (0-14)	0 (0)	0 (0)	 15 (6.0-20)	0 (0)
Coughing ($W=0.94^{***}$)	0 (0)	 20 (16.5-20)	0 (0)	0 (0-3.5)	0 (0-0.5)
Reduced appetite ($W=0.38^*$)	 3 (0-12.0)	 13 (3.0-20)	0 (0-2.0)	0 (0-4.0)	0 (0-2.0)
Loss of tail hair ($W=1.00^{***}$)	 20 (20-20)	0 (0)	0 (0)	0 (0)	0 (0)
Tearing ($W=0.35^*$)	 8 (0-20.0)	0 (0)	0 (0)	0 (0-5.0)	0 (0)
Swollen joints ($W=1.00^{***}$)	0 (0)	0 (0)	0 (0)	0 (0)	 20 (20-20)
Reduced milk ($W=0.73^{***}$)	0 (0-8.0)	0 (0-1.5)	 20 (12-20)	0 (0-3.0)	0 (0-0.5)
Rough coat ($W=0.90^{***}$)	0 (0-1.5)	0 (0-2.0)	 20 (16-20)	0 (0)	0 (0)
Abortion ($W=0.42^{**}$)	 3 (0-10)	0 (0-3.0)	0 (0-10.)	0 (0-3.0)	 12 (3.5-20)

† Number of informant groups = 7; W = Kendall coefficient of concordance (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Medians are presented in each cell and the 95% CI for the medians are shown in parentheses.



Plate 4.3

A case of *jul* in Cuie-cek cattle camp, near Thiet. The coat has a thick, woolly appearance

4.3.2 Causes of disease

Nuer and Dinka names for internal parasites, biting flies, ticks and snails are listed in Table 4.4. The researcher judged these names to be provided by informants without hesitation when they were shown samples of preserved specimens, or observed actual specimens on live cattle or in carcasses.

Table 4.4
Dinka and Nuer names for parasites and vectors associated with chronic wasting in cattle

Dinka name, Thiet	Nuer name, Nyal	Notes on identification and interpretation
No name	<i>Chuie</i>	In Nyal, paramphistomes in the rumen and abomasum, and liver flukes (<i>Fasciola gigantica</i>) all were called <i>chuie</i> . Some Nuer informants also called liver flukes <i>daichom</i> (see below).
<i>Guak achom</i>	<i>Daichom</i>	<i>Daichom</i> was another Nuer name for liver flukes (<i>F. gigantica</i>). The name meant 'calf of the snail' and this name was used because the parasites were thought to originate from snails. Similarly, the Dinka name <i>guak achom</i> was specific for liver flukes and reflected local perceptions that liver flukes were young forms of snails.
<i>Chom</i>	<i>Chom</i>	<i>Chom</i> was the Dinka and Nuer name for snails. The snails that were associated with sick cattle were described as small, green-brown snails. Species of snails were not collected during the research. When fluke-infected livers were observed post mortem, the hard, dark greenish bile concretions in the liver were called <i>chom</i> by some informants.
<i>Ngany</i>	<i>Loak</i>	Both names were used to describe nematodes such as <i>Haemochus</i> and <i>Trichuris</i> species, and schistosomes.
<i>Atek</i>	<i>Tharkuach</i>	These were flat-bodied biting flies with a distinctive, patterned thorax and stocky legs. These flies rested on the flanks, belly and limbs of livestock and were identified as Hippoboscid species.
<i>Luang</i>	No name	<i>Luang</i> was a general Dinka name for 'flies' that was derived from the concept of 'passing on something bad'.
<i>Rum</i>	<i>Rom</i>	These were large biting flies that were reported to occur in great numbers cause severe distress to cattle and people. These flies were identified as Tabanid species.
<i>Achak</i>	<i>Chak</i>	These were the names used for all types of ticks.

Although some specimens were identified easily by informants, other parasites and flies caused much discussion and various names were suggested. Among the flies, preserved specimens of tsetse flies were never identified using a name that was specific for that type of fly alone. In Nyal, tsetse flies were called *rom*, *mau* or *wath*. Informants did sometimes state that these flies were biting flies and in some cases, tsetse were thought to be young *rom* (Tabanids). Overall however, there were mixed views regarding the local name for tsetse and the importance of this fly in Nyal.

In Thiet, informants also expressed mixed opinions on the name and importance of tsetse flies. Most commonly, these flies were called *mau* and were thought to spread disease. One informant provided more detailed information on *mau* as follows:

'The bite of mau makes the animal become very thin. Mau feeds mainly on buffalo and giraffe so it is not found around here. In bad years some people migrate as far as the Zande tribe areas, about 10 days walk away. These areas are forested and hilly, and have more wild animals. It is here that cattle become bitten by mau, when cattle come close to buffalo in the swamps in those places. These people bring cattle suffering from mau to this area.'

In both Nuer and Dinka locations, the importance of flies as causes of ill health in cattle was reflected in the daily practice of using smoke fires in the cattle camps and houses to repel flies. Ash also was rubbed into the coat of cattle to deter flies.

During post mortem examination of cattle in Nyal and Thiet, informants never identified schistosomes in mesenteric blood vessels. When shown these parasites, people either did not name them or called them *loak* or *ngany* (non-specific names for nematodes). All types of ticks were called *chak* or *achak* and these parasites were thought to 'go to sick cows' rather than being causes of disease in their own right.

In Nyal, there was evidence of strong agreement between informant groups for 7/9 disease causes and moderate agreement for 1/9 disease causes (Figure 4.4).

Figure 4.4
Matrix scoring of causes or sources of cattle diseases in Nyal†

Causes or sources	Diseases				
	<i>Liei</i>	<i>Dat</i> (FMD)	<i>Maguar</i>	<i>Doop</i> (CBPP)	<i>Macueny</i>
Liver fluke <i>Daichom</i> ($W=0.68^{***}$)	•• 2 (0-4.5)		••• 3 (0-7)	0 (0)	••••• ••••• ••••• 15 (10.0-20.)
Sick cow entering herd ($W=0.74^{***}$)	0 (0-1)	••••• 8 (5.0-10.0)	• 1 (0-3)	••••• 9 (5.0-12.0)	0 (0-0.5)
Paramphistome <i>Chuie</i> ($W=0.33^*$)	•••• 5 (0-12)	0 (0)	•••• 5 (0-12.5)	0 (0)	•••• 5 (0-13.5)
Stomach worms <i>Luok</i> ($W=0.45^{**}$)	••• 3 (0-5.5)	0 (0)	••••• 8 (3.5-14.0)	0 (0)	•••• 5 (5.0-10.0)
Flooding ($W=0.49^{***}$)	••••• 8 (2.5-13.0)	0 (0)	•••• 6 (2.5-12.5)	0 (0)	•••• 4 (3.75-10.0)
Biting flies <i>Rom</i> ($W=0.82^{***}$)	•••••• •••••• •••••• •••••• 19 (15.5-20)	0 (0)	0 (0-6)	0 (0)	0 (0-1.5)
Ticks <i>Chak</i> ($W=1.00^{***}$)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Snails <i>Chom</i> ($W=0.60^{***}$)	•• 2 (0-4.5)	0 (0)	•••• 5 (2.5-9.0)	0 (0)	••••• ••••• ••••• 10 (5.0-15.0)

† Number of informant groups = 12; W = Kendall's Coefficient of Concordance (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Actual samples of flies, ticks, liver flukes, paramphistomes, worms and snails were used. Medians are presented in each cell and the 95% CI for the medians are shown in parentheses.



Plate 4.4

A disease causes matrix in Lwali, near Nyal. The diseases are represented by the five objects visible at the bottom of the picture, and causes of disease are represented by the diagrams along the left side of the picture. Piles of stones have been placed in shallow holes to show the association between diseases and causes of disease.

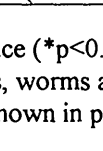


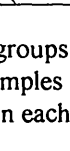

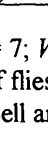
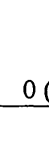
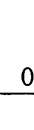
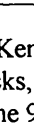
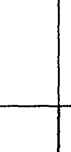

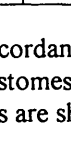
The indicator 'caused by grazing wet grass' received varied scores and the level of agreement between informant groups was low ($W=0.02$). The two control diseases in the matrix, *dall*/foot and mouth disease and *doop*/CBPP, received high scores for 'sick cow entering the herd' as a cause or source of disease. These two diseases were not associated with other causes or sources of disease.

Liei was associated strongly with biting flies (specifically, the flies called *rom*; Tabanids). *Liei* was related to flooding, liver flukes, paramphistomes, abomasal worms and snails. Similar causes and sources of disease were linked to the disease *macueny* (with the exception of biting flies). In particular, *macueny* was associated with liver flukes (as seen in the liver of affected animals).

Informants consistently related the presence of liver flukes to snails (Table 4.4), and in the matrix scorings, snails were scored highly under *macueny*. *Maguar* was related to similar factors as *macueny*, but with more emphasis on stomach worms and less emphasis on liver flukes. The indicator 'flooding' referred to exceptionally heavy rainfall that resulted in large areas of grazing land being covered by water. In this event, cattle were living constantly in very wet conditions. Informants explained that flooding resulted in both stress to cattle and increased exposure to snails that lived on wet grass.

There was evidence of strong agreement for all 6/8 indicators and moderate agreement for 2/8 indicators used in the matrices in Thiet (Figure 4.5). The control diseases *abuot pou*/CBPP and *cual*/brucellosis received high scores 'sick cow entering herd' and were not associated with other causes or sources of disease. In common with the results from Nyal, *liei* was associated with Tabanids, flooding and snails. However, in Thiet *liei* was not associated with liver flukes whereas the disease *jong acom* was scored highly for liver flukes, snails, flooding and wet grass. Some informants remarked that small snails were present on wet grass and when these snails were consumed by cattle, they caused the disease *jong acom*. *Jul* received a low score for 'flooding'.

Figure 4.5
Matrix scoring of causes or sources of cattle diseases in Thiet†

Causes or sources	Diseases				
	<i>Liei</i>	<i>Abuot pou</i> (CBPP)	<i>Jul</i>	<i>Jong acom</i>	<i>Cual</i> (Brucellosis)
Liver fluke <i>Daichom</i> ($W=0.68^{**}$)	0 (0-10.0)	0(0)	0 (0)	 20 (10.0-20)	0 (0)
Sick cow entering herd ($W=0.65^{**}$)	0 (0-3.0)	 9 (6.0-11)	0 (0-6.0)	0 (0)	 7 (3.5-10)
Worms ($W=0.43^*$)	0 (0)	0 (0)	0 (0)	 10 (0-20)	0 (0)
Wet grass ($W=0.57^{**}$)	 10 (0-20)	0 (0)	0 (0)	 10 (0-20)	0 (0)
Flooding ($W=0.35^*$)	 10 (0-20)	0 (0-1.5)	 3 (0-12.0)	 4 (0-13.5)	0 (0-0.5)
Biting flies <i>Rom</i> ($W=1.00^{***}$)	 20 (20-20)	0 (0)	0 (0)	0 (0)	0 (0)
Ticks <i>Chak</i> ($W=1.00^{***}$)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Snails <i>Chom</i> ($W=0.63^{**}$)	 5 (0-14.0)	0 (0)	0 (0)	 15 (6.0-20)	0 (0)

† Number of informant groups = 7; W = Kendall coefficient of concordance ($*p<0.05$; $**p<0.01$; $***p<0.001$). Actual samples of flies, ticks, liver flukes, paramphistomes, worms and snails were used. Medians are presented in each cell and the 95% CI for the medians are shown in parentheses.

4.3.3 Herders' ability to distinguish between diseases with similar clinical signs

In Nyal (Figures 4.2 and 4.4), two forms of *liei* were recognised. One was associated with biting flies (this disease produced thin carcasses with pale, watery meat but the liver appeared to be normal) and the other form was associated with flooding and snails (characterised by thin cattle and liver flukes). The latter disease was also called *macueny*. Informants diagnosed the two forms of *liei* according to post-mortem findings rather than clinical signs of disease. In Thiet (Figure 4.3), herders distinguished between *liei* and *jong acom* using the clinical sign 'loss of tail hair'. Both diseases were linked to wet grass and flooding, but only *liei* was associated with biting flies (whereas *jong acom* was associated with liver flukes and snails). The loss of tail hair only appeared towards the end of the sickness when the animal was already in very poor condition. Also, although *jong acom* caused more diarrhoea than *liei* (and also caused abdominal pain), these differences were not thought to be obvious in all cases. In common with Nuer informants in Nyal, Dinka herders in Thiet relied heavily on post-mortem findings to diagnose cases of *liei* and *jong acom*.

4.3.4 Post mortem examinations

The median age of the 13 cattle examined post mortem was eight years (range three to 12 years). Eleven cattle were female and two were male. Information on case histories, clinical signs, packed cell volume (PCV) and parasitological findings is presented in Table 4.5. Gradual loss of body condition was reported and observed in all cases, and occurred over periods ranging from six months to three years. Regarding case histories, less commonly reported features were diarrhoea (two cases) and in cows, a history of abortion (two cases). Less frequently observed clinical signs included diarrhoea (two cases), pale mucous membranes (two cases), corneal ulceration (two cases) and laboured respiration (two cases). The mean PCVs of cattle sampled in Nyal and Thiet were 24.6% and 28.5% respectively.

In cases of tick infestation, *Amblyomma* tick species predominated followed by *Hyalomma* species. Infestations usually involved approximately 20-50 ticks. Among internal parasites that were considered by the researcher to be potentially important pathogens, *Haemonchus* (7/13 cases), schistosomes (11/13 cases), liver flukes (10/13 cases) and trypanosomes (2/13 cases) were detected. Trypanosome antibody was detected in 10/12 cases. In 9/13 cases, there was evidence of mixed infections involving two, three or four different parasites. Full clinical and gross pathology details for each case are provided Appendix 4.2.

Histopathological examination of tissues demonstrated the widespread prevalence of lesions typical of schistosomiasis, fascioliasis and parasitic gastroenteritis. *Schistosoma*- related damage was evident in 10 cases and affected the portal vessels of the liver and the walls of the small and large intestine. Myocarditis due to *Sarcocyst* infection was seen in all 13 cases. Renal lesions were common and included mild, multifocal lymphocytic aggregates, occasionally accompanied by local tubular or glomerular damage. The multifocal distribution and the interstitial and perivascular location of the lesions indicated haematogenous spread of the aetiological agent. Histopathology was unable to elucidate the role of trypanosomes in these cattle.

Table 4.5
Case histories, clinical signs and parasitological findings in cattle suffering from chronic wasting and examined post mortem

Clinical and pathological features	Case location and identity													
	Nyal										Thiet			
	1	2	3	4	5	6	7	8	9	10	1	2	3	
<u>Case history</u>														
Chronic weight loss	+	+	+	+	+	+	+	+	+	+	+	+	+	+
No response to treatment	+	+		+	+	+	+			+				+
Loss of tail hair			+								+	+		
Poor appetite									+	+		+		
<u>Clinical signs</u>														
Emaciation	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Poor coat condition		+	+	+		+	+					+	+	
Tick infestation	+			+	+			+	+	+		+	+	
Enlarged lymph nodes								+	+			+		
Loss of tail hair		+			+	+					+			
Tear staining	+			+	+	+				+				
Diarrhoea	+				+									+
<u>Parasitological findings</u>														
Flukes		+		+	+	+		+	+	+	+	+	+	+
Haemonchus		+	+	+				+	+	+				+
Schistosomes		+	+	+	+	+	+	+	+	+	+	+		
Trypanosomes ^a								+	+					
Trypanosome antibody ^b	ms	+	+	+			+	+	+	+	+	+	+	+
Packed cell volume (%)	ms	24	18	14	20	22	23	15	10	18	22	22	24	

- a Parasitological diagnosis in Nyal was based on thin smears. In Thiet, the microhaematocrit centrifugation technique was used. Both positive cases were *Trypanosoma congolense*.
b ELISA was used to detect trypanosome antibody.
ms missing sample

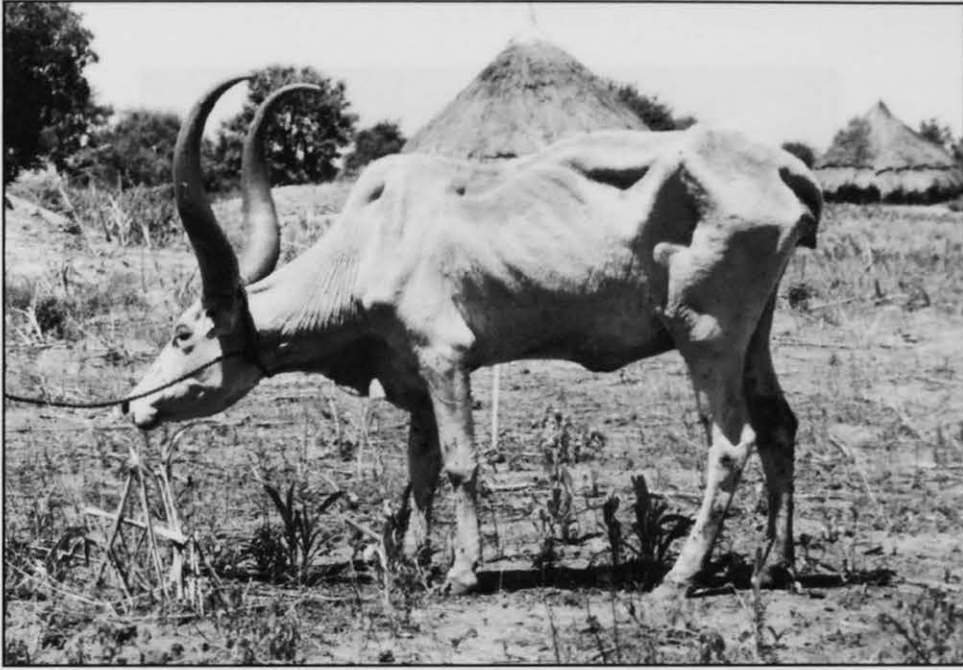


Plate 4.5

A typical case of chronic wasting in Nyal village (Table 4.5: Case 2, Nyal)



Plate 4.6

Tear staining in a case of chronic wasting in Nyal village (Table 4.5: Case 4, Nyal)

4.3.5 Prevalence

The mean ages of the cattle tested in Nyal and Thiet were 5.7 years and 7.5 years respectively. Prevalence estimates of parasites are presented in Table 4.6. Using parasitological diagnostic tests for trypanosomiasis, prevalence was 9.6% in Nyal (n=365, thin smears) and 6.0% in Thiet (n=633, MHCT). *Trypanosoma congolense* was the predominant trypanosome species, representing 74.2% (26/36) of cases in Nyal and 94.7 % (36/38) of cases in Thiet. The only other trypanosome species identified in Nyal and Thiet was *T.vivax*.

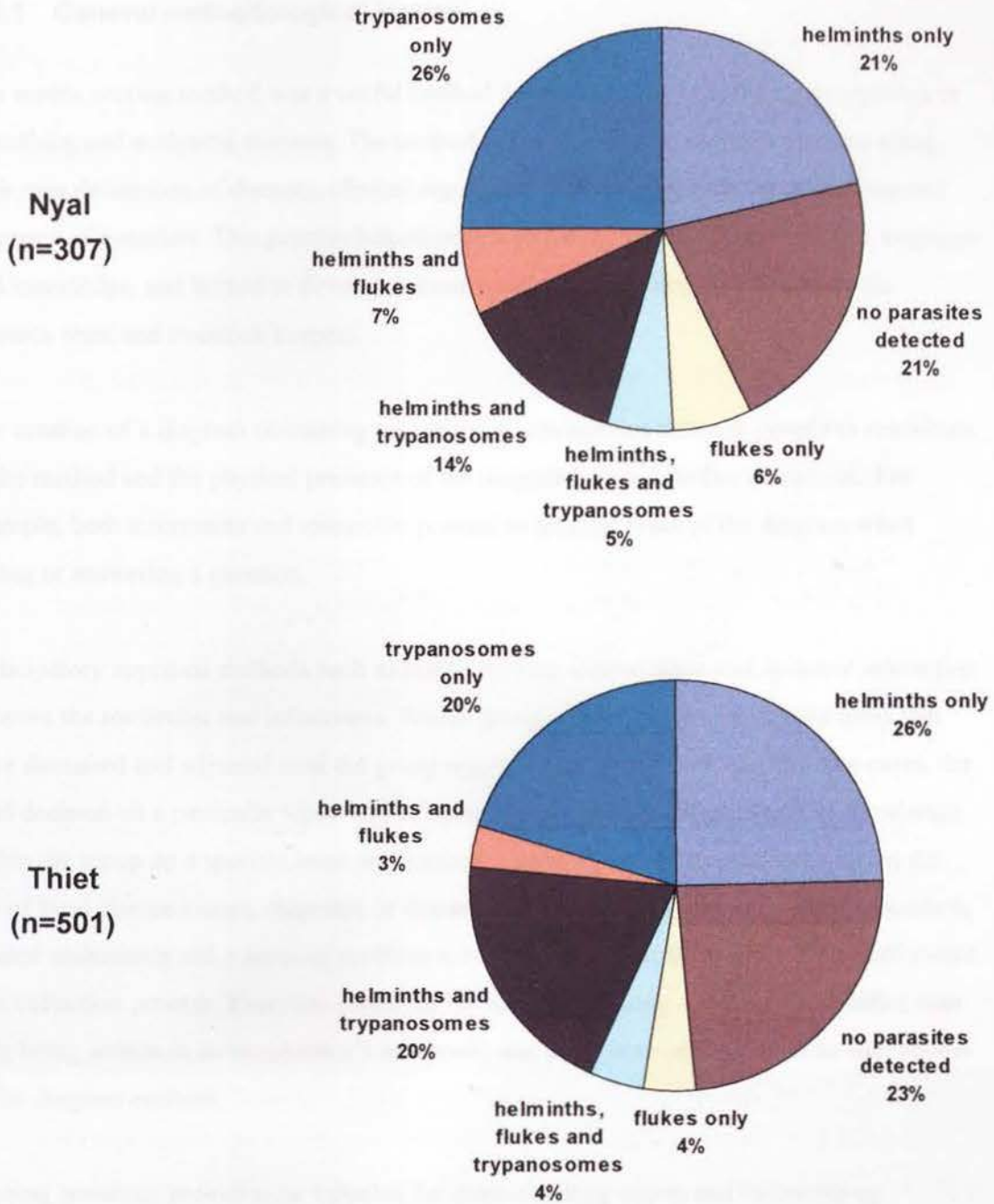
In order to estimate the prevalence of mixed parasite infections, data were compiled for all cases for which complete sets of results were available for gastrointestinal nematodes, liver flukes and antibody to trypanosomes. The proportions of cattle showing evidence of no infection, single infection and mixed infections were similar in the two study sites (Figure 4.6).

Table 4.6
Summary of prevalence estimates for gastrointestinal nematodes, liver flukes and trypanosomes

Location	Gastrointestinal nematodes	Liver flukes	Trypanosomes	
			Serological diagnosis	Parasitological diagnosis
Nyal	46.0% (n=446)	21.1% (n=437)	45.0% (n=365)	9.6% (n=365) thin smears
Thiet	50.2% (n=598)	15.3% (n=575)	45.5% (n=633)	6.0% (n=633) MHCT

MHCT=microhaematocrit centrifugation technique

Figure 4.6
Proportions of cattle showing evidence of no infection, single infection^a and mixed infections^b



- Trypanosome prevalence based on serological diagnosis; parasitological prevalence is reported in the text.
- Figure prepared using data from only those cases for which a full set of laboratory results for liver fluke, helminths and trypanosomes were available. Some samples were lost in transit or damaged, and not all tests were performed on all samples. Therefore, the number of samples tested for all parasites was less than the number of samples collected in Nyal (n=511) and Thiet (n=633).

4.4 Discussion

4.4.1 General methodological issues

The matrix scoring method was a useful method for encouraging informant participation in describing and analyzing diseases. The method enabled people to describe diseases using their own definitions of diseases, clinical signs and vectors, rather than the definitions and language of outsiders. This process helped people to feel confident about their own language and knowledge, and helped to develop mutually supportive relationships between the research team and livestock keepers.

The creation of a diagram containing no written words enabled illiterate people to contribute to the method and the physical presence of the diagram assisted further discussion. For example, both informants and researcher pointed to specific areas of the diagram when asking or answering a question.

Participatory appraisal methods such as matrix scoring created open and dynamic interaction between the researcher and informants. Within groups, different people offered ideas that were discussed and adjusted until the group reached a collective decision. In some cases, the final decision on a particular topic was acceptance that opinions differed or that knowledge within the group on a specific issue was limited. Novel aspects of the method, such as the use of local disease names, diagrams of disease signs and causes, and the scoring procedure, created enthusiasm and a sense of problem solving that differed from a more straightforward data collection process. Everyone could see the results appearing on the ground (rather than only being written in an enumerator's notebook) and there were opportunities to alter results as the diagram evolved.

Probing questions proved to be valuable for cross-checking scores and following-up interesting leads. This type of questioning is difficult to standardise and depends on the skill and previous experience of the researcher. For example, the use of open, probing questions in Nyal revealed information on two forms of *liei*. One was associated with biting flies and the other with liver flukes. This experience indicated that although methods such as matrix scoring might be standardised, the flexibility and open-ended aspects of participatory inquiry

can be retained if follow-up questioning is included as an essential part of the method.

4.4.2 Surveys and sampling methods

In both Nyal and Thiet, the choice of the purposive sampling method was influenced by a lack of baseline data on the cattle population in these areas. In Nyal, access to cattle camps was hindered by lack of roads and no vehicular transport, the need to remain in regular radio contact with base camp for security reasons and the rapid relocation of the cattle camps by herders to avoid the attention of soldiers. Consequently, in spite of arrangements to visit a particular cattle camp, it was possible that the cattle camp would move unexpectedly.

Despite this, a number of workers have conducted surveys based on non-random sampling procedures and produced useful information (e.g. McDermott *et al.*, 1987; Majok *et al.*, 1993). A participatory approach was adopted in the present study and the following experiences relate to the sampling method used.

1. The use of participatory assessment and analysis before sampling provided an opportunity for livestock keepers to describe the chronic wasting problem and discuss the notion of mixed and complex infections. As dialogue developed, the researchers were able to explain that in common with herders, veterinarians were sometimes unable to diagnose disease on clinical findings alone; therefore, further tests were needed. Using this approach and due to the local importance of *liei*, herders quickly grasped the rationale for allowing their animals to be sampled. However, it was important to organise the work so that the participatory assessment preceded the sampling.
2. The sampling teams comprised CAHWs and stockpersons workers who had been selected locally and who were members of the communities concerned. This approach probably improved the acceptance of the researchers and showed that basic-level workers could play a very useful role in sample collection.
3. Perhaps due to the initial participatory assessment and use of local animal health workers described above, the sampling was not affected by the reluctance of cattle owners to allow their animals to be sampled, as experienced by Majok *et al.*, (1993). In Dinka cattle camps around Thiet, all ages and both sexes of cattle were sampled. When herders refused to allow animals to be sampled, this was usually because the cattle owner was absent and the people looking after the cattle were unwilling to make decisions on behalf of the absentee owner.

A random sampling method could have been developed for the present study. For example,

in dialogue with local chiefs and cattle camp leaders, it might have been possible to produce maps showing the distribution and numbers of cattle in specific areas. These maps could then have been used as a sampling frame. However, in the researchers' opinion it was likely that logistical and security factors would have prevented the use of a random sampling procedure.

4.4.3 Reproducibility of matrix scoring

Agreement between informant groups was assessed using the Kendall coefficient of concordance (W). This nonparametric test measures the association between sets of ranks assigned to objects by judges (or in the present study, groups of judges) and computes a W value between 0 and 1. A high or significant W value means that the judges are ranking the objects using a similar standard. The test is particularly useful for determining inter-judge reliability (Siegel and Castellan, 1988). The agreement between informant groups for the four matrices presented in Figures 4.2 to 4.5 is summarised in Table 4.7 and indicated that the matrix scoring method was repeatable, even with small sample sizes.

Table 4.7
Assessment of inter-informant group reliability using p-values for the Kendal coefficient of concordance

Location and type of indicator	Number of indicators showing evidence of agreement		
	Weak ($p > 0.05$)	Moderate ($p < 0.05$)	Strong ($p < 0.01$)
<i>Nyal (n=12)</i>			
Disease signs	2/11	0/11	9/11
Disease causes	1/9	1/9	7/9
<i>Thiet (n=7)</i>			
Disease signs	1/12	2/12	9/12
Disease causes	0/8	2/8	6/8

In both Nyal and Thiet there was weak agreement for some indicators. For example, when scoring disease signs in Nyal, there was disagreement concerning the sign 'disease causes death'. Although this indicator was suggested by informants during pair-wise comparisons, the researcher did not clarify its precise meaning. Therefore, some informants may have interpreted 'disease causes death' as a high case fatality whereas others may have scored it based on herd mortality. Similarly, the disease sign 'shivering' was not clarified. Regarding disease causes, the very weak agreement for the indicator 'grazing wet grass' was due to

confusion over the meaning of the term. As the research in Nyal progressed, it became apparent that some informants interpreted the indicator as meaning grass submerged under water (as occurs during seasonal flooding) whereas others interpreted it as dew on grass early in the morning, or grass after rainfall. This misunderstanding was corrected by the time the matrix scoring was conducted in Thiet. These experiences show that in common with questionnaires, careful explanation and wording of questions is required.

The researcher did not seek out key informants and therefore the results reflect the views of typical livestock keepers in the study sites. The results were achieved despite the somewhat vague, non-specific clinical signs of *liei* and some of the other diseases used in the matrix scoring.

4.4.4 Validity of matrix scoring and interviews

The validity of herders' opinions was assessed according to four sets of qualitative judgements by the researcher.

4.4.4.1 Comparison of PA results with post mortem findings and textbook descriptions of diseases

Comparison of matrix scoring results (Figures 4.2 to 4.5) and interviews with post mortem findings (Table 4.5) and textbook descriptions of diseases (Table 4.1) revealed considerable overlap between indigenous knowledge and modern veterinary knowledge.

a. Disease diagnosis

This study demonstrated much overlap between indigenous knowledge of diseases such as *liei*, *macueny* and *jong acom*, and western diseases such as trypanosomiasis and fascioliasis. When looking at the linkages between these two bodies of knowledge, the study focussed on those aspects of health problems that were visible macroscopically rather than microscopically. This approach assumed that Nuer and Dinka informants could not be expected to observe those things that veterinarians detect using microscopes, biochemical tests or other technologies.

Livestock keepers in southern Sudan characterised chronic wasting disease in cattle using criteria that are very similar to those used by veterinarians. Although the signs of *liei* were non-specific, herders used information on exposure to disease vectors and intermediate

hosts, and post mortem findings in order to identify different causes of chronic wasting. Cattle keepers could not be expected to recognise microscopic disease agents and with this in mind, the naming of chronic wasting diseases and associations between disease and visible factors were rational and very closely related to modern veterinary thinking.

The local disease name *liei* encompassed various diseases that are recognised by veterinarians. These 'western' disease names occurred as single entities and as mixed infections involving up to four groups of parasites *viz.* trypanosomes, liver flukes, schistosomes and gastrointestinal nematodes. In cattle suffering from chronic wasting that were examined post mortem, 14/16 cases showed evidence of mixed infections involving two, three or four different parasites. This pattern of infection in debilitated cattle is similar to that reported by Mefit-Babtie (1983) and Fison (1993). In chronic wasting cases from Nyal and Thiet gross pathology revealed lesions due to liver flukes, schistosomes and gastrointestinal nematodes, and these findings were supported by histopathology. Microscopic examination also showed lesions suggestive of trypanosomiasis (Appendix 4.2). Post mortem findings were supported by estimates of parasite prevalences, although the low sensitivity and specificity of diagnostic tests probably led to under-estimations of prevalence.

Figure 4.7 illustrates the relationship between Nuer disease names and diseases recognised by veterinarians. The diseases trypanosomiasis, PGE, fascioliasis, schistosomiasis or any of the nine possible mixed infections would be called *liei* by Nuer herders. Fascioliasis might also be called *macueny*, and PGE might also be called *maguar*. Regardless of whether a case involved single infections or combined infections, the animal in question would have a similar clinical appearance.

In Nyal, two forms of *liei* were recognised. One form of *liei* was associated with Tabanids (*rom*) and other biting flies, flooding and oedematous, pale carcasses. The other form of *liei* was associated with snails (*chom*), flooding and diseased livers containing liver flukes (*daichom*). This second form of *liei* was also called *macueny*, a name that referred specifically to livers affected by fascioliasis-type lesions. The two forms of *liei* were not readily distinguished on clinical grounds. The disease *maguar* was associated with gastrointestinal worms and was thought to develop into *liei* if untreated.

Figure 4.7

Relationships between Nuer names for chronic wasting in cattle, and western disease names

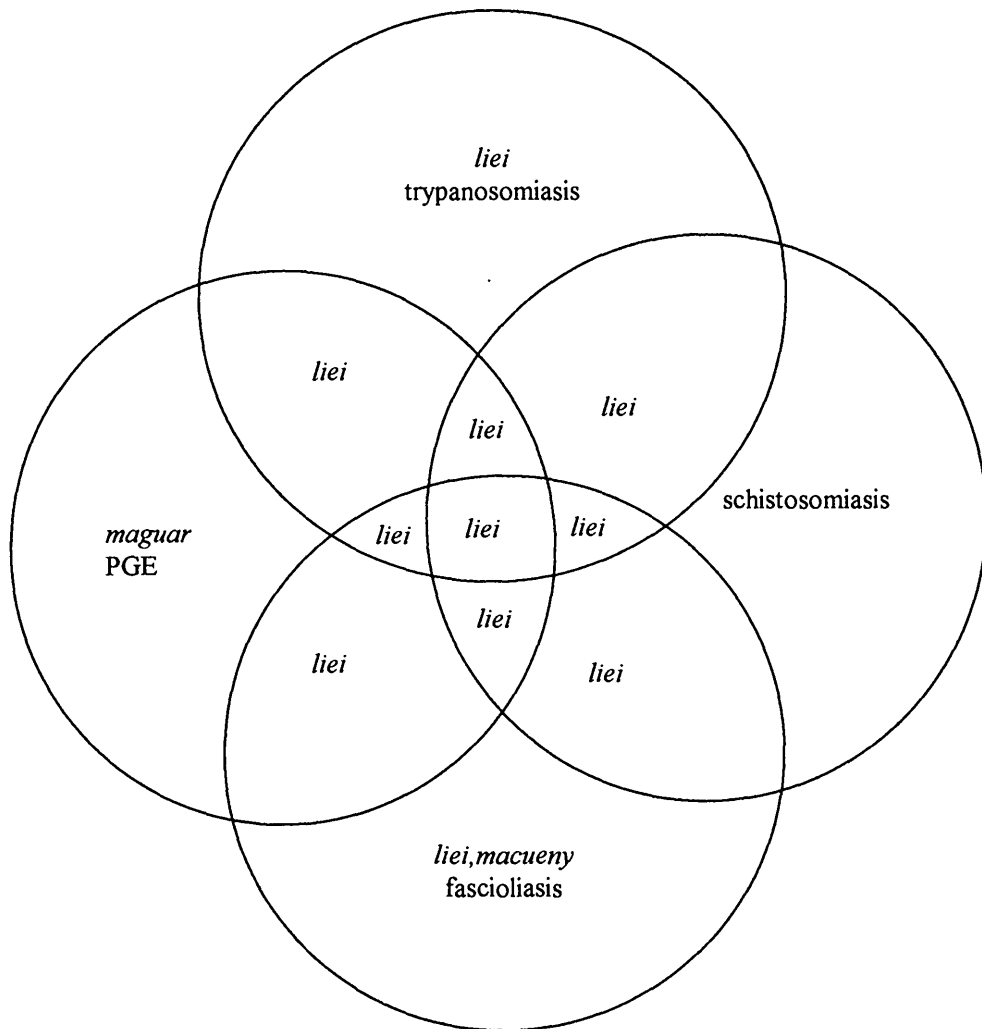
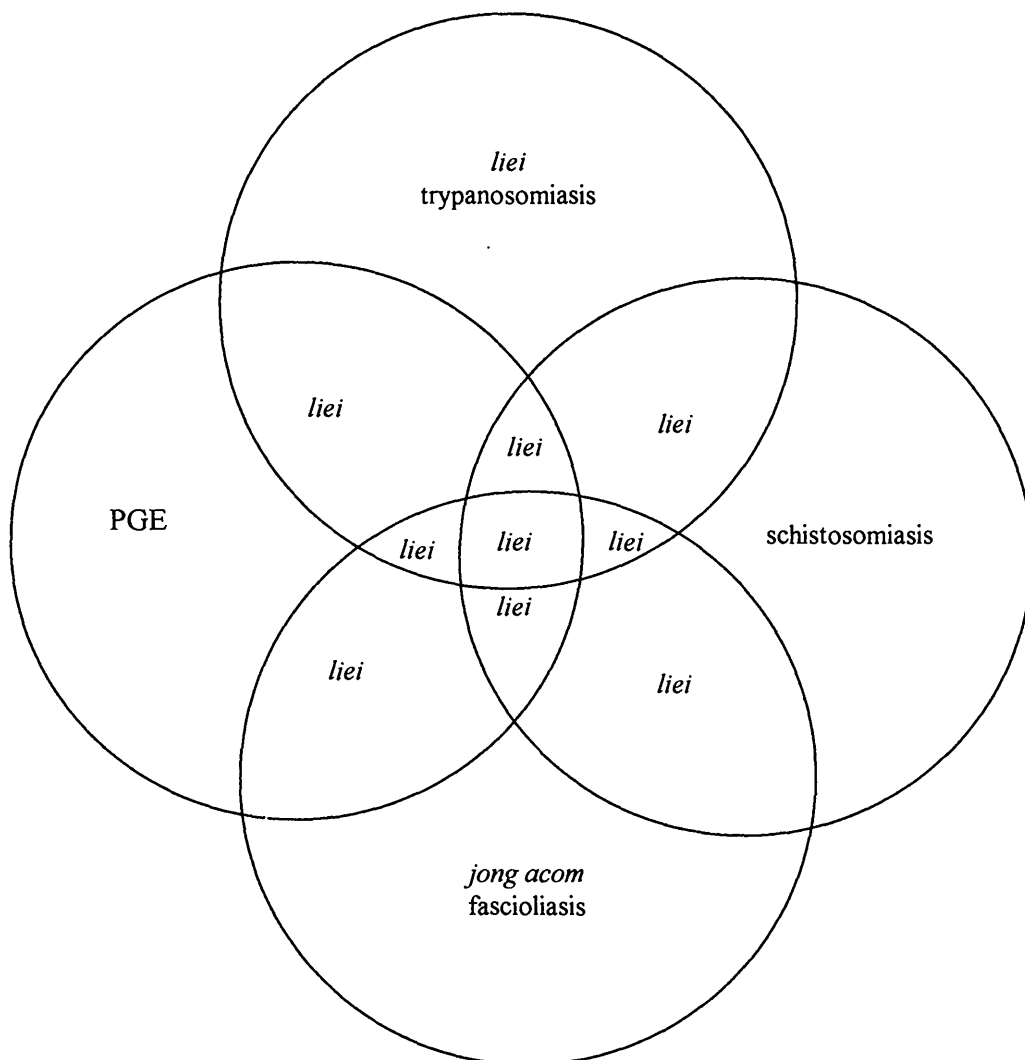


Figure 4.8 illustrates the relationship between Dinka disease names and diseases recognised by veterinarians, and shows up to nine possible mixed infections with trypanosomes, flukes, schistosomes or helminths.

The diseases *liei* and *jong acom* ('disease of snails') showed similar signs and causes to the diseases *liei* and *macueny* in Nyal. Although loss of hair from the tail was often cited as a clinical sign that distinguished *liei* from *jong acom*, this sign appeared relatively late in the course of the disease. Also, while *jong acom* was thought to cause abdominal discomfort and more diarrhoea than *liei*, these signs were inconsistent features of the disease. In common with *macueny* in Nyal, the name *jong acom* was linked to the observation of livers affected by fascioliasis.

Figure 4.8
 Relationships between Dinka names for chronic wasting in cattle, and western disease names



Matrix scoring also produced information that is not well described in veterinary texts. For example, loss of tail hair is not commonly noted in textbooks as a clinical sign of trypanosomiasis in cattle. However, accounts of ethnoveterinary knowledge among pastoralist groups such as the Turkana (Ohta, 1984), Tuareg (Wolfgang and Sollod, 1986) and Somali (Catley and Mohammed, 1995) in Africa and pastoralists in India (Köhler-Rollefson, 1996) indicate that this sign commonly is observed in cattle and camels affected by trypanosomiasis.

Regarding *jul*, a previous report from southern Sudan noted that *jul* was characterised by poor body condition and reduced productivity in adult cattle (Linguist *et al.*, 1996). Results

from Thiet suggested that *jul* was a result of a previous illness called *dat* (usually interpreted by veterinarians as FMD). Although chronic manifestations of FMD disease are not described in many veterinary textbooks, Radostits *et al.* (1994) noted that a sequel to FMD in cattle was a chronic syndrome of dyspnoea, anaemia, overgrowth of hair and lack of heat tolerance.

b. The role of biting flies in disease transmission

In the minds of cattle keepers, the fly most consistently associated with chronic wasting in cattle was called *rom* (Nuer) or *rum* (Dinka). These flies were repeatedly and confidently identified by informants when observing specimens in isolation, or when comparing different types of flies. Both *rom* and *rum* were identified as Tabanids by the researchers, and the presence of these flies in southern Sudan has been noted on numerous occasions by other workers (e.g. Evans-Pritchard, 1940; Rahman *et al.*, 1991b).

Informants in both Dinka and Nuer areas also used specific names for Hippoboscids flies, calling them *atek* and *tharkwach*, and associated these flies with *liei*. Evans-Pritchard (1940) noted the link between *tharkwach* and thin cows more than sixty years ago. In western veterinary medicine, Tabanids and Hippoboscids are known to be mechanical vectors of *T. vivax* (Leak, 1999) and therefore, there is some overlap between herders' views on the role of *rom/rum* and *tharkwach/atek* in *liei*, and the identification of *T. vivax* in cattle. However, the most common trypanosome species identified in the study sites was *T. congolense*, a finding that agrees with previous surveys in southern Sudan (Mefit-Babtie, 1983; Rahman *et al.*, 1991a; Fison, 1993). According to many tsetse and trypanosomiasis workers, *T. congolense* is not transmitted mechanically, but cyclically. However, debate concerning the possible mechanical transmission of *T. congolense* in southern Sudan continues in forums such as FAO's electronic Programme Against African Trypanosomiasis (PAAT) network. Workers with field experience in southern Sudan tended to note the high incidence of *T. congolense* in cattle hundreds of kilometres away from the recognised tsetse belt, with no migration of cattle into the tsetse areas and no detection of tsetse in fly surveys where *T. congolense* occurred. Workers with no experience of field conditions in southern Sudan insisted that *T. congolense* cannot be maintained in cattle populations in the absence of tsetse flies.

Of the three study sites, only informants in Thiet were able to name tsetse flies and offer confident opinions regarding their significance. In general, such informants were few and

used the name *mau* when shown samples of tsetse. The name *mau* seems to have been in use in southern Sudan for at least 140 years and was noted by workers in the 1860s (Lewis, 1949). In terms of proximity to known tsetse areas, Thiet was closer to the tsetse belt than Nyal (approximately 80km and 250km respectively). These factors indicate that indigenous knowledge about tsetse was due to people's actual experience of the fly.

The situation in Nyal regarding the transmission of trypanosomiasis was far less clear. Although low to moderate prevalence of *T. congolense* was detected, there was no evidence from the literature or indigenous knowledge to indicate the presence of tsetse flies. These findings agree with reports from southern Sudan of disease due to *T. congolense* in areas far outside the known tsetse belt (e.g. Fison, 1993). Although it might be argued that small populations of tsetse remain undetected in Upper Nile, it was surprising that informants did not recognise tsetse flies although they were knowledgeable about a range of disease causes, signs, vectors and epidemiological factors. In terms of validating indigenous knowledge, these experiences are of interest but they highlight how expert veterinary opinion can be divided, even on basic aspects of disease transmission and for a disease of major economic importance.

c. *The role of snails in disease transmission*

Livestock keepers in both study sites made strong associations between snails, liver flukes and some of the chronic lesions of fascioliasis. Typically, liver flukes were regarded as 'young snails' and the hard, rounded and coloured concretions of bile seen in chronically diseased livers had a similar appearance to snails. Small snails adhering to wet grass, particularly in flooded areas, were thought to be consumed by cattle and the young snails passed into the liver. Considering that herders could not be expected to know about the microscopic larval stages of liver flukes, the similarity between their understanding of liver fluke development and the complex life cycle that is known by veterinarians, was striking. The research did not attempt to discover whether herders recognised (and named) different species of snails.

d. *Schistosomes and the chronic wasting problem*

It was notable that during the 13 post mortem examinations conducted in the presence of livestock keepers, they did not appear to recognise schistosomes in mesenteric blood vessels. There were no specific local names for these parasites and they were not associated with

particular health problems. This apparent deficit in indigenous knowledge might relate to the difficulty in observing schistosomes which although quite large parasites (up to about 1.5 cm in length), can only be seen if fresh mesentery is stretched so that the worms become visible in the flattened blood vessels. The worms cannot be seen once the blood has clotted. While herders seemed to lack knowledge about schistosomes, there was little evidence to show that veterinarians working in southern Sudan were better informed. Although the veterinary literature from Sudan notes the importance of schistosomiasis as a cause of chronic weight loss in cattle, the disease did not feature in the livestock programme in southern Sudan.

e. Ticks and the chronic wasting problem

Regarding the role of ticks (*chak* or *achak*) as causes of disease, these parasites were not thought to be a cause of chronic wasting disease (Figures 4.3 and 4.5). Occasionally, informants gave moderate scores for ticks against *liei* or other chronic diseases, but invariably explained that ticks tended to seek out sick cattle and exacerbated existing illnesses. Blood smears examined during the research provided limited evidence of *Babesia*, *Anaplasma* or other tick-borne parasites. *Amblyomma* ticks, as observed frequently on thin cattle, cause substantial blood loss.

f. Divine and mystical causes of diseases

The research did not reveal any local perceptions or manifestations of diseases that were related to divine or mystical influences. Although spiritual causes of disease were reported in early anthropological accounts of the Nuer (Evans-Pritchard, 1940) and Dinka (Leinhardt, 1961), a more-recent study in Nuer areas described a trend towards more modern interpretation of disease events (Hutchinson, 1996). This change was attributed to the provision of basic human health services by missionaries, and the conversion of increasing numbers of Nuer to Christianity.

4.4.4.2 Reliability of the matrix scoring method

According to Thrusfield (1995), a method that produced reliable results was more likely to produce valid results than an unreliable method. However, in the southern Sudan study, the possibility that reliable results might be invalid was also recognised. Results indicated that the matrix scoring method for disease signs (Figures 4.2 and 4.3) and disease causes (Figures 4.4 and 4.5) was reliable.

4.4.4.3 Scoring of control diseases

The scores allocated to the control diseases *dat* and *doop* in Nyal (Figures 4.2. and 4.4), and *cual* and *abuot pou* in Thiet (Figures 4.3 and 4.5) were as expected, assuming these diseases were indeed FMD and CBPP in Nyal, and brucellosis and CBPP in Thiet. These results showed that informants were able to observe and explain specific clinical signs of disease, and specific modes of disease transmission. The disease name *cual* derives from the hygromas observed in cows after abortion. Significant correlation between observation of hygromas and abortion due to brucellosis has been reported in central Africa (Domenech *et al.*, 1982).

4.4.4.4 Comparison of results with prevalence estimates

Prevalence estimates indicated a high prevalence of trypanosomes, liver flukes and gastrointestinal nematodes, and mixed infections of these parasites (Table 4.6 and Figure 4.6). This result agreed with the results of post mortem findings (Table 4.5), and indicated that herders' associations between diseases and disease causes (Figures 4.4 and 4.5) were valid. The study did not attempt to judge the validity of herders' diagnoses of diseases using quantitative comparisons with conventional data because it was assumed that the low sensitivity of the diagnostic tests used for prevalence estimates would limit the value of such comparisons. Furthermore, prevalence estimates were used to detect existing or previous exposure to parasites rather than disease.

4.4.5 Limitations of conventional diagnostic methods

To some extent, the reliance on qualitative comparisons of information derived from PA and conventional methods in this study was influenced by the limitations of conventional diagnostic tests. For example, the sedimentation method for the detection of fluke eggs is reported to be the most sensitive diagnostic method available but detects only 30% of eggs in a sample (Happich and Boray, 1969). Similarly, the MHCT for the detection of trypanosomes in Thiet probably had a sensitivity of approximately 50% (Eisler – personal communication), and the sensitivity of thin smear examination in Nyal was probably far lower. Although not used in the present study, the detection of schistosome eggs in faeces has a sensitivity of 44% in adult cattle (De Bont, 1995). With these test characteristics in mind, the researcher chose not to attempt a direct comparison of herder diagnosis with laboratory diagnosis using a test such as the kappa statistic.

4.5 Summary

This study in southern Sudan was the first known attempt to standardize a PA method for veterinary research, summarise data using statistical tests and assess reliability and validity. A standardized matrix scoring method was developed in the field to investigate local perceptions of cattle disease signs and causes. The method showed good reliability, as assessed using quantitative analysis, and good validity as assessed using qualitative analysis. The low sensitivity of conventional diagnostic tests and operational constraints hindered a quantitative assessment of the validity of the matrix scoring method.

Chapter 5

PARTICIPATORY INVESTIGATION OF A CHRONIC WASTING DISEASE IN CATTLE IN DINKA COMMUNITIES IN SOUTHERN SUDAN: SPATIAL AND SEASONAL FACTORS

5.1 Introduction

This chapter describes the use of mapping and seasonal calendars to investigate seasonal and spatial aspects of *liei*, other cattle diseases, disease vectors, intermediate hosts and rainfall in and around Thiet, southern Sudan. Typically, these methods have been used only once in a particular animal health study or survey (Chapter 2). Also, in most reports limited information is provided to enable readers to cross-check results against other data.

The research was conducted to complement the diagnostic investigation on chronic wasting in cattle reported in Chapter 4, and predict the most appropriate time to plan preventative or curative interventions for *liei* and other diseases. The reproducibility and validity of the seasonal calendar method is assessed, and outcomes research findings from this chapter and Chapter 4 are presented.

5.2 Materials and Methods

5.2.1 Research location

The research was conducted with Dinka livestock keepers in Thiet, Tonj County, Bahr el Ghazal, southern Sudan over a four week period during the dry season (January and February, 2000), as described in Chapter 4. According to measurements by Bontkes (1991), the mean ambient annual temperature in the area was 27.7°C. Maximum temperatures were recorded in February and March (37.0°C) and minimum temperatures occurred in January (20.1°C). Dinka communities in Thiet used agropastoral livestock production systems. The location comprised low-lying grassy plains, which flooded during the wet season, surrounded by relatively higher and drier forest and plain areas. Herds move away from the flood plains as the rains begin because vegetation becomes covered with water. Movement into the flood plains occurs towards end of the dry season. A CAHW programme had been operating in Thiet for more than five years. Livestock keepers were familiar with the programme and had worked with veterinarians to prioritize animal diseases and select

people for training as CAHWs. Also, the programme operated on a cost-recovery basis and people were accustomed to purchasing veterinary medicines from CAHWs and paying for other services.

5.2.2 Participatory methods

5.2.2.1 Selection of informants

Informants were selected during visits to Dinka cattle camps within 30 km to the southeast of Thiet. These cattle camps were seasonal camps in the dry season flood plains. During the research, the camps were gradually expanding as more herds moved into the area.

Therefore, on consecutive days, more people arrived in the camps and were involved in the research. The camps were selected according to the need to sample cattle and examine blood samples within a few hours after sampling, as described in Chapter 4. In each cattle camp, informants included those people whose cattle were being sampled and other people who were present nearby and invited to join the discussion by the researchers. The four main cattle camps visited were called Cuie-cek, Diang, Madhol and Maker, and the number of informant groups in each camp was three, two, two and three respectively (a total of 10 independent informant groups). Group sizes varied from four to eight individuals. In Diang and Madhol, the two informant groups were interviewed on the same day and these groups were located in different parts of the cattle camp. In Cuie-cek and Maker a similar procedure was used but a third informant group was interviewed on the following day. These latter groups comprised people who had moved into the camp that morning.

5.2.2.2 Translation

The same Dinka translator detailed in Chapter 4 was used. He was trained in the seasonal calendar and mapping methods described below by the researcher.

5.2.2.3 Seasonal calendar

To construct the seasonal calendar, the researcher drew a line in the ground of about 1 metre in length and explained that this line represented one full year. The line was then divided into the four Dinka seasons starting with *mai* (February to April) and followed by *ker* (May to July), *ruil* (August to October) and *rut* (November to January). Each season was labeled using a nearby object. For example, a bone might be used to represent *mai*, a broken gourd

to represent *ker*, and so on. The informants were asked to explain the meaning of the objects back to the researcher to check that they understood the correct meaning.

The informants were then asked to think about rainfall and how amounts of rain might vary between seasons. They were given a pile of 20 seeds and asked to divide the seeds against the four seasons to show the relative amount of rainfall in each season. During the division of the seeds, the translator had been instructed not to interfere, other than to clarify the scoring procedure if necessary. Also, the group was asked to discuss the set task and to reach a group decision regarding the placement of the seeds. They were also requested to use all 20 seeds and, other than specifying that seeds should be placed against the different seasons, no advice was offered concerning the specific year or years to be considered. When the placing of seeds against seasons was complete, the group was asked to carefully check the scores and, if they wished, change the scores until they were satisfied with the result. At this stage, another object was used to label the row of scores as 'rainfall'.

Using a similar scoring method to that described above, more items were added one by one to the seasonal calendar and scored. These items were the five cattle diseases called *liei*, *about pou*, *jul*, *jong acom* and *cual* (as used in the disease signs matrix scoring described in Chapter 4); three types of biting fly called *rum*, *luang* and *mau*; snails called *chom*; and ticks called *achak* (as used in the disease causes matrix scoring described in Chapter 4). Cattle diseases were represented using more every-day objects and the flies, ticks and snails were represented using actual specimens. These specimens were passed around the group before scoring to check that informants recognized the specimens and used Dinka names that were consistent with the previous experience of the researchers. A completed seasonal calendar comprised four seasons along the *x*-axis of the diagram and 12 items along the *y*-axis of the diagram. Following scoring, the researchers used the diagram to assist further questioning and discussion. Open and probing questions were used such as 'why do you see *liei* mainly in *ruil* and *rut*?' and 'when is the best time to use medicine to prevent *jong acom*?'.

The seasonal calendar was repeated with the 10 informant groups described in section 5.2.2.1. Agreement between informant groups was assessed using the Kendal coefficient of concordance (*W*) in SPSS software, version 9.0 (SPSS, 1999).

Rainfall data produced by the seasonal calendars were compared with objective measures of rainfall collected by the Famine Early Warning System (FEWS) of the United States Agency for International Development. The FEWS rainfall data were derived from a combination of satellite data, rain-gauge reports, model analyses of wind and relative

humidity, and orography (describing the affect of hills and mountains on rainfall) to estimate accumulated rainfall (Herman *et al.*, 1997). Rainfall measurements were made at 10-day intervals by FEWS and the data used in the comparison were collected from Tonj County, Bahr el Ghazal, for the period 1995 to 1998. The FEWS rainfall data were compiled into mean amounts of rainfall per Dinka season and then proportions of total annual rainfall per Dinka season were calculated. The median scores for rainfall arising from the 10 seasonal calendars also were converted into proportions of total annual rainfall per Dinka season.

5.2.2.4 Mapping

Mapping was used after the seasonal calendar method to cross-check information arising from the seasonal calendars and understand perceptions of spatial factors. The method was conducted twice with informant groups in Diang and Madhol cattle camps.

To construct a map, the researcher identified 'this cattle camp' as a starting reference point that was known by all the informants in the group. The researcher then illustrated the cattle camp by making a mark on the ground, and requested the informants to draw a map to show seasonal cattle movements. After these movements had been illustrated, informants were then asked to visualize and clarify issues that had arisen during the seasonal calendar method. For example, if the seasonal calendar had shown that snail populations increased during the wet season, informants were asked to depict areas with high snail populations on the map. A distance scale was applied to the map by asking informants to specify the walking time between different points on the map.

Maps were copied as line drawings into the researcher's notebook and orientation was added by reference to published maps of southern Sudan.

5.3 Results

5.3.1 Seasonal variations

Results from the 10 seasonal calendars are summarised in Figure 5.1. There was evidence of strong agreement among the 10 informant groups for 7/11 indicators, and evidence of moderate agreement for 3/11 indicators. Agreement was weak for the disease *cual*/brucellosis ($W=0.21$) and the biting fly *mau*, assumed to be tsetse fly ($W=0.08$).

Figure 5.1
Summarised seasonal calendar for livestock diseases, biting flies, ticks and snails in Thiet†

	Seasons			
	<i>Mai</i> (Feb-Apr)	<i>Ker</i> (May-Jul)	<i>Ruil</i> (Aug-Oct)	<i>Rut</i> (Nov-Jan)
Rainfall (as a proportion of total annual rainfall) ($W=0.96^{***}$)	0 (0-0)	7.0 (5.0-9.0)	11.0 (10.0-13.5)	1.0 (0-2.5)
<i>Liei</i> Mixed parasitism ($W=0.32^*$)	3.5 (1.0-7.0)	1.0 (1.0-2.0)	7.0 (3.0-11.5)	7.0 (3.0-10.5)
<i>Abuot pou</i> /CBPP ($W=0.41^{**}$)	3.0 (1.5-4.5)	4.0 (2.5-5.0)	8.0 (6.5-10.0)	5.0 (3.0-7.0)
<i>Jul</i> /chronic FMD disease (?) ($W=0.38^*$)	3.0 (0-10.0)	3.0 (0-5.5)	11.0 (5.5-15.5)	3.0 (0-5.5)
<i>Jong acom</i> / fascioliasis ($W=0.50^{**}$)	0 (0-0.5)	7.0 (0-11.5)	9.0 (4.5-11.0)	4.0 (0-6.5)
<i>Rum</i> /Tabanid sp. ($W=0.42^*$)	1.0 (0-2.5)	9.0 (5.0-11.0)	4.0 (2.0-8.0)	6.0 (2.0-9.5)
<i>Luang</i> /Stomoxys sp. ($W=0.38^*$)	5.0 (3.0-7.0)	7.0 (4.0-9.0)	7.0 (4.5-9.0)	2.0 (0-3.5)
<i>Dhier</i> /mosquitoes ($W=0.85^{***}$)	0 (0-0.5)	5.0 (2.0-6.5)	12.0 (11.0-15.0)	4.0 (1.0-5.5)
<i>Chom</i> /snails ($W=0.83^{***}$)	0 (0-0)	9.0 (5.0-12.0)	9.0 (7.0-14.5)	0 (0-2.0)
<i>Achak</i> /ticks ($W=0.79^{***}$)	0 (0-2.5)	11.0 (6.0-14.0)	6.0 (3.5-9.0)	1.0 (0-2.5)

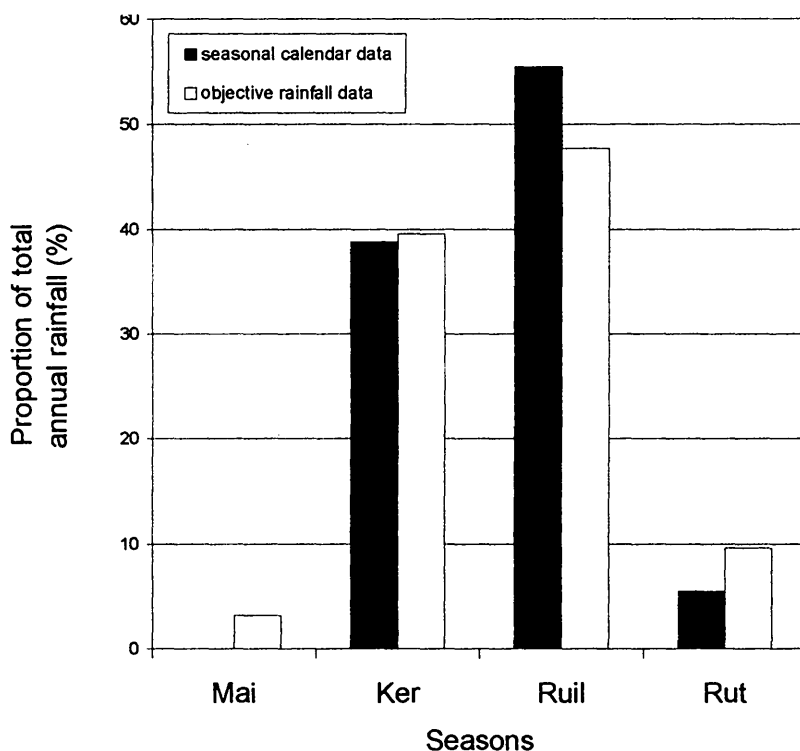
† Number of informant groups =10; W =Kendal coefficient of concordance ($*p<0.05$; $**p<0.01$; $***p<0.001$). Medians are presented in each cell, and minimum and maximum values are presented in parentheses.

In general, disease incidence, fly populations and tick and snail populations peaked during the wet seasons *ker* and *ruil* (May to October). The comparison between seasonal calendar and objective measures of rainfall is shown in Table 5.1 and Figure 5.2.

Table 5.1
Comparison of seasonal rainfall patterns in Thiet as determined by seasonal calendars and objective rainfall data

Seasons	Data from seasonal calendars (N=10 informant groups)				Data from Famine Early Warning System 1995-1998	
	Rainfall score			Median score as a proportion of total annual score (%)	Mean rainfall (mm)	Rainfall as a proportion of total annual rainfall (%)
	Minimum	Median	Maximum			
<i>Mai</i> (Jan-Mar)	0	0	0	0	40	3
<i>Ker</i> (Apr-Jun)	3	7	10	37	499	40
<i>Ruil</i> (Jul-Sep)	9	11	15	58	601	48
<i>Rut</i> (Oct-Dec)	0	1	4	5	121	10

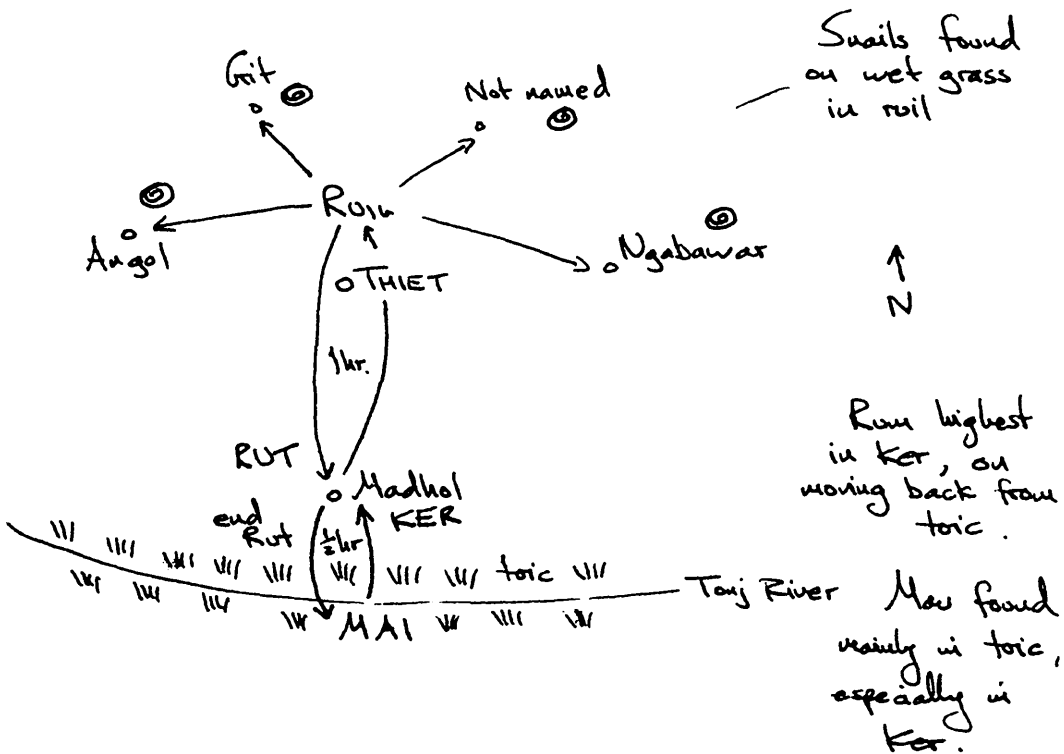
Figure 5.2
Comparison of seasonal rainfall patterns in Thiet as determined by seasonal calendars and objective rainfall data (N=10 informant groups)



5.3.2 Maps

Maps produced by informants in Madhol and Cuie-cek are shown in Figure 5.3 and 5.4 respectively. Figure 5.3 shows the informants' permanent home locations called Ngabawar, Git and Angol. Informants were present in these places during the wet season and although some distance from the river, snails were found on the grass and in pools at this time. As the dry season began and pasture availability decreased, cattle were slowly moved towards the riverside, dry season grazing areas (*toic*). Behind the moving herds, the old pasture was burnt. Cattle were most annoyed by flies such as *rum* and *mau* during *ker* (May to July). The movement pattern described by these informants involved transhumance over quite small distances, as the distance from the main settlements to the *toic* was only 1.5 to 2 hours walk.

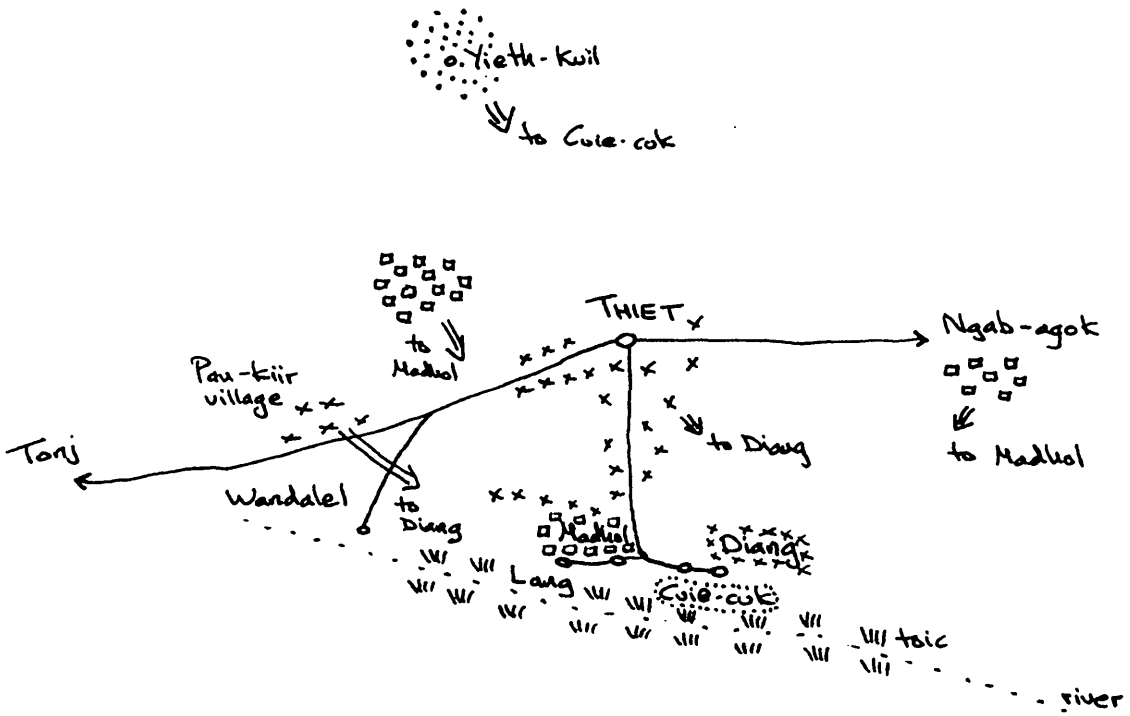
Figure 5.3
Seasonal movements of cattle from Madhol cattle camp, near Thiet



Map produced by seven informants in Madhol cattle camp.
Scale assessed by walking time between Thiet and Madhol of approximately 1 hour.
Arrowed lines indicate cattle movements; seasons were *mai* (February to April), *ker* (May to July), *ruil* (August to October) and *rut* (November to January); curled, circular symbols represent high exposure to snails.

Figure 5.4 is a map covering a wider area than Figure 5.3, and shows the location of home (wet season) grazing areas relative to dry season grazing areas called *toic*. Again, seasonal movements were modest and involved only one or two days walk at most. Some herds were close to the *toic* in both wet and dry seasons (e.g. herds occupying Diang cattle camp). Herders noted that these cattle were constantly exposed to wet, snail-infested areas.

Figure 5.4
Seasonal movements to cattle camps in the dry season grazing areas, south of Thiet



Map produced by five informants in Cuie-cek.
 Arrowed lines show major cattle movements.
 Scale assessed by distance from Thiet to Cuie-cek, being approximately 1 hour walking time.
 X = cattle that were always close to the swampy areas, even in the dry season and perceived to be more exposed to disease
 • and □ = cattle far from the swampy areas in the dry season

5.4 Discussion

5.4.1 General methodological issues

Although initially described as a visualization method, the adaptation of the seasonal calendar to produce numerical data meant that the standardized method was very similar to the matrix scoring used in Chapter 4. In common with matrix scoring, informants appeared to easily understand the scoring procedure and enjoyed the challenge of assigning stones to the correct seasons for each indicator. A dynamic interaction between researcher and informants was achieved and there was a strong sense of informants' trying to reach the 'right answer' rather than simply give an answer that the researcher wanted to see or hear.

When combined with other PA methods, seasonal calendars and maps have diagnostic value because results can be cross-checked against other findings. For example, results supported the findings of matrix scoring of disease signs and causes in Thiet which demonstrated associations between the Dinka disease name *jong acom* and fascioliasis (Chapter 4). The higher incidence of *jong acom* and *chom* (snails) in the wet season supported the view that *jong acom* was caused by liver flukes. These findings show the value of triangulation as a core aspect of PA and how information derived from different methods can be verified.

In common with matrix scoring, the use of additional open and probing questions was considered to be an essential part of the seasonal calendar and mapping methods. For example, having completed a seasonal calendar or map, informants could be asked to refer to their diagram and predict the best time for using drugs to prevent or treat a particular disease. This form of questioning could then lead into discussion on treatment versus prevention, and accessibility to veterinary drugs at different times of year.

Despite the potential value of seasonal calendars, care is required when comparing indigenous concepts of season with the months and seasons of the Gregorian calendar. Amongst Dinka and Nuer communities in southern Sudan, the concept of season is more closely associated with human activities such as agricultural tasks (e.g. weeding, planting, harvesting) or movement of livestock rather than specific dates or lunar position (Lienhardt, 1961; Evans-Pritchard, 1940). Therefore, the timing of Dinka and Nuer seasons varies from year to year. In most 'normal' years, these variations are minor, but in times of drought or displacement (e.g. due to armed conflict) changes in timing of seasons can be marked.

5.4.2 Reliability of seasonal calendars

Although used with only a small number of informant groups, the seasonal calendar method showed good reproducibility. However, for two indicators there was weak agreement between informants. Informants did not agree about the seasonal variation of the fly called *mau* and this might be related to the location of the study sites outside of officially recognised tsetse-infested areas. Cattle herders in Tonj County avoid these tsetse-infested areas and only visited them during drought or conflict. Therefore, it is possible that not all informants had encountered *mau* and their knowledge about the fly was limited relative to other biting flies. Confusion about tsetse was partly confirmed when informants were asked to describe the physical appearance of *mau* and various descriptions were offered. This variation in response was not apparent when people were asked to describe other biting flies, such as tabanids, hippoboscids, *Stomoxys* spp. or mosquitoes.

Informants also seemed to disagree ($W=0.21$) about seasonal variation in the incidence of the disease *cual*, assumed to be brucellosis. Reference to the raw data showed no obvious seasonal pattern to scores for *cual*. However, breeding of cattle is not managed on a seasonal basis by the Dinka and brucellosis is thought to be endemic (McDermott *et al.*, 1987). Also, a common sign of brucellosis in cattle in southern Sudan is hygroma and this lesion can appear at various time intervals after infection. Therefore, the signs of brucellosis are unlikely to show a distinct seasonal pattern. The low W value for *cual* appears to be an anomaly of the test, as indicators showing greater seasonal variation produced higher W values.

5.4.3 Validity of seasonal calendars

Validity of the seasonal calendar method was assessed in two ways. First, at the onset of the study it was assumed that populations of parasites, vectors and intermediate hosts for important livestock diseases (e.g. fascioliasis, trypanosomiasis and parasitic gastroenteritis) in southern Sudan were closely linked to rainfall (because seasonal changes in ambient temperature were minor). This is conventional veterinary thinking and agreed with the seasonal calendar results for seasonal populations of ticks, biting flies and snails (Figure 5.1). Similarly, veterinarians would expect the incidence of fascioliasis to peak during wet periods as indicated in Figure 5.1.

Regarding rainfall, rainfall patterns as determined by seasonal calendar results were similar to objective measures of rainfall (Table 5.1 and Figure 5.2).

5.4.4 Potential uses of seasonal calendars

In many areas of the Horn of Africa, the use of conventional veterinary investigation and epidemiological methods is constrained by severe operational and resource constraints, as outlined in Chapter 2. Longitudinal studies are particularly problematic when highly mobile herds in remote and insecure areas need to be located and examined on a regular basis (de Leeuw *et al.*, 1995). Methods such as seasonal calendars might be used to complement conventional methods, particularly where livestock keepers possess well-developed indigenous knowledge. It seems likely that PA will be most useful when the subject under investigation is either a disease that is well characterized by local people, or involves livestock parasites, disease vectors or intermediate hosts that are visible to the naked eye (in either live or dead animals).

5.4.5 Outcomes of the research

As described in Chapter 2, participatory approaches are intended to be action-orientated and lead to initiatives at community level to solve locally expressed problems. Some outcomes of the studies described in Chapter 4 and this chapter are described below.

5.4.5.1 Training

At the time of the research, training programmes for CAHWs and other veterinary workers in southern Sudan were based specific western diseases, including trypanosomiasis and fascioliasis. One outcome of this research was that training programmes were revised to include the concept of mixed infections and explain how veterinary workers might prevent or treat disease such as *liei*. The OLS Livestock Programme already was providing trypanocides and anthelmintics that were sold by CAHWs to livestock keepers. The programme planned to develop training materials to explain how treatment with a single drug might not be effective, and in such cases, an alternative drug also should be used.

5.4.5.2 Applied research on treatment options for *liei*

In the absence of a specific diagnosis (or diagnoses) in cases of *liei*, an animal health worker will probably use a 'best-bet' treatment. In order to identify the best treatment for *liei*, a research proposal was formulated to test different treatment options. These options were:

1. Simultaneous, combined therapy with trypanocide and albendazole (at flukicidal doses) in order to eliminate trypanosomes, liver flukes and parasitic gastrointestinal nematodes. This option was designed to treat three of the four different parasites associated with *liei* but was relatively expensive.
2. Sequential use of trypanocide and albendazole. This option used either trypanocide or albendazole initially, followed by the other drug in the event of poor response to the first treatment. This option might be less expensive than option 1. in some cases but when two treatments are required, would be more expensive than option 1. because two visits from the CAHW are needed.

5.5 Summary

The research demonstrated that seasonal calendars were a useful PA method for understanding Dinka livestock keepers' perceptions of seasonal patterns of livestock diseases, disease vectors and rainfall. Seasonal rainfall patterns obtained from seasonal calendars were validated using an objective measure of rainfall. The method showed good reliability and validity, and could be cross-checked at field level using participatory mapping. When combined with methods such as matrix scoring, seasonal calendars and mapping had diagnostic value. Seasonal calendars may be particularly useful in areas where operational or resource constraints hinder longitudinal studies, but where livestock keepers possess good indigenous knowledge on livestock diseases.

Chapter 6

PARTICIPATORY INVESTIGATION OF BOVINE TRYPANOSOMIASIS IN ORMA COMMUNITIES, KENYA: DISEASE DIAGNOSIS AND INCIDENCE ESTIMATES

6.1 Introduction

This chapter describes the repetition of the matrix scoring methods used in southern Sudan (Chapter 4) in a different country and with a different ethnic pastoralist group, the Orma. The chapter also describes the adaptation and of a PA method called proportional piling to estimate the incidence of bovine trypanosomiasis and other important cattle diseases.

6.1.1 Origins of the research

Within Kenyan livestock research institutes in the mid to late 1990s there was increasing interest in ways to involve rural communities in the definition of research problems and identification of solutions. In part this interest was due to increasing awareness of approaches such as PRA (as described in Chapter 2) and greater pressure from international donors for research to become more 'client-focussed' (e.g. Jordan *et al.*, 1998).

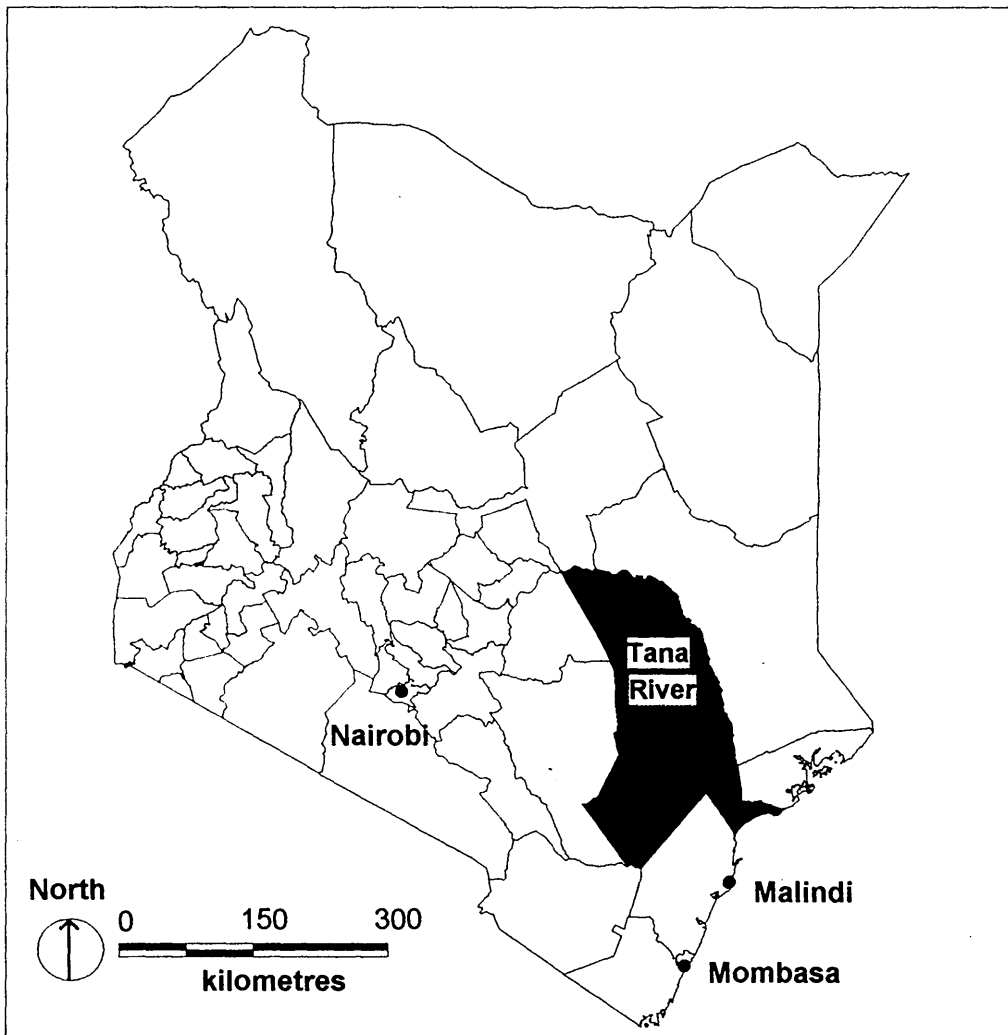
Also in the 1990s, numerous research organisations in Africa began to implement community-based tsetse control projects. Typically, these projects aimed to transfer tsetse trapping or targeting methods to communities, and establish systems within communities for the long-term management and maintenance of the traps or targets. While initial results were often promising (with dramatic reductions in tsetse fly populations), in many cases the technology was not sustained and areas were re-invaded with tsetse (Barrett and Okali, 1998; Budd, 1999). Reasons for poor long-term impact included confusion over roles, responsibilities and ownership of projects, a tendency for researchers to focus on technical issues rather than developing local management capacity, and lack of clarity regarding project objectives (i.e. tsetse control or tsetse eradication). Initial assessments rarely described local perceptions of the importance of trypanosomiasis relative to other livestock diseases or more general problems at community-level, and researchers seemed to overlook trypanosomiasis control methods that were already being used by livestock keepers, often on an individual basis. Researchers often assumed that traps or targets would automatically

be preferable to other control options. In view of these apparent deficits, it was often difficult to ascertain whether communities were likely to embark on prolonged collective action to control tsetse flies.

6.1.2 Orma pastoralists in Tana River District

Tana River District in the Coastal Province of Kenya comprises approximately 39,000km² of semi-arid bush land around the flood plains of the Tana River (Figure 6.1). The district is divided into seven administrative divisions of which Garsen, in the south of the district, is the largest. The district is characterised by limited development, poor infrastructure and a livestock-centred economy based on pastoral production systems. The human population is approximately 150,000 and the two main ethnic groups are the Orma and the Pokoma.

Figure 6.1
Tana River District, Kenya



The Orma number approximately 50,000 people and they are predominantly cattle-keeping pastoralists who undergo seasonal movements to and from the flood plain grazing areas adjacent to the Tana River. The Orma are directly related to the large Oromo ethnic group, with the Borana of northern Kenya being their closest ethnic and linguistic relatives (Braaksma, 1994). The Orma also have strong linguistic and culture links to the Somali, who occupy territory to the north and east of 'Ormland'. The cattle population of Tana River District has been estimated at 200,000 animals (Irungu, 2000a). The Pokoma are sedentary farmers who are permanent inhabitants of the flood plains and river delta areas.

6.1.3 Bovine trypanosomiasis in Orma cattle

The southern parts of Tana River District and the riverine areas further north were heavily infested with tsetse, and bovine trypanosomiasis was considered by government veterinarians to be the major livestock disease in the area. For example, monthly reports from the Garsen Division Veterinary Office for the period 1998-1999 consistently reported trypanosomiasis as endemic in Garsen Division (although there was no laboratory confirmation of disease diagnosis). Daybook records from the Witu Veterinary Investigation Laboratory for the period 1992-1995 showed regular and frequent diagnoses of bovine trypanosomiasis due to *T. congolense* and *T. vivax* (unpublished data). The same daybook records also contained occasional reports of haemorrhagic syndrome due to *T. vivax*, including detection of haemorrhagic lesions at post mortem and identification of *T. vivax*.

In 1999 an ethnoveterinary survey in Tana River District by an Orma veterinarian used a questionnaire to collect information on livestock diseases (Mahdi, 1999). This survey noted the Orma disease names *gandi* for chronic trypanosomiasis and *buku* for acute, haemorrhagic trypanosomiasis, although no confirmation of diagnosis was provided. Based on the number of respondents mentioning different diseases, trypanosomiasis was ranked as the most important disease.

In Tana River District, Orma pastoralists have a long history of both avoiding tsetse-infested areas and using trypanocidal drugs (Dolan, 1998). In addition, research on trypanotolerance conducted on Galana Ranch (in Kilifi and Tana River Districts) between 1980 and 1996 showed that Orma Boran cattle were less susceptible to trypanosomiasis than other breeds. However, apart from the Galana Ranch studies, relatively little was known about bovine trypanosomiasis in Orma cattle or the pros and cons of different disease control methods under traditional herding systems.

Preliminary work by the KETRI in Tana River District had collected background information on cattle keeping by Orma communities and outlined some of the trypanosomiasis control methods in use (Irungu, 2000a). Further cross-sectional surveys provided estimates of trypanosomiasis prevalence and information on tsetse challenge (Irungu 2000b). Using the MHCT, trypanosome prevalence in four Orma villages was estimated at 5.0% (n=456) and *T. congolense* (15 cases) and *T. vivax* (5 cases) were identified. There was widespread use of trypanocidal drugs in the survey sites and therefore the results were probably under-estimates of the true prevalence. *Glossina pallidipes* was the most commonly trapped species of fly, with low numbers of *G. brevipalpis*, *Stomoxys* and Tabanids also caught.

6.1.4 Research objectives

With the KETRI team, the researcher agreed objectives for the research as follows:

1. To explore and compare livestock keepers' and researchers' knowledge on bovine trypanosomiasis, and estimate disease incidence.
2. To identify preferred or 'best-bet' trypanosomiasis control options to be implemented and evaluated by KETRI and local stakeholders.

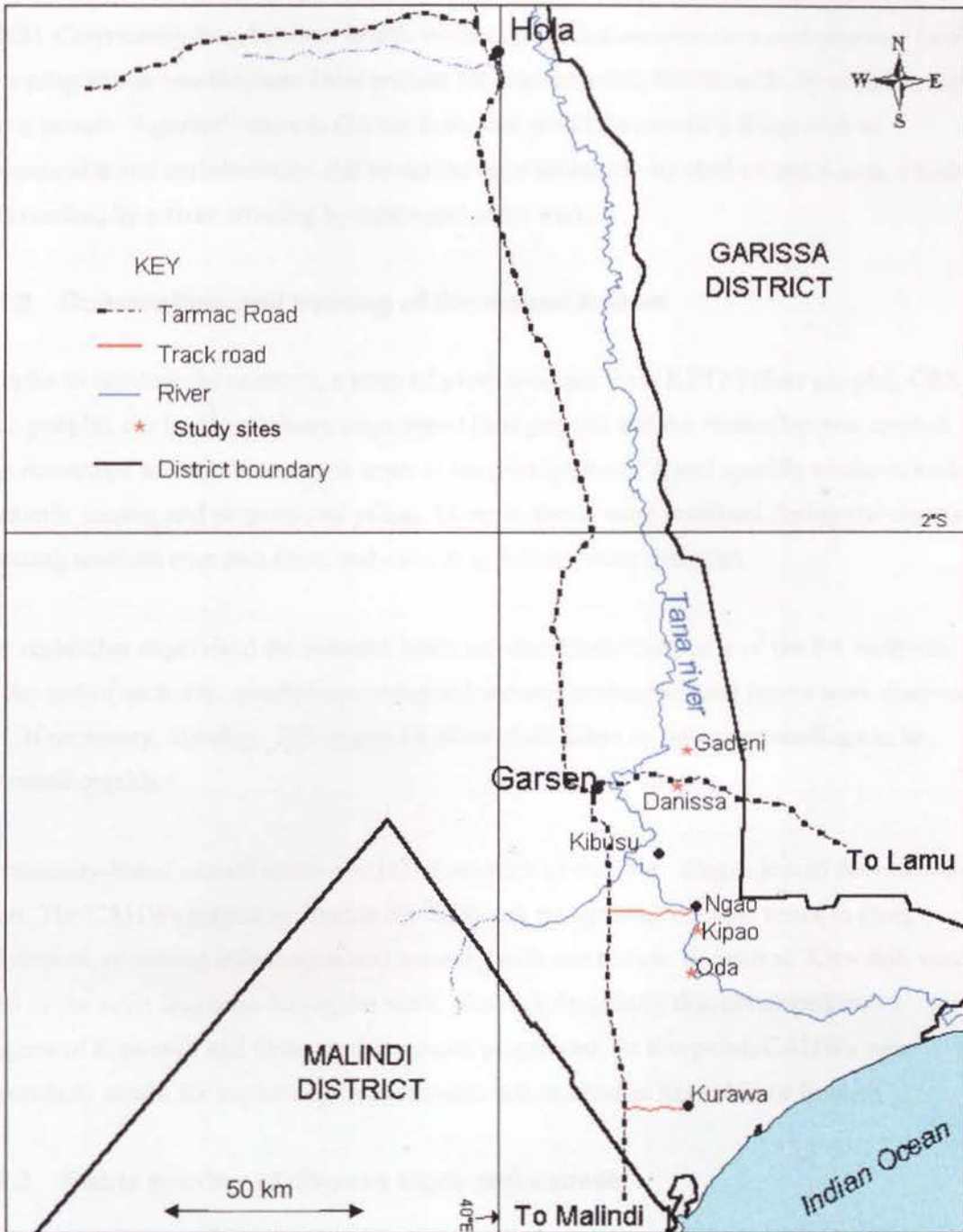
This chapter focuses on objective 1 and describes local characterization of bovine trypanosomiasis and provides estimates of disease incidence using PA methods. Spatial and seasonal aspects of the disease and local preferences for different control methods are described in Chapter 7.

6.2 Materials and Methods

6.2.1 Research sites

The study was conducted in four Orma villages called Gadeni, Danissa, Oda and Kipao in Garsen Division, Tana River District (Figure 6.2) in November, 2000.

Figure 6.2
Location of research sites in Garsen Division



These locations were selected because KETRI had previously conducted trypanosome and tsetse surveys in the area, and the Catholic Diocese of Malindi had been operating a CAHW programme in Garsen Division since 1998, with support from Catholic Relief Services (CRS). Community-based animal health workers provided services on a cost recovery basis. This programme was the main local partner for implementing the research. In addition, there was a private 'Agrovet'¹ store in Garsen town that stocked veterinary drugs such as trypanocides and anthelmintics. All locations were accessible by road except Kipao, which was reached by a river crossing by canoe and short walk.

6.2.2 Composition and training of the research team

In order to conduct the research, a team of seven workers from KETRI (four people), CRS (two people), the local veterinary department (one person) and the researcher was created. The researcher trained the research team in the principles of PA and specific methods such as matrix scoring and proportional piling. These methods were practised during training and planning sessions over two days, and recording formats were designed.

The researcher supervised the research team and also conducted some of the PA methods. At the end of each day, results were compiled and any methodological issues were discussed and, if necessary, clarified. This approach allowed mistakes or misunderstandings to be corrected quickly.

Community-based animal health workers from each of the four villages joined the research team. The CAHWs helped to arrange the fieldwork by agreeing suitable times to meet informants, recording information and assisting with translation. In general, Kiswahili was used as the main language during the work, although frequently this developed into a mixture of Kiswahili and Orma as discussions progressed. At this point, CAHWs were particularly useful for explaining Orma disease information in Kiswahili or English.

6.2.3 Matrix scoring of disease signs and causes

The matrix scoring methods used was similar to the method used in southern Sudan (Chapter 4) because one aim of the research was to repeat the southern Sudan methods with a different ethnic group. The disease signs matrix used with Orma informants included the

¹ In Kenya, 'Agrovet' stores supply both agricultural products (such as pesticides) and veterinary medicines.

two suspected forms of trypanosomiasis, called *gandi* and *buku*, and three control diseases: CBPP, FMD and rinderpest. Reference to the ethnoveterinary survey by Madhi (1999) and informal interviews with CAHWs indicated that the Orma names for these diseases were *somba*, *hoyale* and *madobesa*, respectively. These three control diseases were selected because they were considered by the researcher to show very different clinical signs to acute or chronic forms of trypanosomiasis. Also, interviews with CAHWs indicated that CBPP and FMD were endemic in Orma cattle, and livestock keepers considered these diseases to be important. Therefore, it was likely that people would be willing to spend time discussing them. Rinderpest was selected as a control disease because, although it was thought not to be present in Orma cattle, it was a major disease of recent history and, in the researcher's experience, often well known by pastoralists.

The five diseases were represented using common objects (e.g. cup, knife, pen, bunch of keys, cigarette packet) and placed along the top *x*-axis of the matrix. Each of the five diseases in the matrix was scored against a list of nine clinical signs or features of diseases (indicators). The researcher selected these indicators based on typical textbook descriptions of the diseases in question.

The indicators were illustrated using simple line drawings that were placed along the left, *y*-axis of the matrix. For each disease sign, informants were asked to score each disease by dividing piles of 20 stones against the five diseases. The more important a particular disease sign, the greater the pile of stones assigned to it. After the scoring of each disease sign, the researcher prompted the informants to check their scoring and confirm that as a group, they agreed that the scores were correct. When all the disease signs had been scored, the results were recorded and the researcher asked additional questions to cross-check and probe the responses. The questions asked were open questions designed to elicit additional information and follow-up interesting scores.

The disease signs matrix scoring was repeated with three informant groups in each of the four villages (a total of 12 informant groups). Group sizes varied from five to 12 individuals. The level of agreement between informant groups was assessed using the Kendal coefficient of concordance (*W*) in SPSS software, version 9.0 (SPSS, 1999). Confidence interval software (Gardner *et al.*, 1992) was used to calculate medians and 95% CI for the medians.

When a disease signs matrix was completed, the card illustrations of disease signs were removed and replaced, sequentially, by illustrations of six disease causes. These illustrations were supported by samples of biting flies such as tsetse flies, Hippoboscids and Tabanids. These samples were passed around the informants in order to elicit the Orma name for the flies. A similar scoring and questioning procedure was used as for the disease signs matrix.

6.2.4 Proportional piling of livestock diseases

According to the results of the matrix scoring, the researcher judged that Orma informants' descriptions of *gandi*, *buku*, *hoyale*, *somba* and *madobesa* were similar to textbook descriptions of chronic trypanosomiasis, acute haemorrhagic trypanosomiasis, FMD, CBPP and rinderpest respectively. Therefore, proportional piling was used to estimate the incidence of these in different age groups of cattle.

The first stage of the proportional piling method involved informal interviews with Orma elders and CAHWs to determine local definitions of cattle age groups. These interviews showed that Orma pastoralists categorised their cattle by age as follows:

<i>Jabie</i>	Calves up to around weaning age; age group approximately birth to two years.
<i>Waela</i>	Weaner group, approximately two to three years old.
<i>Goromsa</i>	Young adult stock, including heifers and young bulls; approximately three to four years old.
<i>Hawicha</i>	Adult stock, particularly the milking cows kept around the permanent villages; greater than four years of age.

The proportional piling method was repeated with each of the four age groups of cattle and involved the following stages:

1. Using a pile of 100 stones to depict each age group, the stones were divided by an informant into 'sick cattle during the last year' and 'healthy cattle during the last year'.

2. The pile of stones representing sick cattle was then sub-divided by the informant to show the pattern of new cases of *gandi*, *hoyale*, *buku*, *somba*, *madobesa* and 'other diseases' affecting cattle in that age group.

Following the division of stones, informants were asked additional questions to cross-check their responses.

This method was repeated with six informants in Gadeni, 15 informants in Danissa, 19 informants in Oda and 10 informants in Kipao (a total of 50 informants). Data were entered into an SPSS (version 9.0) spreadsheet. The proportional piling was conducted using an initial pile of 100 stones and therefore, piles of stones attributed to each disease category were recorded as a percentage. The mean herd incidence and 95% CI for the mean were calculated for each disease by age group using SPSS software (SPSS, 1999).

The proportional piling method was repeated with each of the four Orma age groups (*jabie*, *waela*, *goromsa* and *hawicha*). These age groups were coded 1 to 4 respectively in the same SPSS spreadsheet that was used to record the disease incidence estimates. Correlation between age and disease incidence was assessed using Pearson's correlation coefficient in SPSS software (SPSS, 1999).

Incidence estimates for *gandi*/trypanosomiasis were compared with the results of a trypanosome survey conducted in the area by KETRI in October 2000 (Irungu, 2000b), approximately four weeks before the participatory assessment. In this survey, 456 cattle were randomly tested using the MHCT.












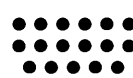








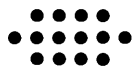

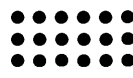


6.3 Results

6.3.1 Characterisation of trypanosomiasis and other diseases

When scoring disease signs (Figure 6.3) there was evidence of strong agreement for 8/9 signs and moderate agreement for 1/9 signs. The control disease *hoyale* (FMD) was mainly associated with shade seeking (indicative of fever) and reduced appetite whereas the control disease *somba* (CBPP) was mainly associated with weight loss and coughing. The control disease *madobesa* (rinderpest) was mainly associated with diarrhoea.

Figure 6.3

Summarised matrix scoring of disease signs by Orma informants, Tana River District[†]

Signs	Diseases				
	<i>Gandi</i>	<i>Hoyale</i>	<i>Buku</i>	<i>Somba</i>	<i>Madobesa</i>
Chronic weight loss ($W=0.59^{***}$)	 4.5 (3.5-6.0)	 1.5 (0-3.0)	0 (0-0.5)	 11.5 (7.5-14.5)	0 (0-3.0)
Animal seeks shade ($W=0.59^{***}$)	 1.0 (0-3.5)	 15.8 (10.0-20.0)	 1.5 (0-4.0)	 1.0 (0-4.0)	0 (0-0)
Diarrhoea ($W=0.78^{***}$)	 3.0 (1.0-5.5)	0 (0-0)	 5.5 (3.0-8.5)	0 (0-0)	 12.5 (8.5-15.5)
Bloody carcass ($W=0.83^{***}$)	 3.0 (0-5.0)	0 (0-0)	 17.0 (15.0-20.0)	0 (0-0)	0 (0-0)
Coughing ($W=0.86^{***}$)	 4.25 (2.5-6.5)	0 (0-0)	 1.0 (0-2.0)	 14.5 (12.5-16.5)	0 (0-0)
Reduced appetite ($W=0.26^*$)	 5.25 (3.0-7.5)	 6.0 (3.0-9.0)	 2.5 (0-4.5)	 3.0 (0.5-8.5)	 1.5 (0-2.5)
Loss of tail hair ($W=0.65^{***}$)	 14.2 (10.0-19.0)	0 (0-0)	0 (0-2.5)	0 (0-0)	 3.5 (0-7.0)
'Death is sudden' ($W=0.78^{***}$)	0 (0-3.5)	0 (0-0)	 17.5 (13.5-20)	0 (0-0.5)	0 (0-0)
Watery carcass ($W=0.46^{***}$)	 11.0 (5.5-17.5)	0 (0-0)	0 (0-5.0)	 4.0 (0-10.0)	0 (0-0)

[†] Number of informant groups = 12; W = Kendal coefficient of concordance (* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$). Medians are presented in each cell and 95% CI are shown in parentheses.

The disease *gandi* was associated with weight loss, reduced appetite, loss of tail hair, and 'watery carcass'. Further questioning about the signs of *gandi* showed that informants also noted swollen lymph nodes and poor coat condition. *Buku* was mainly associated with diarrhoea, sudden death and a 'bloody carcass'. Further questioning was used to see whether

informants distinguished *buku* from other causes of sudden death in cattle, leading to a haemorrhagic carcass. In these discussions, informants named the disease *bashash* and explained that the difference between *buku* and *bashash* as follows:

Buku

- carcass not harmful when eaten;
- not much blood from orifices of carcass;
- blood clots in the carcass;
- lymph nodes not swollen, but bloody;
- spleen swollen and ‘bursts’;
- bloody diarrhoea;
- caused by the fly called *gandi*


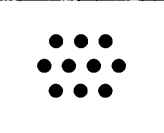

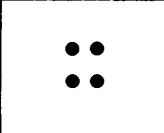
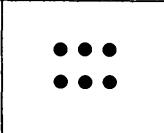
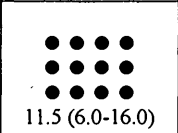
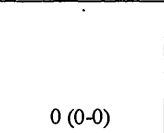
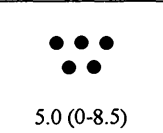
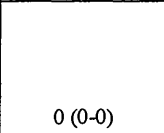
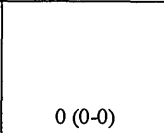
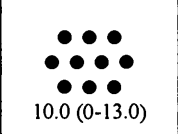
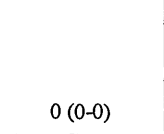
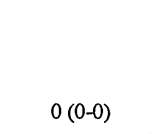
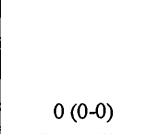
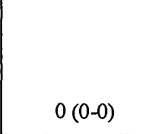
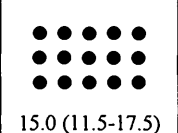
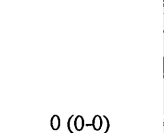
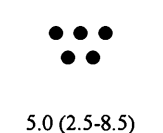
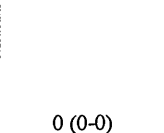
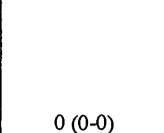
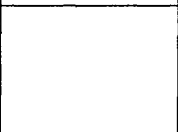
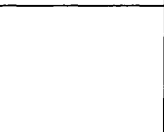
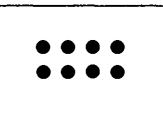

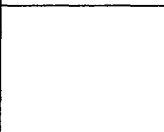
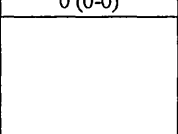
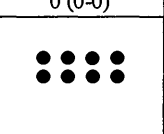
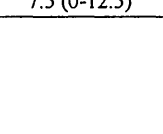
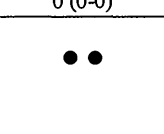
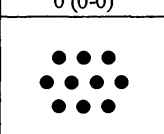
Bashash

- people get sick if the carcass is eaten;
- blood from orifices of carcass;
- blood remains unclotted in the carcass;
- swollen lymph nodes;
- spleen swollen;
- no or less diarrhoea;
- cow-to-cow transmission

When scoring disease causes (Figure 6.4), there was good agreement for all six disease causes. The control diseases *hoyale* (FMD), *somba* (CBPP) and *madobesa* (rinderpest) were all strongly associated with a ‘sick cow entering the herd’. *Hoyale* and *madobesa* were also clearly linked to contact with buffalo. *Gandi* was thought to be caused by flies called *gandi kawaidi* (tsetse) and *shilmi* (ticks). Further questioning about the role of ticks in transmitting *gandi* indicated that informants considered ticks to sometimes cause a disease similar to *gandi*. This tick-borne disease was identified by an enlarged liver at post mortem and no general oedema. Other informants described how large numbers of ticks caused animals to become debilitated, ‘like they have *gandi*’.

When scoring *buku*, six informant groups described a fly called *gandi buku* or *gandi bola*. When cross-checking the identity of tsetse flies, informants consistently called these flies *gandi* and described *gandi buku* and a shorter, blackish fly that lived in crevices in the ground or on bark. Specimens of tabanids and hippoboscids were also identified consistently by informants and called *kobabe* and *kitani* respectively. Neither of these two flies were associated with disease transmission although *kobabe* was said to cause a painful bite and prevent animals from grazing. These factors explained the association between *kobabe* and the disease *gandi*.

Figure 6.4
Summarised matrix scoring of disease causes[†]

<u>Causes</u>	<u>Diseases</u>				
	<i>Gandi</i>	<i>Hoyale</i>	<i>Buku</i>	<i>Somba</i>	<i>Madobesa</i>
Sick cow entering herd ($W=0.71^{***}$)	 0 (0-3.0)	 10.0 (8.0-11.0)	 0 (0)	 4.25 (2.5-6.0)	 6.0 (5.0-7.0)
<i>Shilmi</i> Ticks ($W=0.67^{***}$)	 11.5 (6.0-16.0)	 0 (0-0)	 5.0 (0-8.5)	 0 (0-0)	 0 (0-0)
<i>Kobabe</i> Tabanids ($W=0.38^{**}$)	 10.0 (0-13.0)	 0 (0-0)	 0 (0-0)	 0 (0-0)	 0 (0-0)
<i>Gandi 'kawaida'</i> Tsetse flies ($W=0.86^{***}$)	 15.0 (11.5-17.5)	 0 (0-0)	 5.0 (2.5-8.5)	 0 (0-0)	 0 (0-0)
<i>Gandi buku</i> ¹ Suspect tsetse flies ($W=0.88^{***}$)	 0 (0-0)	 0 (0-0)	 7.5 (0-12.5)	 0 (0-0)	 0 (0-0)
<i>Gadarsi</i> Contact with buffalo ($W=0.75^{***}$)	 0 (0-0)	 8.25 (7.0-10.0)	 0 (0-0)	 1.5 (0-3.0)	 9.5 (7.0-12.0)

[†] Number of informant groups =12; W = Kendal coefficient of concordance (* $p<0.05$; ** $p<0.01$; *** $p<0.001$). Medians are presented in each cell and 95% CIs are shown in parentheses.

¹ Named and scored by only 6/10 informant groups.



Plate 6.1
Matrix scoring of disease causes by informants in Gadeni village



Plate 6.2
Informants cross-checking scores in a disease signs matrix in Danissa village

6.3.2 Estimates of disease incidence

Estimates of disease incidence by age group are presented in Table 6.1, and the data are presented graphically in Figures 6.5 to 6.8. Combined disease incidence estimates for all age groups and healthy cattle are illustrated in Figure 6.9. The Normal distribution of the data, as assessed by PP Plots, is illustrated in Appendix 6.1.

Table 6.1
Estimated mean herd incidence of cattle diseases by age group

Disease	Age group (n=50)			
	<i>Jabie</i> (~0-2 years) Mean herd incidence (95% CI)	<i>Waela</i> (~2-3 years) Mean herd incidence (95% CI)	<i>Goromsa</i> (~3-4 years) Mean herd incidence (95% CI)	<i>Hawicha</i> (> 4 years) Mean herd incidence (95% CI)
<i>Gandi</i> Trypanosomiasis	10.2% (7.80%, 12.57%)	15.10% (12.35%, 17.84%)	17.7% (14.44%, 20.96%)	28.6% (24.13%, 33.09%)
<i>Buku</i> Haemorrhagic trypanosomiasis	3.1% (1.76%, 4.35%)	5.2% (3.66%, 6.73%)	7.1% (5.44%, 8.68%)	9.6% (7.97%, 11.14%)
<i>Hoyale</i> FMD	17.4% (13.74, 21.09%)	15.7% (12.71%, 18.58%)	14.22% (11.37%, 17.07%)	12.7% (10.13%, 15.34%)
<i>Somba</i> CBPP	12.0% (9.60%, 14.40%)	14.6% (12.02%, 17.28%)	11.8% (9.48%, 14.08%)	10.4% (8.52%, 12.23%)
<i>Madobesa</i> ¹ Rinderpest	0.6% (0.15%, 0.99%)	0.9% (0.32%, 1.52%)	0.6% (0.09%, 1.03%)	0.5% (0.08%, 0.88%)
Other diseases	8.1% (6.04%, 10.11%)	6.6% (5.24%, 8.01%)	5.1% (4.01%, 6.23%)	6.4% (5.04%, 7.70%)

¹ Only 3/50 informants reported *madobesa*.

Figure 6.5
 Mean herd incidence of *gandi*/trypanosomiasis in Orma cattle, 1999-2000

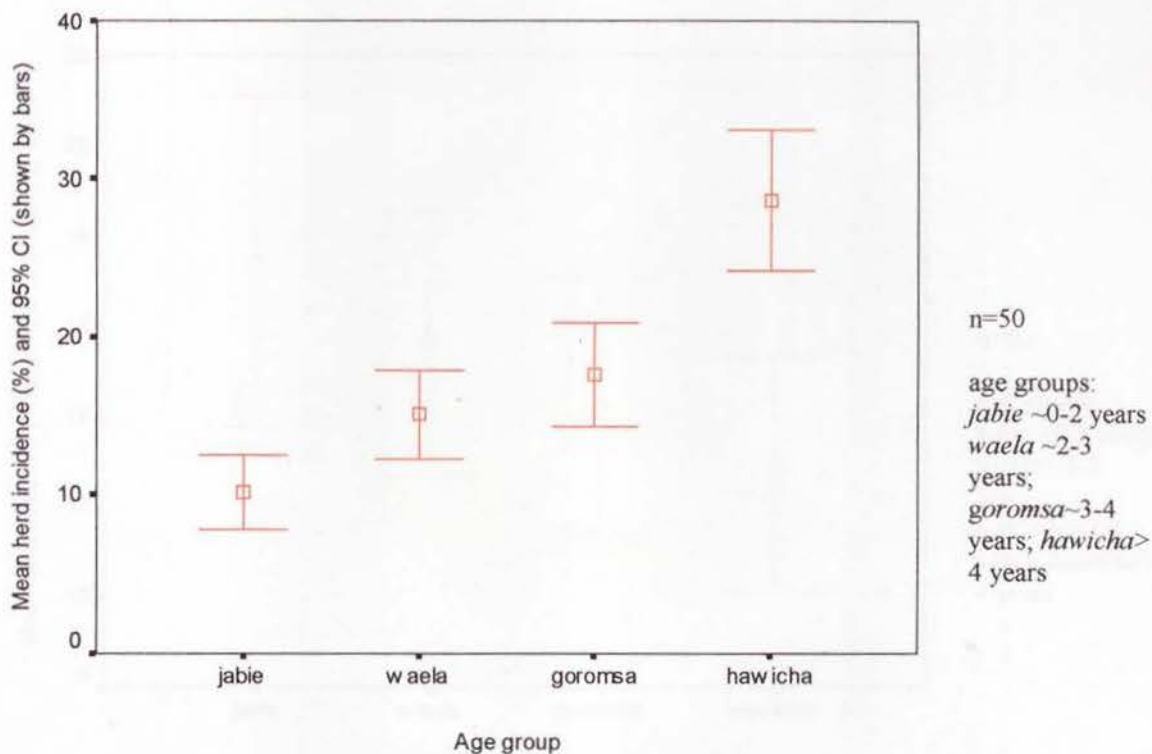


Figure 6.6
 Mean herd incidence of *buku*/acute haemorrhagic trypanosomiasis in Orma cattle, 1999-2000

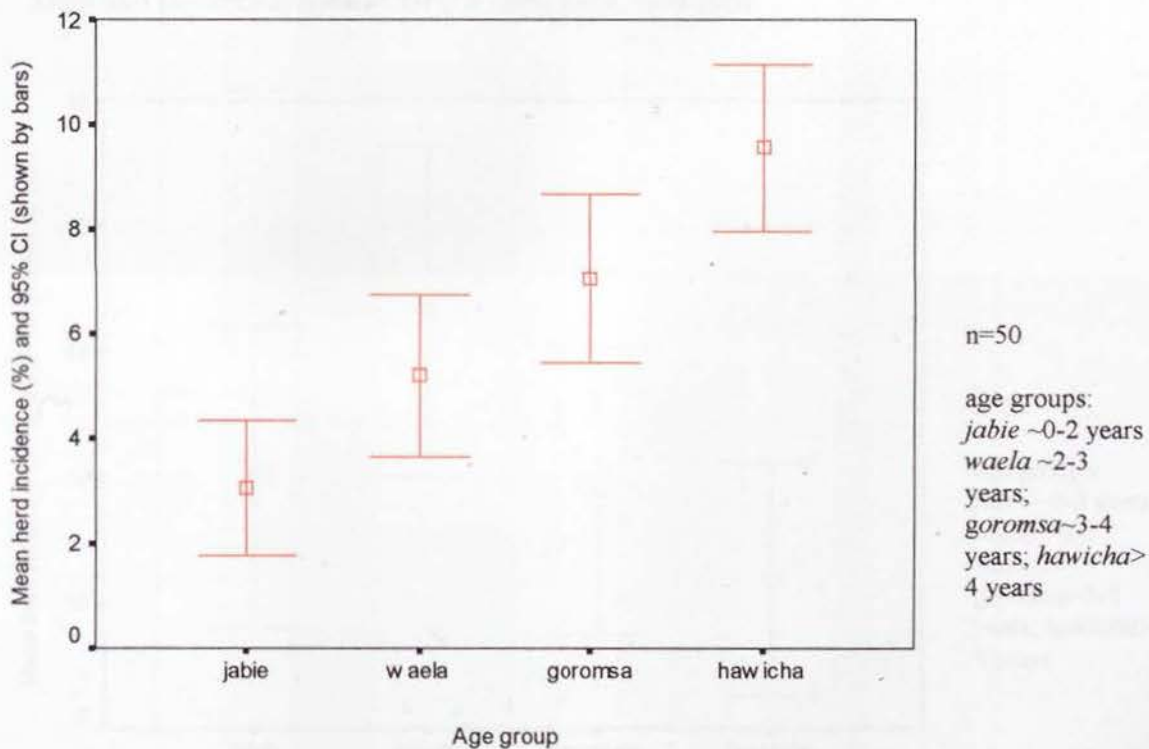


Figure 6.7
 Mean herd incidence of *hoyale*/FMD in Orma cattle, 1999-2000

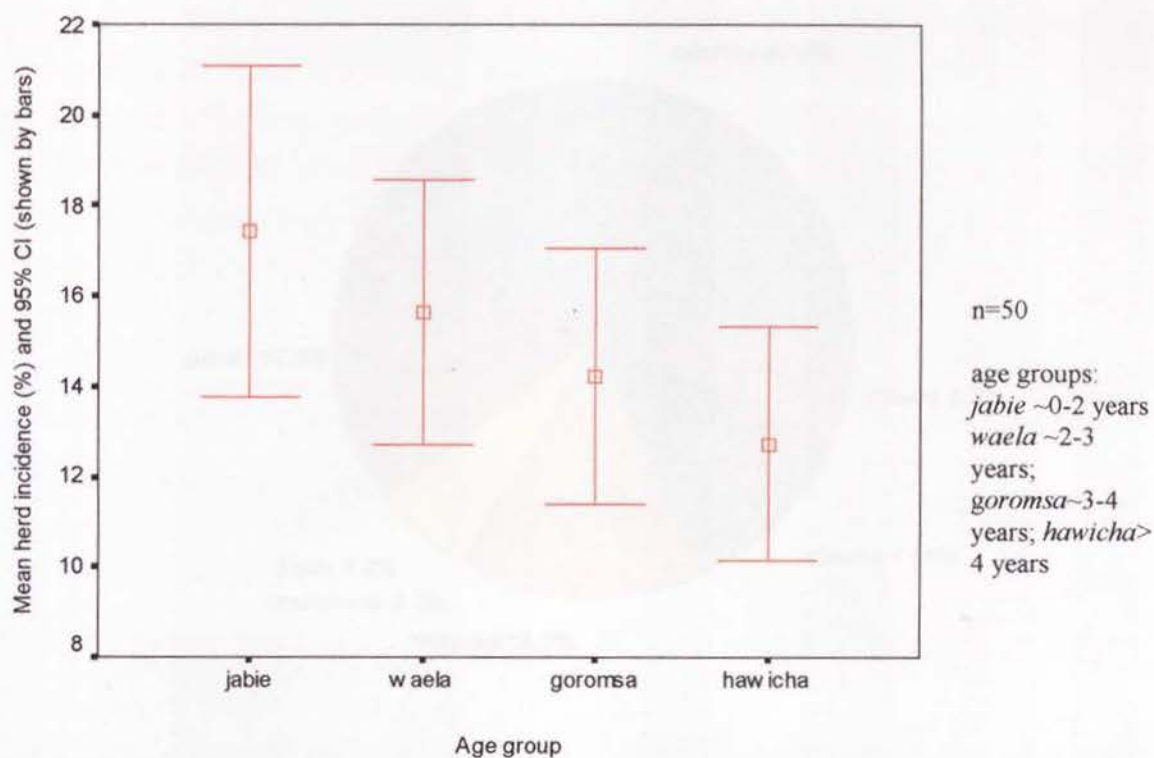


Figure 6.8
 Mean herd incidence of *somba*/CBPP in Orma cattle, 1999-2000

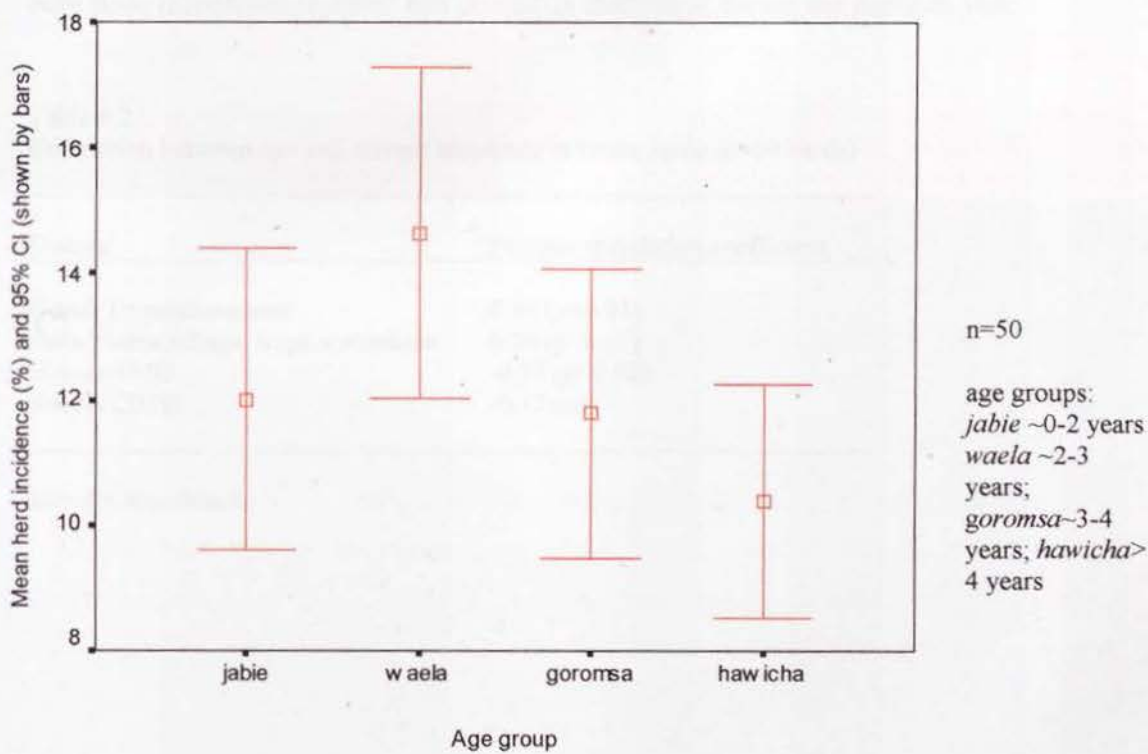
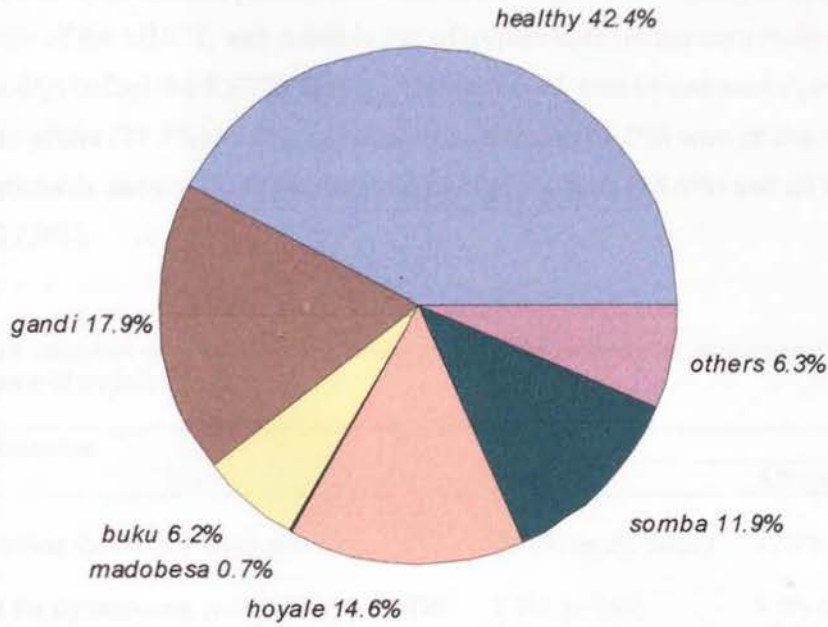


Figure 6.9

Mean herd incidence[†] of cattle diseases and healthy cattle, all age groups, 1999-2000 (n=50)



[†] Percentages were rounded.

Correlations between disease incidence estimates and age of cattle affected are shown in Table 6.2. A correlation coefficient was not calculated for *madobesa*/rinderpest because only three informants reported this disease in their herds during the previous year.

Table 6.2

Correlation between age and disease incidence in Orma cattle (n=50 herds)

Disease	Pearson correlation coefficient
<i>Gandi</i> /Trypanosomiasis	0.49 (p<0.01)
<i>Buku</i> /Haemorrhagic trypanosomiasis	0.39 (p<0.05)
<i>Hoyale</i> /FMD	-0.15 (p<0.05)
<i>Somba</i> /CBPP	-0.12 (ns)

ns = not significant

Comparison of annual incidence estimates for *gandi*/trypanosomiasis (1999-2000) with trypanosome point prevalence (estimated by KETRI in October 2000) is shown in Table 6.3. A corrected, true trypanosome point prevalence was calculated according to the sensitivity and specificity of the MHCT, and possible use of trypanocide (either curatively or prophylactically) before the KETRI survey. The corrected, true trypanosome point prevalence in adults (27.3%) and all age groups combined (18.2%) was similar to the incidence estimates derived from proportional piling for adults (28.6%) and all age groups combined (17.9%).

Table 6.3
Comparison of incidence estimates for trypanosomiasis (1999-2000) using proportional piling and point prevalence of trypanosomes

Method of estimation	Age group ¹	
	Adults	All ages
Proportional piling for disease incidence	28.6% (n=50 herds)	17.9% (n=50 herds)
MHCT result for trypanosome prevalence, by KETRI	7.5% (n=268)	5.0% (n=456)
Estimation of true trypanosome prevalence ²	15.0%	10.0%
Corrected true trypanosome prevalence ³	27.3%	18.2%

¹ The KETRI survey categorised cattle as 'calves' or 'adults', and specific comparison of calves in the KETRI survey with the *japie*, *waela* and *goromsa* age groups in the present study was not attempted.

² Assuming MHCT sensitivity of 50% (Eisler, personal communication) and test specificity of 100% (researcher's own estimate), and use of the formula from Thrusfield (1995):

$$\text{true prevalence} = (\text{test prevalence} + \text{specificity} - 1) / (\text{sensitivity} + \text{specificity} - 1)$$

³ Based on the results of interviews by KETRI with 48 elders indicating that up to 45% of each herd was treated with trypanocide, either curatively or prophylactically, during the wet seasons (including the period October to December)(Irungu, 2000a). This correction assumed a possible reduction in the true trypanosome prevalence of up 45%.

6.4 Discussion

6.4.1 General methodological issues

In general, the use of PA methods in this research led to good rapport and open communication between the researchers and community members. In part, this was due to the importance assigned by livestock keepers to *gandi* and a long history of trying to avoid tsetse-infested areas, and using various medicines and other methods to prevent or control

the disease. These control methods are described in more detail in Chapter 7. The researcher did not experience the problem of lack of cooperation from Orma pastoralists described by Mahdi (1999) or demands of payment in return for information.

At the end of each day, the research team reviewed the data and discussed any methodological issues from the day. These discussions often involved comparison of PA methods with questionnaires, because all team members had previous experience of questionnaire surveys. Initially, team members felt that PA methods were tiring because of the need for constant awareness of their own behaviour and 'body language', and the need to cross-check and probe responses according to a checklist of key issues. According to the team members, this differed from a questionnaire method because all the questions were laid out on a recording form and the enumerator simply filled in the answers provided by the respondent. Apparently, less thought and effort was required on the part of a researcher when using a questionnaire.

As the research progressed, team members became more comfortable with PA methods and more skilled at using open and probing questions. However, this took time and indicated that when researchers are new to PA, important qualitative information can easily be lost during the early stages of the study.

6.4.2 Assessment of the matrix scoring method

6.4.2.1 *Reliability of matrix scoring*

The matrix scoring method showed strong evidence of reproducibility when used with Orma informants (Figures 6.3 and 6.4). Informants soon grasped the methodology and scoring procedure, and the need to assign specific scores to each indicator and disease. The scoring process resulted in much discussion, with different informants suggesting changes to the scores offered by others. Often these changes were minor, but there was still considerable debate before agreement on the 'correct score'. As the method used piles of stones, it was relatively easy for informants to adjust the scores during the debate and everyone could see what was happening, and follow the discussion.

6.4.2.1 *Validity of matrix scoring*

Regarding the validity of matrix scoring, scoring of control diseases matched modern veterinary knowledge for most of the disease signs and disease causes. For example, before conducting the matrix scoring, *hoyale* was assumed to be FMD. During matrix scoring, *hoyale* was associated with shade-seeking behaviour (fever) and reduced appetite. Similarly, *madobesa* (assumed to be rinderpest) was associated with diarrhoea, reduced appetite and loss of tail hair (due to scalding of the tail and perineum) (Figure 6.3). The Orma disease *somba* was assumed to be CBPP and was scored highly for coughing and weight loss. When scoring disease causes, *hoyale* and *madobesa* were strongly associated with contact with sick cattle and buffaloes, but were not scored for ticks, Tabanids or tsetse flies (Figure 6.4).

The results demonstrated much agreement between signs and causes of the Orma disease *gandi*, and bovine trypanosomiasis as reported in veterinary texts. For example, *gandi* was associated with chronic weight loss, mild diarrhoea, mild coughing, reduced appetite and loss of tail hair (Figure 6.3). In the dead animal, oedema and haemorrhage were observed. Apart from coughing, these signs are indicative of trypanosomiasis and are well known by veterinarians working in pastoralist areas. Loss of tail hair is rarely cited in veterinary textbooks as a sign of trypanosomiasis, but this sign is widely reported in the ethnoveterinary literature from pastoralist areas². Other disease-signs, such as ‘swollen lymph nodes’, might have been added to the matrix, but the researcher assumed that the other four diseases in the matrix might also cause this sign. It was also assumed that if too many signs were used in the matrix, the scoring process might become tedious and informants would lose interest.

Assessment of disease causes showed that the disease *gandi* was strongly associated with the fly called *gandi* (tsetse) (Figure 6.4). Similar names are found in other areas. Veterinarians working in Somali areas have used the Somali word *gendi* as a synonym for trypanosomiasis (Mares, 1954b; Dirie, 1984; Catley and Mohammed, 1995). Working with the Yaa Galbo, a Gabra sub-group, Lindquist and Adolph (1992) used the name *gundi* for trypanosomiasis³. Considering that the Orma name for the disease and the fly are the same, this association was anticipated. However, informants also linked the disease *gandi* to

² As detailed in Chapter 4; references include Ohta (1984), Wolfgang and Sollod (1986), Catley and Mohammed (1995), and Köhler-Rollefson (1996).

³ Names for bovine trypanosomiasis in African languages have been reported in the literature for many years. Bruce (1895) noted the Zulu words *nagana*, *injoko* and *munca* for the disease and subsequently, *nagana* was widely used by scientists as a synonym for trypanosomiasis in cattle.

kobabe (Tabanids) and *shilmi* (ticks) (Figure 6.4). Further questioning about *kobabe* and *shilmi* indicated that both these parasites were associated with thin cows and prevented cattle from grazing normally. This finding indicates that cattle losing weight for reasons other than trypanosomiasis might also be called *gandi*. In general, tick-borne diseases were not considered by local veterinary staff or herders to be a serious problem.

The Orma disease *buku* appeared to be an acute, haemorrhagic form of trypanosomiasis that was most commonly seen in coastal areas. Orma herders differentiated the disease from other acute, fatal diseases such as *bashash* (anthrax) using observations such as the degree of haemorrhage from orifices and the coagulation of blood after death. A haemorrhagic form of trypanosomiasis due to *T. vivax* has been reported in coastal areas of Kenya (Mwongela *et al.*, 1981) and was diagnosed at the Witu Veterinary Investigation Laboratory near Tana River District (unpublished data from laboratory daybooks). A mild haemorrhagic syndrome in cattle due to *T. vivax* was also reported along the tsetse-infested Shabelle River in southern Somalia, an area with a similar ecology to Tana River (Dirie *et al.*, 1988). Therefore, Orma knowledge of *buku* seemed to be valid when viewed from a modern veterinary perspective.

Although there was much agreement between Orma and professional knowledge, one point of disagreement was the role of the fly called *gandi buku*. The fly was consistently described by informants as dark in colour, smaller and broader than *gandi* (tsetse), and found in cracks in dry earth or bark. Only a single specimen of a fly called *gandi buku* could be found and this specimen was identified as *Oestrus ovis* by the researchers. It was not known whether this specimen really was *gandi buku* and further research is needed to elucidate the role, if any, of flies other than tsetse in the epidemiology of acute haemorrhagic trypanosomiasis.

6.4.3 Assessment of proportional piling

6.4.3.1 Reliability of proportional piling

The proportional piling method used in the study was the first attempt to adapt this PA method into a standardized method to estimate disease incidence, and repeat the method with more than two or three informants. Therefore, procedures for summarizing and analyzing the data were not well defined in the veterinary literature and were largely drawn from experience with more conventional methods.

6.4.3.2 **Validity of proportional piling**

a. Comparison with general assessment of disease importance

The high incidence of trypanosomiasis detected in this study (Figure 7.9) agrees with disease rankings reported by other workers. Mahdi (1999) assessed disease importance according to the number of pastoralists (n=48) mentioning different diseases. In order of importance, the top five diseases were trypanosomiasis, CBPP, FMD, anthrax and blackquarter. Similarly, Irungu (2000a) interviewed 48 elders in Ormaland and 41 (85.4%) interviewees ranked trypanosomiasis as the most important disease. Although a disease of high incidence may not necessarily be important, it seems that incidence and importance of trypanosomiasis were related in Orma areas.

b. Comparison with estimates of trypanosome prevalence

The results presented in Table 6.3 indicate similarity between the annual incidence estimates for chronic trypanosomiasis (*gandi*) for 1999-2000 derived from proportional piling, and the corrected true trypanosome point prevalences for adult cattle and all age groups⁴. Further comparison between MHCT results and proportional piling results was not possible for other age groups because the KETRI survey did not record the precise ages of animals tested, but categorized cattle as either 'adults' or 'calves'. Also, the KETRI survey did not record recent treatment with trypanocides for each animal tested. For these reasons, the researcher concluded that the comparison presented in Table 6.2 should be regarded as very approximate.

A further consideration was the possibility that incidence estimates were exaggerated because informants were aware that KETRI staff had a particular interest in *gandi*. Previous work by KETRI in Garsen Division (for example, in October 2000) demonstrated their interest in trypanosomiasis to local people and KETRI scientists were easily identified because their vehicles carried a characteristic logo. According to proportional piling, the incidence of *buku* reached 9.6% in adult cattle; this figure appears to be particularly high but no data were available for cross-checking this result.

⁴ Prevalence (P) is related to incidence rate (I) and duration of disease (D) by the formula $P/(1-P) = I \times D$ (Thrusfield, 1995).

c. Comparison with conventional opinion of age-related trends in disease incidence

Proportional piling results were also assessed by comparison of age-specific trends in incidence (Table 6.2; Figures 6.5 to 6.8) with conventional veterinary thinking or previous studies. The increasing incidence of *gandi* and *buku* with age agrees with the assumption that risk of infection with trypanosomes is age-related because older cattle have had greater exposure to tsetse.

Regarding CBPP, studies on Dinka cattle in southern Sudan showed that the prevalence of CBPP antibody, as detected by CFT, peaked in cattle between three months and three years of age (Zessin *et al.*, 1985)⁵. Another study on Dinka cattle demonstrated higher CBPP antibody in the two-to-four year age group, and noted a statistically significant association between herders' diagnosis and laboratory diagnosis for these cattle (McDermott *et al.*, 1987). These studies indicated that in an endemic situation in pastoralist herds, the incidence of CBPP peaks in cattle up to three to four years of age. This trend in incidence is similar to the age specific incidence of *somba*/CBPP shown in Figure 6.8.

For *hoyale*/FMD, the researcher could not find a reference describing age-specific incidence in an endemic situation in pastoralist herds. Considering that natural immunity to FMD virus is short-lived in cattle, lasting for less than five months, and that antibodies in colostrum protect calves for up to five months of age (Scott, 1990), an endemic situation would probably result in lower incidence in calves than adults. One explanation for the decreasing incidence with age illustrated in Figure 6.7 (albeit a relatively minor trend from mean incidence of 17.4% per year in calves to 12.7% in adults) was that informants included perceptions of disease severity in their descriptions of incidence. If this was the case, disease in younger cattle might be more severe than older cattle.

6.4.3.3 Proportional piling compared with questionnaires

The proportional piling method for estimating disease incidence seemed to have a number of advantages when compared with questionnaires. Commonly, questionnaires focus on a single disease that is of specific interest to the researcher and questions are phrased using

⁵ In the case of CBPP, antibody detection by CFT is usually regarded as a good measure of active infection. This contrasts with many other diseases for which the presence of antibody indicates exposure to the disease agent, comprising existing and previous infection.

modern terminology. This approach means that the respondent is aware of the researcher's interest and may respond by either being overly courteous, or exaggerating responses in expectation that some form of assistance may result. For example, a respondent may propose a high incidence of the disease in question, hoping that this answer will lead to provision of free drugs or vaccines. Also, the use of modern or English terms in the questionnaire requires the interviewer to translate words such as 'calves' and 'trypanosomiasis' into a local language and then translate the response back into English. Not only may different interviewers translate these terms in different ways but errors are possible at each point of translation.

A further source of error in questionnaires can be the classification of age groups of cattle by a researcher into categories that are familiar to, or useful for the researcher but are not used on a daily basis by the informant. For example, a questionnaire might ask: 'What proportion of cattle in the following age groups suffered from trypanosomiasis last year?' and then specify age groups such as 0-6 months, 6-12 months, 1-2 years, 2-3 years and so on. When responding to the 0-6 month and 6-12 month categories, an Orma respondent would probably think about the age group called *jabie* (calves to approximately 1 year of age). To give an answer for each of the two age categories proposed by the researcher, the informant would need to perform mental division of the result for *jabie* as a whole. This is likely to reduce the accuracy of the responses⁶. The proportional piling method avoided these kinds of error by using local disease names as characterized using matrix scoring, and using local definitions of cattle age groups.

6.4.3.4 Recall bias

Both questionnaires and proportional piling are subject to recall bias. Veterinary researchers often assume that recall bias is a particular problem with respondents who do not keep written records of herd management and disease events, because people simply forget what happened at a certain time. However, there are a number of reports of pastoralists' ability to provide very detailed verbal accounts of past disease events, covering the entire lifespan of

⁶ An alternative explanation of this error could be as follows. Assume that a researcher asks a British civil servant to specify their monthly mortgage payment. The respondent could probably provide a very quick and accurate answer. However, if the researcher asked 'What is your mortgage for the first nine days of the month and the subsequent 21 days of the month?', the respondent would probably have difficulty calculating the correct responses (at least, without the aid of a calculator). The use of an unfamiliar timeframe for describing mortgage payments hinders a valid answer.

their stock. For example, when studying CBPP and brucellosis in southern Sudan it was noted that on the point of age recollection,

'While in some livestock areas such information cannot be collected accurately, for the Dinka (and other Nilotic cattle-culture peoples), cattle are the central focus of their daily activities and detailed genealogies and life histories for individual animals are known by every owner' (McDermott et al., 1987).

A similar capacity to recall events affecting the lives of individual animals, and even the mothers of each live female in the herd, was reported for Maasai informants in Kenya (Grandin, cited by Iles, 1994b). This recollection of livestock-related incidents probably arises from the fundamental economic and social importance of animals to pastoralists. Livestock topics form a substantial part of the everyday conversation of pastoral communities. In some communities, daily meetings are held to discuss how different animals are performing and should be managed. According to Akabwai (1992) herders in Turkana, northern Kenya are often perceived by outsiders to be lazy because they spend long periods sitting under trees chatting to each other. However, most of the talk is about livestock, whether such and such an animal is pregnant, whether a new calf is growing well, the condition of the pasture and so on. Turkana elders met each day under the 'Tree of Men' to decide how cattle should be watered and grazed, and other livestock-related issues. When studying the Nuer in southern Sudan, Evans-Pritchard (1940) noted the tendency for every conversation to turn to livestock:

'...they are always talking about their beast. I used sometimes to despair that I never discussed anything with the young men but livestock and girls, and even the subject of girls led inevitably to that of cattle. Start on whatever subject I would, and approach it from whatever angle, we would soon be talking of cows and oxen, heifers and steers, rams and sheep, he-goats and she-goats, calves and lambs and kids. I have already indicated that this obsession - for such it seems to an outsider - is due not only to the great economic value of cattle but also to the fact that they are links in numerous social relationships. Nuer tend to define all social processes and relationships in terms of cattle. Their social idiom is a bovine idiom. Most of their social activities concern cattle and 'cherchez la vache' is the best advice that can be given to those who desire to understand Nuer behaviour.'

6.4.3.5 Further adaptation and application of proportional piling

Reference to the literature, as detailed above, suggests that a method such as proportional piling might be used to estimate disease events over periods longer than the one-year period used in this study. In order to assess both endemic and epidemic situations, PA methods such as timelines could be used to identify periods of relatively stability with respect to

disease outbreaks, and the timing of epidemics. The use of timelines at the start of a study would also enable a researcher to make a provisional assessment of local capacity to recall livestock-related events. According to the results of timelines, proportional piling could be repeated to cover both a 'typical endemic period' and a 'typical epidemic period' depending on the diseases in question. Timelines have been used during searches for rinderpest in East Africa and aggregated results used in a time series model to test for significant patterns and periodicity (Mariner and Roeder, 2003).

A second use or adaptation of proportional piling could be to expand the method to include disease mortality. To estimate mortality, the pile of counters representing the incidence of diseases would be further divided to show the pattern of animals surviving relative to animals dying. This additional piling would enable calculation of herd mortality and case fatality for different diseases, and would also facilitate discussion on treatments used and the success of treatment.

6.5 Summary

This study demonstrated the value of matrix scoring for understanding how livestock keepers characterized cattle diseases. The method was repeatable and allowed easy comparison of local descriptions of disease signs and causes with textbook descriptions of disease. There was much overlap between Orma and modern descriptions of trypanosomiasis. In the case of acute haemorrhagic trypanosomiasis due to *T. vivax*, the disease is well known by Orma herders but important aspects of the diseases, such as modes of transmission, are not well described in the veterinary literature.

The study was the first attempt in veterinary epidemiology to estimate disease incidence using a standardized, indirect proportional piling method. The method demonstrated good repeatability and validity, and seemed to have numerous advantages over questionnaire methods with regard to incidence estimates.

Chapter 7

PARTICIPATORY INVESTIGATION OF BOVINE TRYPANOSOMIASIS IN ORMA COMMUNITIES, KENYA: SPATIAL AND SEASONAL FACTORS, AND LOCAL PREFERENCES FOR CONTROL OPTIONS

7.1 Introduction

Herders' diagnosis of bovine trypanosomiasis in Garsen Division, Tana River District and incidence estimates using PA methods indicated strong ability of herder's to recognise two forms of the disease (Chapter 6). The chronic form of trypanosomiasis was called *gandi* whereas an acute haemorrhagic form of the disease was called *buku*. Results also indicated high incidence of bovine trypanosomiasis. In order to investigate options for improving control of these diseases, PA methods were used to investigate seasonal and spatial aspects of trypanosomiasis, and herders' analysis and preferences for different disease control options. The Kenya Trypanosomiasis Research Institute (KETRI) was particularly interested in assessing the feasibility of establishing community-based tsetse control projects in the four study villages covered by the research.

This chapter describes the use of mapping and seasonal calendars to assess geographical and seasonal factors, and matrix scoring and matrix ranking to understand local preferences for different control methods. This research was conducted as part of the participatory assessment of trypanosomiasis in Garsen Division described in Chapter 6 with a view to complementing information on Orma diagnosis of trypanosomiasis, and identifying options for testing disease control methods. Maps were used as a qualitative tool for cross-checking information already obtained on local perceptions of disease diagnoses and causes.

Seasonal movements of the Orma have been described and are based on transhumance between dry season homesteads in the Tana River delta and wet season grazing areas (Ensminger, 1984; Irungu, 2000a). Movement away from the delta occurred at the beginning of the rainy season to avoid flooding and increasing numbers of biting flies. However, not all livestock moved away from the delta, and the older men, women and children remained with some milking cows and other livestock, while other livestock are

moved to the wet season grazing areas in the ‘hinterland’. The research focussed on the permanent dry season villages in the delta.

7.2 Materials and Methods

The research was conducted in the same four villages, Gadeni, Danissa, Oda and Kipao, described in Chapter 6 and the same research team was involved.

7.2.1 Participatory mapping

Participatory mapping was used to understand local perceptions of the distribution of tsetse flies around the four villages. On the ground, the researcher created a reference point that was known to the informants, such as a river, mosque or school. Informants were then asked to show the important features of their village and the surrounding vegetation, water resources, areas of cultivation and grazing, and tsetse infested areas. Informants were advised to use materials to hand, such as branches, leaves and stones, to build the map. They were left alone for about 30 minutes to work on their maps and then the researcher checked whether the map was finished. If so, informants were then asked to explain their maps, and open questions were used to start discussion on issues such as seasonal cattle movements and tsetse fly distribution.

Maps were constructed on the ground by one group of informants in each of the four villages. Group sizes varied from five to 12 individuals. Completed maps were copied on to newsprint and this copy was left with the informants. Other copies were made into the researchers’ notebooks.

Tsetse distribution as described on maps was compared with the results of a fly survey conducted by KETRI in October 2000 (Irungu, 2000b) in Oda, Gadeni and Danissa¹. Results from the fly survey are summarised in Table 7.1. Official tsetse distribution maps for Kenya were also consulted and showed high infestation with *Glossina pallidipes*, *G. brevipalpis* and *G. austeni* in the Tana River delta.

¹ The KETRI tsetse survey did not include Kipao because the survey team considered the village to be difficult to access. The survey used biconical traps baited with acetone and sachets of octenol, methylphenol and propyl in a ratio of 12:4:1. Traps were left at survey locations for 48 hours.

Table 7.1

Results of fly survey (mean number of flies per trap) conducted by KETRI in October 2000 (source: Irungu, 2000b)

Location (number of traps)	Tsetse		<i>Stomoxys</i> species	<i>Tabanid</i> species
	<i>Glossina pallidipes</i>	<i>Glossina brevipalpis</i>		
Oda (10)	29.7	0.01	17.8	0.1
Gadeni (5)	2.3	0	46.0	1.0
Danissa (5)	3.3	0	79.0	2.4

7.2.2 Seasonal calendars

Seasonal calendars were used to describe the seasonal incidence of the same diseases used in the matrix scoring of disease signs and causes (Chapter 6), and seasonal populations of ticks, biting flies and cattle-buffalo interactions. Rainfall was also depicted. The methodology for constructing the seasonal calendars was similar to the matrix scoring for disease signs and causes.

Local names for seasons were used and each season was represented using an object placed along the *x*-axis of the diagram. Diagrams depicting diseases and parasites, and specimens of parasites, flies and ticks were placed along the *y*-axis of the diagram. This type of seasonal calendar was used with same group of informants in each village who constructed maps (section 7.2.1).

7.2.3 Analysis of existing control methods for trypanosomiasis

In order to understand local preferences for existing control methods for trypanosomiasis, a matrix scoring method was used. This matrix comprised different control methods (both indigenous and modern methods) along the *x*-axis of the matrix and various features of these methods (e.g. cost, effectiveness) along the *y*-axis of the matrix. Both the methods and indicators were represented using line drawing on pieces of card. The methods were identified by asking groups of informants to list all the ways they prevented or treated the disease. The researcher identified the indicators to be scored against each control method. However, after the scoring, informants were also asked if they wanted to add any indicators to the matrix.

Indicators were scored using piles of stones, and informants selected the number of stones they wished to use. Scores were then converted into ranks and median ranks calculated. The method was conducted with one large group of informants (15-24 people) in each of the four villages.

7.2.4 Analysis of trypanosomiasis control options during a stakeholder workshop

In order to seek community opinions regarding possible ways to improve the control of trypanosomiasis, a stakeholder workshop was held in Minjila, near Garsen, on 29th and 30th November 2000. The workshop was attended by community representatives from Gadeni (six participants), Danissa (five participants), Oda (five participants) and Kipao (seven participants). The other stakeholders who attended the workshop were a socioeconomist, a veterinarian and an entomologist from KETRI, two representatives from the Catholic Diocese of Malindi, the District Veterinary Officer, and a representative from the private Agrovet store in Garsen. The researcher facilitated the workshop assisted by KETRI staff.

7.2.4.1 *Identification of researchers' preferences for future interventions*

During the stakeholder workshop, it was anticipated that the researchers would present their views, as a team, to community representatives on three trypanosomiasis control interventions. This required the researchers to conduct their own analysis of various trypanosomiasis control options before the workshop in order to reach some form of consensus and ensure clarity concerning the advice to be offered.

The researchers' own analysis of trypanosomiasis control options involved two main activities:

1. Discussion and ranking of different trypanosomiasis control methods based on technical knowledge and knowledge of project resources. This process was intended to narrow down a wide range of options to a smaller number of researchers' preferences. During a discussion facilitated by the researcher, six other members of the research team listed the advantages and disadvantages of seven trypanosomiasis control methods. The methods were community-based tsetse targets or traps, trypanocidal drugs, 'pour-ons' (e.g. containing deltamethrin or flumethrin), bush clearance, cattle movement, deltamethrin dips and insecticide spraying. The same

team members then individually selected a preference rank of 1 (high preference) to 7 (low preference) for each of the control methods. The Kendal coefficient of concordance (W) in SPSS software, version 9 (SPSS, 1999) was used to determine the level of agreement between the six researchers.

2. The six researchers then ranked the three most preferred control methods identified from activity 1 against 'sustainability indicators'. The selection of sustainability indicators was based on increasing knowledge of the technical and social features of the project area as the fieldwork progressed and knowledge of some important sustainability issues affecting community-based animal health initiatives generally (see section 6.1.1, Chapter 6). The six sustainability indicators used are described in detail in Table 7.2. The indicators did not include 'effectiveness' because the researchers considered all of the selected control methods to be effective if properly used. A matrix ranking method was used in which each researcher assigned a rank to each indicator by disease using ranks of 1 (high rank) to 3 (low rank). The level of agreement was determined using the Kendal coefficient of concordance (W) in SPSS software, version 9 (SPSS, 1999).

7.2.4.2 *Preferences of community representatives for trypanosomiasis control methods*

The second stage of the workshop required each group of community representatives ($n=4$) to rank the three trypanosomiasis control methods identified by the researchers (section 7.2.4.1) against sustainability indicators (Table 7.2), using matrix ranking. However, after presentations by KETRI staff on their three most preferred control methods, workshop participants suggested the addition of a fourth control method (community-based dips). Therefore, the matrix ranking was conducted with four control methods and six sustainability indicators. Ranks of 1 (high rank) to 4 (low rank) were assigned to each control method by sustainability indicator by each group of community representatives. After the matrix ranking, the same community representatives were then asked to reflect on their results and conduct an overall ranking of the four control methods.

Table 7.2
Sustainability indicators used to assess trypanosomiasis control interventions

Sustainability indicator	Notes
'Community commitment to contribute finance, labour and management'	This indicator was a measure of collective commitment to invest in an intervention.
'Low financial cost to end-users'	It was assumed that the lower the cost of a disease control method, the greater the willingness and capacity to pay at community-level.
'Builds on existing knowledge and practices'	More successful community-based animal health projects have utilized indigenous veterinary skills and knowledge, particularly in pastoralist communities (such as the Orma).
'Individuals can benefit by acting alone'	This indicator was used to highlight disease control methods that did not require collective action or group contributions to use the method. It was assumed that group action was less sustainable than individual action because it required prolonged community organization and management inputs.
'Resistant to crises'	Pastoral areas of Kenya and other countries are prone to drought, conflict and other crises. It was assumed that a sustainable disease control method should withstand these crises and continue to be available and accessible during crises.
'Avoids conflict with neighbours'	Competition for natural resources between pastoral communities and sedentary farming communities was an important issue in the Tana River delta. It was assumed that a sustainable disease control method should not contribute to conflict by, for example, enabling pastoral herds to encroach further into tsetse-infested, farmed areas.

7.2.4.3 Commitment of outside agencies to support future interventions

While community representatives were conducting the matrix ranking described in 7.2.4.2, other stakeholder groups, ranked their commitment to contribute finance, labour and management inputs to the same four control methods. Following the ranking exercises, results were collated and presented to the workshop participants in order to verify the findings. This process was followed by elaboration of activities to support the most preferred intervention and the formulation of a provisional work plan.

In summary, the workshop involved the following activities:

Day 1

- Welcome, introduction, aims and objectives of the workshop.
- Feedback from communities on participatory assessment of trypanosomiasis conducted in villages; verification and cross-checking results.
- Presentations by KETRI staff to explain the key features, advantages and disadvantages on four possible control interventions:
 - community-based tsetse control using targets and traps;
 - better use of trypanocides (including monitoring drug resistance);
 - use of pour ons;
 - use of dips.

Day 2

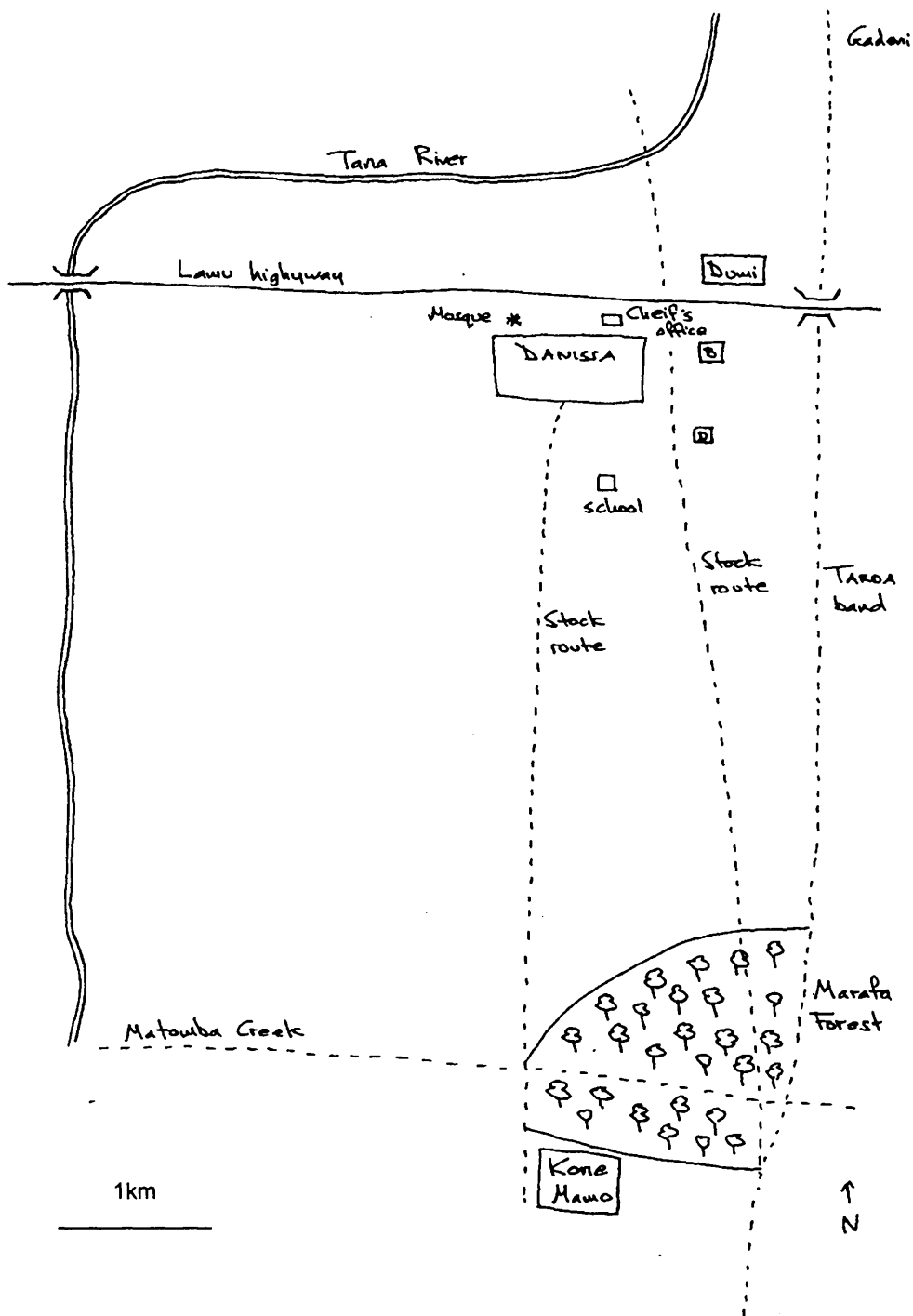
- Ranking of four possible control interventions against sustainability indicators.
- Ranking of commitments by public, private and technical stakeholders.
- Analysis of results and joint-identification of the most preferred control intervention.
- Outline of intervention by KETRI.
- Agreement on future roles and responsibilities of different players.
- Formulation of draft action plan.

7.3 Results

7.3.1 Geographical factors

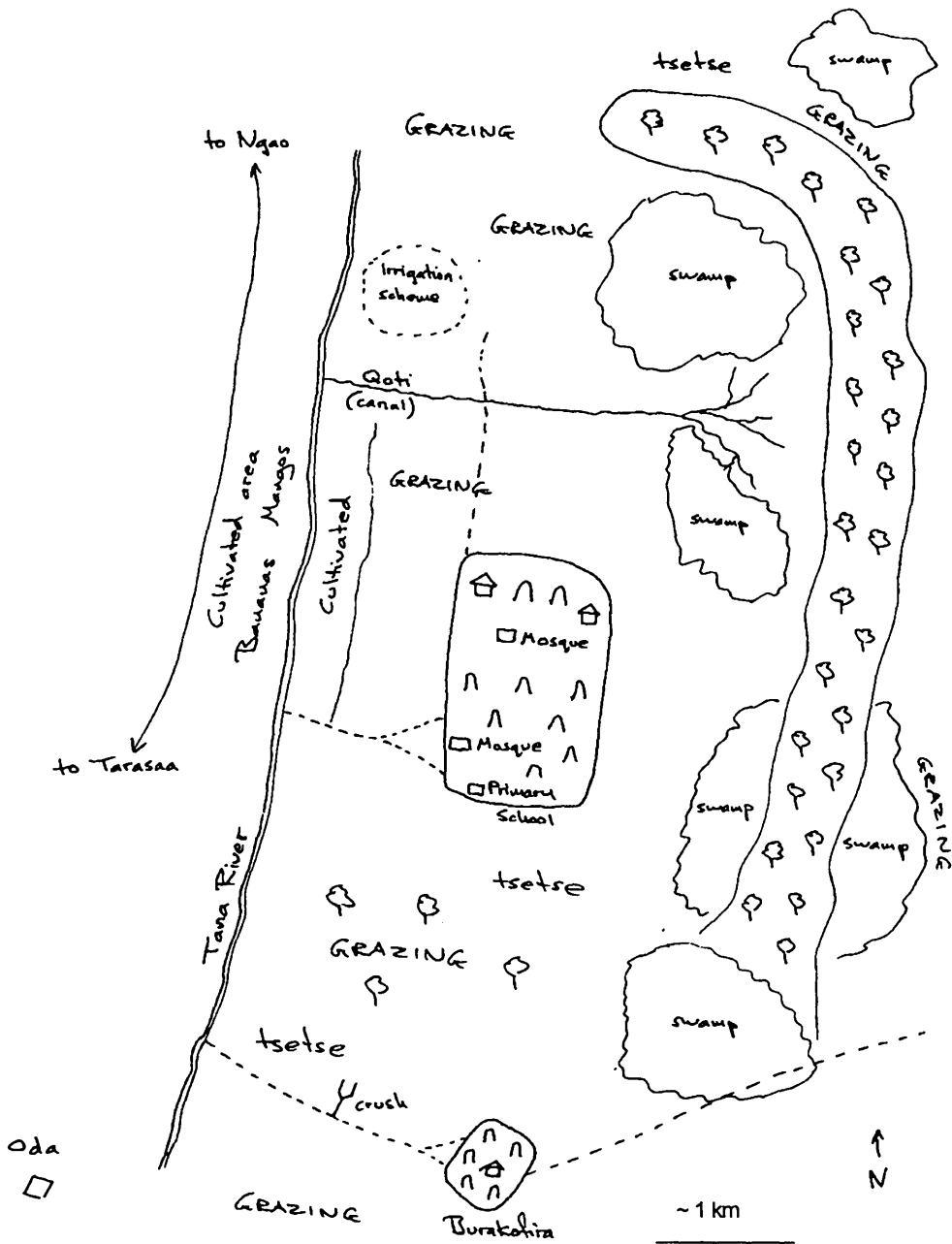
Maps for each village are shown in Figures 7.1 to 7.4.

Figure 7.1
Map of Danissa village and surrounding area



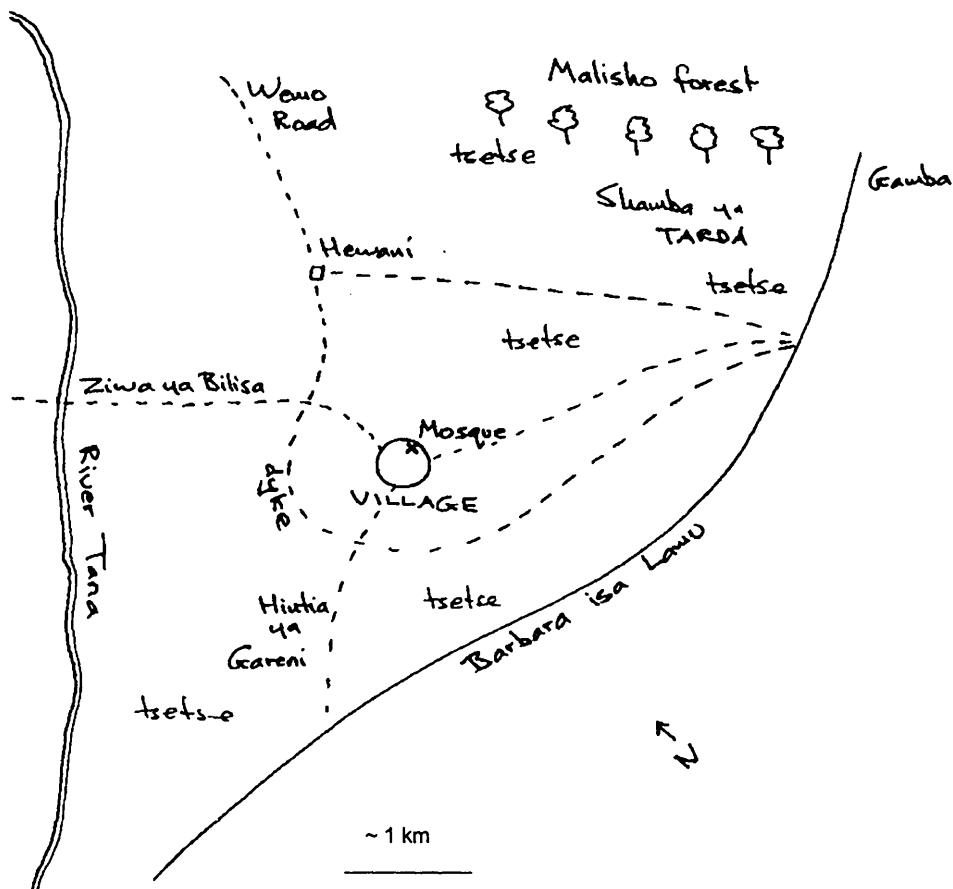
The main source of tsetse flies was thought to be Marafa forest, although flies were present all over the grazing areas to the south of the village.

Figure 7.2
Map of Kipao village and surrounding area



The main grazing areas were to the north, east and south of the village. All these areas were infested with tsetse. Swamps to the east fed into the Tana River delta and acted as a natural barrier against movement of cattle in that direction. The village could only be reached by canoe across the Tana River.

Figure 7.4
Map of Gadeni village and surrounding area



7.3.2 Seasonal variations

Results from the four seasonal calendars are summarised in Figure 7.5. Despite the small sample size, there was evidence of strong agreement for two indicators and moderate agreement for four indicators. There was evidence of weak agreement for four of the indicators.

Figure 7.5
Summarised seasonal calendar for livestock diseases, biting flies, ticks and cattle-buffalo contact[†]

	Orma seasons											
	<i>Hageiya</i>			<i>Bona hageiya</i>			<i>Gana</i>			<i>Shur-icha</i>		<i>Bona adoles</i>
	Months by Gregorian calendar											
	O	N	D	J	F	M	A	M	J	J	A	S
Rainfall <i>Roba</i> ($W=0.87^{**}$)	5.5 (4-7) ●●●●			0 (0-0)			10.0 (9-11) ●●●●●●●●			3.5 (3-4) ●●●		1.0 (0-2) ●
Trypanosomiasis <i>Gandi</i> ($W=0.74^*$)	6.5 (6-7) ●●●●			8.5 (7-10) ●●●●			1.0 (0-2) ●			1.0 (0-2) ●		2.5 (1-4) ●●
FMD <i>Hoyale</i> ($W=0.76^*$)	4.0 (3-5) ●●			9.5 (8-11) ●●●●●			1.5 (0-3) ●●			1.5 (0-3) ●●		3.5 (3-4) ●●●
Haemorrhagic trypanosomiasis <i>Buku</i> ($W=0.91^{**}$)	8.0 (6-10) ●●●●			12.0 (10-14) ●●●●●●			0 (0-0)			0.5 (0-2) ●		1.5 (0-4) ●●
CBPP <i>Somba</i> ($W=0.13$)	0 (0-0)			0 (0-0)			4.0 (0-8) ●●●			6.0 (0-12) ●●●●		10.0 (0-20) ●●●●●●
Rinderpest <i>Madobesa</i> ($W=0.25$)	3.0 (0-6) ●●			0 (0-0)			3.5 (0-7) ●●●			3.5 (0-7) ●●●		0 (0-0)
Contact with tsetse flies <i>Gandi</i> ($W=0.54$)	5.5 (4-7) ●●●●			6.0 (4-8) ●●●●			2.0 (0-4) ●●			4.5 (4-5) ●●●●		2.0 (0-4) ●●
Contact with Tabanids <i>Kobabe</i> ($W=0.81^*$)	15.0 (10-20) ●●●●●●●●			3.5 (0-7) ●●			1.5 (0-3) ●●			0 (0-2)		0 (0-2)
Contact with ticks <i>Shilmi</i> ($W=0.69^*$)	5.5 (3-8) ●●●●			11.0 (10-12) ●●●●●●			1.0 (0-2) ●			1.0 (0-2) ●		1.5 (0-3) ●●
Contact with buffalo <i>Gadarsi</i> ($W=0.57$)	2.5 (0-5) ●●			11.5 (8-15) ●●●●●●			0 (0-0)			0 (0-2)		6.0 (0-12) ●●●●

[†] Number of informant groups =4; W =Kendal coefficient of concordance; $^{**}p<0.01$, $^*p<0.05$. Medians are presented in each cell and minimum and maximum values are shown in parentheses.

Follow up questioning and discussion after the scoring of indicators focussed on how scores were related to the seasonal movements of cattle. Informants explained that more cattle were present in the delta and permanent villages during *hageiya* (October to December) and *bona hageiya* (January to mid March). As the delta was wet (during *hageiya*) and hot (in both *hageiya* and *bona hageiya*) during these seasons, exposure to biting flies and ticks was high. When the main rainy season *gana* (mid March to mid-June) started, cattle were moved out of the delta to avoid flooded areas, and into the hinterland grazing areas. As the hinterland was drier than the delta and had different vegetation, exposure to biting flies and ticks was less. This pattern of seasonal movement into and out of tsetse and tick-infested areas in the delta determined the level of contact between cattle and these disease-vectors. Contact between cattle and buffalo peaked during the two main dry periods *bona hageiya* (January to mid March) and *bona adoles*a (August to September) because wild and domesticated animals congregated around dry season water points at these times.

7.3.3 Analysis of existing trypanosomiasis control methods

Table 7.3 shows the results of preference scoring of existing trypanosomiasis control methods. Orma herders used various indigenous and modern methods for controlling trypanosomiasis. Indigenous methods included movement of cattle away from tsetse-infested areas, bush clearance, use of dung fires in the kraals, blood letting and use of herbal remedies. In general, these methods were ranked high for low cost and ease of use, but some were considered to be less effective than modern methods. Modern methods included the use of trypanocidal drugs, pour-ons and dips. Although termed ‘modern’ Orma herders had clearly been using trypanocides for many years and could recall their parents using the drugs regularly. Herders obtained trypanocides from three main sources viz. informal traders (*duka za magendo*), CAHWs and an Agrovet shop in Garsen (the main town in Garsen Division). Ranking of these three sources of trypanocides indicated that only minor differences in cost and effectiveness. Overall, the results indicated that herders were already using an integrated trypanosomiasis control approach that included 10 or more control options, with varying degrees of cost, effectiveness and ease of use.

Table 7.3

Preference ranking of control methods for *gandi* in Gadeni, Danissa, Oda and Kipao

Indicator	Median rank for control methods							Trypanocides from:		
	Herbal remedy	Burning the bush ¹	Bleeding ²	Movement ³	Dung fires ⁴	Pour On	Dips	Hawkers and shops	CAHW ⁵	Agrovat
Effectiveness	8.5	6.0	7.0	7.0	7.0	4.0	3.0	3.0	2.0	3.0
Low financial cost	1.0	1.0	1.0	2.0	1.0	10.0	9.0	6.0	7.0	9.0
Easily used ⁶	4.0	2.0	6.0	3.0	1.0	8.0	9.0	5.0	5.0	6.0
Requires group action ⁷	3.0	3.0	3.0	2.0	3.0	3.0	3.0	3.0	3.0	3.0
Individual acts alone ⁸	5.0	7.0	6.0	8.0	1.0	6.0	8.0	1.0	1.0	1.0

Interpretation of ranks: 1=most preferred; 10=least preferred.

1. Bush clearance by burning is against Kenya government environmental policy.

2. Bleeding or blood letting involved removal of blood from the jugular vein.

3. Cattle movement to and from the river delta to avoid flooding and tsetse.

4. Dung fires are lit among the cattle in the kraals every evening.

5. Community animal health workers

6. 'Easily used' included availability of the materials required to use the method, time and labour inputs, and the level of specialist knowledge required by the users. This specialist knowledge could be either indigenous knowledge e.g. about a specific herbal remedy, or technical knowledge about the use of a veterinary medicine.

7. 'Requires group action' referred to methods that could only be used when people organised themselves for collective action. This indicator was considered to be a negative indicator.

8. 'Individual acts alone' meant that a single livestock keeper could use the method independently of other community members, and any benefits would be received by that person alone.

7.3.4 Stakeholder workshop

7.3.4.1 *Researchers' initial assessments of trypanosomiasis control methods*

Researchers' ranking of seven trypanosomiasis control methods before the stakeholder workshop is presented in Table 7.4. There was evidence of strong agreement between the six researchers ($W=0.60$) and the three most preferred control interventions were better use of trypanocidal drugs, use of pour-ons and community-based tsetse control.

Matrix ranking by researchers of the three most preferred control methods against sustainability indicators is presented in Table 7.5 and showed evidence of strong agreement between the researchers for four of the sustainability indicators. The researchers did not agree on ranking of the indicator 'resistant to crises' ($W=0.08$). In terms of overall sustainability, the three methods were ranked in the order better use of trypanocides (1st), use of pour-ons (2nd) and community-based tsetse control (3rd).

Table 7.4
 Researchers' assessment of trypanosomiasis control methods before the stakeholder workshop

Trypanosomiasis control method	Advantages	Disadvantages	Median preference rank ¹
Community-based targets and traps	<ul style="list-style-type: none"> • Effective • Environmentally friendly • Relatively inexpensive • Easy to use and train users 	<ul style="list-style-type: none"> • Agency resources insufficient relative to coverage area required for adequate tsetse control. • Limited evidence of sustained benefits; weak hand-over to community management • Traps and targets easily stolen or damaged 	2.5
Trypanocidal drugs	<ul style="list-style-type: none"> • Easy to use and train users • Effective • Depends on an individual's private action 	<ul style="list-style-type: none"> • Limited information on usage at community level • Relatively expensive • Potential drug resistance • Drug residues may affect human health 	1.0
Pour-ons	<ul style="list-style-type: none"> • Easy to use and train users • Effective • Depends on an individual's private action 	<ul style="list-style-type: none"> • Very expensive 	2.5
Bush clearance	<ul style="list-style-type: none"> • Community already knows how to use the method • Good sustainability 	<ul style="list-style-type: none"> • Requires potentially difficult agreements between neighbouring communities • Legal implications 	4.5
Cattle movement	<ul style="list-style-type: none"> • Community already knows how to use the method • Good sustainability • Effective 	<ul style="list-style-type: none"> • Potential conflict with settled farming communities 	5.0
Deltamethrin dips	<ul style="list-style-type: none"> • Effective 	<ul style="list-style-type: none"> • Requires expensive rehabilitation or building of dips • High management inputs from community 	5.5
Insecticide spraying	<ul style="list-style-type: none"> • Effective short-term 	<ul style="list-style-type: none"> • Adverse environmental effects • Expensive • Repeated spraying needed to prevent re-invasion of tsetse 	6.5

1. The lower the median rank, the greater the preference. Each method was ranked from 1 to 7 by each of six researchers; $W=0.60$; $p=0.001$.

Table 7.5
 Researchers' ranking of best-bet control interventions against sustainability indicators

Sustainability indicator	Median ranks for control intervention		
	Community-based tsetse control project	Improved use of trypanocides	Wider use of pour-on
Low financial cost to individual end-users ($W=0.96^{***}$)	1.0	2.0	3.0
Builds on existing systems (including indigenous knowledge) ($W=0.96^{***}$)	3.0	1.0	2.0
An individual can benefit by acting alone ($W=0.93^{***}$)	3.0	1.0	2.0
Resistance to crises (e.g. drought, conflict) ($W=0.08$)	3.0	2.0	1.0
Avoids conflict with neighbours ($W=0.84^*$)	3.0	1.0	2.0
Overall sustainability rank	3.0	1.0	2.0

The sustainability indicator 'community commitment to contribute finance, labour and management' listed in Table 7.2 was not ranked by the researchers, because community commitment was not known before the workshop. Communities ranked their commitment during the workshop, as shown in Table 7.6.

Ranking by six researchers: the lower the rank, the greater the preference. W =Kendal coefficient of concordance (* $p<0.05$; *** $p<0.01$).

7.3.4.2 **Community representatives' assessment of the sustainability of trypanosomiasis control methods**

The ranking of trypanosomiasis control methods against sustainability indicators by the four groups of community representatives is shown in Table 7.6 and their overall ranking is presented in Table 7.7.

Table 7.6
Ranking of possible control interventions against sustainability indicators by community representatives

Sustainability indicator	Median ranks for possible control intervention ¹			
	Community-based tsetse control project	Improved use of trypanocides	Use of pour-on	Community-based dips ²
Community commitment to contribute:				
• Finance	3.5	1.0	1.5	3.5
• Labour	3.5	1.0	1.5	2.0
• Management	3.5	1.0	1.0	2.0
Low financial cost to individual end-users	2.0	1.0	3.0	4.0
Builds on existing systems (including indigenous knowledge)	3.5	1.0	2.5	2.5
An individual can benefit by acting alone	3.5	1.0	1.0	3.0
Resistance to crises (e.g. drought, conflict)	3.5	1.0	1.0	3.0
Avoids conflict with neighbours	4.0	1.0	1.0	3.0

¹ Ranking method based on ranks 1st = most preferred to 4th = least preferred. N=4.

² This control method was added to the matrix at the request of workshop participants.

Table 7.7
Summarised ranking of control options by village

Village (number of representatives) ²	Ranks for control intervention ¹			
	Community-based tsetse control project	Improved use of trypanocides	Use of pour-on	Community-based dips
Oda (n=5)	4 th	1 st	2 nd	3 rd
Kipao (n=7)	4 th	1 st	2 nd	3 rd
Danissa (n=5)	3 rd	1 st	2 nd	4 th
Gadeni (n=6)	4 th	1 st	2 nd	3 rd
Overall rank	4 th	1 st	2 nd	3 rd

- 1st=most preferred; 4th=least preferred.
2. Village representatives ranked each control option as a group rather than as individuals.
3. There was no significant difference between the ranks of the four villages (Friedman's test, p=1.000).

7.4.3.3 **Commitment of outside agencies to support trypanosomiasis control interventions**

Outside agencies ranked their commitment to support future trypanosomiasis control interventions as detailed in Table 7.8.

Table 7.8
Commitment to contribute to resources¹ to different control interventions by outside agencies

Agency	Ranks for possible control intervention			
	Community-based tsetse control project	Improved use of trypanocides	Use of pour-on	Community-based dips
KETRI	1 st	4 th	1 st	1 st
Catholic Diocese of Malindi	2 nd	1 st	4 th	2 nd
Veterinary Department	2 nd	1 st	2 nd	4 th
Private sector - Agrovot	4 th	1 st	1 st	3 rd

¹ For example, time, labour, management support; technical support, material supplies; finance.

Comparison of the views of researchers (Tables 7.4 and 7.5) and community representatives (Tables 7.6 and 7.7) indicated agreement that the preferred control method was ‘better use of trypanocides’. In addition, three of the technical stakeholders were most willing to contribute towards this control intervention relative to the other three options (Table 7.8).

Although KETRI staff gave community-based tsetse control a low sustainability rank (Table 7.5), they were still more willing to support this intervention rather than the improved use of trypanocides, the preferred option of community representatives and outside agencies. However, further discussion within the workshop revealed that KETRI’s interest in community-based tsetse control was largely due to the inclusion of the intervention in their original research proposal to a donor, and concern that the donor would be unwilling to support alternative activities. Eventually, consensus was reached that KETRI should modify their proposal. With workshop participants, a revised proposal was suggested with four main activities as follows:

- Activity 1 Conduct participatory research to quantify trypanocidal drug use, including timing of treatments, use of different products, local criteria for selecting animals to be treated and knowledge on correct doses, fake drugs and correct drug handling. This research would provide the baseline data against which the impact of future activities could be measured.

- Activity 2 Identify herds in each village for assessment of trypanocidal resistance. Implement field research to assess levels of resistance.

- Activity 3 Using the results from Activities 1 and 2, design and implement participative training courses on ‘better use of trypanocides’; to include production and dissemination of illustrated booklets in the Orma language to all households in target villages. Conduct refresher training for community-based animal health workers; conduct training for Agrovet staff.

- Activity 4 Conduct an impact assessment. Measure levels of knowledge and use of trypanocidal drugs relative to baseline data.

7.4 Discussion

7.4.1 General issues

7.4.1.1 *Participatory versus conventional research approaches*

During the research described in Chapter 6 and when using seasonal calendars and maps in this research, copies of results were left with community representatives in each village. The initial stage of the stakeholder workshop involved presentation of these results back to a wider group of community representatives, livestock keepers and other interest groups. Village representatives presented the information using matrix scoring and seasonal calendar diagrams, pie charts showing the incidence of different diseases, and large copies of village maps. Orma terminology was used for disease names, biting flies and other relevant information. Later stages of the workshop involved analysis of trypanosomiasis control options based on presentations by KETRI staff on the pros and cons of each option.

This approach appeared to have a number of benefits. First, it helped to reinforce the notion of communities as research partners with their own useful insights and opinions to contribute to the research process. Presentations by community representatives were a kind of role reversal, with the scientists in the audience and communities taking centre-stage. Clearly, this was a novel experience for both sides and reinforced the idea that local knowledge and analysis were as important, if not more important, than the views of the researchers.

A second benefit of the approach was the rapid, on-site collation and cross-checking of information, with the researchers leaving copies of results with community representatives. Relative to conventional research approaches, this helped to improve the community's ownership of information and reduce local frustration with researchers who fail to provide reports (written or verbal) to the people who provided the original data. Related to this aspect of the work was agreement on future activities to be conducted, and therefore local people knew what was going to happen as a result of the research. Again, this differs from a conventional approach in which the researchers alone make major decisions about needs and activities.

This description of events presents a very positive picture of the relationship between communities and researchers. However, this was only the early stage of a research project

that was anticipated to take several months, and require further investments of time and effort from community members. Furthermore, KETRI staff were responsible for organising follow-up activities according to the outcome of the stakeholder workshop. One outcome was an important change in research objectives away from tsetse control towards improved use of trypanocides. While communities strongly supported this shift in direction, KETRI were less committed (Table 7.8).

7.4.1.2 *Institutional issues affecting participatory approaches*

In the KETRI project, community-based tsetse control featured prominently in the original research proposal. Therefore, KETRI were expecting to implement a community-based tsetse control project, based on the assumption that targets or traps were appropriate technologies for long-term adoption by communities in the project area. However, local analysis of trypanosomiasis control methods with communities revealed the potential constraints facing community-based tsetse control relative to other control options. Despite the cost of trypanocides, people were more willing to continue to control trypanosomiasis according to individual, private action rather collective, group action. Based on earlier interviews with 25 Orma pastoralists, Irungu (2000a) estimated a mean cattle herd size of 124 head and annual expenditure on trypanocides per herd at Kenya Shilling 15,575 (US\$ 200).

An important feature of participatory research is a capacity to alter research activities as new learning takes place. With this approach, the initial research objectives in a proposal might be restricted to a single learning or information-gathering objective, based on a participatory assessment or feasibility study. The results of this assessment then define further objectives and activities. This kind of open-ended approach to research requires much flexibility on the part of both research institutes and donors. For the research institute, precise objectives linked to the research agendas of scientists might be difficult to identify at the onset. Commonly, this makes some researchers feel uncomfortable because research outputs (e.g. in the form of scientific publications) cannot easily be predicted. For donors, participatory approaches require reversals in funding patterns with more resources required as the project progresses, and new objectives and activities materialise (Thompson, 1995). The research described in this report is an example of how research activities identified by scientists were modified according to the findings of participatory assessment.

7.4.1.3 Participatory appraisal and questionnaires

The research described in Chapter 6 and this chapter is the first study of bovine trypanosomiasis using a methodology comprising multiple PA methods and triangulation of information. In common with other research on animal health topics, trypanosomiasis researchers have tended to interpret PRA or RRA as 'questionnaire'. For example, Snow & Rawlings (1999) claimed to use PRA in a 'rapid appraisal' of trypanosomiasis in the Gambia but actually used only a standardised questionnaire in the participatory component of the survey. Similarly, van den Bossche *et al.* (2000) surveyed the socio-economic impact of trypanosomiasis and its control in southern Africa. Although claiming to use RRA, this survey also used a standardised questionnaire.

7.4.2 Assessment of mapping

Mapping was used to triangulate information on disease causes derived from matrix scoring (Chapter 6) and therefore was used in a qualitative manner to compare livestock keepers' opinions derived from two different PA methods. Maps were not used to show the exact locations of features such as forest boundaries or rivers, but to illustrate the general proximity of cattle to tsetse-infested areas and facilitate discussion on perceptions of high-risk areas with regards the transmission of *gandi*. Informants were asked to produce maps only for their permanent home villages where KETRI were considering the establishment of community-based tsetse control projects.

Orma herds are usually split into a small herd of milking cows that remains in the village, and a larger herd (the *fora* herd) of bulls, young stock, non-milking cows and calves that is herded around the village in the dry season and away from the villages in the wet season. Although the maps did not show exposure to tsetse in wet season grazing areas, interviews with informants indicated that their cattle were most exposed to tsetse in the delta and home village grazing areas. Provisional surveys by KETRI identified tsetse in grazing areas around Oda, Danissa and Gadeni (Irungu, 2000b), showing that tsetse were indeed present in these areas.

7.4.3 Assessment of seasonal calendars

Due to time constraints, the seasonal calendar was repeated only four times (once in each village). Despite this small sample size (four repetitions), there was evidence of moderate or

good agreement was evident for 6/10 indicators.

Variations in the incidence of *gandi* indicated that most cases were observed in the short rains *hageiya* (mid-October to December) and the main dry season *bona hageiya* (January to March) (Figure 7.5). The summarised seasonal calendar does not show changes in tsetse population but patterns of contact between cattle and tsetse. This contact peaked when most cattle (both the *fora* and milking herd) were present in the villages in the delta between October and mid-March. These trends varied from those described for Orma Boran cattle on Galana Ranch in Kenya. On the ranch, trypanosome prevalence followed a bimodal pattern in-line with rainfall (Dolan, 1998). Therefore, prevalence peaked in December and January and was followed by second, usually lower peak, in April to June. It was noted that under ranch conditions, trypanosome prevalence was associated with seasonal changes in tsetse challenge rather than seasonal grazing patterns².

The incidence of *buku* (acute haemorrhagic trypanosomiasis due to *T. vivax*) peaked in the short wet season (*hageiya*) and main dry season *bona hageiya*. This pattern was similar to that observed for *gandi* and indicated that *buku* could be associated with exposure to tsetse. A similar pattern of incidence was noted for haemorrhagic disease due to *T. vivax* along the Shabelle River in southern Somalia (Dirie *et al.*, 1988). However, the summarised seasonal calendar also showed high contact between cattle and *kobabe* (Tabanids) immediately before the peak in the incidence of *buku*. As mechanical transmission of *T. vivax* is known to occur (Leak, 1999), it is possible that Tabanids are also involved in the epidemiology of acute haemorrhagic trypanosomiasis. Haemorrhagic disease in cattle due to *T. vivax* has been reported in apparently tsetse-free areas (Roeder *et al.*, 1984).

The seasonal variation in the incidence of FMD followed a very similar pattern to seasonal contact with buffalo, with most contact occurring around dry season watering holes. This apparent association fits modern veterinary knowledge on the epidemiology of FMD under extensive conditions in Africa (Thomson *et al.*, 2003).

² The Galana Ranch studies measured trypanosome prevalence not the incidence of trypanosomiasis.

7.4.4 Assessment of ranking methods

7.4.4.1 Existing methods to control bovine trypanosomiasis

The Orma have a long history of both moving their cattle to avoid tsetse and using trypanocides (Dolan, 1998). However, some of the other control methods noted in this assessment (Table 7.3) have not received much attention. For example, the control method 'herbal remedy' could be sub-divided into at least four specific remedies viz. soups prepared from sheep head or tail fat, soups prepared from fish waste, use of roasted coffee beans and a drench prepared from *hargesa*, an Aloe species. A factor that was not reflected in the results or discussion on control methods was trypanotolerance. This feature of Orma Boran cattle has evolved over many years and is probably an important underlying influence on the types of control methods used, and when and how they are applied.

7.4.4.2 Use of ranking to assess sustainability of trypanosomiasis control methods

There is no standard method for predicting the sustainability of animal disease control measures and the ranking methods used in the stakeholder workshop were developed spontaneously in the field. The identification of sustainability indicators was based on the previous experience of the researcher and knowledge of the literature on community-based tsetse control projects, including a review by Barrett and Okali (1998). Although relatively simple and crude, all stakeholders understood the methods and comparison of ranks between groups was possible. Furthermore, results were produced and presented during the workshop, so all participants could follow the discussion about the results and any conclusions reached.

Alternative methods for predicting whether people will support or pay for a service include contingent valuation and this method has been used during the planning of tsetse control programmes in Ethiopia (Swallow and Woudyalew, 1994) and Kenya (Echessah *et al.*, 1997). Contingent valuation aims to elicit a stated willingness to pay for a good or a service for which the market does not give a good measure of its value. The method requires researchers to provide respondents with information about a proposed intervention and then gauge their willingness to contribute. In the Kenya and Ethiopia studies, information was provided to communities in the form of posters, lectures, dramas, or brochures, and then a questionnaire was used a few weeks later to collect data on people's views on the proposed tsetse control programme. Therefore, the results of contingent valuation were largely

dependent on the type of information provided by the researchers during the pre-survey educational events. In both countries, researchers had already decided that tsetse control was the most appropriate intervention for reducing the incidence of trypanosomiasis and large, well-funded programmes had already started. In these situations, it is unclear how the researchers would have responded if communities had rejected the proposed intervention.

A second weakness with contingent valuation was the need for sophisticated survey design and data analysis, meaning that only the researchers really understood how the results were generated. This is similar to Farming Systems Research (see Chapter 2) in which computer assisted data analysis, usually by specialised scientists, placed the control and ownership of information solely in the hands of researchers. In both contingent valuation and FSR, this aspect of the approach also restricts the use of the methods to localised research projects³.

Regarding community-based tsetse control generally, poor sustainability has been associated with management and financing issues at community level (Barrett and Okali, 1998; Budd, 1999). These problems were evident even though low-cost tsetse traps, costing only approximately US\$8.5 per unit, were developed in Kenya (Brightwell *et al.*, 1991). Analysis of options by Orma communities showed that despite the apparently low cost of traps, communities could predict problems with tsetse trapping projects if they were provided with sufficient information. Furthermore, people cited rational reasons for investing in alternative interventions or areas of research.

In addition to the social and project management issues hindering community-based tsetse control, theoretical modelling studies indicate that small-scale community-based tsetse control activities may be subject to rapid reinvasion of tsetse (Hargrove, 2000). The researcher only became aware of these studies after the research with Orma communities, but it seems that community-based tsetse projects are currently hindered by a combination of important social and technical constraints.

³ A further weakness in the contingent valuation was the exclusion of key stakeholders. Although both Ethiopia and Kenya had emerging private sector operators, supported by government policy and selling trypanocides, this stakeholder group appeared not to have been consulted. Trypanocide sales probably accounted for a substantial proportion of profits for private veterinary suppliers (or government staff conducting private veterinary activities) in the areas in question, but sales would fall during an externally-funded tsetse control programme. Consequently, the proposed programme might reduce the incidence of trypanosomiasis using an approach with unproven sustainability, while also undermining the capacity of the private sector to provide a general service for other animal health problems.

7.5 Summary

This research used mapping and seasonal calendars to triangulate information on the diagnosis and causes of *gandi* and *buku* by Orma pastoralists. Results confirmed earlier conclusions that *gandi* was chronic trypanosomiasis and *buku* was acute haemorrhagic trypanosomiasis due to *T. vivax*. Therefore, the research showed the value of triangulating information using different PA methods. Spatial and seasonal variations in trypanosomiasis (acute and chronic forms) and biting flies, and explanations of disease transmission and incidence by Orma informants were considered to be valid when compared with modern veterinary knowledge.

Simple ranking methods were considered to be useful tools for facilitating and summarising discussion on trypanosomiasis control methods. All stakeholders could use the methods and results were available quickly, thereby allowing immediate cross-checking and further debate. The methods also allow qualitative information (e.g. people's commitment to support an intervention) to be expressed numerically, and so results from different informants could be easily compared.

Chapter 8

PARTICIPATORY DIAGNOSIS OF A HEAT INTOLERANCE SYNDROME IN CATTLE IN TANZANIA AND ASSOCIATIONS WITH FOOT AND MOUTH DISEASE

8.1 Introduction

This chapter describes the further use of matrix scoring (as used in southern Sudan and Kenya, Chapters 4 and 6 respectively) and proportional piling (as used in Kenya, Chapter 6) with Maasai and Sukuma communities in Tanzania. The chapter also describes how these two methods were adapted to test possible association between acute and chronic manifestations of a disease.

A possible limitation in the use of PA methods is the varying levels of indigenous knowledge on livestock diseases between different ethnic groups. The literature indicates well-developed knowledge among pastoralists compared with more sedentary communities, or communities who are less reliant on livestock for their livelihood (e.g. Grandin and Young, 1996). In order to compare the use of PA methods in communities with varying reliance on livestock, the research in Tanzania was conducted in Maasai and Sukuma communities. The Maasai are generally considered to be pastoralists with strong economic and social dependence on livestock, particularly cattle. They are also reported to possess considerable indigenous knowledge on livestock and wildlife diseases (Mathias-Mundy and McCorkle, 1989; IT Kenya/IIRR, 1996; Ministry of Water and Livestock Development/VetAid, 2001). In comparison, the Sukuma are more sedentary agriculturalists and agropastoralists. Although they keep large numbers of cattle, they rely mainly on crop production (Malcolm, 1953; Birley, 1982).

8.1.1 Foot and mouth disease in Tanzania

The first report of FMD in Tanzania referred to an outbreak in Kahama District, Arusha Region in 1927 attributed to type O virus (Anon, 1927). Since then the disease has been reported annually in almost every region of the country and is generally assumed to be endemic in East Africa (Vosloo *et al.*, 2002). Regarding virus strains, types O, A, SAT-1 and SAT-2 were noted in late 1960s (Rweyemamu, 1970), and SAT-3 was reported in 1996

in Arusha Region. Kivaria (2003) reported FMD in Tanzania due to type C virus. Tanzania has a substantial indigenous cattle population of approximately 17 million head (Ministry of Agriculture and Food Security, 2002). Many of these animals are managed using agropastoral and pastoral systems, and the country has extensive, largely unregulated borders with Kenya, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Zambia, Mozambique and Malawi. Seasonal and trade-related movements of cattle across borders are likely to encourage the maintenance of FMD in Tanzania. The country also has a high population of African buffalo (*Cyncerus caffer*), a species known to act as a carrier of FMD virus (Brooksby, 1972). Contact between cattle and buffalo is common in pastoral and agropastoral areas, particularly in the dry season when animals congregate around watering points.

8.1.2 The heat intolerance syndrome in cattle in Tanzania

In the late 1990s a syndrome of heat intolerance (HI) and overgrowth of hair in cattle was reported by workers in Morogoro region, Tanzania (Makene, 1998). Affected cattle spent less time grazing than normal cattle, and more time resting in the shade of trees or wallowing in water. The coat developed a long, thick appearance and affected animals panted during the heat of the day. Based on descriptions of FMD by Radostits *et al.* (1994), it was suggested that HI was a sequel to FMD and was caused by damage to the endocrine system by FMD virus. Soon after the study on HI in Morogoro, workers in the Lake Zone of Tanzania reported that Sukuma farmers were complaining about a disease in cattle they called *luzwiga*, also characterised by heat intolerance and overgrowth of hair (Magoma *et al.*, 2000). This study confirmed that HI cases became pyrexia and developed high respiratory rates as ambient temperature increased from early morning to afternoon. The Sukuma word *luzwiga* was derived from *kuzwigila* meaning 'difficult breathing'. However, this study was unable to confirm whether HI was associated with FMD particularly because farmers refuted this hypothesis. Some farmers stated that some *luzwiga* cases were later affected by FMD and died from the disease.

8.1.3 Heat intolerance in cattle in other countries

Reference to the literature indicated that the HI syndrome and its association with FMD had been reported since at least the 1940s. In India affected cattle were known as 'panthers' (Scott, personal communication; Anon, 1955a) and similarly in Pakistan the condition was called panting or *hanpa* (Minett, 1949). In Kenya, woolly coats, panting and reduced

fertility were noted as complications of FMD (Anon, 1955b) and it was suggested that the problem only occurred in high-grade cattle and not indigenous African types. More recently, there reports of HI following FMD outbreaks in cattle in pastoralist areas of Africa. The diseases *juol*, *jul* and *akumol* were noted in Nuer communities in southern Sudan (Blakeway *et al.*, 1996). Further north in Sudan the disease *ha'ish*, meaning 'ugly', (Kenyon, personal communication) was similar to HI reported in other areas.

8.1.4 Development of a research proposal to further investigate the heat intolerance syndrome

The HI syndrome reported in Tanzania (Makene, 1998; Magoma *et al.*, 2000) appeared to be very similar to the diseases *juol* and *codurki* described by Dinka and Orma herders respectively, and reported in Chapters 4 and 6 of this thesis. In meetings with workers from the Faculty of Veterinary Medicine, Sokoine University of Agriculture (Morogoro Region) and the Veterinary Investigation Centre, Mwanza (Mwanza Region) it was noted that reports of association between HI and FMD from Tanzania and elsewhere were all descriptive, and sometimes anecdotal in nature. Also, there were no published accounts of the incidence of HI in affected herds. Therefore, a research proposal was developed to investigate a putative association between HI and FMD, and estimate the incidence of HI in indigenous cattle in Tanzania.

The research was an opportunity to test the value of PA methods to explore possible association between acute (FMD) and chronic (HI) manifestations of disease. At the same time, the PA methods that were developed were similar to the matrix scoring (used in southern Sudan and Kenya) and proportional piling (used in Kenya) methods that had already been assessed. Therefore, the research was also the third repetition of a matrix scoring method and second repetition of the proportional piling methods with regards using informants from different and geographically isolated ethnic groups.

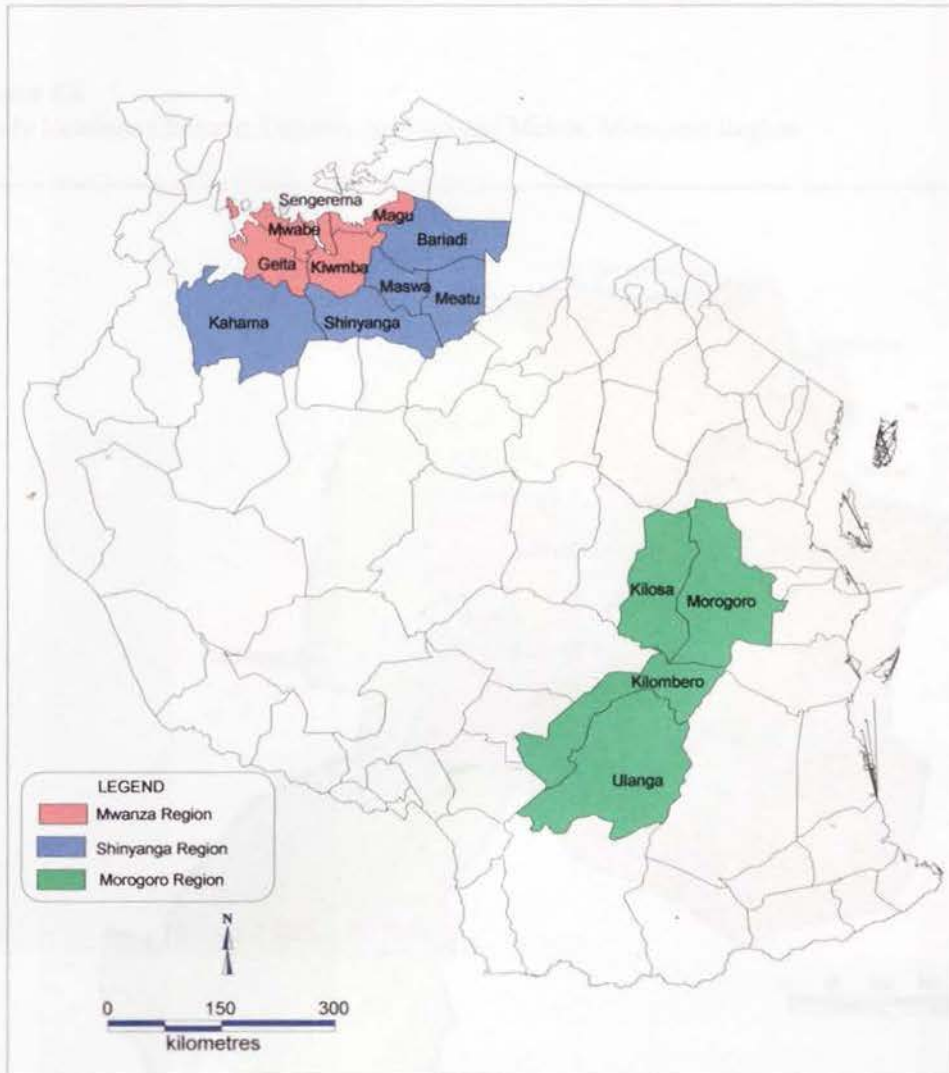
8.2 Materials and Methods

8.2.1 Study locations and sampling

In 2000 an FMD epidemic affected Tanzania and the disease was reported from all the major cattle-rearing regions of the country (Kivaria, 2003). The main criterion for selection of study locations was evidence that livestock keepers recognised a HI-like syndrome and had requested advice from local veterinarians on how best to solve the problem. A further

consideration was the presence of research partners in the locality who were interested in HI and willing to invest time in studying the disease. According to these criteria, the research was conducted with Maasai communities in Morogoro Region and Sukuma communities in Mwanza and Shinyanga Regions (Figure 8.1).

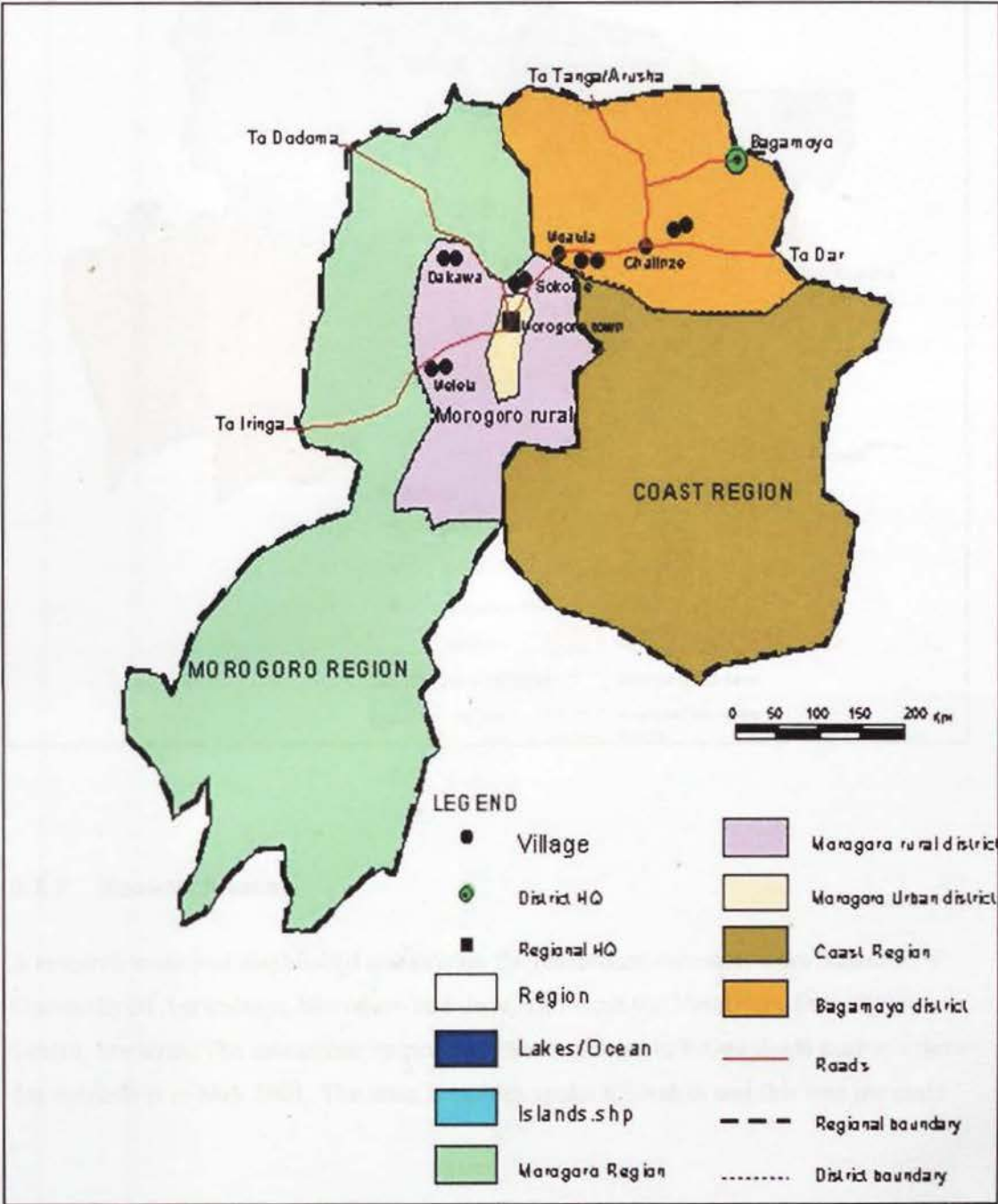
Figure 8.1
Regional map of Tanzania



The Maasai are pastoralists who inhabit large tracts of the Rift Valley in Kenya and Tanzania. In recent years they have expanded their range to Morogoro and Coast regions of Tanzania. The Sukuma are sedentary agropastoralists who rely more heavily on crops than livestock as a source of livelihood.

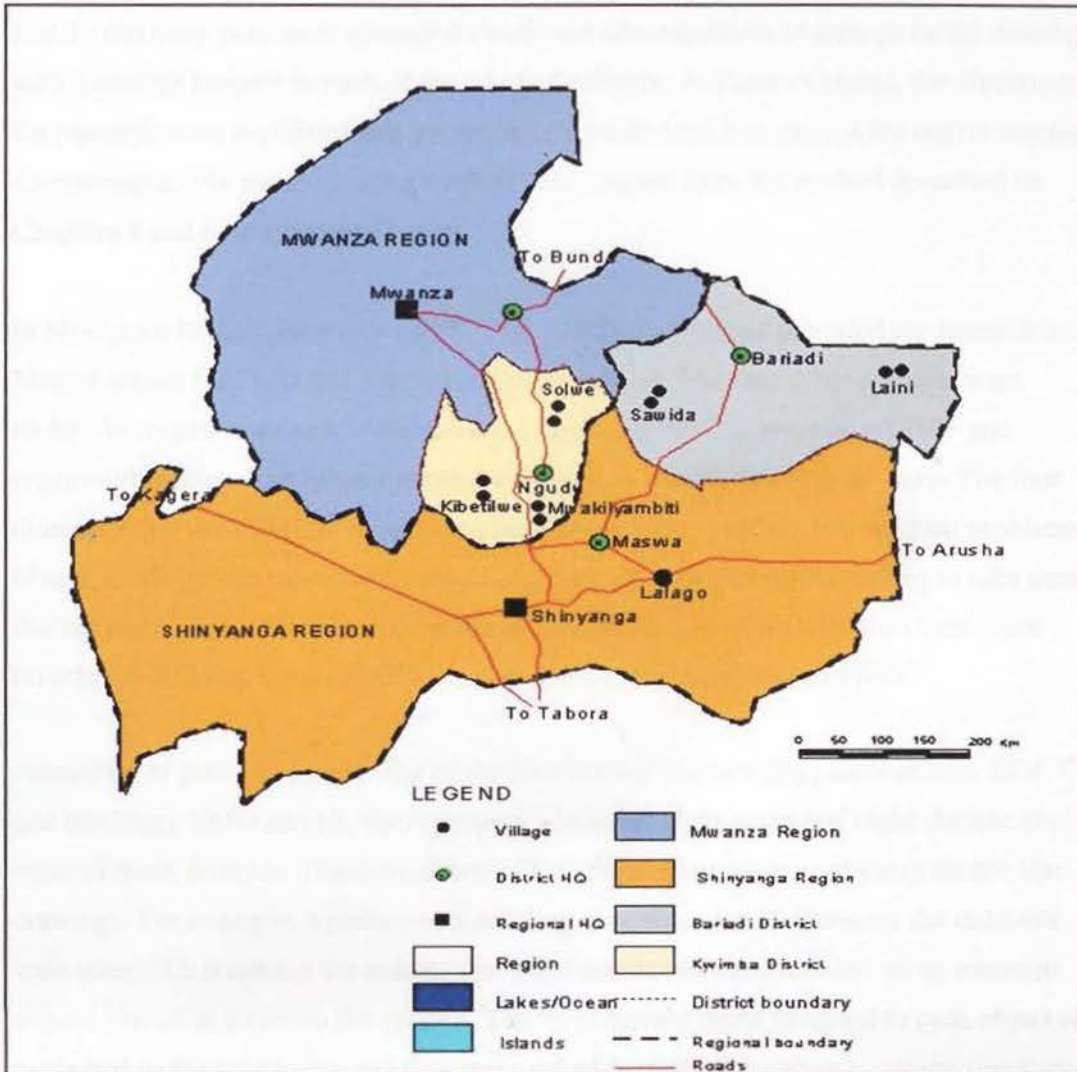
Within each region, sampling of villages was purposive (Barnett, 1991) and influenced by a need to examine herds with and without HI cases in approximately equal numbers in each village, in order to assess possible association between HI and FMD (sections 8.2.4 and 8.2.5). In each region, local veterinary workers selected villages where HI cases had been reported and where similar livestock production systems and ecology were observed. In Morogoro Region research was conducted in Wami-Dakawa, Merela, Matuli, Sokoine and Lumanda-Chalinze villages (Figure 8.2) over a two-week period in May 2001.

Figure 8.2
Study locations Chalinze, Dakawa, Sokoine and Melela, Morogoro Region



In Mwanza/Shinyanga Regions research was undertaken in Kibetilwa, Ng'walalya, Solwe, Sawida and Laini villages (Figure 8.3) during a two-week period in June 2001.

Figure 8.3
Study locations Solwe, Kibetilwa and Malakilyambati (Ng'walalya) in Mwanza Region, and Laini and Sawida in Shinyanga Region



8.2.2 Research team

A research team was established comprising the researcher, two staff from Sokoine University of Agriculture, Morogoro and three staff from the Veterinary Investigation Centre, Mwanza. The researcher trained the team members in PA methods during a three-day workshop in May 2001. The team members spoke Kiswahili and this was the main

language used during the study in Morogoro. One of the team members was a Sukuma, and therefore, both Kiswahili and Sukuma were used during the study in Mwanza and Shinyanga Regions.

8.2.3 Matrix scoring

Local veterinary personnel contacted chiefs and administrators to arrange initial meetings with livestock keepers in each of the selected villages. At these meetings, the objectives of the research were explained and participants were divided into groups for matrix scoring of disease-signs. The matrix scoring method was adapted from the method described in Chapters 4 and 6, as described below.

In Morogoro Region, interviews with local veterinary workers provided the researchers with Maasai names for FMD and four other cattle diseases. The four other diseases were *endorobo*/trypanosomiasis, *oltikana*/East Coast fever (ECF), *emwilalas*/CBPP and *engluwet*/blackleg. The Maasai name for FMD was assumed to be *olukuluku*. The four diseases other than FMD were selected because they appeared to be important problems in Maasai cattle and the researchers assumed that informants would be willing to take time to discuss them. These four diseases acted as controls in the matrix and at no time were informants told that the research team was particularly interested in FMD.

According to previous knowledge of the four control diseases (trypanosomiasis, ECF, CBPP and blackleg), FMD and HI, the researcher identified eight acute and eight chronic clinical signs of these diseases. These signs were illustrated on pieces of card using simple line drawings. For example, a picture of a drooling cow was used to represent the indicator 'salivation'. To construct the matrix, the five diseases were represented using common objects placed in a row on the ground. The local disease name assigned to each object was explained to the informants and they were asked to repeat the names to ensure that they understood the meaning of each object. The researcher then selected the acute disease sign 'coughing', showed the informants a picture of a coughing cow and explained the meaning of the picture. This explanation included the idea of acute disease signs, being signs that were observed within five days of an animal becoming sick. Informants were then asked to score the five diseases by dividing a pile of 20 stones to show the relationship between coughing and the diseases. They were instructed to use all 20 stones. After this scoring, the researchers prompted the informants to check their scores and confirm that as a group they agreed that the scores were correct.

The scoring procedure was repeated with each acute disease sign in turn. The researchers then explained that some diseases caused signs of disease that appeared weeks or months after the animal first became sick. The chronic disease signs were then added one by one to the matrix and the scored using the same procedure with 20 stones. When all the disease signs had been scored, the results were recorded and the researcher asked additional questions to cross-check and probe the scores. The questions were open-ended, designed to elicit additional information and to follow up interesting scores. In particular, open questions were used to probe apparent associations between acute and chronic disease signs, as suggested by the matrix scoring. A reporting format for matrix scoring is shown in [Appendix 8.1](#).

In Mwanza/Shinyanga Regions, the same matrix scoring method for acute and chronic disease signs was used. The researchers used Sukuma disease names for the same five diseases used in the matrix scoring in Morogoro as follows: *ndorobo* /trypanosomiasis; *madundo*/ECF; *bugigi*/FMD; *mabuupu*/CBPP; *lyoho*/ blackquarter.

In Morogoro Region, matrix scoring was repeated with nine groups of informants (comprising six to 16 individuals) in Dakawa (one group), Chalinze (four groups), Malela (two groups) and Sokoine (two groups). In Mwanza/Shinyanga Regions, matrix scoring was repeated with 11 informant groups (comprising eight to 25 individuals) in Kibetilwa, Ng'walalya, Solwe, Sawidi (two groups per village) and Laini (three groups). The Kendall coefficient of concordance (W) (Siegal and Castellan, 1988) using SPSS software, version 9.0 (SPSS, 1999) was used to assess agreement between informant groups and the reproducibility of the method. Matrix scoring sessions were concluded by the research team explaining the need to conduct further investigation on HI and to visit herds with and without HI cases. Participants then selected appropriate herds to visit. The carers of these herds participated in proportional piling, and cattle in the herds were sampled for FMD serology.

8.2.4 Proportional piling

Proportional piling was used to estimate the incidence and mortality of cattle diseases in different age groups of cattle in Maasai herds, and possible associations between HI and these diseases. Local definitions of cattle age groups were used (Table 8.1).

Table 8.1
Maasai and Sukuma definitions of cattle age groups

Age group	Maasai terminology	Sukuma terminology
<i>Calves</i>		
Calves up to one year of age	<i>Lohok</i>	-
Calves to 18 months of age	-	<i>Ndama</i>
<i>Young stock</i>		
Young stock one to three years of age	<i>Lenok/ endawowa</i>	-
Young stock 18 months to three years of age	-	<i>Ndogosa/ kayagamba-kanyabuka</i>
<i>Adult stock</i>		
Mature cattle, greater than three years of age	<i>Engeshulapowa</i>	<i>Mbogoma/ nzagamba</i>

Proportional piling was used with individual informants who were the carers of specific herds. With each informant the method was repeated with each cattle age group. Using a pile of 100 stones to depict the age group, the informant was asked to divide the stones to show the pattern of 'sick cattle during the last year' and 'healthy cattle during the last year'. The pile of stones representing sick cattle was then sub-divided by the informant to show the pattern of cattle suffering from five diseases (as used in the matrix scoring) plus a category called 'other diseases' (a total of six disease categories).

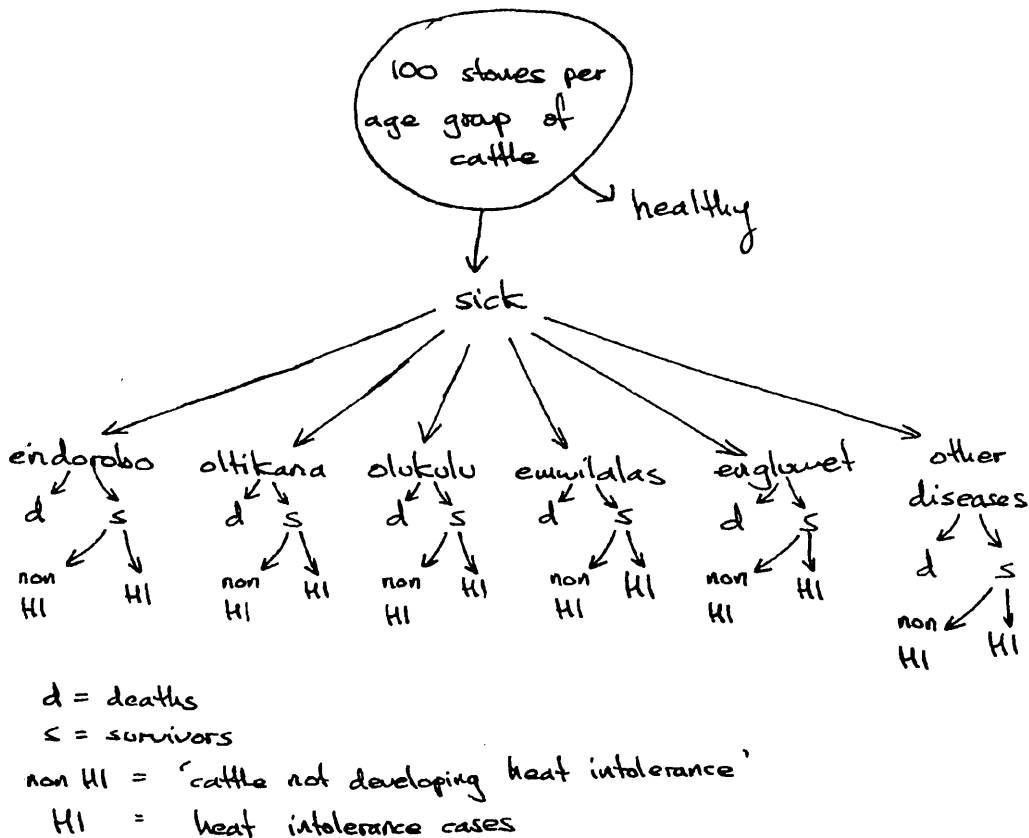
Each pile of stones representing the six disease categories was then further sub-divided to show the pattern of cattle dying and surviving for each disease category. This resulted in two piles of stones for each of the five diseases and the 'other diseases' category. The informant was then asked to concentrate on the six piles of stones representing surviving cattle, and divide these stones to show cattle developing HI versus cattle not developing HI. The method is illustrated in Figure 8.4 and a reporting format for proportional piling is shown in Appendix 8.2.

Proportional piling was repeated with 50 individual informants (providing data from 50 herds) in Morogoro and 73 individual informants in Mwanza/Shinyanga (providing data from 73 herds). The reporting format used for proportional piling is shown Appendix 8.2. Association between HI and FMD were assessed by crosstabulation of the number of herds with and without HI, and herds with and without a history of clinical FMD. Fisher's exact test (Thrusfield, 1995) in SPSS software (SPSS, 1999) and relative risk in Confidence

Interval Analysis Version 2.0.0 software (Altman *et al.*, 2002) were used to test association. The mean herd incidences of FMD and HI were compared by region using the 95% CI for the difference in the means (Altman *et al.*, 2002).

Figure 8.4

Diagrammatic representation of the proportional piling method used in Morogoro Region



8.2.5 Foot and mouth disease serology

Blood samples were collected and examined for antibody to FMD virus (types SAT-1, SAT-2, SAT-3, type O, type A and type C). In Morogoro, 249 samples (173 adults and 76 immature) were collected from 51 herds. In Mwanza and Shinyanga, 241 (175 adults and 66 immature) samples were collected from 59 herds. Serum samples were tested at the Onderstepoort Veterinary Institute, South Africa. The liquid phase blocking ELISA was used, as described by Hamblin *et al.* (1986), using reagents developed in-house to the six

types of FMD virus. Seroprevalence of FMD by region and age group of cattle was compared using the 95% CI for proportions (Altman *et al.*, 2002).

Blood samples were also examined for antibody to 3ABC non-structural proteins of FMD virus by ELISA (Chekit-FMD-3ABC, Intervet). This antibody is only detected in animals reported to have shown clinical signs of FMD (Mackay *et al.*, 1998; Kitching, 2002) and persists for at least 395 days post infection (Vosloo, unpublished data). The carers of sampled herds had previously been involved in the proportional piling method, and herds reported to be with and without HI cases were sampled. Association between previous clinical FMD (as determined by the detection of antibody to 3ABC non-structural proteins) and HI was assessed using the Chi-square test (Thrusfield, 1995) in SPSS version 9.0 software (SPSS, 1999) and relative risk in Confidence Interval Analysis version 2.0.0 software (Altman *et al.*, 2002).

8.3 Results

8.3.1 Disease signs and association between diseases and HI using matrix scoring

A summarised matrix scoring for Maasai informants in Morogoro Region is shown in Figure 8.5. There was evidence of strong agreement between informant groups for 8/8 acute disease signs and 7/8 chronic disease signs. There was evidence of moderate agreement between informant groups for 1/8 chronic disease signs. For disease signs categorised by the researcher as 'acute', the disease *olukuluku* was associated with salivation, abortion, lameness and reduced milk yield, whereas *olitikana* was associated with enlarged lymph nodes, coughing, salivation, death and reduced milk yield. The most prominent sign of *endorobo* was diarrhoea, whereas *emwilalas* was linked to coughing.

For the chronic disease signs, informants made strong associations between shade-seeking behaviour, panting, overgrowth of hair and hooves, reduced fertility, wallowing and *olukuluku*. When questioned further about this clinical picture, the disease names *oliepangipang* and *enondwani* were frequently offered as a specific name for the problem. Informants also advised that, despite treatment with antibiotics, anthelmintics and trypanocides, these cases never recovered. Owners tried to sell affected animals soon after the disease was observed. The chronic disease signs 'weight loss' and 'loss of tail hair' were associated with *endorobo*.

Figure 8.5

Summarised matrix scoring of acute and chronic disease signs by Maasai informants[†]

Signs	Diseases				
	<i>Endorobo</i> Trypanosomiasis	<i>Oltikana</i> ECF	<i>Ohukuluku</i> FMD	<i>Emwilalas</i> CBPP	<i>Engluwet</i> Blackquarter
Coughing (<i>W</i> =0.79***)	●● 2.5 (0-4)	●●● 5.0 (0-15)	0 (0-1)	●●●●●●●● 14.0 (3-16)	0 (0-1)
Diarrhoea (<i>W</i> =0.77***)	●●●●●●●● 20.0 (3-20)	0 (0-17)	0 (0-0)	0 (0-0)	0 (0-0)
Salivation (<i>W</i> =0.78***)	0 (0-2)	●● 4.0 (0-6)	●●●●●●●● 14.0 (6-20)	● 1.0 (0-8)	0 (0-0)
Abortion (<i>W</i> =0.90***)	●●● 6.0 (3-8)	0 (0-4)	●●●●● 10.0 (5-14)	0 (0-4)	0 (0-0)
Enlarged lymph nodes (<i>W</i> =1.00***)	●●● 6.0 (3-8)	●●●●●●●● 14.0 (12-17)	0 (0-0)	0 (0-0)	0 (0-0)
Lameness (<i>W</i> =0.87***)	0 (0-0)	0 (0-0)	●●●●●●●● 17.5 (10-20)	0 (0-0)	●● 2.5 (0-10)
Disease causes death (<i>W</i> =0.53**)	0 (0-4)	●●● 7.0 (0-20)	0 (0-3)	● 1.0 (0-5)	●● 3.5 (0-20)
Reduced milk yield (<i>W</i> =0.60***)	0 (0-10)	●● 0 (0-4)	●●●●●●●● 14.0 (7-20)	0 (0-0)	0 (0-0)
Cow seeks shade (<i>W</i> =0.95***)	0 (0-6)	0 (0-0)	●●●●●●●● 20 (14-20)	0 (0-0)	0 (0-0)
Weight loss (<i>W</i> =0.32*)	●●●● 7.5 (0-20)	0 (0-5)	●● 2.0 (0-15)	●● 5.0 (0-20)	0 (0-0)
Overgrowth of hair (<i>W</i> =1.00***)	0 (0-0)	0 (0-0)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)
Panting (<i>W</i> =0.84***)	0 (0-0)	0 (0-4)	●●●●●●●● 20 (10-20)	0 (0-0)	0 (0-0)
Reduced fertility (<i>W</i> =0.63***)	0 (0-9)	0 (0-0)	●●●●● 15.5 (0-20)	0 (0-0)	0 (0-0)
Overgrowth of hooves (<i>W</i> =1.00***)	0 (0-0)	0 (0-0)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)
Loss of tail hair (<i>W</i> =1.00***)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Wallows in water (<i>W</i> =0.95***)	0 (0-5)	0 (0-0)	●●●●●●●● 20 (15-20)	0 (0-0)	0 (0-0)

[†] Number of informant groups =9. Median scores are presented in each cell, and minimum and maximum values are shown in parentheses. *W* = Kendal coefficient of concordance (**p*<0.05; ***p*<0.01; ****p*<0.001). Maasai disease names are italicised.



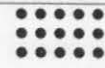











Plate 8.1
Matrix scoring of acute and chronic disease signs in Melela, Morogoro Region



Plate 8.2
A case of *oleipangipangi* near Melela, showing hirsutism

Figure 8.6

Summarised matrix scoring for Sukuma informants in Mwanza and Shinyanga Regions[†]

	<i>Ndorobo</i> Trypanosomiasis	<i>Madundo</i> ECF	<i>Bugigi</i> FMD	<i>Mabuupu</i> CBPP	<i>Lyoho</i> Blackquarter	
Acute disease signs	Coughing (<i>W</i> =0.63**)	0 (0-15)	0 (0-20)	0 (0-2)	 15.0 (0-20)	0 (0-0)
	Diarrhoea (<i>W</i> =0.20)	0 (0-10)	0 (0-20)	0 (0-20)	0 (0-10)	0 (0-0)
	Salivation (<i>W</i> =0.86**) <i>W</i> =0.86**	0 (0-5)	0 (0-5)	 20.0 (10-20)	0 (0-0)	0 (0-3)
	Abortion (<i>W</i> =0.16)	0 (0-20)	0 (0-0)	0 (0-10)	0 (0-20)	0 (0-10)
	Enlarged lymph nodes (<i>W</i> =1.00**) <i>W</i> =1.00**	0 (0-0)	 20 (20-20)	0 (0-0)	0 (0-0)	0 (0-0)
	Lameness (<i>W</i> =0.93**) <i>W</i> =0.93**	0 (0-0)	0 (0-0)	 10.0 (5-10)	0 (0-0)	 10 (0-15)
	Disease causes death (<i>W</i> =0.48**) <i>W</i> =0.48**	0 (0-8)	 5.0 (0-5)	0 (0-3)	 5.0 (0-10)	 8 (0-20)
	Reduced milk yield (<i>W</i> =0.35**) <i>W</i> =0.35**	0 (0-10)	0 (0-10)	 5.0 (0-20)	 2.0 (0-5)	0 (0-5)
Chronic disease signs	Cow seeks shade (<i>W</i> =0.05)	0 (0-0)	0 (0-0)	0 (0-5)	0 (0-3)	0 (0-5)
	Weight loss (<i>W</i> =0.48**) <i>W</i> =0.48**	0 (0-16)	0 (0-0)	 5.0 (0-10)	0 (0-15)	0 (0-0)
	Hair overgrowth (<i>W</i> =0.12)	0 (0-20)	0 (0-0)	0 (0-0)	0 (0-10)	0 (0-0)
	Panting (<i>W</i> =0.28*) <i>W</i> =0.28*	0 (0-5)	0 (0-4)	0 (0-10)	 8 (0-20)	0 (0-10)
	Reduced fertility (<i>W</i> =0.09)	0 (0-20)	0 (0-0)	0 (0-0)	0 (0-10)	0 (0-10)
	Overgrowth of hooves (<i>W</i> =0.28*) <i>W</i> =0.28*	0 (0-0)	0 (0-0)	0 (0-20)	0 (0-0)	0 (0-0)
	Loss of tail hair (<i>W</i> =0.36**) <i>W</i> =0.36**	0 (0-20)	0 (0-0)	0 (0-20)	0 (0-0)	0 (0-0)
	Wallows in water (<i>W</i> =0.91**) <i>W</i> =0.91**	0 (0-2)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)

[†] Number of informant groups =9. Median scores are presented in each cell, and (minimum and maximum values are shown in parentheses. *W* = Kendal coefficient of concordance (**p*<0.05; ***p*<0.01; ****p*<0.001). Sukuma disease names are italicised.

A summarised matrix scoring for Sukuma informants in Mwanza and Shinyanga Regions is shown in Figure 8.6. For acute disease signs there was evidence of strong and weak agreement for 6/8 and 2/8 signs, respectively. The disease *bugigi*, presumed by the researcher to be FMD, received high scores for ‘salivation’, ‘lameness’ and ‘reduced milk yield’, and there was good agreement between groups for the scoring of these signs. The control diseases *madundo* (presumed to be ECF), *mabuupu* (presumed to be CBPP) and *lyoho* (presumed to be blackquarter) received high scores for ‘enlarged lymph nodes’, ‘coughing’ and ‘lameness’ respectively. The control disease *ndorobo* (presumed to be trypanosomiasis) received median scores of 0 for all eight acute disease signs. Further questioning revealed that the disease was of very low incidence and few informants had observed the disease.

For chronic disease signs scored by Sukuma informants, there was evidence of strong agreement for 3/8 signs, moderate agreement for 2/8 signs and weak agreement for 3/8 signs. Only two chronic signs received median scores greater than 0. These signs were ‘weight loss’ scored for *bugigi*/FMD and ‘coughing’ scored for *mabuupu*/CBPP.

8.3.2 Associations between diseases and HI using proportional piling

In Mwanza/Shinyanga Regions 40 (55%) informants reported FMD and six (8%) informants reported HI in their herds. In Morogoro Region, reporting of FMD and HI was significantly higher than Mwanza/Shinyanga Regions with 41 (82%) informants reporting FMD (95% CI for difference in proportions 9.9%, 44.5%) and 23 (45%) informants reporting HI (95% CI for difference in proportions 20.9%, 54.7%). The Normal distribution of the data, as assessed by PP Plots, is illustrated in Appendices 8.3 and 8.4.

Proportional piling of diseases with Maasai and Sukuma informants showed no significant associations between the presence of HI cases and previous cases of trypanosomiasis, ECF, CBPP, blackleg or cattle in the ‘other diseases’ category. In contrast, significant associations between HI and previous clinical FMD were evident in Maasai and Sukuma herds, as presented in Table 8.2. Mean herd incidence and mortality due to FMD and mean herd incidence of HI are presented in Table 8.3, and differences between regions are shown in Table 8.4. The incidence of both FMD and HI was significantly lower in Sukuma herds compared with Maasai herds. Incidence and mortality of diseases by age group are illustrated in Figures 8.7 to 8.18.

Table 8.2

Association between observation of HI in herds and previous clinical FMD as detected by proportional piling

Age group	Herd type	
	Maasai herds (n=50)	Sukuma herds (n=73)
<u>Calves</u>		
Fisher's exact test	p<0.01	p=ns
Relative risk (95% CI)	1.6 (1.26, 2.12)	1.0 (0.98, 1.06)
<u>Young stock</u>		
Fisher's exact test	p<0.01	p<0.05
Relative risk (95% CI)	2.5 (1.71, 3.65)	1.1 (0.98, 1.31)
<u>Adults</u>		
Fisher's exact test	p<0.001	p=ns
Relative risk (95% CI)	3.7 (2.25, 6.18)	2.1 (0.50, 8.95)
<u>All age groups</u>		
Fisher's exact test	p<0.001	p<0.01
Odds ratio (95% CI)	44.4 (5.87, 336.09)	5.9 (1.78, 19.55)

Table 8.3

Herd incidence and mortality estimates for foot and mouth disease, and incidence estimates for heat intolerance in Morogoro and Mwanza/Shinyanga regions, 2000-2001

Region, disease and age group	Mean herd incidence (%) (95% CI)	Mean herd mortality (%) (95% CI)
<i>Morogoro (n=50)</i>		
FMD		
- Calves	44.4 (32.43, 56.36)	9.5 (5.04, 13.91)
- Young stock	49.9 (37.73, 62.23)	3.4 (0.59, 6.13)
- Adults	52.5 (40.54, 64.38)	2.9 (0.61, 5.31)
- All ages	48.9 (42.13, 55.76)	5.3 (3.34, 7.19)
HI		
- Calves	1.4 (0.58, 2.26)	-
- Young stock	2.2 (1.16, 3.16)	-
- Adults	2.7 (1.76, 3.59)	-
- All ages	2.1 (1.56, 2.61)	-
<i>Mwanza and Shinyanga (n=73)</i>		
FMD		
- Calves	2.60 (-0.59, 5.79)	0.00 (0,0)
- Young stock	22.1 (12.85, 31.33)	0.03 (-0.01, 0.07)
- Adults	27.4 (18.24, 36.27)	0.64 (-0.08, 1.37)
- All ages	17.3 (12.74, 21.96)	0.22 (-0.02, 0.47)
HI		
- Calves	0.03 (-0.01, 0.07)	-
- Young stock	0.15 (-0.07, 0.37)	-
- Adults	0.15 (0.07, 0.23)	-
- All ages	0.12 (0.03, 0.19)	-

Table 8.4
Differences in mean herd incidence of FMD and HI in Morogoro (n=50) and Mwanza/Shinyanga (n=73) Regions based on proportional piling

Age group	Difference in mean herd incidences of FMD (%) (95% CI)	Difference in mean herd incidences of HI (%) (95% CI)
Calves ¹	41.8 (29.41, 57.72)	1.4 (0.52, 2.26)
Young stock ¹	27.8 (12.64, 42.91)	2.1 (1.03, 3.07)
Adults	25.1 (10.24, 39.92)	2.6 (1.63, 3.47)
All ages	31.6 (17.21, 45.98)	1.9 (1.05, 2.93)

¹ See Table 8.1 for age definitions. Comparisons of Maasai and Sukuma calves were not considered to be direct comparisons because the Maasai age group *lohok* included calves to 1 year of age whereas the Sukuma age group *ndama* included calves to 18 months of age. Similarly, the Maasai age group *lenok* and *endawowa* included cattle from one to three years of age, compared with the Sukuma age groups *ndogosa* and *kayagamba-kanyabuka* comprising cattle from 18 months to three years of age.

Figure 8.7
Mean herd incidence and mortality estimates for *olukuluku* /FMD in Maasai herds, Morogoro region, 2000-2001 (n=50)

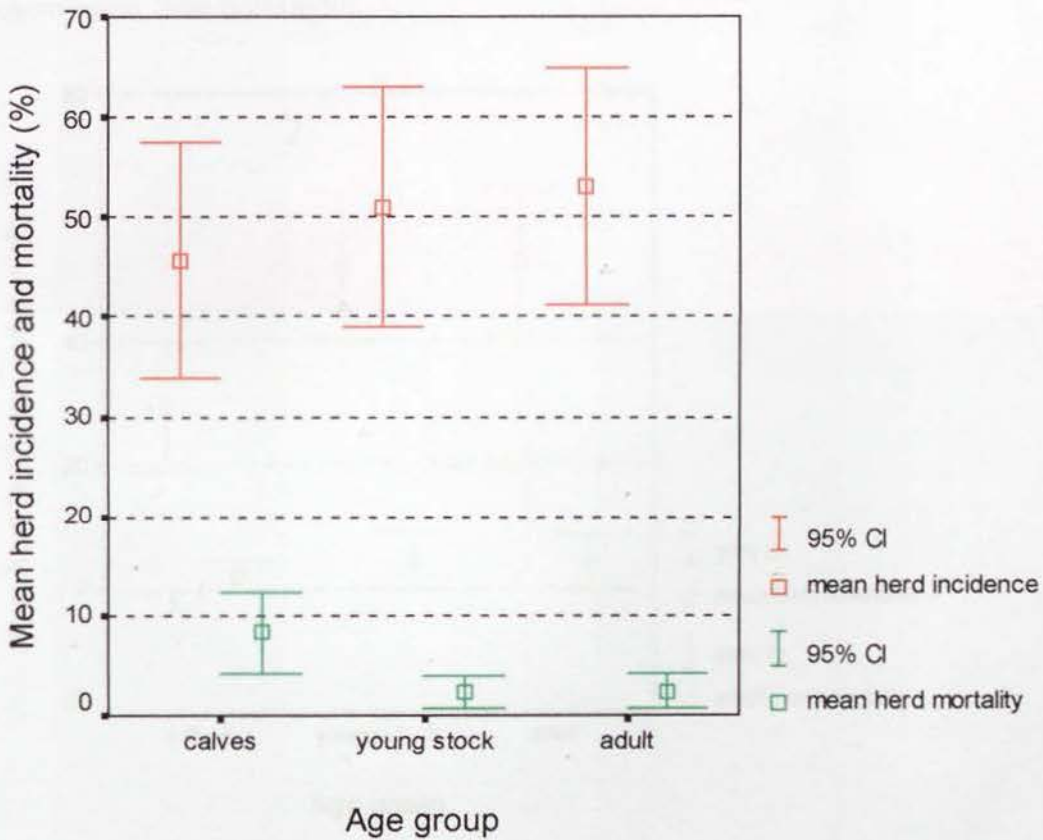


Figure 8.8
 Mean herd incidence of HI by age group in Maasai herds, Morogoro Region, 2000-2001 (n=50)

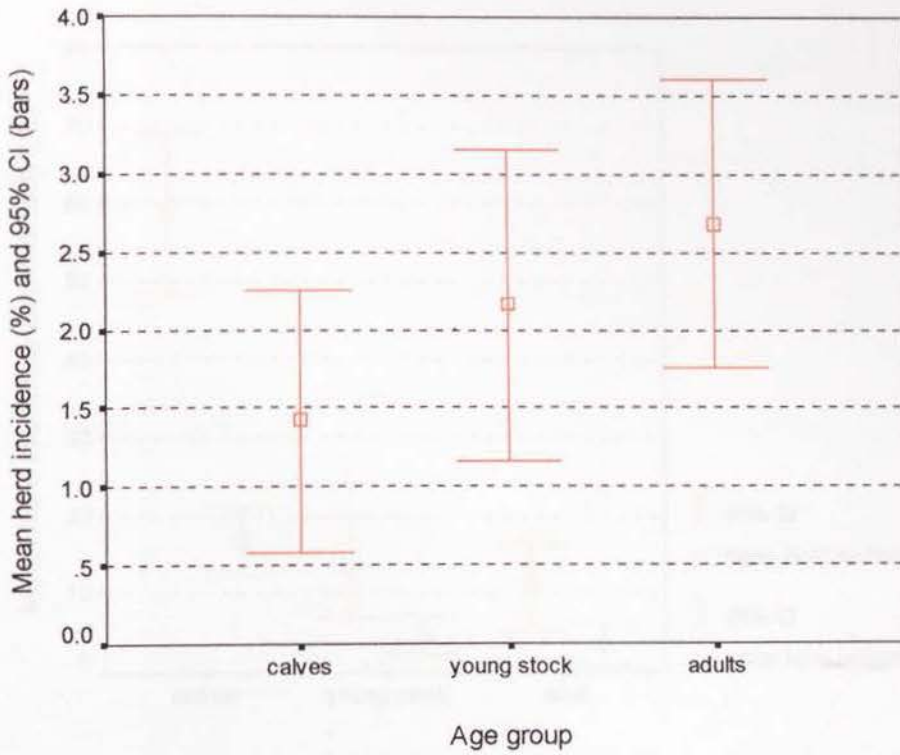


Figure 8.9
 Mean herd incidence and mortality estimates for *endorobo*/trypanosomiasis in Maasai herds, Morogoro region, 2000-2001 (n=50)

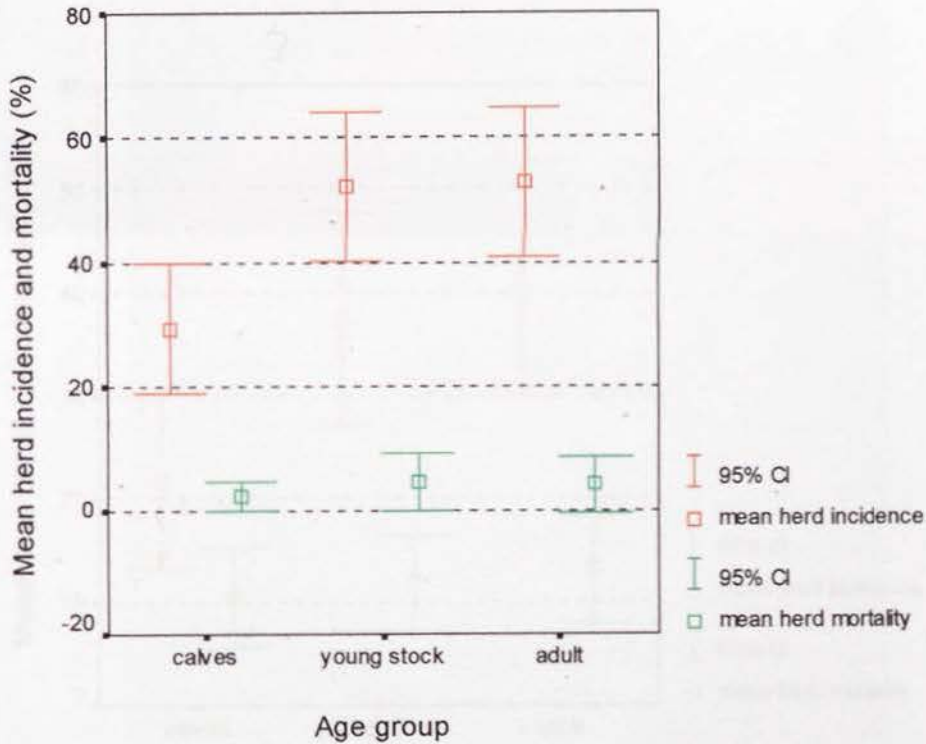


Figure 8.10
 Mean herd incidence and mortality estimates for *otikana*/ECF in Maasai herds, Morogoro region, 2000-2001 (n=50)

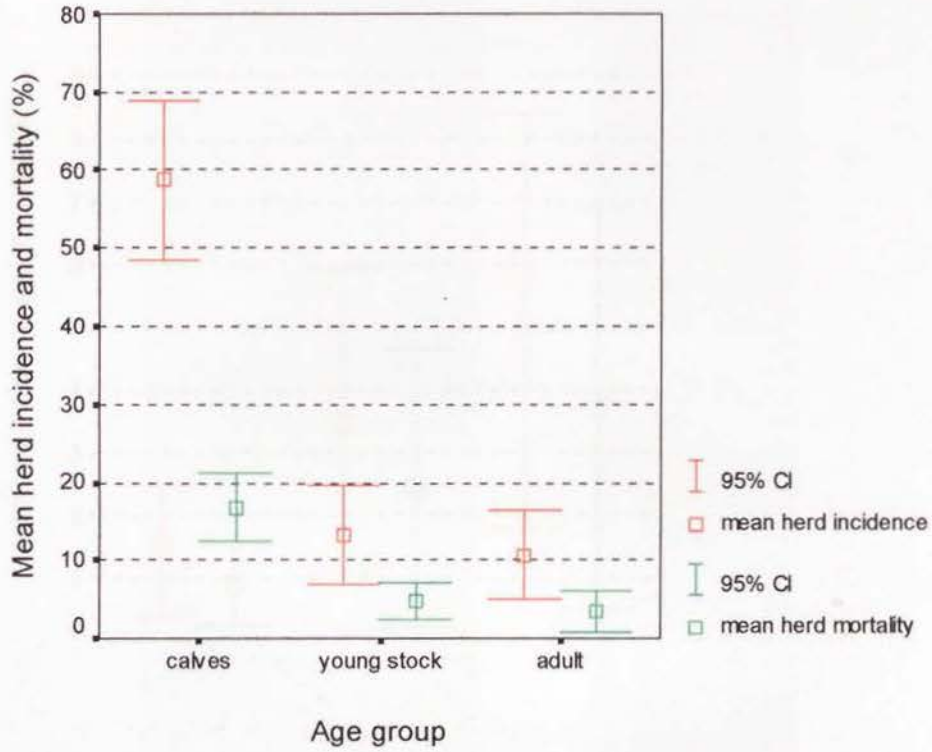


Figure 8.11
 Mean herd incidence and mortality estimates for *emwilalas*/CBPP in Maasai herds, Morogoro region, 2000-2001 (n=50)

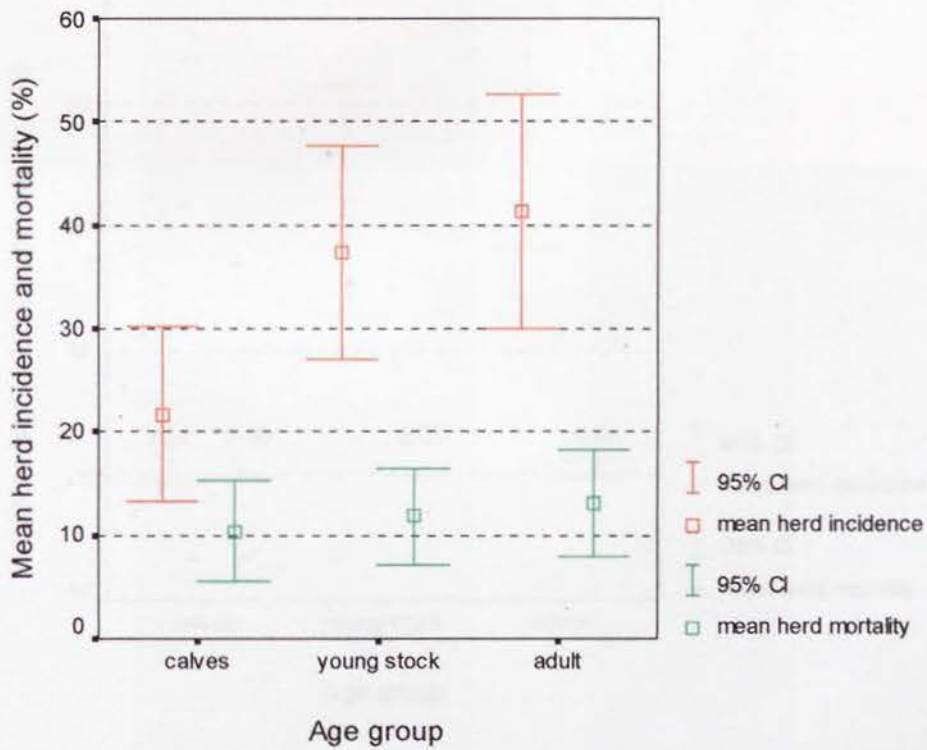


Figure 8.12
 Mean herd incidence and mortality estimates for *engluwet*/blackleg in Maasai herds, Morogoro region, 2000-2001 (n=50)

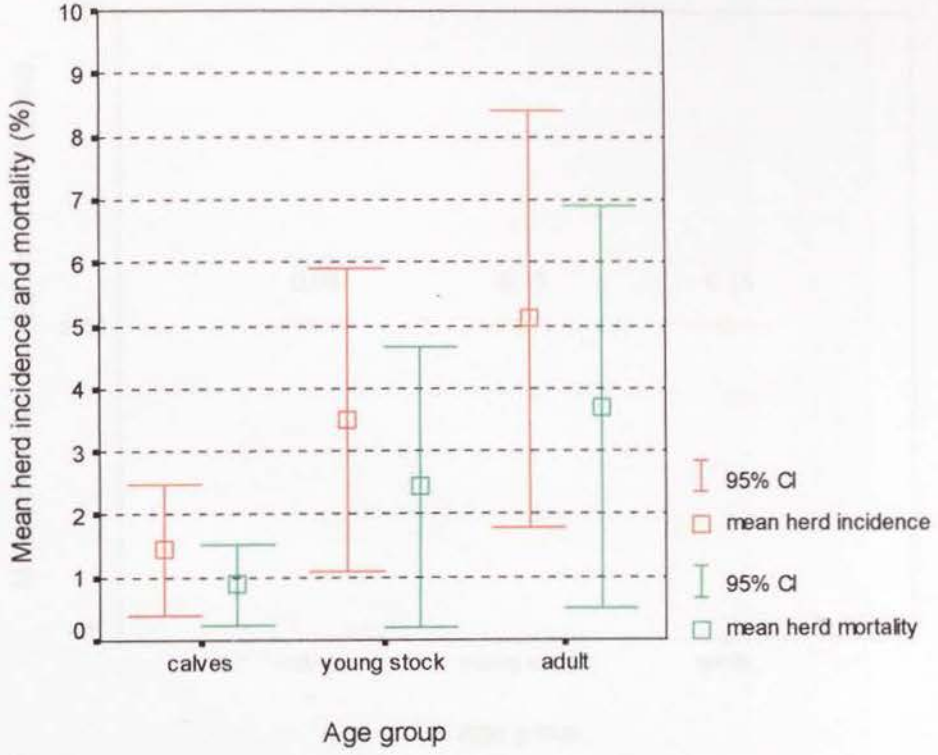


Figure 8.13
 Mean herd incidence and mortality estimates for *bugigi*/FMD in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)

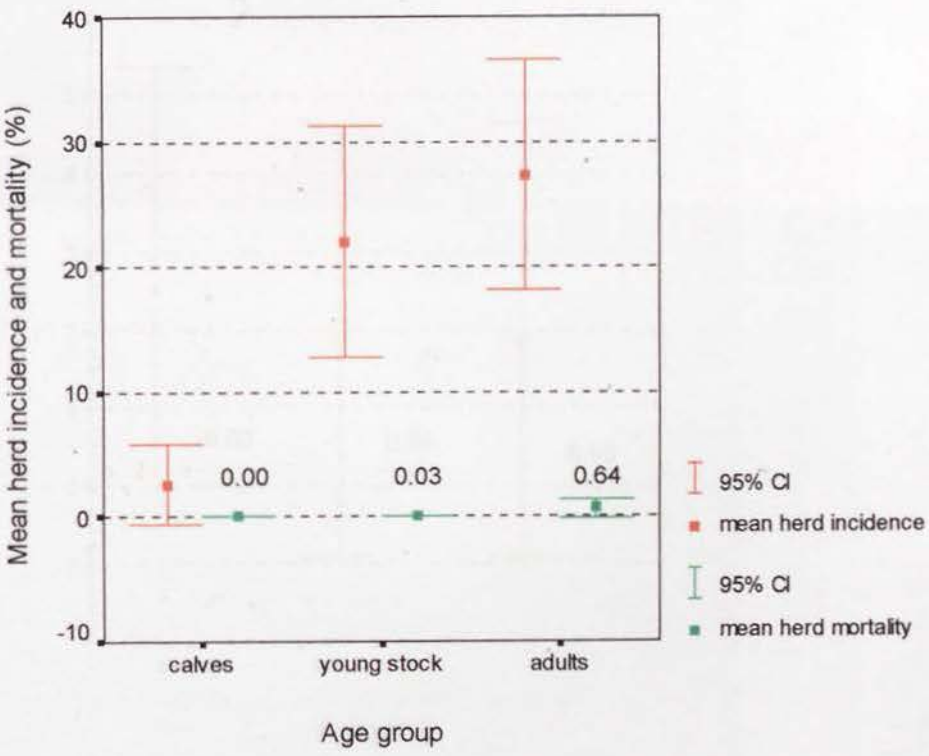


Figure 8.14
 Mean herd incidence of HI in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)

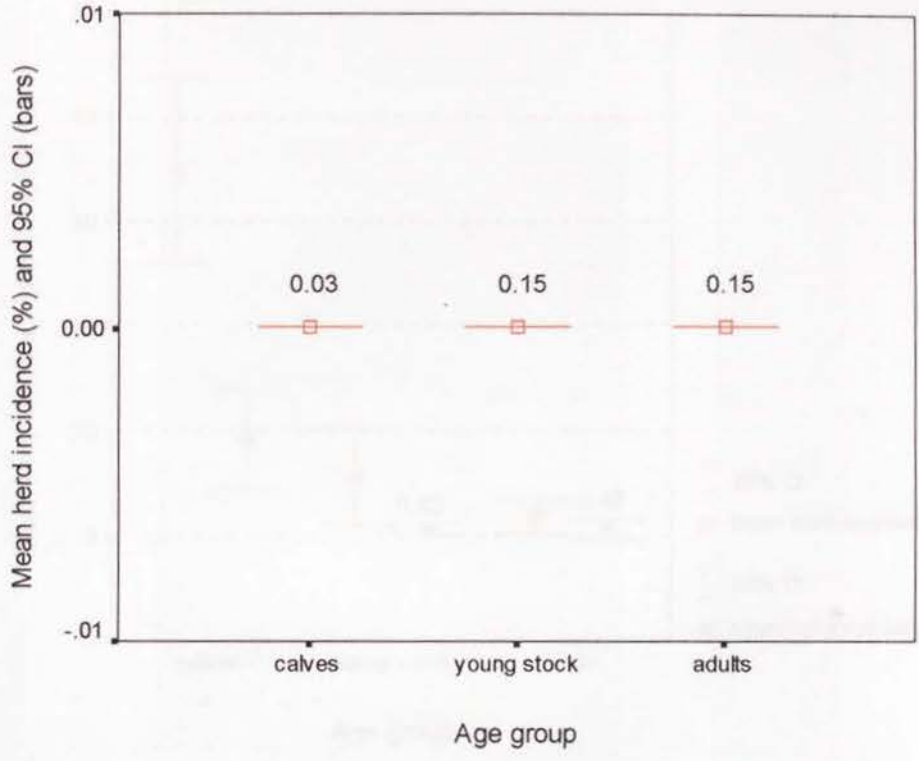


Figure 8.15
 Mean herd incidence and mortality estimates for *ndorobo*/trypanosomiasis in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)

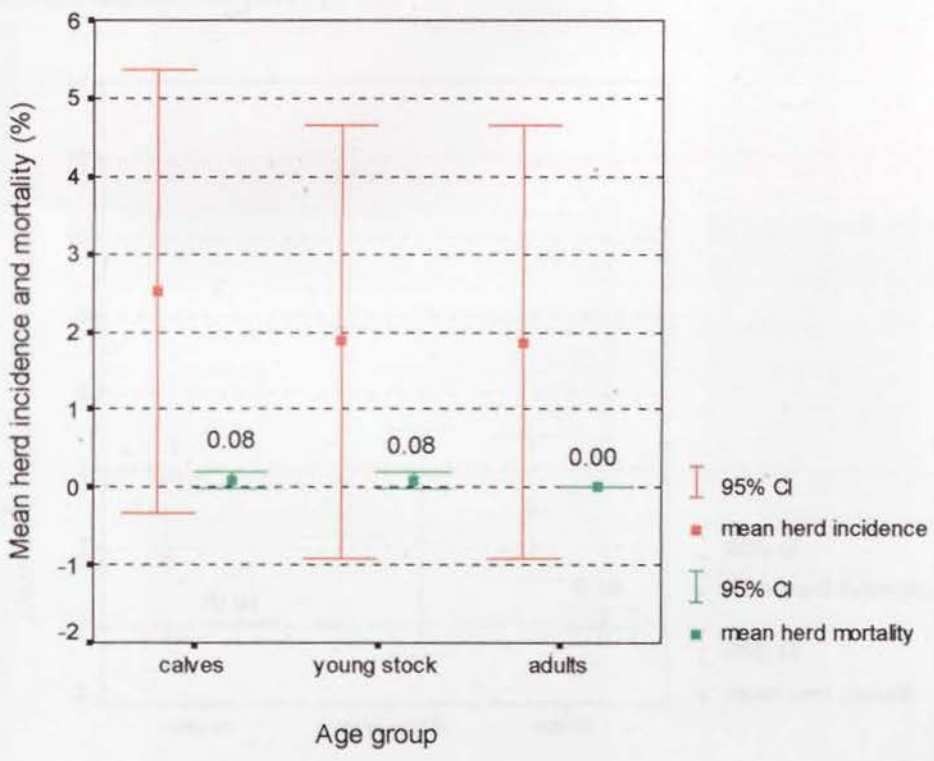


Figure 8.16
 Mean herd incidence and mortality estimates for *madundo*/ECF in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)

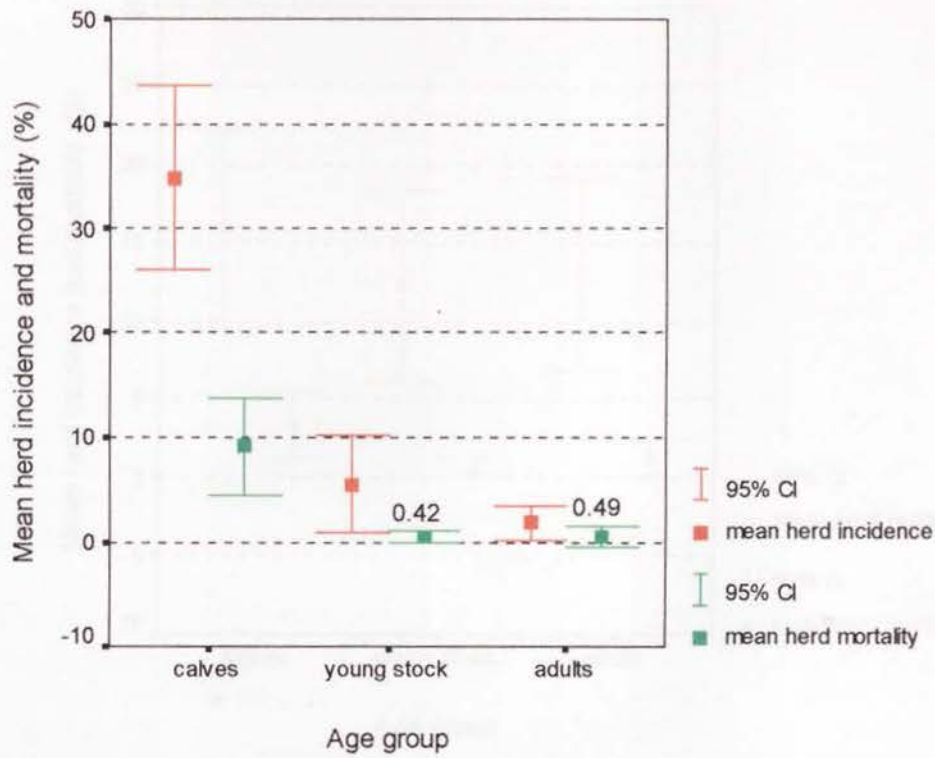


Figure 8.17
 Mean herd incidence and mortality estimates for *mabuupu*/CBPP in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)

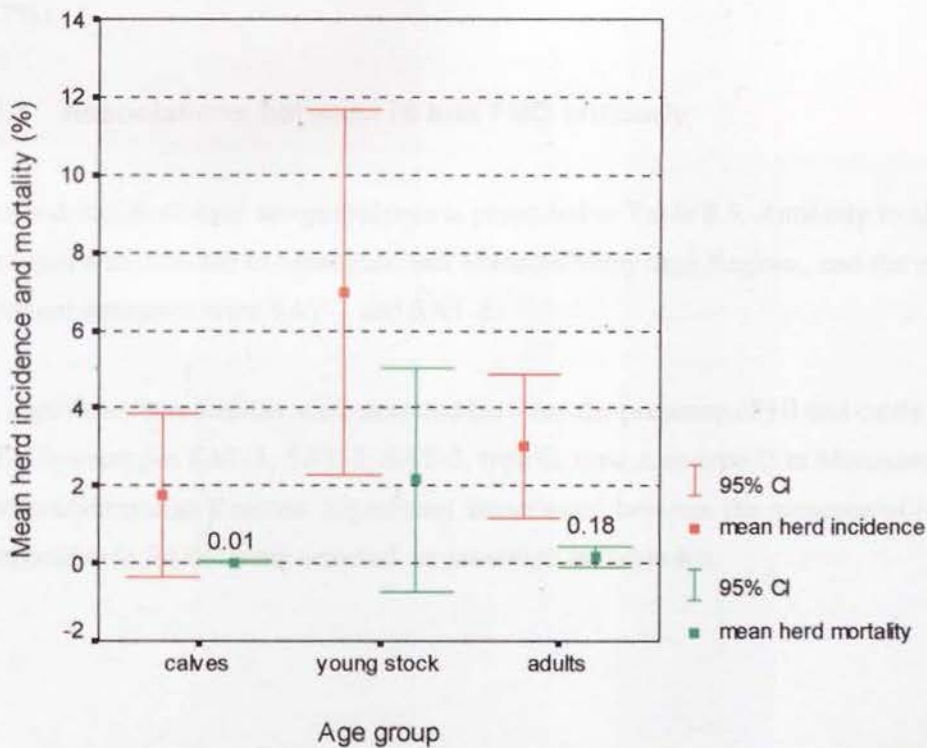
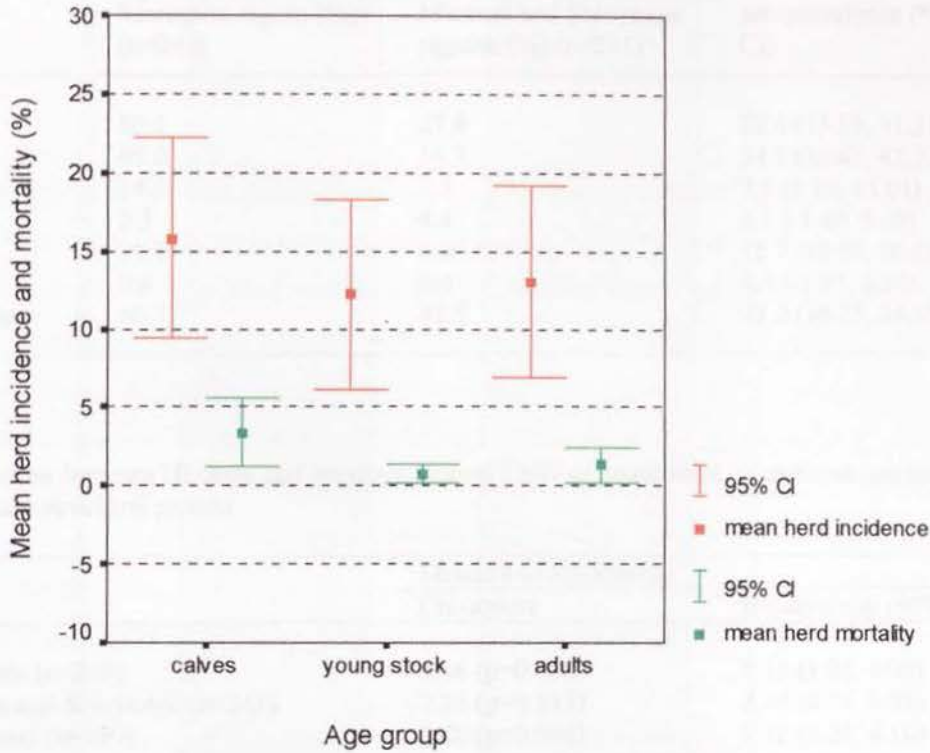


Figure 8.18
 Mean herd incidence and mortality estimates for *lyoho*/blackleg in Sukuma herds, Mwanza and Shinyanga Regions, 2000-2001 (n=73)



Proportional piling data were also used to calculate the proportion of FMD-affected cattle that survived an acute FMD outbreak but later developed HI. In Morogoro Region, the mean proportion of FMD survivors developing HI was 12% (95% CI 7.2%, 16.3%). In Mwanza Region, the mean proportion of FMD survivors developing HI was 4% (95% CI 0.49%, 7.57%).

8.3.3 Associations between HI and FMD antibody

Foot and mouth disease seroprevalence is presented in Table 8.5. Antibody to all six FMD serotypes was detected in Morogoro and Mwanza/Shinyanga Regions, and the most prevalent serotypes were SAT-1 and SAT-2.

No significant associations were detected between the presence of HI and cattle seropositive to FMD serotypes SAT-1, SAT-2, SAT-3, type O, type A or type C in Morogoro and Mwanza/Shinyanga Regions. Significant associations between the presence of HI and cattle seropositive to 3ABC were detected, as presented in Table 8.6.

Table 8.5

FMD seroprevalence in Morogoro and Mwanza/Shinyanga Regions by type, May to June 2001

Type	Seroprevalence by region		Difference in seroprevalence (%) (95% CI)
	Morogoro region (%) (n=249)	Mwanza and Shinyanga regions (%) (n=241)	
SAT-1	50.2	27.8	22.4 (13.59, 31.21)
SAT-2	49.0	14.3	34.7 (26.67, 42.73)
SAT-3	14.6	7.5	7.1 (1.19, 13.01)
Type O	2.3	4.4	2.1 (-1.49, 5.69)
Type A	16.5	0.8	15.7 (10.55, 20.85)
Type C	0.8	0.4	0.4 (-1.37, 2.17)
Any type	66.7	41.5	25.2 (16.25, 34.15)

Table 8.6

Associations between HI cases and previous clinical FMD as determined by cattle seropositive to 3ABC non-structural protein

Region	Measure of association	
	Chi-square	Relative risk (95% CI)
Morogoro (n=249)	4.68 (p=0.030)	2.19 (1.06, 4.49)
Mwanza and Shinyanga (n=241)	2.26 (p=0.133)	2.25 (0.76, 6.59)
All regions (n=490)	8.28 (p=0.004)	2.32 (1.29, 4.16)

8.4 Discussion

8.4.1 Assessment of the matrix scoring method

8.4.1.1 Reliability of matrix scoring

The reproducibility of matrix scoring as assessed by *W* values indicated that the method was reliable (Figures 8.5 and 8.6). Stronger agreement was evident between Maasai informant groups compared with Sukuma informant groups. For example, compared with the Maasai, Sukuma informants disagreed over their scores for the indicators 'diarrhoea' and 'abortion'. In part, this difference may have been due to the very low incidence of trypanosomiasis in Mwanza and Shinyanga Regions compared with Morogoro Region, and therefore Sukuma informants had relatively little experience of this disease. A weakness of the method was that the researcher identified the control diseases in Morogoro (the first study location) where trypanosomiasis was considered to be an important problem. However, the researcher did not check whether trypanosomiasis was also a priority in Mwanza and Shinyanga

Regions (the second study locations). Therefore, although some Sukuma informants were aware of trypanosomiasis, this disease was not a good choice for a control disease in Sukuma locations.

8.4.1.2 *Validity of matrix scoring*

The validity of the matrix scoring method was assessed by comparison of matrix scoring results with modern veterinary knowledge. For acute signs of disease, there was good agreement between the opinions of Maasai and Sukuma informants, and typical descriptions of the diseases in veterinary textbooks. Sukuma scoring of *ndorobo*/trypanosomiasis was disregarded due to the very low incidence of trypanosomiasis in the study locations, as explained in section 8.4.1.1 (and verified by proportional piling in Figure 8.15). The scoring of *endorobo*/trypanosomiasis by Maasai informants matched modern veterinary thinking apart from a very high score assigned to 'diarrhoea'. Although some veterinary texts state that diarrhoea is a sign of trypanosomiasis (e.g. Radostits et al., 1994), Figure 8.5 implies that the Maasai perceived this to be a major sign of the disease.

This result arose because the scoring procedure required informants to use all 20 stones for each indicator. Therefore, if only one disease was associated with a particular sign it would receive a score of 20. This is a possible weakness of the method because it can lead to apparent emphasis of a particular sign (or signs) if results are viewed on a disease-by-disease basis, rather than on a sign-by-sign basis. When probed, Maasai informants consistently stated that diarrhoea was only observed in *endorobo* and not the other diseases in the matrix.

This experience indicates that matrix scoring could be amended so that informants selected the number of stones they wished to use for each sign. With this scoring method, it would be possible to assign stones to only a single disease but also show the 'importance' or severity of the sign. This approach would not unduly affect W values because the calculation of W requires the conversion of scores to ranks (Siegal and Castellán, 1988). However, this scoring method would be more complicated and potentially difficult to explain to informants.

For chronic signs of disease, there were marked differences in the scoring patterns of the Maasai and Sukuma. The Maasai scored the control disease *endorobo*/trypanosomiasis as expected, with stones assigned to weight loss (median = 7.5, $W=0.32$) and loss of tail hair

(median = 20, $W=1.00$). Compared with the Sukuma, the Maasai consistently scored *olukuluku*/FMD for those signs associated with heat intolerance. In terms of validity, the Maasai scores matched a textbook description of chronic manifestations of FMD (Radostits *et al.*, 1994) and reports of ‘chronic FMD’ from other pastoral areas (section 8.1.3), and the Maasai gave this collection of disease signs specific names.

The finding that Sukuma informants did not associate the signs of HI with FMD (or any other disease) agrees with the conclusions of Magoma *et al.* (2000). Also, during proportional piling far fewer Sukuma informants reported HI compared with Maasai informants, and estimates of herd incidence of HI were significantly lower in Sukuma herds (apart from calves) (Table 8.4). Therefore, it is likely that fewer Sukuma informants had actually observed HI relative to Maasai informants.

As the matrix scoring method was used with informant groups and consensus of opinion was encouraged, it is possible that the views of a relatively small number of Sukuma informants who knew about HI were ‘over-ruled’ by the majority who had not observed the disease. If this was the case, it indicates that a standardised matrix scoring method with informants groups may be less appropriate in situations where knowledge about a particular problem resides with a small number of informants (for example, for a disease of very low incidence). This problem might have been overcome by categorising informants into those people who had *luzwiga* cases in their herds and those that did not. The method could then be repeated with these two informant categories.

8.4.2 Assessment of the proportional piling method

The proportional piling method was a useful, indirect way to explore perceptions of links between FMD and HI. When starting the method, an informant was not aware of the researcher’s interest in FMD or HI and so there was less risk that responses to these diseases would be exaggerated. Only after scoring all six disease categories for incidence and mortality, was an informant asked to think specifically about HI. Furthermore, the logical division of stones into sick and healthy animals, followed by further division to show patterns of specific diseases and ‘other diseases’ meant that it was impossible for an informant to backtrack and suddenly assign a large number of stones to a particular disease. For example, if a Maasai informant illustrated the incidence of *emwilalas* (CBPP) using a pile of 10 stones, mortality from *emwilalas* could never exceed this pile. Although informants were encouraged to check the piles of stones and make adjustments if they

wished, a dramatic change would have been obvious and led the researcher to probe the response.

8.4.2.1 Assessment of trends in age-specific incidence and mortality

Comparison of disease incidence and mortality by age group revealed similarities to modern veterinary knowledge for the Maasai diseases *olukuluku* (FMD), *endorobo* (trypanosomiasis) and *oltikana* (ECF). For FMD, high disease incidence but low mortality was observed in young stock and adults relative to calves (Figure 8.7). These trends can be explained by antibody in colostrum reducing FMD incidence in calves for up to five months (Scott, 1990), but relatively high mortality in calves due to factors such as cardiac disease and starvation (calves with oral lesions are unable to suck and mastitis in cows reduces suckling). In older cattle, duration of immunity following natural infection is short-lived and therefore in an endemic situation, recurrent disease is observed. Trypanosomiasis showed a similar pattern to FMD with regards to disease incidence but not mortality. Both incidence and mortality increased with age (Figure 8.9) because disease is associated with exposure to tsetse, immunity is short-lived and in endemic situations, older animals experience more contact with tsetse. Age-specific incidence and mortality for ECF is explained by the prolonged immunity that develops in cattle surviving infections as calves (Figure 8.10).

For *emwilalas* (CBPP) in Maasai herds, incidence and mortality increased with age (Figure 8.11). However, the mean herd incidence in young stock (33.4%) was only slightly lower than the mean herd incidence in adults (38.4%). Similarly, mortality in young stock was 15.8% compared to 16.0% in adults. Surveys of CBPP in pastoral herds in other endemic areas show a higher incidence in young adults of three to four years of age (McDermott *et al.*, 1987).

To the author's knowledge, there are no published accounts of age-specific incidence and mortality in pastoral herds due to blackleg. In ranched cattle, the disease seems to be reported most frequently in young adults, particularly those in good condition. Figure 8.12 shows increasing blackleg incidence and mortality with age.

8.4.2.2 Comparison of FMD serology with estimates of FMD incidence

The point prevalence of FMD antibody (all serotypes) in Morogoro and Mwanza/Shinyanga Regions was 66.7% and 41.5%, respectively (Table 8.5), compared with estimated annual

incidence of FMD (2000-2001) by proportional piling of 48.9% and 17.3% respectively (Table 8.3). As not all cattle exposed to FMD virus would be expected to show clinical signs of disease, the lower incidence estimates (as measured by proportional piling) relative to the seroprevalence estimates is expected.

8.4.2.3 Comparison of associations between HI and FMD

Proportional piling of disease incidence and previous clinical disease affecting HI cases indicated strong association between HI and FMD, with more marked association in Maasai herds (Table 8.3). If the hypothesis that HI was a sequel to FMD was correct, a higher number of HI cases could be expected in herds with higher exposure to FMD virus. Table 8.6 demonstrated significantly higher exposure to FMD virus in Maasai herds compared with Sukuma herds. Similarly, the use of seroconversion to 3ABC non structural proteins as a measure of previous clinical FMD showed significant association between HI cases and FMD in Maasai cattle (Table 8.7).

No association between 3ABC and HI was evident in Sukuma cattle. This result may have been due to the low sensitivity of the 3ABC ELISA coupled with the relatively low incidence of FMD in Sukuma herds and a small sample size. Experience from Onderstepoort Veterinary Institute indicates that the sensitivity of the 3ABC ELISA may be as low as 43% (Vosloo, personal communication). This was a source of information bias in the study and specifically, nondifferential misclassification that would tend to produce bias towards the null hypothesis, that is, no association between HI and FMD (Rothman and Greenland, 2002).

8.4.3 Outcomes of the research

As a result of the research, cartoon-style information leaflets were designed to explain the association between FMD and HI to livestock keepers. The leaflets focussed on clinical recognition of HI and highlighted that veterinarians had learnt a great deal about the syndrome by listening to herders. As there were reports of herders attempting to treat HI using modern drugs such as antibiotics and anthelmintics, or indigenous methods such as local brews, the leaflet advised that any treatment was unlikely to be successful and was probably a waste of money. Culling affected cattle was the best option. The leaflets were produced as two-sided pamphlets with Kiswahili written on one side and Maasai (for Morogoro Region) and Sukuma (for Mwanza/Shinyanga Regions) written on the other side.

8.5 Summary

A matrix scoring method for cattle disease signs was adapted to investigate possible associations between a chronic heat intolerance (HI) syndrome in cattle and previous clinical FMD. Potential associations were also investigated using a modified proportional piling method. The adapted proportional piling method also allowed estimations of disease incidence and disease mortality. These two methods were used in two geographically isolated regions of Tanzania with distinctive cattle production systems and ethnic groups. Use of the matrix scoring and proportional piling methods with Maasai informants demonstrated clear association between FMD and HI. With Sukuma informants, the matrix scoring method did not indicate association between FMD and HI, whereas the proportional piling method did indicate an association. Difference in perceptions between Maasai and Sukuma informants were explained by reference to the significantly lower prevalence of FMD in Sukuma areas and the possible restriction of knowledge about HI to a relatively small number of livestock herders who had observed the disease. The matrix scoring method was judged to be reproducible in both study locations.

Associations between FMD and HI were also investigated by comparing the incidence of HI in herds with and without previous clinical FMD, as determined by detection of 3ABC non-structural proteins to FMD virus. Results were consistent with those obtained from PA methods.

This research demonstrated that participatory appraisal methods can be successfully adapted to explore associations between acute and chronic manifestations of disease. However, when the incidence of a disease is low, methods used with groups of informants may not reveal knowledge held by a few individuals. In such situations, methods focussing on individual informants are preferred.

Chapter 9

USING MATRIX SCORING TO COMPARE INDIGENOUS AND PROFESSIONAL CHARACTERISATION OF CATTLE DISEASES

9.1 Introduction

During field studies in southern Sudan, Kenya and Tanzania the researcher made judgements about the similarity of disease signs and causes, as evident from matrix scoring, and textbook descriptions of diseases. This comparison was one method that was used to assess the validity of informants' observations on clinical and post mortem signs, and their knowledge about disease transmission. This approach was justified according to:

1. the low sensitivity and specificity of confirmatory laboratory tests for many of the diseases in question, particularly in regard to parasite or antigen detection in the live animal. For example, diagnostic tests for trypanosomiasis (MHCT) and fascioliasis (detection of fluke eggs) had low sensitivity;
2. for some diseases, the absence of a diagnostic test to detect parasite or antigen in the live animal e.g. CBPP and blackleg;
3. the difficulty of using many of the available diagnostic tests under field conditions. Other than the MHCT for trypanosomiasis and examination of lymph nodes smears for ECF, many tests were cumbersome to use in the field (particularly if travelling on foot).
4. in the absence of diagnostic tests for technical, logistical or resource constraints the 'gold standard' diagnostic test is the opinion of a veterinarian.

However, the researcher's comparison of informants' and textbook descriptions of disease suffered from at least two flaws. First, in the field there can be much variation in the observed manifestation of disease and the typical clinical picture provided in texts. Secondly, the researcher's experience of PA methods before conducting the research might have biased the comparison of PA results with conventional veterinary knowledge.

In order to compare PA results and modern veterinary opinion in a more systematic manner, the matrix scoring method was adapted for use with veterinarians to allowing a direct comparison of 'local' and 'modern' knowledge.

9.2 Materials and Methods

In order to assess the relationship between herders' and veterinarians' characterisation of diseases by disease signs and causes, a paper version of the matrix scoring method was developed for use with veterinarians.

9.2.1 Provisional translation of local disease names to modern veterinary terminology

Paper versions of the matrix were developed in English. The researcher used the results of matrix scoring by herders' to translate local disease names into modern veterinary terminology (Table 9.1).

Table 9.1
Provisional translation of local cattle disease names

Local disease name	Provisional translation into modern veterinary terminology
Nuer, southern Sudan	
<i>Liei</i>	Trypanosomiasis
<i>Dat</i>	FMD
<i>Maguar</i>	Parasitic gastroenteritis
<i>Doop</i>	CBPP
<i>Macueny</i>	Fascioliasis
Orma, Kenya	
<i>Gandi</i>	Chronic trypanosomiasis
<i>Buku</i>	Acute haemorrhagic trypanosomiasis due to <i>T.vivax</i>
<i>Hoyale</i>	FMD
<i>Somba</i>	CBPP
<i>Madobesa</i>	Rinderpest
Maasai, Tanzania	
<i>Endorobo</i>	Trypanosomiasis
<i>Oltikana</i>	ECF
<i>Olukuhuku</i>	FMD
<i>Emwilalas</i>	CBPP
<i>Engluwet</i>	Blackleg

In the case of *liei*, results presented in Chapter 4 indicated that this disease was a combination of single and mixed infections. In the paper version of the matrix the researcher assumed that it would be too complicated to label a single disease column with all the different diseases (trypanosomiasis, fascioliasis, PGE, schistosomiasis) and combinations of diseases that could comprise *liei*. Also, contact with veterinarians in the OLS programme indicated that they commonly used *liei* as a synonym for trypanosomiasis. Therefore, trypanosomiasis was used in the paper versions of the matrices for the sake of simplicity but also to check whether the interpretation of *liei* by veterinarians was correct.

9.2.2 Development of a paper version of the matrix scoring method

The paper versions of the matrices comprised blank matrix diagrams with the translated disease names along the *x*-axis of the matrices, and disease signs and causes written down the *y*-axis of the matrices. Each matrix was designed to fit on to an A4-size piece of paper and was administered with a packet of 20 buttons for each indicator in the matrix.

A set of written guidelines were developed and attached to the matrices. The guidelines advised informants to consider each indicator in turn and distribute the 20 counters (buttons) against each disease to show the relationship between the indicator and disease. The number of counters should then be written in the corresponding cell of the matrix. Informants were advised that, for each indicator, all 20 counters should be used. However, if informants felt that there was no relationship between the indicator and the diseases, a score of 0 should be given to each disease. Informants were also asked to complete the matrices without consulting colleagues or literature. All blank matrices and guidelines for their use are shown in Appendix 9.1.

9.2.3 Pre-testing the paper versions of the matrices

Each paper version of a matrix was pre-tested with veterinarians, as detailed in Table 9.2.

9.2.4 Selection of informants

The informants were veterinarians known to have clinical experience of cattle diseases but with no field experience in southern Sudan, Tana River District in Kenya or Morogoro Region in Tanzania (Table 9.2). Individual informants were used and the number of informants was similar to the number of herder informant groups.

Table 9.2
Summary methodology for comparing the perceptions of livestock keepers and veterinarians

Informants		Comparison	Location and number of veterinarians conducting the pre-testing of matrices
Livestock keepers (informant groups)	Veterinarians (individual informants)		
Nuer, southern Sudan (n=12)	Kenyan - Kenya Veterinary Association Meeting, Mombasa, April 2000 (n=12)	Disease signs and disease causes	Operation Lifeline Sudan Livestock Programme, Nairobi and Sudan (n=8)
Orma, Kenya (n=12)	Tanzanian - Sokoine University of Agriculture, May 2001(n=11)	Disease signs and disease causes	African Union/Interafrican Bureau for Animal Resources, Nairobi (n=5)
Maasai, Tanzania (n=9)	Kenyan, Ugandan, Eritrean, Ethiopian and Sudanese – Regional Training Course, Arusha, June 2002 (n=10)	Acute and chronic disease signs	African Union/Interafrican Bureau for Animal Resources, Nairobi (n=4)

9.2.5 Administration of the matrices

Matrices were administered during meetings or workshops (Table 9.2). For one set of matrices, the researcher identified a contact person to administer the matrices at the Kenya Veterinary Association meeting. Two sets of matrices were administered by the researcher during a training workshop on PA methods at Sokoine University of Agriculture, Tanzania, and a regional training course in PA in Arusha, Tanzania.

9.2.6 Data analysis

9.2.6.1 Data from matrix scoring by veterinarians

Data from matrix scoring by veterinarians were summarised using the median score and 95% CI (Gardner *et al.*, 1992). Agreement between veterinarians was assessed using the Kendal coefficient of concordance (W) (Siegal and Castellan, 1988) in the SPSS software version 11.0 (SPSS, 2001).

9.2.6.2 Comparing matrix scoring data derived from livestock keepers and veterinarians

Matrix scoring data obtained from livestock keepers and veterinarians were compared using three methods.

a. Direct visual assessment of summarised matrices

A simple visual assessment of the summarised matrices of the herders' and veterinarians' scores was conducted to identify general similarities in scoring patterns.

b. Hierarchical cluster analysis

Cluster analysis is a generic term for various multivariate statistical methods that are used to classify entities into clusters (Aldenderfer & Blashfield, 1984). Although there are numerous methods for conducting cluster analysis, a common feature is a quantitative estimation of 'similarity' between entities and representation of entities as coordinates. When visualised on a diagram, the closer the distance between entities, the greater their similarity.

A clustering method called hierarchical cluster analysis (HCA) was used to explore relationships between local disease names and modern veterinary terminology. In this analysis, the entities were the diseases that were scored by the herders and veterinarians. One of the outputs of HCA is a dendrogram (sometimes called a tree diagram) in which the entities in question are linked according to their levels of similarity. Various levels (hierarchies) of similarity can be visualised simultaneously on one dendrogram.

The HCA was conducted using SPSS software, version 11.0 (SPSS, 2001). Both disease signs and disease causes indicators were used in the analysis because it was assumed that the recognition of a disease by either herders or veterinarians depended on observation of both clinical features and epidemiological factors. The squared Euclidean distance was used as a measure of similarity between diseases according to guidelines in SPSS. The 'average linkage' method was selected as the clustering method.

c. Multidimensional scaling

In common with cluster analysis, multidimensional scaling (MDS) is a multivariate statistical method based on the analysis of similarity (or dissimilarity) between objects. In MDS, a numerical measure called proximity is used to indicate the degree of closeness between objects and the main output of the method is a spatial representation of the objects under investigation (Kruskal and Wish, 1978). The method has been commonly used in the social sciences in studies of human perception (Forgas, 1982).

The calculation of Euclidean distance in MDS uses a similar formula to that used in cluster analysis. Euclidean distances are related to proximities by the use of an objective function¹, sometimes called 'f-stress', that indicates how well the configuration of objects represents the data. In summary, MDS seeks to minimise stress and produce the best fit between distances and proximities.

When comparing the perceptions of herders and veterinarians, it was assumed that each type of informant used various types of clinical, epidemiological and experiential information to reach a diagnosis and apply a disease name to a disease. Multidimensional scaling was conducted using SPSS software, version 11.0 (SPSS, 2001). All the disease signs and disease causes indicators were used in the analysis (as for HCA) and the squared Euclidean distance was used as a measure of similarity between diseases. Distance was calculated from the data assuming an ordinal level of measurement.

¹ The basic concept of an objective function is used in many statistical methods and includes names such as goodness-of-fit function, error function and criterion function.

9.3 Results

9.3.1 Comparison of matrix scoring by Nuer herders (southern Sudan) and veterinarians from Kenya

Matrix scoring of disease signs by Kenyan veterinarians is summarised in Figure 10.1b and shows evidence of strong, moderate and weak agreement for 6/9, 2/9 and 1/9 disease signs, respectively. The most obvious difference to the matrix scoring by Nuer informants (Figure 9.1a) was a median score of 0 assigned to the indicator 'loss of tail hair' for trypanosomiasis whereas with Nuer informants a median score of 20 was obtained. Veterinarians associated loss of tail hair with CBPP (median score = 6) rather than trypanosomiasis.

Matrix scoring of disease causes by Kenyan veterinarians is summarised in Figure 9.2b and shows evidence of strong, moderate and weak agreement for 6/8, 1/8 and 1/8 disease causes, respectively. Informants did not agree on the role of ticks as causes of disease ($W=0.08$) whereas Nuer informants consistently disassociated ticks with the five diseases ($W=1.00$; median score = 0 for all five diseases)(Figure 9.2a).

Hierarchical cluster analysis (Figure 9.3) and MDS (Figure 9.4) outputs indicated five primary clustered pairs of diseases corresponding to the disease-pairs in Table 9.1. Two secondary clusters each comprising two disease-pairs were also evident from HCA. These clusters were *dat*/FMD and *doop*/CBPP (being infectious diseases with cow-to-cow transmission), and *macueny*/fascioliasis and *maguar*/ PGE-haemonchosis (being parasitic diseases caused by macroscopically-visible parasites). Proximity matrices and agglomeration schedules for HCA are shown in Appendix 9.2. Agglomeration schedules show the sequence in which pairs of diseases were clustered during the analysis. Stress results and configuration coordinates for MDS outputs are shown in Appendix 9.3.

Figure 9.1
Matrix scoring of disease signs by Nuer livestock keepers and Kenyan veterinarians[†]

Signs	Diseases					Signs	Diseases				
	<i>Liel</i>	<i>Dat</i>	<i>Mogiar</i>	<i>Doop</i>	<i>Macaery</i>		Trypanosomiasis	Foot and mouth disease	Haemonchosis	CBPP	Fasciolosis
Chronic weight loss ($W=0.51^{***}$)	10 (6.0-16)	1 (0-2.5)	3 (0-3.0)	1 (0-2.5)	1 (0-2.0)	Chronic weight loss ($W=0.53^{***}$)	6 (5.5-8)	1 (0-2.5)	3.5 (2.5-4.5)	3.5 (1.5-5)	5 (4-6.5)
Animal scabs shade ($W=0.88^{***}$)	0 (0)	20 (17-20)	0 (0)	0 (0-3.0)	0 (0)	Fever ($W=0.77^{***}$)	6 (4-8.5)	9 (6.5-13)	0 (0)	3.75 (2-6)	0 (0)
Diarrhoea ($W=0.52^{**}$)	4 (0-8.5)	0 (0)	11 (6.0-16)	0 (0)	4 (0-7.5)	Diarrhoea ($W=0.23^*$)	3 (0-5.5)	2 (0-3.5)	8 (4-12.5)	2 (0-5)	3 (0-5)
Reduced milk yield ($W=0.51^{***}$)	2 (0-4.0)	13 (7.0-20)	3 (0-9.0)	1 (0-2.5)	0 (0-1.0)	Reduced milk yield ($W=0.73^{***}$)	4.5 (2.5-7)	10 (8.5-14)	0.5 (0-1.0)	3 (0.5-5.5)	0 (0-1.0)
Coughing ($W=0.76^{**}$)	0 (0-0.5)	0 (0-0.5)	0 (0-2.0)	19 (16.5-20)	0 (0-0.5)	Coughing ($W=0.56^{**}$)	0.5 (1-1.5)	0 (0-0.5)	0 (0-0.5)	16 (9.5-20)	0 (0-2)
Reduced appetite ($W=0.54^{***}$)	0 (0)	13 (7.0-20)	0 (0)	5 (0-10)	0 (0)	Reduced appetite ($W=0.48^{**}$)	3 (0-4)	8.5 (5-13.5)	1 (0-2.5)	3.5 (0-7)	0.5 (0-1.5)
Loss of tail hair ($W=0.89^{***}$)	20 (16.5-20)	0 (0)	0 (0-3.5)	0 (0)	0 (0)	Loss of tail hair ($W=0.15$)	0 (0-0)	0 (0-1)	0 (0-1)	6 (0-10)	0 (0-0.5)
Tearing ($W=0.28^*$)	6 (3.0-13)	2 (0-6.5)	4 (0-8.5)	0 (0-1.5)	3 (0-8.0)	Tearing ($W=0.27^*$)	8 (0-13)	0 (0-4.5)	0 (0-3)	0 (0-2)	0 (0-0.5)
Salivation ($W=0.50^{**}$)	2 (0-3.0)	14 (7.0-20)	3 (0-6.5)	1 (0-2.0)	0 (0-0.5)	Salivation ($W=0.70^{***}$)	0 (0-1)	20 (14-20)	0 (0-0)	0 (0-1.5)	0 (0-0)

a. Nuer informant groups, southern Sudan (n=12)

b. Veterinarians, Kenya (n=12)

Figure 9.2
Matrix scoring of disease causes by Nuer livestock keepers and Kenyan veterinarians†

CAUSES OF SOURCES	Diseases					CAUSES OF SOURCES	Diseases				
	Lier	Dar	Moguar	Doop	Maceruy		Trypanosomi- asis	Foot and mouth disease	Haemochosis	CBPP	Fasciolosis
Liver fluke <i>Daichom</i> ($W=0.68^{***}$)	•• 2 (0-4.5)	••••• 0 (0-2.5)	•• 3 (0-7)	••••• 0 (0)	••••• 15 (10.0-20)	Liver fluke ($W=0.83^{***}$)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 20 (20-20)
Sick cow entering herd ($W=0.74^{***}$)	••••• 0 (0-1)	••••• 8 (5.0-10.0)	• 1 (0-3)	••••• 9 (5.0-12.0)	••••• 0 (0-0.5)	Sick cow entering herd ($W=0.86^{***}$)	••••• 10 (7.5-12)	••••• 0 (0-0)	••••• 10 (6.0-10)	••••• 0 (0-0)	••••• 0 (0-0)
Paraphistomes <i>Chire</i> ($W=0.33$)	••••• 5 (0-12)	••••• 0 (0)	••••• 5 (0-12.5)	••••• 0 (0)	••••• 5 (0-13.5)	Paraphistomes ($W=0.53^{***}$)	••••• 0 (0-0)	••••• 1 (1-20)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)
Stomach worms <i>Luck</i> ($W=0.45^{**}$)	••••• 3 (0-5.5)	••••• 0 (0)	••••• 8 (3.5-14.0)	••••• 0 (0)	••••• 5 (5.0-10.0)	Stomach worms ($W=0.71^{***}$)	••••• 0 (0-0)	••••• 15 (10-20)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)
Flooding [†] ($W=0.49^{**}$)	••••• 8 (2.5-13.0)	••••• 0 (0)	••••• 6 (2.5-12.5)	••••• 0 (0)	••••• 4 (3.75-10.0)	Flooding ($W=0.25$)	• 1 (0-5)	••••• 3 (0-10)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 3 (0-9-0)
Biting flies <i>Rom</i> ($W=0.82^{***}$)	••••• 19 (15.5-20)	••••• 0 (0)	••••• 0 (0-6)	••••• 0 (0)	••••• 0 (0-1.5)	Biting flies ($W=0.93^{***}$)	••••• 20 (17.5-20)	••••• 0 (0-0.5)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)
Ticks <i>Chak</i> ($W=1.00^{***}$)	••••• 0 (0)	••••• 0 (0)	••••• 0 (0)	••••• 0 (0)	••••• 0 (0)	Ticks ($W=0.08$)	••••• 0 (0)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)	••••• 0 (0-0)
Snails <i>Chom</i> ($W=0.60^{***}$)	••••• 2 (0-4.5)	••••• 0 (0)	••••• 5 (2.5-9.0)	••••• 0 (0)	••••• 10 (5.0-15.0)	Snails ($W=0.89^{**}$)	••••• 0 (0)	••••• 0 (0)	••••• 0 (0)	••••• 0 (0)	••••• 20 (19-20)

† W = Kendall coefficient of concordance (* $p<0.05$; ** $p<0.01$; *** $p<0.001$). Medians are presented and 95% CI are shown in parentheses.

Figure 9.3

Dendrogram of matrix scores from groups of Nuer herders (n=12) and Kenyan veterinarians (n=12) for diseases of adult cattle using hierarchical cluster analysis

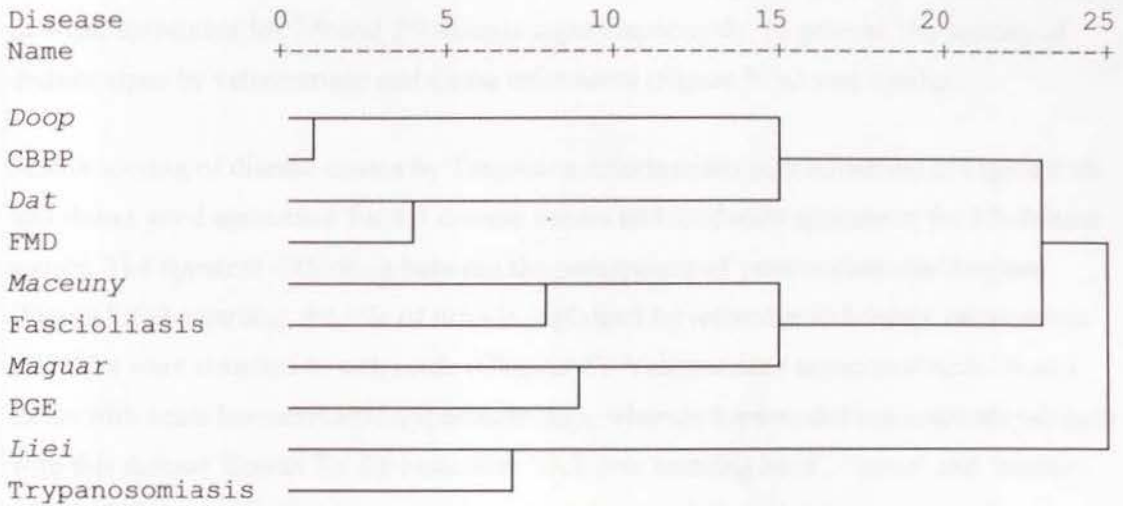
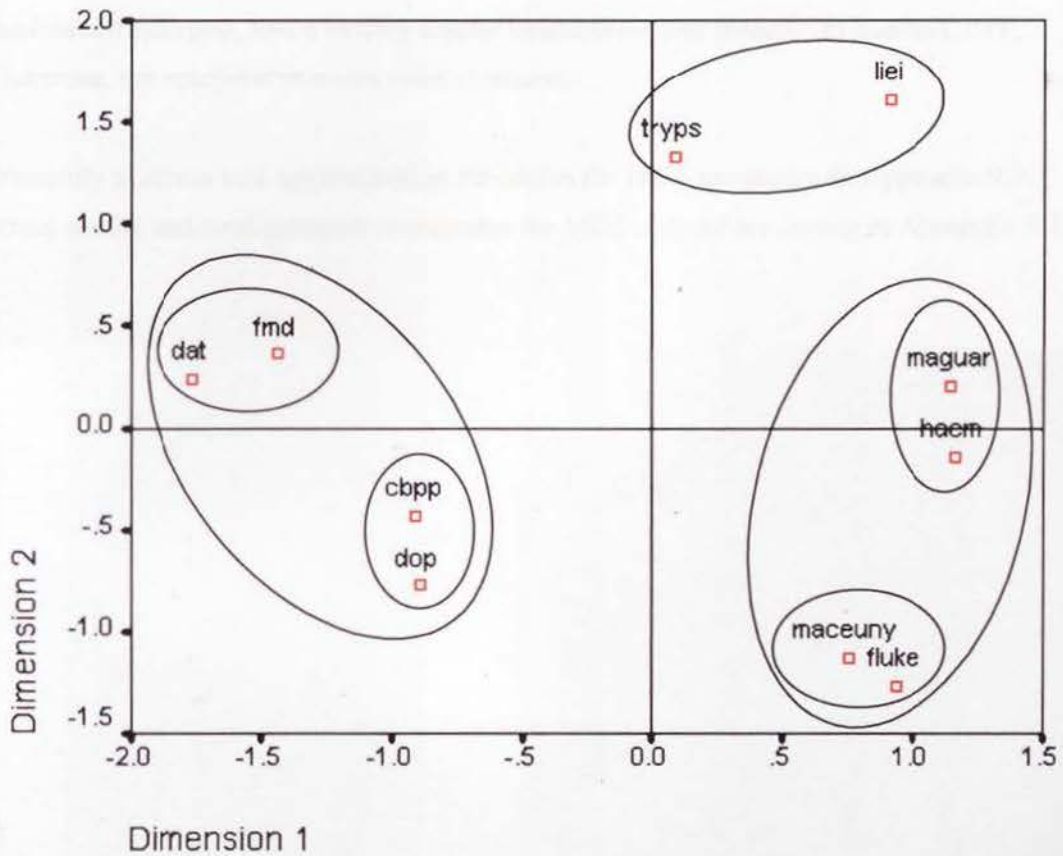


Figure 9.4

Plot of matrix scores from groups of Nuer herders (n=12) and Kenyan veterinarians (n=12) for five diseases of adult cattle using multidimensional scaling and hierarchical cluster analysis



9.3.2 Comparison of matrix scoring by Orma herders (Kenya) and veterinarians from Tanzania

Matrix scoring of disease signs by Tanzanian is summarised in Figure 9.5b and shows good or weak agreement for 7/9 and 2/9 disease signs respectively. In general, the scoring of disease signs by veterinarians and Orma informants (Figure 9.5a) was similar.

Matrix scoring of disease causes by Tanzanian veterinarians is summarised in Figure 9.6b and shows good agreement for 4/5 disease causes and moderate agreement for 1/5 disease causes. The apparent difference between the perceptions of veterinarians and herders (Figure 9.6a) regarding the role of ticks is explained by reference to herders' observation that ticks were attracted to sick cattle (Chapter 7). Veterinarians associated tabanids and tsetse with acute haemorrhagic trypanosomiasis, whereas herders did not associate tabanids with this disease. Scores for the indicators 'sick cow entering herd', 'tsetse' and 'contact with buffalo' were similar between the veterinarians and Orma herders.

Hierarchical cluster analysis (Figure 9.7) and MDS (Figure 9.8) outputs indicated five primary clustered pairs of diseases corresponding to the disease-pairs in Table 9.1. In the HCA dendrogram, a secondary cluster comprised the diseases *hoyale*/FMD and *madobesa*/rinderpest, and a tertiary cluster linked these two diseases to *somba*/CBPP. Therefore, the epizootic diseases were clustered.

Proximity matrices and agglomeration schedules for HCA are shown in Appendix 9.3. Stress results and configuration coordinates for MDS outputs are shown in Appendix 9.4.

Figure 9.5
Matrix scoring of disease signs by Orma livestock keepers and Tanzanian veterinarians†

a. Orma informant groups, Kenya (n=12)

Signs	Diseases			
	<i>Camdi</i>	<i>Hoyale</i>	<i>Buku</i>	<i>Somba</i>
Chronic weight loss ($P=0.59^{***}$)	4.5 (3.5-6.0)	1.5 (0-3.0)	0 (0-0.5)	11.5 (7.5-14.5)
Animal sores shade ($P=0.59^{***}$)	1.0 (0-3.5)	15.8 (10.0-20)	1.5 (0-4.0)	1.0 (0-4.0)
Diarrhoea ($P=0.78^{***}$)	3.0 (1.0-5.5)	0 (0-0)	5.5 (3.0-8.5)	0 (0-0)
Haemorrhagic carcass ($P=0.83^{***}$)	3.0 (0-5.0)	0 (0-0)	17.0 (15.0-20)	0 (0-0)
Coughing, ($P=0.86^{***}$)	4.25 (2.5-6.5)	0 (0-0)	1.0 (0-2.0)	14.5 (12.5-16.5)
Reduced appetite ($P=0.26$)	5.25 (3.0-7.5)	6.0 (3.0-9.0)	2.5 (0-4.5)	3.0 (0.5-8.5)
Loss of tail hair ($P=0.65^{***}$)	14.2 (10.0-19.0)	0 (0-0)	0 (0-2.5)	0 (0-0)
'Death is sudden' ($P=0.78^{***}$)	0 (0-3.5)	0 (0-0)	17.5 (13.5-20)	0 (0-0.5)
Oedematous carcass ($P=0.46^{***}$)	11.0 (5.5-17.5)	0 (0-0)	0 (0-5.0)	4.0 (0-10.0)

b. Veterinarians, Tanzania (n=11)

Signs	Diseases			
	Chronic trypanosomiasis	FMD	Acute trypanosomiasis due to <i>T. vivax</i>	CBPP
Chronic weight loss ($P=0.81^{***}$)	9.75 (8-11)	2 (1-3.5)	0 (0-1)	5.5 (4-7)
Animal sores shade ($P=0.10$)	2.0 (1-10)	6 (3-11)	3.75 (1-6.5)	2.75 (1-5)
Diarrhoea ($P=0.75^{***}$)	1 (0-2)	0 (0-2)	2 (0-3.5)	0 (0-2)
Haemorrhagic carcass ($P=0.75^{***}$)	0.5 (0-3)	0 (0-1)	16.8 (13.5-20)	0 (0-1)
Coughing, ($P=0.83^{***}$)	0 (0-3)	0 (0-2)	0 (0-1.5)	17.5 (15-20)
Reduced appetite ($P=0.49^{***}$)	2 (1-3.5)	6.5 (4.5-9)	3.5 (2-4.5)	3.5 (3-4)
Loss of tail hair ($P=0.77^{***}$)	18.5 (10-20)	0 (0-1.5)	0 (0-1)	0 (0-1)
'Death is sudden' ($P=0.66^{***}$)	0 (0-0)	0 (0-4.5)	8.25 (4.5-12.5)	1 (0-3)
Oedematous carcass ($P=0.13$)	5 (0-10)	0 (0-0)	0 (0-7.5)	1 (0-7.5)

† Rinderpest

Figure 9.6

Matrix scoring of disease causes by Orma livestock keepers and Tanzanian veterinarians†

a. Orma informant groups, Kenya (n=12)

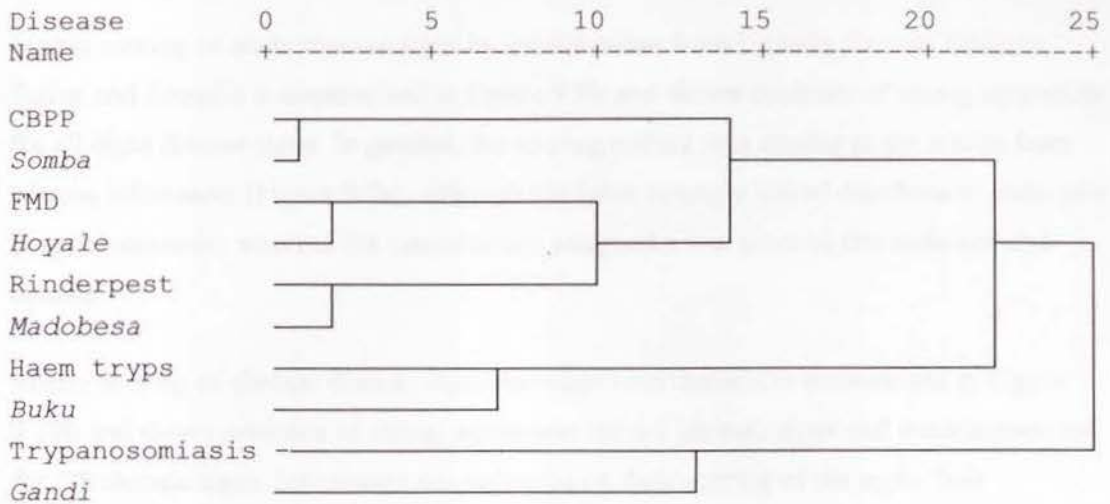
CAUSES	Diseases				
	Gandi	Hoyale	Buka	Somba	Madobesa
Sick cow entering herd (W=0.71 ^{***})	0 (0-3.0) •••••	10.0 (8.0-11.0) •••••	0 (0) •••••	4.25 (2.5-6.0) ••	6.0 (5.0-7.0) •••••
Shilmi Ticks (W=0.67 ^{***})	11.5 (6.0-16.0) •••••	0 (0-0)	5.0 (0-8.5) •••••	0 (0-0)	0 (0-0)
Kobobe Tabanids (W=0.38 [*])	10.0 (0-13.0) •••••	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Gandi 'kawala' Tsetse (W=0.86 ^{***})	15.0 (11.5-17.5) •••••	0 (0-0)	5.0 (2.5-8.5) •••••	0 (0-0)	0 (0-0)
Gadarsi Contact with buffalo (W=0.75 ^{***})	0 (0-0)	8.25 (7.0-10.0) •••••	0 (0-0)	1.5 (0-3.0) ••	9.5 (7.0-12.0) •••••

b. Veterinarians, Tanzania (n=11)

CAUSES	Diseases				
	Chronic trypanosomiasis	FMD	Acute trypanosomiasis due to <i>T. vivax</i>	CBPP	Rinderpest
Sick cow entering herd (W=0.86 ^{***})	0 (0-0.5) •••••	6.5 (6-8) •••••	0 (0-0.5) •••••	6 (5.5-7) •••••	7 (5.5-8) •••••
Ticks (W=1.00 ^{***})	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Tabanids (W=0.42 [*])	••••• 5 (0-10)	0 (0-0)	••••• 5 (0-10)	0 (0-0)	0 (0-0)
Tsetse (W=0.93 ^{***})	••••• 10 (10-15)	0 (0-0)	••••• 10 (5-10)	0 (0-0)	0 (0-0)
Contact with buffalo (W=0.60 ^{***})	0 (0-0)	6 (2.5-10) •••••	0 (0-0)	2.5 (0-3.5) •••••	9 (5-15) •••••

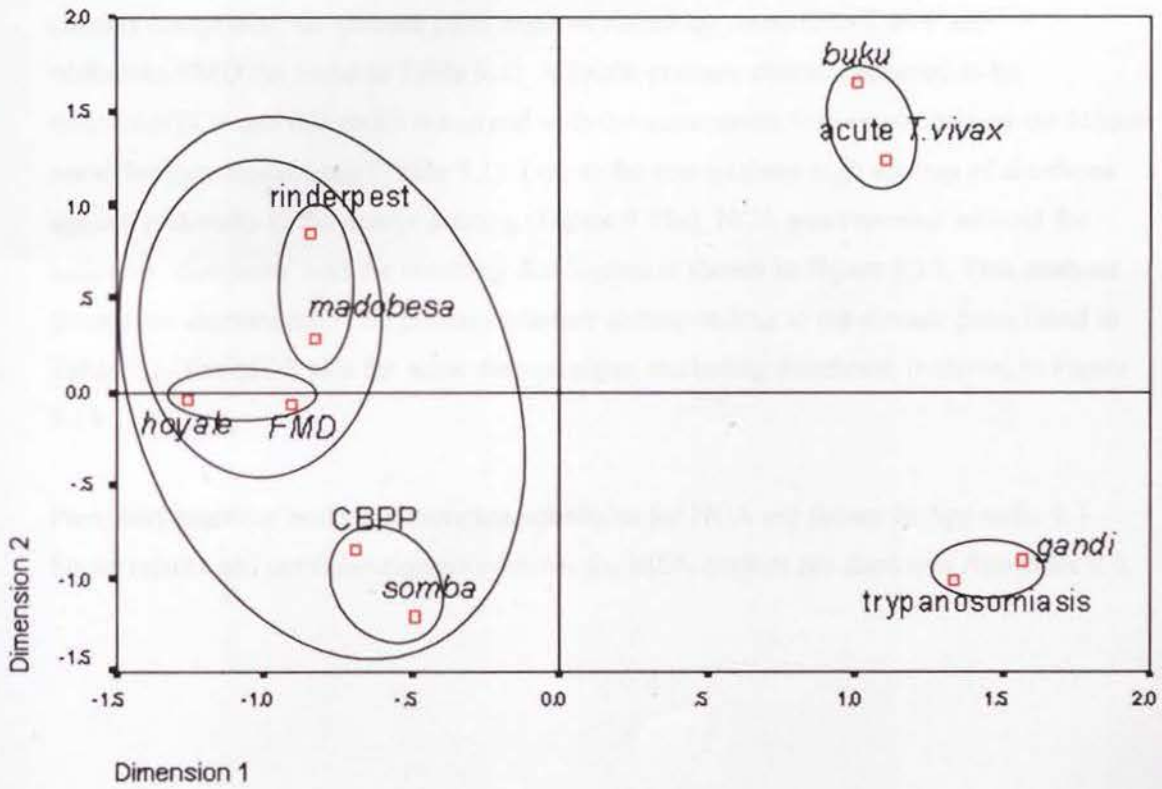
† W = Kendal coefficient of concordance (*p<0.05; **p<0.01; ***p<0.001). Medians are presented and 95% CI are shown in parentheses.

Figure 9.7
Dendrogram of matrix scores from groups of Orma herders (n=12) and Tanzanian veterinarians (n=11) for diseases of adult cattle using hierarchical cluster analysis



Note
'Haem tryps' = acute haemorrhagic trypanosomiasis due to *T. vivax*.

Figure 9.8
Plot of matrix scores from groups of Orma herders (n=12) and Tanzanian veterinarians (n=11) for five diseases of adult cattle using multidimensional scaling and hierarchical cluster analysis



9.3.3 Comparison of matrix scoring by Maasai herders (Tanzania) and veterinarians from Ethiopia, Eritrea, Somalia, Sudan and Uganda

Matrix scoring of acute disease signs by veterinarians from Uganda, Eritrea, Ethiopia, Sudan and Somalia is summarised in Figure 9.9b and shows evidence of strong agreement for all eight disease signs. In general, the scoring pattern was similar to the results from Maasai informants (Figure 9.9a), although the latter strongly linked diarrhoea to *endorobo* (trypanosomiasis) whereas the veterinarians assigned a low score to this indicator and disease.

Matrix scoring of chronic disease signs the same veterinarians is summarised in Figure 9.10b and shows evidence of strong agreement for 6/8 chronic signs and weak agreement for 2/8 chronic signs. Informants did not agree on their scoring of the signs 'hair overgrowth' ($W=0.19$) and 'wallows in water' ($W=0.08$). There were marked differences between the scorings of the veterinarians and Maasai herders, with the latter assigning high scores (medians = 15.5 to 20) to various chronic disease signs for the disease *olukuluku* (FMD). Also, there was good agreement between the Maasai informants for the six chronic disease signs scored for *olukuluku* (FMD) (W values 0.84 to 1.00).

Figure 9.11 shows the HCA dendrogram for acute disease signs and three obvious primary clusters comprising the disease pairs *engluwet/blackleg*, *emwilalas/CBPP* and *olukuluku/FMD* (as listed in Table 9.1). A fourth primary cluster appeared to be *endorobo/ECF* and this result disagreed with the assumption that *endorobo* was the Maasai name for trypanosomiasis (Table 9.1). Due to the unexplained high scoring of diarrhoea against *endorobo* in the matrix scoring (Figure 9.10a), HCA was repeated without the indicator 'diarrhoea' and the resulting dendrogram is shown in Figure 9.12. This analysis groups the diseases into five primary clusters corresponding to the disease pairs listed in Table 9.1. The MDS plot for acute disease signs, excluding diarrhoea, is shown in Figure 9.14.

Proximity matrices and agglomeration schedules for HCA are shown in Appendix 9.3. Stress results and configuration coordinates for MDS outputs are shown in Appendix 9.4.

Figure 9.9
Comparison of Maasai and veterinarian's scoring of acute disease signs†

a. Maasai informants		b. Veterinarians				
	<i>Endorobo</i>	<i>Oltikana</i>	<i>Olukuluku</i>	<i>Emwilatas</i>	<i>Eng'letvet</i>	
Coughing (<i>W</i> =0.79***)	•• 2.5 (0-4)	••• 5.0 (0-15)	0 (0-1)	••••• 14.0 (3-16)	0 (0-1)	Trypanos- omiasis
Diarrhoea (<i>W</i> =0.77***)	••••• 20.0 (3-20)	0 (0-17)	0 (0-0)	0 (0-0)	9.5 (0-15)	ECF
Salivation (<i>W</i> =0.78***)	••	••	••••• 14.0 (6-20)	•	••••• 16.5 (10-20)	FMD
Abortion (<i>W</i> =0.90***)	••• 6.0 (3-8)	4.0 (0-6)	••• 10.0 (5-14)	0 (0-4)	••• 6 (0-20)	CBPP
Enlarged lymph nodes (<i>W</i> =1.00***)	••• 6.0 (3-8)	••••• 14.0 (12-17)	0 (0-0)	0 (0-0)	••••• 7 (0-15)	Blackquarter
Lameness (<i>W</i> =0.87***)	0 (0-0)	0 (0-0)	••••• 17.5 (10-20)	0 (0-0)	••••• 14.5 (4-20)	0 (0-1)
Disease causes death (<i>W</i> =0.53***)	••• 0 (0-4)	••• 7.0 (0-20)	0 (0-3)	••• 3.5 (0-5)	••••• 10.5 (6-20)	0 (0-0)
Reduced milk yield (<i>W</i> =0.60***)	••••• 0 (0-10)	••••• 14.0 (7-20)	0 (0-0)	0 (0-0)	••••• 5 (3-10)	0 (0-5)

Figure 9.10
Comparison of Maasai and veterinarian's scoring of chronic disease signs[†]

a. Maasai informants		b. Veterinarians							
Endorobo	Oltikana	Olukulutu	Emwilalas	Engilwet	Trypanosomiasis	ECF	FMD	CBPP	Blackquarter
Cow seeks shade ($W=0.95****$)	0 (0-6)	●●●●●●●● 20 (14-20)	0 (0-0)	0 (0-0)	●●●●●●●● 5 (0-20)	●●●●●●●● 4 (0-20)	●●●●●●●● 1.5 (0-10)	●●●●●●●● 0 (0-15)	0 (0-3)
Weight loss ($W=0.32*$)	●●●●●●●● 7.5 (0-20)	●●●●●●●● 2.0 (0-15)	●●●●●●●● 5.0 (0-20)	0 (0-0)	●●●●●●●● 9 (5-20)	●●●●●●●● 1 (0-5)	●●●●●●●● 1.5 (0-6)	●●●●●●●● 5.5 (0-15)	0 (0-2)
Hair overgrowth ($W=1.00****$)	0 (0-0)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)	0 (0-20)	0 (0-6)	0 (0-20)	0 (0-1)	0 (0-1)
Panting ($W=0.84****$)	0 (0-0)	●●●●●●●● 20 (10-20)	0 (0-0)	0 (0-0)	0 (0-10)	0 (0-10)	0 (0-10)	●●●●●●●● 11 (0-20)	0 (0-1)
Reduced fertility ($W=0.63****$)	0 (0-9)	●●●●●●●● 15.5 (0-20)	0 (0-0)	0 (0-0)	●●●●●●●● 6 (0-20)	0 (0-5)	●●●●●●●● 0.5 (0-15)	0 (0-9)	0 (0-2)
Overgrowth of hooves ($W=1.00****$)	0 (0-0)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)	0 (0-5)	0 (0-3)	●●●●●●●● 10 (0-20)	0 (0-5)	0 (0-3)
Loss of tail hair ($W=1.00****$)	●●●●●●●● 20 (20-20)	0 (0-0)	0 (0-0)	0 (0-0)	●●●●●●●● 6 (0-20)	0 (0-3)	0 (0-4)	0 (0-18)	0 (0-1)
Wallows in water ($W=0.95****$)	0 (0-5)	●●●●●●●● 20 (15-20)	0 (0-0)	0 (0-0)	0 (0-20)	0 (0-20)	0 (0-4)	0 (0-4)	0 (0-4)

[†] W = Kendall's Coefficient of Concordance (* $p<0.05$; ** $p<0.01$; *** $p<0.001$). Medians are presented, and minimum and maximum values are shown in parentheses.

Figure 9.11

Dendrogram of matrix scores from groups of Maasai herders (n=9) and veterinarians from Ethiopia, Eritrea, Sudan, Somalia and Uganda (n=10) for acute disease signs of adult cattle using hierarchical cluster analysis

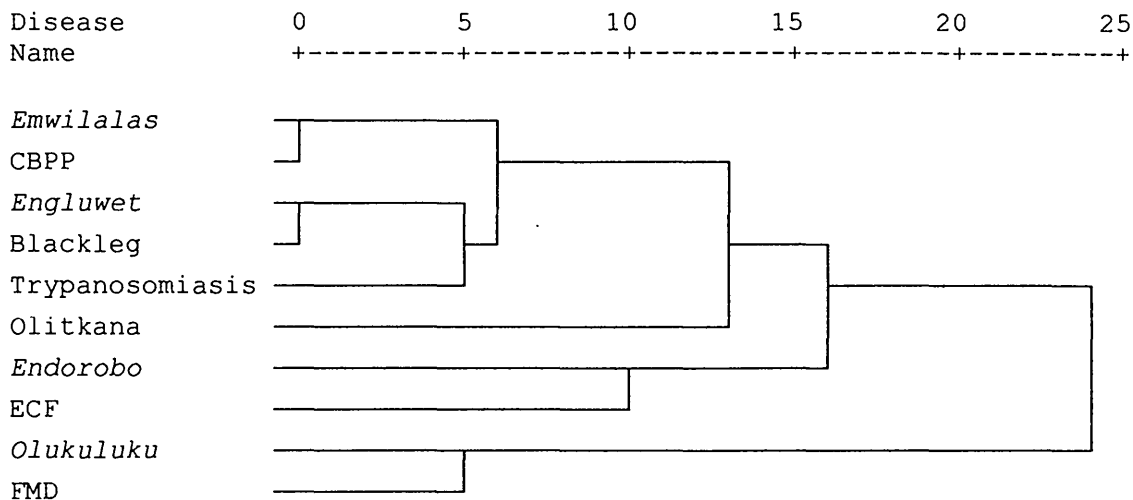


Figure 9.12

Dendrogram of matrix scores from groups of Maasai herders (n=9) and veterinarians from Ethiopia, Eritrea, Sudan, Somalia and Uganda (n=10) for acute disease signs of adult cattle using hierarchical cluster analysis, excluding the acute disease sign 'diarrhoea'

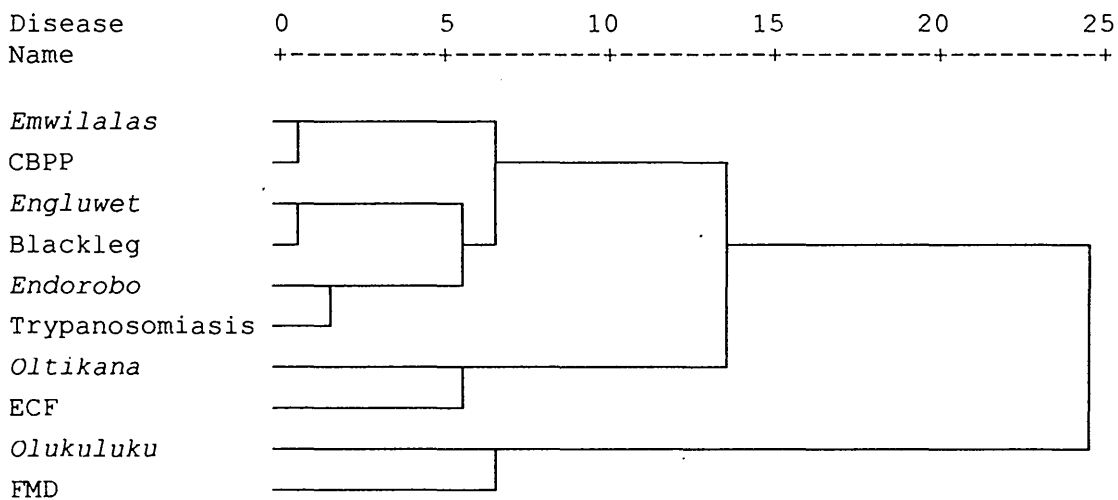


Figure 9.13
 Combined HCA and MDS plot for acute signs of disease as perceived by Maasai informants and veterinarians

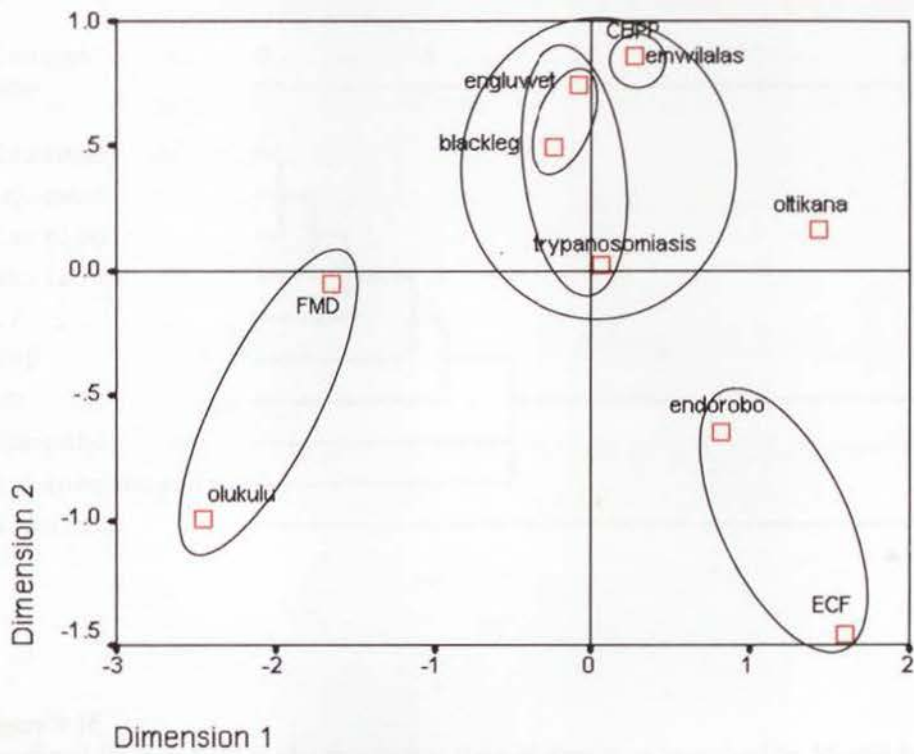


Figure 9.14
 Combined HCA and MDS plot for acute signs of disease as perceived by Maasai informants and veterinarians, excluding the acute disease sign 'diarrhoea'

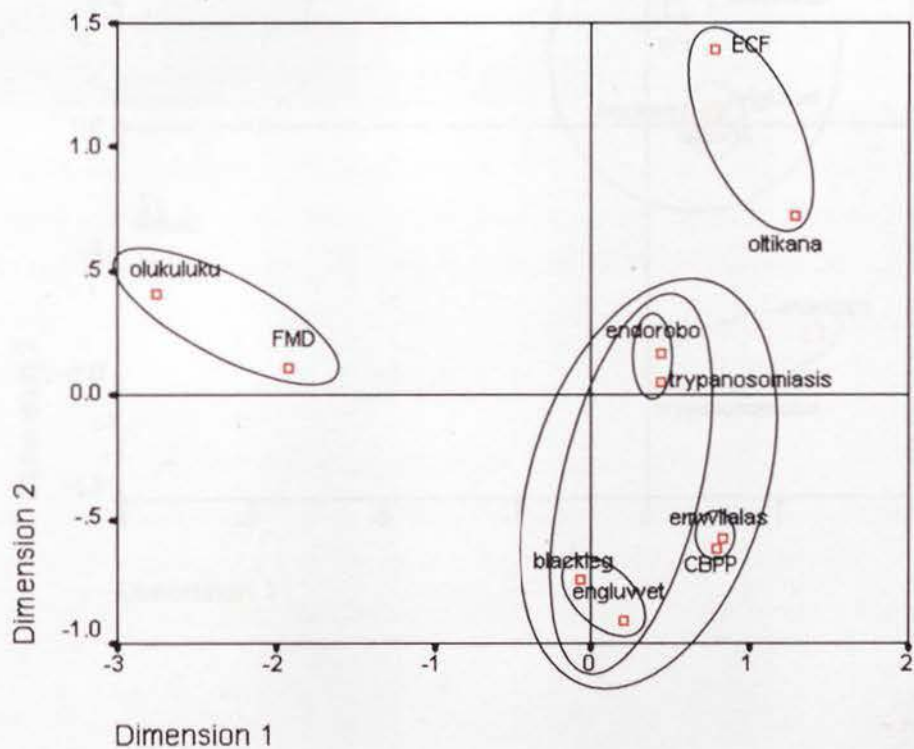


Figure 9.15

Dendrogram of matrix scores from groups of Maasai herders (n=9) and veterinarians from Ethiopia, Eritrea, Sudan, Somalia and Uganda (n=10) for chronic disease signs of adult cattle using hierarchical cluster analysis

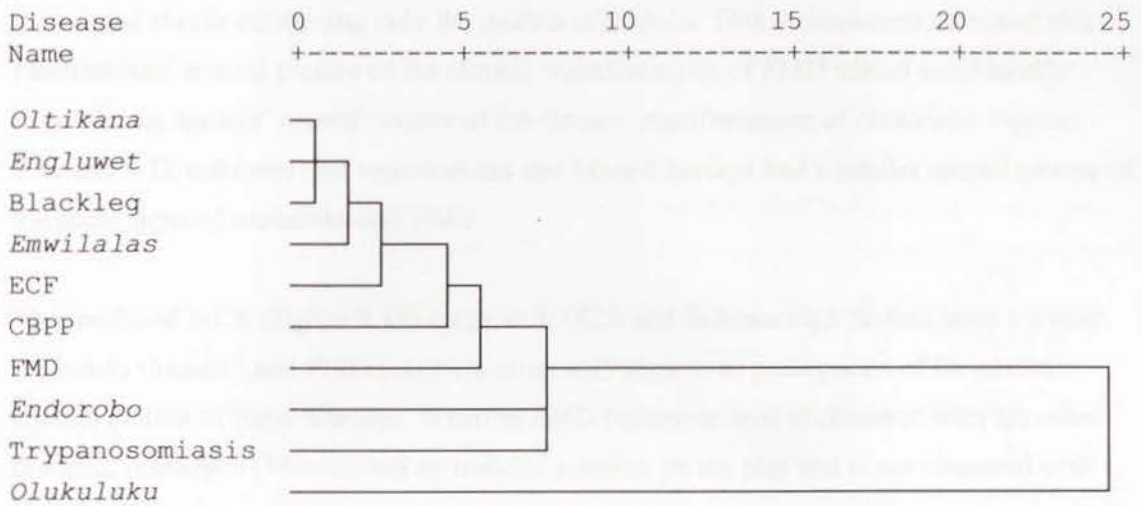


Figure 9.16

Combined HCA and MDS plot for chronic signs of disease as perceived by Maasai informants and veterinarians

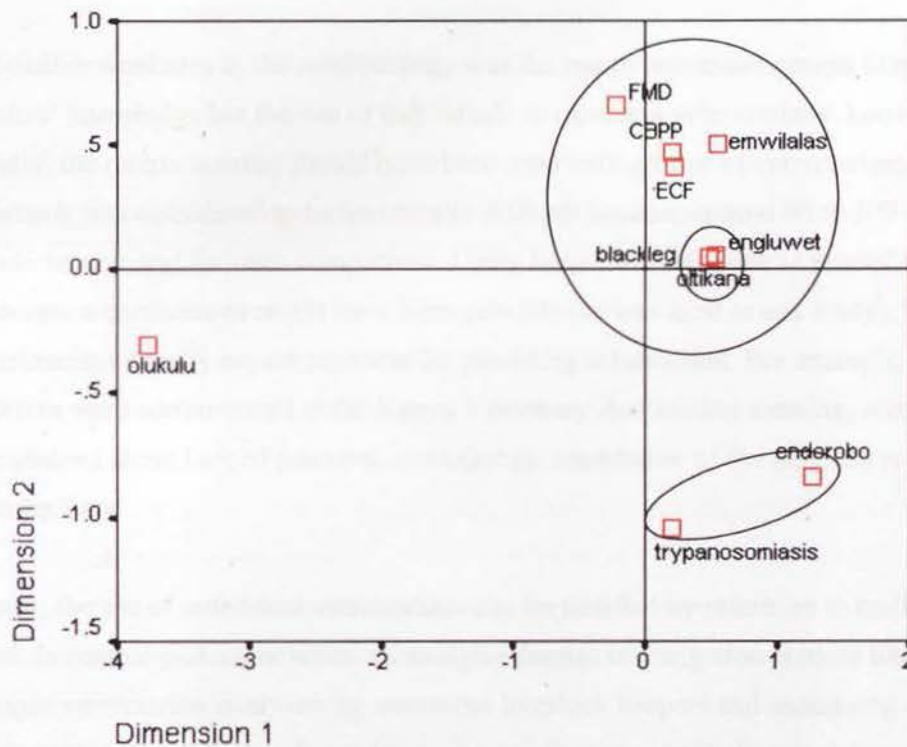


Figure 9.15 shows the HCA dendrogram for chronic disease signs. Four main clusters can be defined, being a cluster comprising *oltikana*, *engluwet* and blackleg, a cluster with *emwilalas*, ECF, CBPP and FMD, a paired cluster with *endorobo* and trypanosomiasis, and an isolated cluster containing only the disease *olukuluku*. This arrangement indicated that veterinarians' mental picture of the chronic manifestations of FMD varied considerably from Maasai herders' mental picture of the chronic manifestations of *olukuluku*. Figures 9.11 and 9.12 indicated that veterinarians and Maasai herders had a similar mental picture of the acute signs of *olukuluku* and FMD.

The results of MDS (Figure 9.16) agree with HCA and indicate high dissimilarity between *olukuluku* (Maasai) and FMD (veterinarians) with regards to perceptions of the chronic clinical picture of these diseases. Whereas FMD (veterinarians) is clustered with six other diseases, *olukuluku* (Maasai) has an isolated position on the plot and is not clustered with any other disease.

9.4 Discussion

9.4.1 General methodological issues

9.4.1.1 Selection of informants

A possible weakness in the methodology was the use of informant groups to represent herders' knowledge but the use of individuals to represent veterinarians' knowledge. Ideally, the matrix scoring should have been used with groups of veterinarians but this approach was considered to be logistically difficult because around 80 to 100 veterinarians would be required for each comparison. Using large meetings such as annual veterinary association conferences might have been possible (as was used in one study), but veterinarians usually expect payment for providing information. For example, when scoring matrices were administered at the Kenya Veterinary Association meeting, some respondents complained about lack of payment, even though completion of the matrices required only 15 minutes or so.

In part, the use of individual veterinarians can be justified by reference to realities at field level. In remote pastoralist areas, meaningful disease investigation is more likely to involve a single veterinarian interviewing numerous livestock keepers and examining different herds, rather than a group of veterinarians interviewing a single livestock keeper.

9.4.1.2 Selection of indicators

The HCA and MDS analyses were conducted using the matrix scoring data for both disease signs and disease causes for each of the three comparisons. This approach was used because the researcher assumed that when reaching a diagnosis, herders and veterinarians used information on both disease signs and causes.

In southern Sudan, indicators were produced by pair-wise comparison of diseases (Chapter 5) and therefore local informants identified the indicators. However, these indicators were very similar to those used by veterinarians when diagnosing the five diseases in question and there was evidence of strong agreement between veterinarians when scoring the diseases (Figures 9.1 and 9.2). In Tana River District of Kenya, the researcher identified the indicators, but agreement between groups of herders and individual veterinarians was still strong (Figure 9.5 and 9.6). Similarly, the HI study in Tanzania used indicators identified by the researcher but agreement between herder groups and vets for acute disease signs was also strong (Figures 9.9).

The disadvantage of using researcher-selected indicators is that important local ways to describe a disease can be lost. For example, a researcher with limited experience might exclude a disease sign such as 'loss of tail hair' when exploring local diagnosis of trypanosomiasis. Similarly, pastoralists often describe how cattle with CBPP will cough, but only on exercise. Using these and other local indicators is probably the best approach for ensuring that important indigenous knowledge is not overlooked. When matrix scoring is based on local indicators, researchers can always add their own indicators after the local indicators have been scored. Also, indicators about age-specific incidence or mortality, and seasonality of diseases can be used.

Although it may be tempting to use a long list of indicators, the use of more than 12-15 indicators in a single matrix can result in a diagram that is too large and complex. When this happens, the diagram becomes far less useful for facilitating discussion and probing the scores because informants cannot easily identify the piles of counters corresponding to specific indicators and diseases. A matrix with 12 to 15 disease signs can be scored by a group of informants in approximately 45 minutes and follow-up questioning might take another 15 to 20 minutes.

9.4.2 Interpretation of results

9.4.2.1 Comparing Nuer diseases and modern veterinary opinion

Comparison of Nuer disease descriptions and modern veterinary opinion indicated that Nuer perceptions of disease were logical and relatively specific, with Nuer disease being paired in a cluster with the expected modern disease name. Also, the epizootic diseases (*dat*/FMD and *doop*/CBPP) formed a distinct cluster from diseases associated with visible parasites (*macueny*/fascioliasis and *maguar*/PGE). A simple visual comparison of summarized matrix scores (Figures 9.1 and 9.2) allowed results from Nuer and veterinary informants to be compared on an indicator-by-indicator basis, whereas MDS and HCA plots (Figures 9.3 and 9.4) used all matrix scoring data to show the overall relationships between diseases.

An important finding was that Kenyan veterinarians' scoring of trypanosomiasis was similar to the Nuer scoring of *liei* for disease signs and the involvement of biting flies. This result agreed with the researcher's observation that veterinarians working in southern Sudan tended to use *liei* as a synonym for trypanosomiasis. However, although Nuer informants clearly associated *liei* with biting flies and clinical signs typical of trypanosomiasis, they also linked the disease to liver flukes (*daichom*), stomach worms (*luok*), flooding and snails (*chom*). This result indicated that *liei* might involve mixed infection and this hypothesis was shown to be valid by the post mortem examination of cases of *liei* in Nyal (Table 4.5, Chapter 4). In Nyal, liver flukes were detected in 7/10 cases of *liei* examined post mortem, trypanosome antibody was detected in 7/9 cases examined and *Haemonchus* spp. were detected in 6/10 cases. Furthermore, gross lesions and histopathology showed severe liver damage attributable to liver flukes in 6/10 cases (Appendix 4.1). In these six cases, it seems likely that treatment with trypanocide alone would not have resulted in full clinical recovery due to liver pathology and the continued presence of flukes.

In this example, matrix scoring helped to show similarities in the clinical appearance of a disease as perceived by herders and veterinarians, but also revealed important differences in perceptions of disease causation. Veterinarians' interpretations of *liei* were too specific and may have resulted in CAHW training courses over-emphasising the curative value of trypanocides. As a result of the research, CAHW training courses were revised to include concepts of mixed infections, as explained in Chapter 5.

9.4.2.2 Comparing Orma diseases and modern veterinary opinion

A simple visual assessment of disease scoring patterns indicated considerable agreement of scores derived from Orma informants and Tanzanian veterinarians (Figures 9.5 and 9.6). Although the indicators were selected by the researcher (a veterinarian), Orma informant groups showed evidence of moderate or strong agreement for all 14 indicators in the two matrices (disease signs and disease causes) whereas the individual veterinary informants disagreed over their scores for ‘animal seeks shade’ and ‘oedematous carcass’.

Analysis of data by MDS (Figure 9.7) and HCA (Figure 9.8) showed paired clusters of Orma and modern disease names according to the provisional translation by the researcher. In common with the results from Nuer informants (Figures 9.3 and 9.4), the epizootic diseases formed a distinct cluster.

9.4.2.3 Comparing Maasai diseases and modern veterinary opinion

Figure 9.9 showed much similarity between scoring of acute signs of Maasai diseases and modern veterinary terms, and evidence of strong agreement between informant groups (Maasai) and individual informants (veterinarians). Regarding the original aims of the study in Tanzania, scoring patterns of acute signs for *olukuluku* and FMD showed considerable agreement. Scoring of the indicator ‘diarrhoea’ was the main difference between the herders and the veterinarians, and exclusion of this indicator from the MDS and HCA calculations resulted in paired clusters of diseases according to the researcher’s provisional translation (Figure 9.12 and 9.14).

Figures 9.10, 9.15 and 9.16 show that relative to perceptions of acute FMD (Figure 9.9), there were marked differences between the Maasai and veterinarians regarding the clinical signs of chronic FMD. The term ‘chronic’ was explained to both sets of informants as meaning disease signs that were observed weeks or months after an initial disease outbreak. The veterinary informants were senior-level personnel and included national PACE coordinators, epidemiologists from PACE and lecturers in epidemiology from veterinary schools.

A well-known veterinary textbook states that,

'A sequel to foot and mouth disease in cattle, due probably to endocrine damage, is a chronic syndrome of dyspnoea, anemia, overgrowth of hair, and lack of heat tolerance described colloquially as panting' (Radostits *et al.*, 1994).

While the Maasai scoring matched this description, many of the veterinarians seemed not to be aware of the chronic manifestations of FMD. The Maasai also had specific names for the syndrome.

9.4.3 Future uses of matrix scoring

In the author's experience, veterinarians tend to disregard local disease names because the literal interpretation of the name is thought to have a non-specific meaning. For example, the literal meaning of the Orma word *somba* is 'lung' whereas in southern Sudan, *liei* means 'to steal slowly'. This research indicated that comparison of diseases using matrix scoring showed that livestock keepers possessed specific mental pictures of most of the diseases in question. Disease names were assigned to health problems showing specific combinations of disease signs, lesions or parasites observed post mortem, and contact with risk factors such as exposure to swamps, biting flies, wildlife or sick cattle. In addition, spatial and seasonal information added to the 'picture' of each disease, because certain diseases were associated with particular areas and times of the year. Other workers have indicated that local disease names are useful and specific. In Somalia, Baumann (1990) reported correlation between the incidence of *sambab* (literally 'lung') in goats and seropositivity to contagious caprine pleuropneumonia. Studies on CBPP in southern Sudan noted the Dinka name *about pou* (literally 'sticking together')² for CBPP (Zessin *et al.*, 1985) and comparison of herder diagnosis and seropositivity to CBPP showed significant agreement in young stock (McDermott *et al.*, 1987).

It is also interesting to note that many modern veterinary disease names are derived from non-specific features of a disease. For example, although the literal meaning of blackleg means an animal with a black leg, the name encompasses disease signs such as recumbency, a swollen limb and sudden death, and epidemiological information, such as higher incidence in young, well grown stock³.

This research showed that not only did Nuer, Orma and Maasai pastoralists characterise diseases using the logic of modern veterinary medicine, for some diseases they knew more

² Refers to the adhesions between lungs and chest wall observed post mortem in CBPP cases.

³ There are many other examples, such as redwater, foot and mouth disease and lumpy skin disease.

than veterinarians. For example, Maasai were more knowledgeable about chronic manifestations of FMD than veterinary informants, even though FMD is an epizootic disease of major international importance. While it could be argued that central-level epidemiologists are not necessarily field clinicians, they do make decisions about national disease surveillance systems.

This research showed how the systematic use of matrix scoring revealed relationships between local and modern disease terminology, and therefore could be used to improve the accuracy of disease surveillance. At present, the very limited diagnostic facilities in pastoralist areas means that surveillance is based on information passed to government veterinary workers by livestock keepers, and clinical examination of livestock in the vicinity of government clinics. As described in Chapter 2, clinic daybooks records often show over-interpretation of clinical signs (e.g. coughing is reported as pasteurellosis) and veterinary staff may not understand the local language⁴ and descriptions of disease are also misinterpreted.

A method such as matrix scoring requires someone who knows how to use the method, a notebook and pen, some pieces of card to illustrate the indicators, and stones or large seeds. The method can be used with informants visiting a clinic, livestock market or well, and does not necessarily require travel to remote locations.

9.5 Summary

A paper version of a matrix scoring method was designed to assess veterinarians' characterization of cattle diseases, and to compare the perceptions of livestock keepers and veterinarians. The modified matrix scoring method was used with three groups of veterinary informants and in each case, the method was judged to be reproducible.

Three methods were used to compare the results obtained from livestock keepers and veterinarians viz. direct visual comparison of summarised matrices, multidimensional scaling and hierarchical cluster analysis. All three methods were judged to be useful and demonstrated considerable overlap between indigenous and modern veterinary knowledge.

⁴ The author once interviewed the District Veterinary Officer for Tana River District in Kenya, who had been filing disease reports for more than five years. Although the Orma are one of the main livestock keeping communities in the district, this officer was not aware that the Orma had their own disease names.

It was proposed that the further use of matrix scoring could assist epidemiologists to develop surveillance systems based on improved understanding of indigenous disease terminology. Although veterinarians sometimes consider local disease names as too vague for meaningful interpretation, the research demonstrated that local terms are based on rational observation of clinical and epidemiological factors leading to specific disease names for different diseases.

Chapter 10

GENERAL DISCUSSION

10.1 Introduction

The main aim of this thesis was to investigate issues affecting the use of PA methods in animal health information systems and research in pastoralist areas of Africa. Following a review of the literature (Chapter 2), the research focussed on veterinarians' concerns about the reliability and validity of PA methods. To a large extent, these concerns were based on perceptions of PA as a qualitative system of inquiry which as such, lacked the rigour of quantitative and scientific investigation. The research showed that these concerns were misguided. Three field studies were conducted with a common approach of comparing data derived from PA and conventional methods. The research design also acknowledged that previously, PA methods were used not only to collect data but also to enhance community involvement in defining local problems, describing and analysing these problems, and working with development agents to identify and test solutions.

Considering that PA as a set of methods, and PA as a development approach or philosophy are intertwined, it was assumed that participatory methods could not be usefully assessed in isolation of a participatory approach. Therefore, although three field studies were conducted with a common aim of assessing PA methods, in each case the specific research topic was heavily influenced by local needs. This aspect of the research was to have an important influence on the assessment of validity of methods, as described in section 10.2.1 below.

A second important factor influencing the research was the focus on pastoralist communities because of the need to improve understanding of livestock diseases in dryland areas, and the apparent limitations of conventional epidemiological methods in remote and marginalized areas. Therefore, the research was influenced by the operational challenges of working in more remote areas with few modern facilities or reliable baseline demographic data. The fieldwork in southern Sudan was conducted in insecure locations characterised by ground-level armed conflict, deployment of landmines, minimal communication facilities and occasional aerial bombardment. Although it might be tempting to view this situation as extreme, similar constraints are widespread and chronic in pastoralist areas of the Horn of

Africa such as eastern Ethiopia, Somalia and northern Uganda¹. Less marked insecurity also affects pastoralist areas and takes the form of large-scale livestock raiding and banditry, both aided by sophisticated modern weapons. In Tana River District, Kenya (Chapters 6 and 7), areas away from the main urban settlements were generally regarded as ‘unsafe’ and the official view was that armed police escorts were required when traveling north or west out of Malindi. Within the region, security was far better in Tanzania than other countries, even in pastoralist areas.

Due to these constraints and a general lack of baseline data on the communities involved in the research, sampling procedures were purposive in the three studies. Local veterinary workers, administrators and NGO staff were involved in defining typical populations and provided advice on accessibility to communities and security problems. Indigenous terminology was viewed as specific to the communities in the study locations, and the dangers of generalizing local disease terminology are discussed in section 10.4.2.1.

In pastoralist areas, the potential value of methods partly depends on practical considerations. Resource and operational constraints mean that methods that are inexpensive and flexible are more likely to be applied than methods that are costly and difficult to adapt to particular situations. Similarly, methods are required that produce information and lead to action within short timeframes, because access to communities is unpredictable and difficult to prolong. Therefore, these and other factors were included in the overall assessment of the epidemiological value of PA methods, in addition reliability and validity.

10.2 Design and methodological issues affecting the research

10.2.1 Limitations of modern diagnostic tests

An important methodological consideration when designing the field studies was that communities and local research partners identified the disease problems and consequently, were willing to invest time in the research. It was assumed that PA methods could not be properly assessed unless they were used in a context for which they were originally intended, that is, to assist local problem analysis and problem solving. Although the researcher designed each field study to include comparison of information derived from

¹ In 1998, 11 out of 46 countries in sub-Saharan African were considered by UNICEF to be engaged in ‘major armed conflicts’ (UNICEF, 2000). This did not include Somalia, Djibouti, Mozambique or other countries in post-conflict situations, or a further six countries where ‘landmines or unexploded ordnance threaten civilians’.

participatory and conventional methods, the choice of diseases under investigation was not predetermined. This feature of the research approach meant that diagnostic tests were also not predetermined but selected according to the disease problems (or suspected problems) in question. Whereas the ideal situation for assessing validity of PA methods might have used diagnostic tests of high sensitivity and specificity (i.e. a good gold standard test), such tests were not available for the diseases studied in southern Sudan, Kenya or Tanzania.

A further consideration was the use of PA methods to measure disease presence over a specified time period using proportional piling (Chapters 6 and 8). The method assumed that informants would be able to describe their observations of sick animals and therefore a measure of disease incidence could be obtained. However, many diagnostic tests detect exposure to or infection with a disease agent, and provide measures of point prevalence not disease incidence. In the case of matrix scoring, the use of veterinarians to cross-check some results helped to confirm the researcher's opinions (Chapter 9).

In the Tanzania study, seroconversion to 3ABC non-structural proteins was used as a direct measure of previous clinical FMD. It was known that 3ABC antibody persisted for at least 395 days post infection (Vosloo, personal communication), and association between 3ABC non-structural proteins and clinical FMD was reported in the literature (Mackay *et al.*, 1998).

10.2.2 Limitations of research centres and laboratories as research partners

From the broader perspective of participatory approaches to development, the absence of sensitive, specific and robust field-tests for major livestock diseases, such as those studied during this research, reflects the limited capacity of research institutions to produce useful diagnostic products for primary animal health services in rural areas. For example, despite many years of research on antigen tests for animal trypanosomiasis in Africa, a reliable test has yet to be developed (Eisler *et al.*, 1998) and field workers still rely on the MHCT. This test has a sensitivity of approximately 50% (Eisler, personal communication). Even the MHCT requires a microhaematocrit centrifuge, microscope and power source (such as a small generator) to be carried to the site of testing and therefore the method is cumbersome. Hand-held, battery operated microhaematocrit centrifuges are available but process small numbers of samples and so are not suitable for survey work. Also, this equipment uses smaller capillary tubes than standard centrifuges and therefore the sensitivity of the test is

reduced².

After using the thin smear method to diagnosis trypanosomiasis in Nyal, southern Sudan (Chapter 4), the researcher contacted a centre in the United Kingdom with specialised knowledge of diagnostic tests for this disease. At this time, a polymerase chain reaction (PCR) test had been developed and was promoted by the centre as being highly sensitive and specific. Consequently, when sampling cattle in Thiet, southern Sudan blood drops were collected on filter paper and submitted for PCR. Due to the high cost of the test, only 300 samples were submitted plus 38 samples that had tested positive on the MHCT in the field. In these cases, *T. congolense* had been identified in thin smears. When testing the 38 known positives using PCR with four primer sets for *T. congolense*, the number of positives was 9/38 (Forest type), 12/38 (Savannah type), 3/38 (Kilifi type) and 0/38 (Tsavo type). Therefore, even using the three primers that detected *T. congolense*, the sensitivity of the PCR was 37% lower than the MHCT. Consequently, the 300 samples were never tested using PCR.

In addition to the limitations of sensitivity for some laboratory diagnostic tests, the reporting period for a number of tests was prolonged even when conducted on a commercial basis. For example, full histopathology results for tissues from southern Sudanese cattle were available six months after the tissues were submitted to a laboratory in the United Kingdom. Similarly, FMD serology results from a laboratory in South Africa took six months to be reported. In both cases, the laboratories in question were specialised centres, specifically equipped to handle these types of tests.

One of the principles of participatory research is on-site analysis of problems by researchers and communities. In theory, this process could be greatly assisted if the results of diagnostic tests were available rapidly. In this situation, local descriptions of diseases could be verified by conventional means, and researchers would have greater confidence in decisions taken to solve animal health-related issues. However, this research demonstrated that rapid confirmation of disease diagnosis at field level is often extremely difficult. In part, the characteristics of some diagnostic tests limit their use outside laboratories, and time is needed to transport samples and report results. However, there was also the problem that laboratories did not recognise the importance of rapid reporting, and did not realise that field

² Hand-held microhaematocrit centrifuges use 17 microlitre capillary tubes compared with the standard size 80 microlitre tubes. As the sensitivity of the MHCT partly depends on the volume of blood used in the test, the use of smaller tubes reduces sensitivity by approximately four times.

workers might use results to help them to take action on the ground. Although the researcher advised laboratories that results were required without delay, commonly results were made available in months rather than days. Ironically perhaps, a small laboratory in Lokichokio, northern Kenya provided the quickest reports. This laboratory was part of a large-scale community-based animal health programme and was able to send results back into southern Sudan within days of receiving samples.

10.3 Assessment of participatory approaches and methods

10.3.1 A scientific approach: assessing reliability and validity

The research demonstrated that standardisation of PA methods and repetition, even with small numbers of informants or informant groups, enabled objective assessments of reliability in each of the three field studies. Objective measures of validity were obtained for the seasonal calendar method (in southern Sudan), the proportional piling method (in Tanzania), and matrix scoring of disease signs and causes (southern Sudan, Kenya and Tanzania). Subjective measures of validity were also used for these methods, as summarised in Table 3.3.

10.3.1.1 Matrix scoring

Matrix scoring was repeated in three countries with five ethnic groups (although the Dinka and Nuer of southern Sudan have a similar language and culture). Based on evidence of agreement between informant groups in each location, the method was judged to be reliable (Figures 4.2 to 4.5; 6.3 and 6.4; 8.5 and 8.6). The Kendal coefficient of concordance W was a useful statistical test for measuring agreement between informant groups, and was relatively easy to perform and interpret. With hindsight, it was recognised that W was a function of the variation between the diseases being scored. Therefore, evidence of significant agreement (higher W) between informants groups was more likely when scoring patterns showed marked differences between diseases.

For example, within each of the two data sets below 8/10 and 2/10 informant groups gave exactly the same scores to indicator x and y respectively. However, variation in scores and therefore W is lower for indicator x compared to indicator y. This feature of W indicates that the selection of control diseases and indicators in a matrix scoring method affects the level of agreement between informants as measured by W .

Results for indicator x, $W=0.87$

Informant Group	Disease 1	Disease 2	Disease 3	Disease 4	Disease 5
1	4.00	5.00	5.00	3.00	3.00
2	4.00	5.00	5.00	3.00	3.00
3	4.00	5.00	5.00	3.00	3.00
4	4.00	5.00	5.00	3.00	3.00
5	4.00	5.00	5.00	3.00	3.00
6	4.00	5.00	5.00	3.00	3.00
7	4.00	5.00	5.00	3.00	3.00
8	4.00	5.00	5.00	3.00	3.00
9	3.00	6.00	3.00	3.00	3.00
10	3.00	6.00	3.00	3.00	3.00

Results for indicator y, $W=0.99$

Informant Group	Disease 1	Disease 2	Disease 3	Disease 4	Disease 5
1	10.00	.00	.00	6.00	4.00
2	10.00	.00	.00	6.00	4.00
3	10.00	.00	.00	6.00	4.00
4	10.00	.00	.00	6.00	4.00
5	10.00	.00	.00	6.00	4.00
6	10.00	.00	.00	6.00	4.00
7	10.00	.00	.00	6.00	4.00
8	10.00	.00	.00	6.00	4.00
9	6.00	2.00	2.00	6.00	4.00
10	6.00	2.00	2.00	6.00	4.00

The use of matrix scoring with three sets of individual veterinarians also demonstrated that the method was reliable (Figures 9.1b, 9.2b, 9.5b, 9.6b and 9.9b).

In southern Sudan, matrix-scoring results (disease signs and disease causes; Figures 4.2 to 4.5) were compared with the findings of clinical and post mortem examinations (Table 4.5) and judged to be valid. For fascioliasis, schistosomiasis and haemonchosis, post mortem examination was considered to be the gold standard test. For matrix scoring of disease causes, prevalence estimates for gastrointestinal nematodes, liver flukes and trypanosomes (Table 4.5; Figure 4.6) supported matrix scoring results.

In southern Sudan and Kenya, matrix scoring of disease causes was also validated by identification of disease vectors. In southern Sudan, preserved specimens were used to

cross-check indigenous knowledge (Table 4.4), whereas in Kenya, preserved specimens and a recent fly survey (Table 7.1) were used to cross-check herder descriptions.

Objective measures of validity for the matrix scoring method used veterinary professional opinion as the gold standard, and quantified opinion using paper versions of the matrices. Comparison of herder and professional opinion was conducted using HCA and MDS, following provisional translation of local disease names by the researcher (Table 9.1). Three sets of comparisons were conducted using results from Nuer, Orma and Maasai informants compared with results from three sets of veterinarians (Table 9.2). Each comparison using HCA and MDS showed that local disease descriptions matched the provisional interpretation of disease by the researcher (Figures 9.3, 9.4, 9.7, 9.8, 9.12 and 9.14).

In the case of chronic diseases recognised by Maasai informants, there was disagreement between Maasai and professional opinion concerning chronic signs of FMD. However, objective measures of association between previous clinical FMD and a heat intolerance syndrome in Maasai cattle (Table 8.6) demonstrated that Maasai opinion was valid. This conclusion was supported by reports of chronic manifestations of FMD from other countries (as detailed in Chapter 8). Regarding procedures for the validation of matrix scoring by livestock keepers, this experience indicated that professional veterinary opinion should not always be assumed to be correct.

10.3.1.2 Seasonal calendars

The seasonal calendar method was repeated with Dinka (southern Sudan) and Orma (Kenya) informants. Reliability was assessed using the Kendal coefficient of concordance (W) and for Dinka informant groups ($n=10$), there was evidence of good or moderate agreement 10/12 indicators (Figure 5.1). The method was repeated only four times with Orma informant groups but despite this small sample size, good or moderate agreement was evident for 6/10 indicators (Figure 7.5).

In southern Sudan, seasonal calendar data for rainfall were compared with objectives measures of rainfall and judged to be valid (Table 5.1; Figure 5.2). In Kenya, the researcher was not able to obtain rainfall data from the relevant authorities. Further assessment of validity in both studies used textbook descriptions of seasonal variations in disease incidence and vector populations. Overall, Dinka and Orma opinion matched textbook descriptions.

10.3.1.3 Proportional piling

Proportional piling was repeated in two countries with three ethnic groups (Table 3.3). The validity of proportional piling was assessed using point prevalence estimates for trypanosomiasis (Orma herds, Table 6.3) and FMD (Maasai and Sukuma herds, Table 8.5). In both studies, prevalence estimates supported incidence estimates.

Further assessment of the validity of proportional piling was based on age-specific incidence (Orma herds, Tables 6.2 and 6.2; Figures 6.5 to 6.8) and incidence and mortality trends (Maasai and Sukuma herds, Figures 8.7 to 8.18), and comparison with textbook descriptions and published papers on the diseases in question. The value of this approach was limited by the absence of published information on some diseases, particularly in relation to endemic situations in pastoralist herds. Reasonably detailed information was available for trypanosomiasis and ECF relative to CBPP, FMD and other control diseases used in the proportional piling method. In common with the choice of specific research objectives and diagnostic tests for diseases under investigation (section 10.2.1), the selection of control diseases was not predetermined but depended on local priorities as identified at the onset of each study. It was noticeable that although CBPP and FMD are epizootic diseases of major international importance, published information on the prevalence and epidemiology of these diseases in pastoralist herds in Africa is scarce.

10.3.1.4 Other PA methods

Participatory appraisal methods such as semi-structured interviews and mapping were not assessed by measuring reliability or validity. Semi-structured interviews were an inherent part of every other PA method, and were used to cross-check results and probe interesting or confusing responses. Consequently, the reliability and validity of matrix scoring, seasonal calendars and proportional piling partly depended on the use of semi-structured interviews after the initial scoring stages of these methods. Mapping was judged to be a useful method for cross-checking perceptions of seasonal variations in disease incidence (Figures 5.3 and 5.4) and knowledge of tsetse distribution (Figures 7.1 to 7.4).

10.3.2 Whose validity counts? Alternative approaches to assessing research

Much of the literature on participatory approaches is highly critical of quantitative research and the use of standardised methods. A much quoted article called 'OK, *The Data's Lousy, But It's All We've Got*' (Gill, 1993), describes a tendency for scientists to use whatever numerical data is available regardless of its relevance or quality, as captured in the statement '*Wrong data is better than no data*'. Chambers (1997) expanded on this theme and seemed to have a particular mistrust of economists:

'Quantification and statistics can mislead, distract, be wasteful, simply not make sense or conflict with common values ... Yet professionals, especially economists and consultants tight for time, have a strong felt need for statistics. At worst they grub around and grab what numbers they can, feed them into their computers and print out not just numbers, but more and more elegant graphs, bar charts, pie charts and three-dimensional wonders ... Numbers can also reassure by appearing to extend control, precision and knowledge beyond their real limits ... wrong numbers, one might add, are worst of all because all numbers pose as true.'

In veterinary epidemiology, Mariner (2000) warned about the dangers of quantification and advised that in relation to PA,

'Flexibility and much of the potential to discover new ideas, perspectives and insights would be lost in the interests of statistical significance. The process would be longer and less comprehensive than true PRA as the same key questions and exercises would have to be repeated'

It was also suggested that repetition of methods would lead to expert teams (as used in PA) taking on the role of enumerators and their attention would be directed towards ensuring methodological consistency.

These issues relate very much to this thesis because considerable effort was invested in quantifying PA methods and comparing data with objective data collected using conventional methods. The assumption was not only that quantification mattered but also, that objective assessment was the ultimate test of validity. This reasoning would fit within the positivist values of the scientific establishment, as described in Chapter 2. Indeed, when subjecting research findings in southern Sudan and Kenya to peer-review by journals, reviewers' queries focused on sampling procedures, statistical tests and the nature of the data. However, the overriding measures of validity were subjective veterinary opinion. In the case of clinical and post mortem examinations conducted in the field, the researcher's opinion was the measure of validity. For diseases such as fascioliasis and schistosomiasis,

this was a gold standard test. For other diseases, diagnosis was more reliant on triangulation of information on case history, environmental factors, clinical signs, pathological lesions and laboratory tests. Here, validity was attained using the procedures of qualitative inquiry and was never questioned when papers were submitted for peer review. Similarly, clinical, pathological and epidemiological features of diseases as described by herders were compared with textbook descriptions, giving a second subjective measure of validity. Again, these judgemental comparisons were never queried by reviewers. Given the non-random sampling procedures, the low sensitivity of many diagnostic laboratory tests and the difficulty of comparing herders' incidence estimates with point prevalences of antibody or parasites, the value of 'objective' measures of validity becomes less clear. It is likely that in the absence of any quantitative measures of validity in this research, the overall conclusions would have been very similar.

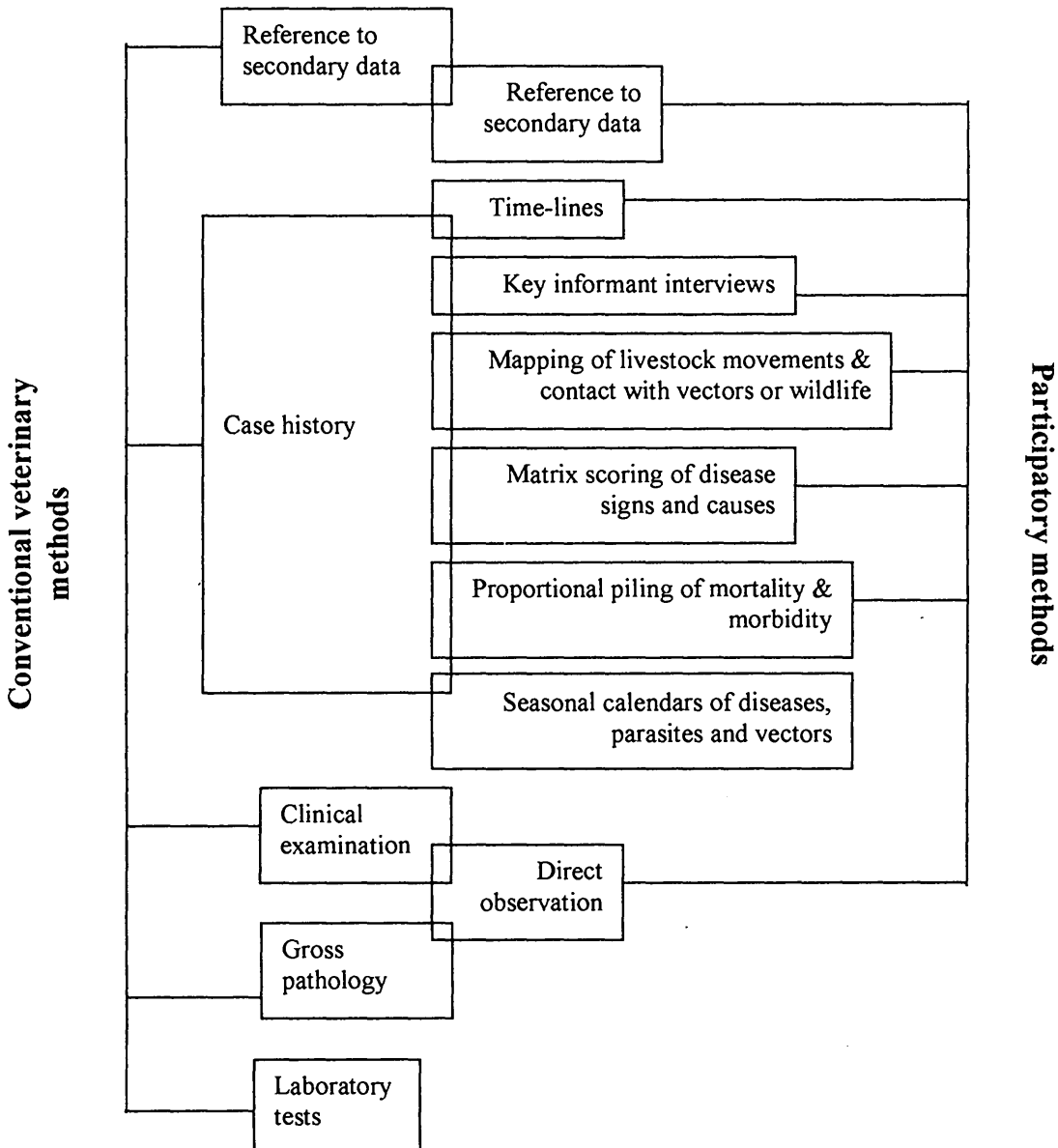
In participatory research, validity is judged not by objectivity of research findings but by the quality of the learning process that takes place and the extent to which meaningful action is initiated. With this approach, a valid learning process is one where researchers and communities conduct joint analysis of problems and agree on appropriate interventions, which may include further research. Participatory methods assist this process by enabling people to describe issues using their own language and by using methods that everyone can understand. Joint analysis of research findings leads to consensus regarding the appropriate action to be taken and mutual recognition that decisions may have been based on imperfect information.

If the field research presented in this thesis was conducted solely within this typical participatory approach, the PA methods used would probably have been repeated only two or three times, if at all, with each community. There may have been some clinical examination of sick livestock, and perhaps a few post mortems. It is also possible that samples would have taken and analysed. Information would have triangulated and represented for further cross-checking. But is this scientific? It is important to note that the process outlined here is very similar to the diagnostic approach used by veterinarians in industrialised countries. Probably the most comprehensive and frequent diagnostic work is conducted in veterinary investigation centres and universities. In the United Kingdom, veterinary investigation centres are among the major contributors of information to national animal health information systems.

10.3.3 Complementary approaches in epidemiology

If it is accepted that veterinary diagnosis involves triangulation of different types of information, PA methods could be considered as complementary to conventional methods. A suggested relationship between the qualitative nature of veterinary diagnosis and PA is illustrated in Figure 10.1

Figure 10.1
Qualitative methods in veterinary investigation and participatory inquiry



In remote rural areas of developing countries such as pastoralist areas of Africa, up to four out of five of the conventional veterinary methods shown in Figure 10.1 can be difficult to use. Limited veterinary services and poor accessibility can mean that secondary data are weak or non-existent. Inaccessibility also means that sick animals cannot be reached by veterinarians, so they cannot easily be examined ante or post mortem, and samples cannot be collected for further tests. In these situations, information provided by livestock owners becomes particularly important.

The studies described in this thesis showed how combinations of PA methods were useful for understanding local perceptions of diseases and allow information on disease signs and causes, seasonality, spatial factors and age specific incidence and mortality to be collected and cross-checked locally. It is proposed that this use of PA methods provides far greater clinical insights into indigenous knowledge than the conventional method for taking the case history (i.e. stand alone interviews). Visualisation methods enable spatial and temporal information to be illustrated and discussed, whereas scoring methods show the relative importance of different variables and diseases. Methods such as matrix scoring are also visualisations of relationships between diseases, signs and causes, and are useful tools for facilitating further discussion and analysis. This potential to use PA methods as diagnostic tools in veterinary medicine is particularly relevant to epidemiology because data collection and initial qualitative evaluation are the starting points for epidemiological studies (Thrusfield, 1995). Furthermore, the thesis demonstrated the value of PA methods in cross-sectional surveys (Chapter 6) and investigating causality (Chapter 8).

In theory, PA methods could be used in more conventional surveys involving randomised sampling and other procedures for enabling extrapolation of findings to a wider population. As already mentioned, the dangers of using PA methods in this way include over emphasis on the collection of numerical data. As standardised forms are designed, space for discussion disappears and the recording of conversations is time-consuming and more tiring than writing numbers in boxes. A second disadvantage relates to data analysis. While PA encourages local analysis and immediate cross-checking of results, more quantitative approaches may involve detailed statistical analysis that is conducted back in offices and laboratories, away from the people who provided the data. Therefore, the research becomes less participatory because local people cannot follow the analytical process and are unlikely to understand how the final results were produced.

In part, the problems of using PA methods in quantitative surveys could be overcome in two ways. First, the field studies showed how some PA methods can be standardised and repeated to produce numerical data. However, each of these methods comprised a quantitative and qualitative component. The former was based on the use of counters (e.g. stones or seeds) to show relationships between the diseases and variables in question. The numbers of counters, diseases and variables was kept constant every time a method was repeated. The qualitative component comprised open and probing questions to cross-check the placing of counters and follow up interesting leads and ideas. A mental checklist of questions was prepared for each method but this checklist was not followed rigidly. In some interviews, not all issues on the checklist were covered but new, unexpected topics were discussed. For methods such as matrix scoring, seasonal calendars and proportional piling, this approach produced a record of the numerical scores plus narrative of the follow up questioning and discussion every time a method was used. The narrative often took the form of annotations overlying the numerical scores.

A second way to combine participatory and quantitative methods is to use PA methods for an initial exploratory survey and to identify key questions and issues. Also, PA methods such as mapping can be used to design sampling frames (Anon, 1998b). The initial survey is followed by a quantitative survey that may or may not use PA methods, and which focuses on specific topics. The early use of the participatory approach helps to ensure that local problems are addressed and provides the qualitative background information. The weakness of this sequenced approach is that the research becomes less participatory over time. As quantification is introduced the researchers take more control over the methods, data analysis and ultimately, the ownership of information. If data analysis takes place in researchers' offices, there is less chance of results being shared with communities. Also, the same constraints facing quantitative inquiry still apply (Chapter 2), particularly when working in pastoralist areas.

Despite these problems, combined participatory-conventional approaches may be a reasonable compromise for improving the involvement of livestock keepers in research or surveillance activities. The literature on community participation increasingly points to the attitude and commitment of professionals, rather than methods, as the key to effective participation (Guijt and Cornwall, 1995; Abbot and Guijt, 1997). If this is the case, even workers using quantitative survey methods might seek to improve participation by involving livestock keepers in identification of problems and earlier feedback of information in a form that can be readily understood. Other options include initial participatory analysis of

problems (as already mentioned) and regular feedback to communities on survey findings based on local, rapid and relatively simple analysis of results. Researchers would need to incorporate these activities into their research proposals and ensure that time and resources were made available. The need for institutional support for participatory animal health research is discussed in section 10.5.

10.4 Adaptation and uses of PA methods

10.4.1 Design of privatised CAHW networks

As described in the literature review (Chapter 2), PA methods have been most commonly used during the design of CAHW projects. In particular, disease-ranking methods have helped to prioritise local needs and informed the content of training courses for CAHWs. Although PA methods have rarely been repeated more than two or three times during these participatory assessments, projects have often demonstrated good impact. In pastoralist areas, examples of impact include CAHW projects in Ethiopia (Mariner, 1996), Kenya (Odhiambo *et al.*, 1998), southern Sudan (Fox *et al.*, 2002) and Tanzania (Nalitolela and Allport, 2002). These experiences tend to agree with the findings of the three field studies presented in this thesis with regards the value of PA methods, as qualitative methods, for identifying appropriate veterinary interventions. Independent of this research, qualitative assessment of animal health needs and solutions using PA methods has been proposed as a key stage in the design of CAHW systems (Hadrill *et al.*, 2002).

Linked to participatory assessment for CAHW projects has been interest in using PA methods to generate information for business plans for private veterinary clinics or pharmacies. With this approach, existing or potential private veterinarians or animal health assistants are included in the assessment team and use PA methods to determine the important disease problems, seasonal variations in diseases (affecting seasonal demand for veterinary medicines) and the willingness and capacity of livestock keepers to pay for services (Catley *et al.*, 2002). This information is then incorporated into a business plan that describes the economic viability of the proposed venture (Eregae, 2003). Although this use of PA methods is relatively new, it raises the prospect that validity of information may be determined less by epidemiologists and more by financial advisers in lending institutions.

10.4.2 Uses of PA methods in disease surveillance

Within international agencies responsible for advising state veterinary services on disease surveillance systems, there is recognition that livestock keepers are often the primary source of useful information. For example, when discussing the role of livestock owners in surveillance an FAO EMPRES manual advises that,

'While some may scoff at this kind of surveillance, it is important to note that most herders have an accurate knowledge of local diseases, and are usually fairly close to target when it comes to making diagnoses' (Paskin, 1999).

However, the same manual assumes that participatory methods are solely data collection methods and focuses on the 'unstructured/semi-structured interview'. The manual does not mention the concept of triangulation or the value of visualisation and scoring methods. A later FAO EMPRES manual on participatory epidemiology provides a far better introduction to participatory approaches and methods for disease surveillance, and focuses on the strengths of qualitative approaches such as participatory disease searching (Mariner, 2000).

10.4.2.1 **Understanding local disease terminology and accuracy of disease diagnosis**

This research indicated that a useful application of a method such as matrix scoring would be to clarify indigenous case definitions. For example, further adaptation of matrix scoring could include the development of Bayesian belief networks for livestock disease diagnosis. Previously, this approach used expert opinion to determine probabilities that specified disease signs were observed with certain cattle diseases (McKendrick *et al.*, 2000).

Information was collected from experts using a 'response matrix' comprising 27 signs associated with 20 cattle diseases. The use of expert opinion is well known in veterinary epidemiology and was described by these workers as *'the tacit knowledge acquired by veterinary researchers and practitioners through training and experience gained over time'*. It was also noted that detailed quantitative information on prevalent cattle diseases in sub-Saharan Africa was rarely available.

This thesis has noted the limited presence of veterinarians in pastoralist areas (Chapter 2). When veterinarians are present they tend to have limited resources or incentives to conduct clinical work, particularly if they are government employees. The findings of the three studies in southern Sudan, Kenya and Tanzania indicate that in the absence of veterinarians

with prolonged clinical experience, pastoralists themselves can be considered experts. While the response matrix used by McKendrick *et al.* (2000) used clinical signs identified by professional experts, PA methods such as pair-wise comparison with pastoralist informants would reveal local indicators of diseases. In addition to clinical signs, these indicators are likely to include modes of disease transmission, age-specific incidence and mortality and seasonal factors. It is proposed that matrices developed using this broader range of indicators (rather than disease signs alone) would lead to more precise diagnoses of the diseases in question. This improved precision arises because clinicians and pastoralists do not diagnose disease using clinical signs *per se*, but mentally combine pieces of information on the environment, characteristics of affected animals, history of contact with other herds (or disease vectors), season (particularly rainfall) *and* clinical signs before reaching a definite or tentative diagnosis. As explained in Chapter 4, the use of indicators other than clinical signs assisted Nuer and Dinka informants to distinguish between diseases of similar clinical appearance.

The value of pair-wise ranking also includes its potential to identify local indicators that veterinarians may have forgotten, do not recognise or do not wish to state because they are not mentioned in veterinary textbooks. An indicator such as 'loss of tail hair' (Chapters 4 and 6) falls into this category. Regarding indicators that veterinarians may not recognise, pastoralists spend considerable time observing their stock and recognise subtle changes in appearance, behaviour and performance of livestock that a veterinarian may overlook during a clinical examination.

In addition to these aspects of matrix scoring, the method can also provide information on mixed infections. The Bayesian belief network developed by McKendrick *et al.* (2000) overlooked the possibility that cattle could suffer from more than one disease at the same time. As shown in Chapter 4, cattle with *liei* could be suffering from trypanosomiasis, fascioliasis, schistosomiasis and PGE as single or mixed infections. This situation is not unique to southern Sudan and mixed infections have been reported from Ethiopia (Mathewos *et al.*, 2001), the Gambia (Dwinger *et al.*, 1994) and Tanzania (Hendy, 1988).

In existing surveillance systems, diseases caused by mixed infections are probably reported as one of the diseases involved. For example, veterinarians in southern Sudan usually reported *liei* as trypanosomiasis. However, in the absence of laboratory confirmation of diagnosis a more accurate description of the disease would either be the word *liei* itself or a term such as 'mixed parasitism'. Therefore, use of matrix scoring could improve the value

of disease surveillance, by helping veterinarians to correctly interpret local disease terminology. Similarly, comparing herders' and veterinarians' opinions using matrix scoring and procedures such as MDS and HCA (Chapter 9), helps to identify relationships between local and modern terminology.

The future use of matrix scoring to improve understanding of local disease names within a surveillance system would require recognition of differences in disease terminology between clans within ethnic groups. For example, it should not be assumed that all Maasai communities in Kenya and Tanzania use the same disease names as those recorded in the study on FMD in Chapter 8. Maasai in Kenya and northern Tanzania sometimes use the disease names *loirobi* for FMD and *olkipei longishu* for CBPP (IT Kenya/IIRR, 1996) compared with the names *olukuluku* and *emwilalas* respectively used around Morogoro. Therefore sampling of ethnic groups to identify disease names for surveillance purposes requires an understanding of ethnic sub-groups and variations in dialect between groups. Collaboration between epidemiologists and ethnographers would probably be beneficial.

10.4.2.2 Use of PA methods in rinderpest eradication

Prior to this research, veterinarians involved in rinderpest eradication programmes were using PA methods. The main use was qualitative assessment of animal health issues during the design of community-based animal health programmes (Leyland, 1996; Mariner, 1996). In these situations, PA methods were used to encourage community participation while also generating information for project design and planning. The second use of PA methods was 'participatory disease searching' (PDS) for rinderpest (Mariner and Roeder, 2003), as mentioned in Chapter 2. This thesis indicated that at least two PA methods could be further adapted to assist rinderpest eradication, as described below.

a. Use of matrix scoring to assess indigenous knowledge on mild rinderpest

In the late 1990s the presence of mild rinderpest in Somali areas of the Horn of Africa was causing concern for the Pan African Rinderpest Campaign (Barrett *et al.*, 1998). This type of rinderpest was characterised by clinical signs such as slight tearing, oral erosions and diarrhoea. In some cases, the signs were considered to be so mild that the disease was overlooked or ignored by livestock keepers and veterinarians. By late 2002 the Somali ecosystem was increasingly regarded as the last foci of rinderpest in Africa and hence there was intense political pressure to eradicate 'mild rinderpest' (Anon, 2002).

As Somali-occupied areas were often highly insecure and remote, few veterinarians were willing to work there. Consequently, the question arose as to how to eradicate a disease that could not easily be detected (Anon, 2002). The debate included discussion on the ability of Somali pastoralists to recognise mild rinderpest considering the apparently vague clinical signs of the disease. At the time of writing, veterinarians were divided on this issue. Those with clinical experience in Somali areas and knowledge of participatory approaches advised that Somali pastoralists recognised mild rinderpest and used specific names for the problem. For example, Mariner and Flanagan (1996) detected cases of mild rinderpest in northeast Kenya using participatory disease searching and confirmed the diagnosis using laboratory tests. Other workers maintained that herders did not recognise mild rinderpest and therefore, there was limited role for herder observation to contribute to disease surveillance.

A matrix scoring method could be used in studies to determine the ability of livestock keepers to recognise mild rinderpest. An example is detailed below and assumes that informants are not aware that the researchers have a particular interest in rinderpest or rinderpest-like disease.

Stage 1

Prepare a set of diagrams depicting the following disease indicators:

Lameness

Diarrhoea

Nasal discharge

Fever

Salivation/drooling

Eye discharge

High mortality

Contact with buffalo

Contact with sick cattle

Stage 2

The informants should not be aware that the researcher is interested in rinderpest. Select the diagram for 'lameness'. Ask the informants to name all the diseases of cattle that cause lameness. For each named disease, use a simple object to represent the disease. Place these objects in a row on the ground and at right angles to the diagram showing lameness. Note that lameness is not an indicator of rinderpest, but will help to introduce the method to the informants and hide the researcher's interest in rinderpest.

At this point, a matrix is starting to emerge on the ground. For example:

Diagrams of indicators ↓	Blackleg	FMD	Thorn injury
Lame cow			

Stage 3

Add the diagram of a cow with diarrhoea. Ask the informants to name all the diseases of cattle that cause diarrhoea. Add these diseases to the matrix. Probe the informants to ensure that all known diseases that cause diarrhoea are added to the matrix. If they do not name rinderpest, suggest that it is added to the matrix.

Diagrams of indicators ↓	Blackleg	FMD	Thorn injury	Worms	Rinderpest	Plant poisoning
Lame cow						
Cow with diarrhoea						

Stage 4

Repeat the process of adding indicators to the matrix and asking informants to name diseases associated with these indicators. Add any new diseases to the matrix. When this process is completed, a matrix will have been produced with all the indicators along the y-axis of the matrix and a number of diseases along the x-axis of the matrix.

Diagrams of indicators ↓	Blackleg	FMD	Thorn injury	Worms	Rinderpest	Plant poisoning	Add more diseases	→
Lame cow								
Cow with diarrhoea								
Add more indicators								
↓								

Stage 5

Using 5 stones per disease as a rule of thumb, give the informants a pile of stones. For example, if 15 diseases are represented in the matrix use 75 stones. Taking the first indicator 'lameness', ask the informants to divide the stones to show the relative importance of all disease as a cause of lameness. Repeat the scoring for all the indicators.

Stage 6

At this stage, there are two possible scenarios:

- if a disease appears in the matrix which according to the scores allocated to it, looks like mild rinderpest use probing questions to find out more about this disease. Ask the informants to add more indicators to the matrix if they wish, and score these indicators.
- if there is no disease in the matrix that looks like mild rinderpest, use probing questions to determine whether informants perceive rinderpest to occur only as severe disease or whether different forms of rinderpest are observed. If responses indicate that a mild form of rinderpest is known, ask about local names for this type of rinderpest. Add the mild rinderpest to the matrix and taking the stones allocated to 'severe rinderpest', ask informants to divide the stones to show how disease signs vary (if at all) between severe and mild forms of the disease. Ask the informants to add more indicators to the matrix if they wish, and score these indicators.

This is an open-ended method in which the researcher pre-determines the disease indicators and allows the informants to name diseases that fit the indicators. There is also scope for informants to add indicators if they wish. An increasing intensity of probing questions is used depending on informants' responses. With this type of method, the initial list of indicators would be identified via consultation with rinderpest experts.

b. Use of proportional piling to assist verification of freedom from clinical disease

When testing a proportional piling method with Orma communities in Kenya, rinderpest was used as one of three control diseases when assessing the incidence of trypanosomiasis (Chapter 6). Due to the dramatic history of rinderpest, it was assumed that informants would know about the disease. Also, Tana River District was officially classified as a rinderpest

surveillance zone and therefore it was anticipated that incidence estimates for rinderpest for 1999 to 2000 would be zero³.

Results from proportional piling showed that 3/50 informants reported *madobesa* (Table 6.2) and the results of matrix scoring showed similarity between the clinical signs and causes of this disease, and rinderpest (Figures 6.3 and 6.4). Therefore, the proportional piling method had unexpectedly indicated the recent presence of rinderpest in a surveillance zone. Probing of the three informants who reported rinderpest indicated that their diagnosis was sound⁴. This evidence of rinderpest in cattle was supported by serosurveillance of wildlife in Tana River District that was conducted by workers with no knowledge of the study on trypanosomiasis reported in Chapters 6 and 7. During wildlife serosurveillance, 18 buffaloes, 18 warthogs and five giraffes were sampled. Of these, antibody to rinderpest virus was detected in one buffalo and one warthog under three years of age. Serological findings supported the hypothesis of a rinderpest epidemic in around 1993 and endemic rinderpest by early 2000 (Chardonnet and Kock, 2001).

An important stage in rinderpest eradication is confirmation of the absence of clinical disease. During this process, randomised questionnaire surveys are among the methods used to collect information on the recent presence of rinderpest as recognised by informants in rural areas. Proportional piling could complement these surveys by providing retrospective information on cattle diseases in an indirect manner. Using this method, informants would not necessarily know that the survey team was interested in rinderpest and would provide information on a range of cattle diseases. This approach would be less leading than asking specific questions about rinderpest in the early stages of a questionnaire survey.

✓10.4.3 Veterinary research

This research demonstrated that PA methods are useful for complementing conventional veterinary investigation and epidemiological methods in pastoralist areas, and have numerous advantages over questionnaires. The use of PA methods encourages community participation in research, but also generates information and analyses that are highly

³ Regarding rinderpest status in Kenya, in 1999 the country was divided into a central zone described as 'provisionally free' and two surveillance zones in the northwest and northeast. The latter included Tana River District.

⁴ This result placed the research team in a potentially sensitive situation. To overcome possible misunderstandings, the District Veterinary Officer was invited to, and attended the stakeholder workshop described in Chapter 7 and was made aware of the results. The term 'rinderpest like disease' was used.

relevant to the research process. The methods are flexible and assuming that researchers have been well trained in their use, can be adapted in the field to suit particular information needs and local preferences. The need to select PA methods according to a particular situation is important, because not all methods work well in very community or culture. For example, Leyland (1993) noted the limitations of diagrams when working in Afghanistan and suggested that interviewing methods were much preferred by informants.

Among the main limitations to the use of PA methods in research is probably the perception among researchers that PA automatically means qualitative methods. However, this research demonstrated that quantitative data is produced relatively easily from PA methods. It is also likely that epidemiologists are less familiar with the various nonparametric statistical tests that can be used to analyse ranks or scores.

Opportunities for the wider use of PA methods in resource-poor or operationally difficult settings are summarized below.

10.4.3.1 Longitudinal studies

Although longitudinal studies are useful in epidemiology for observing disease events and other variables in groups of animals over time, regular monitoring of livestock is extremely problematic in pastoralist herds (de Leeuw *et al.*, 1995), and there are very few examples of longitudinal disease studies from such herds in the veterinary literature. Participatory appraisal methods used in this research such as seasonal calendars, proportional piling and mapping all required informants to consider retrospective events over time. In the case of seasonal calendars and proportional piling, information was judged to be valid thereby indicating that these methods are useful for understanding temporal changes and associations. Although recall bias is clearly a potential source of error, the literature indicates that African pastoralists have extremely good recall with regard to livestock issues⁵.

⁵ It seems that western-trained researchers often find it difficult to accept that illiterate livestock keepers can possess good recall. However, livestock topics form a substantial part of the everyday conversation of pastoral communities and daily meetings are held to discuss how different animals are performing and should be managed. According to Akabwai (1992) herders in Turkana, northern Kenya are often perceived by outsiders to be lazy because they spend long periods sitting under trees chatting to each other. However, most of the talk is about livestock, whether such and such an animal is pregnant, whether a new calf is growing well, the condition of the pasture and so on. Turkana elders meet each day under the Tree of Men to decide how cattle should be watered and grazed, and other livestock-related issues. In Neur areas in southern Sudan, an 'apparent obsession' with talking about cattle over and above all other topics was noted by Evans-Pritchard (1940). Also

In addition to the PA methods used in this research, methods such as the progeny history method (Swift, 1981; Iles, 1994b) are also based on retrospective assessment. Progeny histories were used extensively during research on camel husbandry in northern Kenya with more than 3000 histories collected over a 12-month period (Kaufmann, 1998). When assessing the method, the researcher emphasised the ability of pastoralist informants to remember the histories of their animals and noted that western observers might find this level of recall difficult to comprehend. It was concluded that,

'Participatory methods allowed quick and cost effective collection of reliable data on camel performance in mobile production systems where long-term data are needed for analysis.'

Participatory appraisal methods have also been used in impact assessment of CAHW projects and this has involved retrospective analysis of changes in disease patterns over time. Methods such as 'before and after' proportional piling of disease incidence and mortality have been developed and showed good inter-observer reliability (Catley, 2000a).

Despite these examples of uses of PA methods to collect historical information on animal health and production, it is probable that epidemiologists will still be concerned about recall bias. However, to the author's knowledge there are no published accounts of longitudinal studies in which the final results disagreed with information provided by pastoralists at the onset of the study.

10.4.3.2 Using herders' insights to generate new hypotheses

In general, published information on the epidemiology of major livestock diseases in pastoralist areas of Africa is limited. All three of the field studies described in the thesis produced information on diseases or syndromes that are relatively poorly described in the veterinary literature. In southern Sudan, the disease called *liei* was diagnosed as a complex of parasitic diseases and it was evident that very little previous research had been conducted on mixed infections in livestock under traditional management systems in the tropics.

working in southern Sudan, Mefit-Babtie (1983) noted that the Dinka had sophisticated systems for identifying cattle and describing their colours and markings. Regarding herder's ability to recognise individual animals, it was concluded that *'Dinka herdsmen have a remarkable ability to identify their own animals from among a large herd of very similar coloured and shaped stock. The Dinka recognise and give specific names according to the relative position of the colour patches'*.

Researchers have tended to investigate individual diseases according to their own specialist areas of interest, and in part, this reflects a non-participatory research approach. In many areas of developing countries, primary veterinary care is based on clinical diagnosis and laboratory confirmation of disease is rarely performed. In these situations, better understanding of clinical presentations of diseases and the role mixed infections is needed.

Another finding of the southern Sudan study was the high prevalence of trypanosomiasis, mainly due to *T. congolense*, in cattle in Nyal. This village was located approximately 250km from the nearest recognised tsetse-infested area and was essentially a vast swamp in which cattle were reared on islets of higher ground. This was not typical tsetse habitat and although herders recognised and described numerous biting flies, they appeared not to recognise tsetse flies. This finding leads to the hypothesis that trypanosomiasis is mechanically transmitted by biting flies in parts of southern Sudan, as proposed by numerous field veterinarians with experience in the area. This issue is of interest not only for technical reasons, but also because of the heated debate between professionals that continues in international conferences and electronic networks.

The southern Sudan study also collected information on the chronic disease called *jul* and noted herder's associations between this disease and FMD. This hypothesis was tested in Tanzania where to the author's knowledge an epidemiological association between HI and FMD was demonstrated for the first time. An interesting feature of this work was that during the preparation of the study the researcher contacted a number of senior veterinarians in international agencies, laboratories and universities for advice⁶. Very few of these experts were aware of the HI syndrome or associated it with FMD, although it was mentioned in a well-known veterinary textbook (Radostits *et al.*, 1994). The apparently limited professional knowledge of HI was verified using the adapted matrix scoring method with veterinary professional informants (Figure 9.10). Therefore, the syndrome appears to have become largely forgotten among veterinarians.

In Kenya, Orma pastoralists described the acute haemorrhagic form of trypanosomiasis due to *T. vivax* and associated this disease with tsetse. However, some informants also associated the disease with a fly called *gandi buku* and provided a description of the fly that differed

⁶ Including the Institute for Animal Health (Pirbright, United Kingdom), Food and Agriculture Organization (Rome, Italy) and the Pan African Programme for the Control of Epizootics (Nairobi, Kenya).

markedly from tsetse. This is another example of a hypothesis based on local observation that warrants further research.

These experiences highlight important features of participatory approaches in terms of both the open-ended aspect of the methods and the need for researchers to be open minded to ideas that don't necessarily fit conventional thinking. Consequently, participatory research is particularly useful for revealing local insights that may lead to new hypotheses about animal diseases. This contrasts with survey methods such as questionnaires that tend to restrict dialogue to the issues and questions that have been predetermined by the researchers.

10.4.3.3 *Disease modelling and improved disease control strategies*

As described in the literature review in Chapter 2, PA methods have been used in various combinations with other methods in surveys and research. In northern Kenya, Kaufmann (1998) combined PA, particularly the progeny history technique, with bio-economic modelling to study camel management and productivity.

In veterinary research, PA methods have been used generate data for the calculation of basic parameters for disease models. This approach avoids the need to collect large volumes of data and uses participatory methods to identify parameters such as population demographics, mortality rates, population contact structure and inter-epidemic periods (Mariner *et al.*, 2001). The approach helps to avoid some of the limitations of more conventional modelling in which information is drawn from the literature that may not accurately reflect the behaviour of a disease 'on the ground'.

At the time of writing, 'participatory disease modelling' had been used to improve understanding of control strategies for rinderpest in southern Sudan (Mariner, 2001) and was also being developed to assess different control strategies for CBPP in pastoral areas (Mariner *et al.*, 2002). Consequently, the combination of indigenous knowledge and sophisticated mathematical analyses were being used to inform control strategies for two of the most important livestock diseases in developing countries.

10.5 Institutional and professional issues affecting the wider use of participatory approaches and methods

In recent years, interest in participatory approaches and methods has included recognition of the role that institutions play in promoting new ways of working. For example, while much of the early development of PA focussed on training field workers or middle-level staff, senior managers often failed to understand or support the use of participation. Therefore, information derived from participatory research was regarded as inferior to that produced by conventional research methods, and there were few incentives for researchers to use participatory approaches (Leurs, 1998). Even when participatory approaches were understood and supported by high-level managers, scientists and professionals sometimes resisted change. For example, when describing changes in national research institutes in Kenya in the late 1990s it was noted that,

'Biophysical scientists had negative attitudes towards these (participatory) approaches. The scientists were initially apprehensive and reluctant to adopt PAs as they considered them to be overburdening and an interference with scientific etiquette ... they were also concerned that the results of qualitative studies carried out using PAs would not be accepted for publication in scientific journals. They also feared losing control of the research projects to other collaborators with comparative advantage in the use of PAs.' (Okuthe *et al.*, 2003).

Despite these attitudes, donor policies from the mid 1990s were increasingly using the language of participation to reflect a more client-focused approach to livestock research and development. Formats for project proposals began to request evidence of demand at community level and PRA soon became accepted jargon. However, in the author's view many livestock research institutes simply added the appropriate phrases about participation into their proposals and continued to work in the same top-down manner as before. Commonly, PRA was interpreted as 'questionnaire' or 'semi-structured interview' and researchers continued to focus on disease problems identified by them in isolation of communities or research partners on the ground⁷.

⁷ In 2000 and 2001 the researcher was asked to review 12 research concept notes submitted to a major donor and claiming use of participatory approaches. In six concept notes the researchers indicated that they would 'do a PRA' or similar, and there was no elaboration of methods. The researchers had already identified a specific research topic and failed to note the open-ended, multidisciplinary nature of PRA, or the possibility that communities would identify their own research priorities. In four concept notes PRA methods were defined as semi-structured interviews *per se* (with no triangulation of different methods) and in two concept notes the PRA methods to be used were questionnaires (not a PRA method). None of the concept notes mentioned an initial phase of local identification of problems or the need to train researchers in participatory research methods. Similarly, there was no evidence that researchers had already been trained and none of their listed publications suggested experience in participatory research.

More positive institutional changes have taken place in research centres in Kenya where managers have supported training and practice of participatory research. This was accompanied by changing incentives for researchers and recognition of participatory research as an acceptable and useful approach. Internal appraisal systems for scientists were adjusted to reflect these changes and over time, the need for participation was incorporated into mission statements and core values of the institutes.

'Participatory approaches are now widely accepted tools for conducting research... the attitudes held by scientists that communities had little to offer in technology development and dissemination have changed, and they have learnt that communities have a wealth of knowledge which can be used to enhance research outputs ... the use of PAs has enhanced, strengthened and enriched data collection and analysis by involving all stakeholders in the information chain. Thus the data can be meaningfully used to inform policy formulation and implementation for greater impact at the community level' (Okuthe et al., 2003).

In government veterinary services in Africa, attempts to institutionalise participatory approaches and methods are an important component of the Pan African Programme for the Control of Epizootics (PACE). In December 1999 a unit was established within PACE to assist Horn of Africa countries to strengthen their surveillance and research efforts by using participatory epidemiological approaches⁸. In November 2001 experiences in participatory epidemiology were reviewed in a workshop involving senior epidemiologists from six African countries (Catley and Mariner, 2001) and the need for training of government staff was recognised. Following a regional training course in participatory epidemiology in April 2002, government staff and academics were involved in a series of field studies designed to reinforce the training with practical experience. Simultaneously, various activities with veterinary schools were conducted, including training academics and students, and testing of PA in various operational settings. The role of PA in strengthening government veterinary services in developing countries has also been recognised by international agencies such as FAO (Catley and Mariner, 2002).

Although these activities indicate that participatory epidemiology is becoming more widely accepted by epidemiologists, a number of constraints are evident. These include a huge demand for training in PA but a relatively small group of practitioners who are able to provide training. In common with the expansion of participatory approaches in other sectors, this may lead to poor quality training and in turn, incorrect use of the methods or a fixation on methods rather than attitudes and approach. In national epidemiology units in the Horn of

⁸ Specifically, the Community-based Animal Health and Participatory Epidemiology (CAPE) Unit.

Africa there is often a dearth of animal health information from pastoralist areas and pressure on staff to collect data. This may result in epidemiologists regarding PA as simply a data collection exercise and the poor feedback of information to communities will continue. Associated with the scaling up of participatory approaches is a need to reinforce the notion of surveillance and research for action. At present, government epidemiologists are continuing to ask the question 'What is the maximum amount of data we can collect' rather than 'What information do we need to take meaningful action?' Consequently, data quantity has been the indicator of success and the impact of epidemiology at community level remains obscure.

One way to improve the links between data collection and action on the ground is to integrate community-based animal health systems into official disease surveillance systems (Mariner, 2002; Mariner *et al.*, 2003). This requires legislative change to ensure that privatised, veterinary-supervised CAHWs are recognised as part of a national veterinary service, according to OIE guidelines (Leyland and Catley, 2002). In Kenya, Uganda and Tanzania legislative reform is in process whereas in Ethiopia, new legislation was released in 2002 to recognise CAHWs (Silkin and Kasirye, 2002). Supportive legislation was already in place in Eritrea.

10.6 Conclusions

This research demonstrated that various PA methods are useful epidemiological tools in pastoralist areas of Africa. Although derived from the social sciences and commonly thought to lack a scientific basis, the research showed that standardised PA methods are reliable and valid. Furthermore, some PA methods offer advantages over questionnaires with regard to limiting bias in data collection and analysis. The study on HI and FMD in Tanzania also indicated the value of PA for exploring association. Potential applications of PA include disease surveillance, investigation and research. Regarding research, PA appears to have particular value in generating new hypotheses.

From 2002 until the time of writing, research findings were used in training programmes for veterinary epidemiologists in the Horn of Africa region under the auspices of the Pan African Programme for the Control of Epizootics, and field-level practice and experimentation was underway in six countries. Although veterinary institutions are recognising the value of PA, important challenges remain to ensure quality. In particular, the standardisation of PA methods solely for the purpose of quantitative data collection, should

be avoided. One of the main benefits of PA is that during training, veterinarians are required to reassess their own knowledge and attitudes towards livestock keepers, leading to better relationships and more appropriate disease control interventions. However, such changes will only occur on a large scale if veterinarians operate within supportive institutions. Therefore, change at the highest levels of government veterinary services, research centres, veterinary schools and international agencies is required.

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Appendix 4.1

Examples of checklists for use with semi-structured interviews (SSI) in southern Sudan

The two lists of questions below were mental checklists used during semi-structured interviews. The questions were not always repeated using exactly the same phrasing and additional questions were used to probe interesting responses and develop discussions.

Topic

Naming of parasites, disease vectors and biting flies (actual specimens were used; these specimens were either preserved or detected during post mortem examinations).

Checklist of questions:

- Do you know this parasite/fly?
- What name do you use for this parasite/fly?
- What is the (literal) meaning of that name? Why do you use that name?
- Are there any other names for this parasite? If so, tell me about them.
- Why is this parasite/fly a problem? (i.e. what disease or problem is associated with the parasite/fly? What are the disease signs or other characteristics?)
- What time of year do you see this parasite/fly? (i.e. seasonal variation in population, if any). If seasonal variation, why do the numbers vary by season?
- What else can you tell me about this parasite/fly? Additional questions to cross-check identity of the parasite/fly, depending on the known scientific name. For example, if the fly in question is a biting fly ask about biting behaviour such as time of day when the fly is active, location of bites on host, type of host (including human)
- How do you try to solve the problem of this parasite/fly? Probe use of modern and traditional preventative measures or treatments, and their effectiveness.

Topic

Follow-up SSI after matrix scoring of disease signs in Thiet, to cross-check and probe results.

Checklist of questions:

- When the completed matrix scoring is still visible on the ground, ask informants to 'tell the story' of the matrix and explain its meaning.
- Are there any important disease signs that have been missed off the matrix? If so, describe and explain them.
- Do any of these diseases affect people? If so, tell me about them (used to probe possible knowledge of *cual*/brucellosis as a zoonosis).
- I've not seen this disease *jul* before. Can you tell more about it? (used to probe possible causes and association with FMD/*dat*)
- The diseases called *liei* and *jong acom* look similar. Can you tell me how you distinguish between these two diseases?
- *Liei* and *jong acom* look similar, but which is more important and why?
- Is it possible for a cow to have two diseases at the same time? What do you think about this idea? (If the reply is 'no' use an example from human health to make the point and repeat the question, rephrased).
- Depending on the response to above questions, open up discussion on treatment of *liei* and *jong acom*. What drugs used? Are they effective? If an animal has both diseases, what do you do?

Appendix 4.2

Pathology reports for cases of chronic wasting in Nyal and Thiet, southern Sudan

This appendix contains gross pathology reports for the 13 cases of chronic wasting examined in Nyal and Thiet.

Pathological examination included the following procedures:

- case history;
- clinical examination;
- post mortem examination;
- histopathology;
- examination of thin smears, buffy coat smears and lymph node smears for trypanosomes;
- measurement of ante mortem packed cell volume;
- examination of faeces for helminth eggs.

Full methodological details are provided in Chapter 4.

Only detected abnormalities are reported.

Abbreviations

-ve	negative
+ve	positive
epg	eggs per gramme
F	female
M	male
NAD	no abnormalities detected
PCV	packed cell volume

Case Nyal 1

Date: 3/6/99

Species: Bovine

Age: 8 years

Sex: F

Location: Nyal village

History

Sick for 9 months showing gradual weight loss. Treated with albendazole and oxytetracycline in October 1998 and treated again with oxytetracycline in March 1999. No response to treatment.

Clinical examination

Emaciated, dehydrated and diarrhoeic cow. Eyes sunken and tearing left eye. Irregular enlargement of superficial lymph nodes. ~ 30 *Amblyomma* ticks attached.

Gross pathology

A cachectic, oedematous carcass with patches of gelatinous fat; lymph nodes moderately enlarged and oedematous; dehydrated and diarrhoeic.

The liver was slightly swollen and hepatic lymph nodes were enlarged.

The rumen was full but dry with ~ 50 paramphistomes; abomasal contents were watery and intestinal contents were diarrhoeic throughout. No other lesions were detected. This examination was postponed due to bad light. A thorough examination of the intestinal tract was not conducted.

Further tests

PCV – not measured

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

Examination of faeces

epg - 0

Histopathology

Small intestine

The lamina propria was hypercellular with mononuclear cells and some granulocytes. There was some reduction in crypt numbers.

Large intestine

Focal hypercellularity affected the mucosa. Occasional small lymphocytic infiltrations had formed around small blood vessels in the mesentery.

Lymph node

One portion showed no significant lesions. The other showed a decrease in the number of lymphocytes and plasma cells in the medullary cords. There appeared to be an increase in the numbers of macrophages/histiocytes in the medulla.

Kidney

Some well formed lymphoid aggregates were present to the blood vessels and glomeruli.

Spleen

No significant lesions.

Heart

Moderate numbers of sarcocysts were accompanied by very mild non-suppurative interstitial myocarditis.

Liver

Limited centrilobular fatty change was present. Occasional chronic inflammatory foci were found in the portal tracts.

Lung

No significant lesions.

Case Nyal 2

Date: 6/6/99

Species: Bovine

Age: 8 years

Sex: F

Location: Cattle camp, 40 minutes walk SW of Nyal village

History

None available. Called *liei* by owner.

Clinical examination

A thin cow with poor skin condition and hair loss from the tail. Pale mucous membranes. Marked enlargement of prescapular lymph nodes.

Gross pathology

A thin carcass. The right prescapular lymph node was abscessated with green, cheesy pus. Moderate numbers of paramphistomes in the rumen and ~100 paramphistomes in the abomasum; large numbers of *Haemonchus* spp. in the abomasum and abomasal mucosa thickened and red.

The liver showed diffuse bile duct thickening, calcification and fibrosis. Flukes present in large numbers, including dead and calcified masses in bile ducts; hepatic lymph nodes were enlarged and oedematous.

Mesenteric lymph nodes were enlarged and schistosomes were easily detected in mesenteric vessels. Vessels were thickened proximally.

No other lesions/parasites detected.

Further tests

PCV 24%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

worm count, abomasum - 7000 *Haemonchus* sp.

Examination of faeces

epg - 0

Histopathology

Small intestine

The outer third of the mucosa was autolysed but there was moderate hypercellularity of the lamina propria. One portion showed chronic abscessation and granuloma formation in the submucosa. Excess eosinophils were present within and around small blood vessels in the submucosa. Vasculitis characterised by eosinophils affected moderate-sized vessels in the serosal layer.

Lymph node

A loose focus or band of purulent lymphadenitis was present.

Lung

No significant lesions.

Heart

Moderate numbers of sarcocysts were present in the myocardium but there was no significant accompanying inflammatory change.

Liver

Marked inflammatory cell infiltration was present in the portal areas and tracts. Portal fibrosis was also a feature. Parasites and suspect *Schistosoma* eggs were present within the blood vessels. Multinucleated syncytial cells surrounded parasitic debris in the periportal area of one lobule. Purulent hepatitis was also a feature. The bile duct showed infiltration by lymphocytes, plasma cells and some granulocytes. The wall was thickened by fibrosis.

Kidney

A tiny focus of non-suppurative interstitial nephritis was found.

Spleen

Sheaths and follicles were well developed but there were no significant lesions.

Case Nyal 3

Date: 9/6/99

Species: Bovine

Age: 9 years

Sex: F

Location: Lwali, 3 hours walk south of Nyal village

History

Sick for 10 months with gradual weight loss and hair loss from tail. Not treated.

Clinical examination

An emaciated cow with poor skin condition, hair loss from the tail and laboured respiration.
~ 40 *Amblyomma* ticks.

Gross pathology

A cachectic, oedematous carcass.

Large numbers of paramphistomes were present in the rumen, covering approximately 60% of the mucosa in the dorsal sac; ~ 50 paramphistomes in the abomasum. Large numbers of *Haemonchus* in the abomasum and abomasal mucosa thickened. The liver was friable.

Mesenteric lymph nodes were enlarged and with some searching, schistosomes were detected in mesenteric vessels. The small intestine was virtually empty.

No other lesions/parasites detected.

Further tests

PCV 18%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

Examination of faeces

epg - 100

Abomasal worm count, abomasum - 4000 *Haemonchus* sp.

Histopathology

Small intestine

Eosinophilic vasculitis was a significant feature in the serosa. The lamina propria was hypercellular with mononuclear cells and eosinophils. Nematode parasites were present in the mucosa.

Lymph node

Moderate numbers of eosinophils were aggregating around major blood vessels in the medulla. A 'histiocytic' appearance affected the medulla. The cortex was moderately active with good germinal centres.

Liver

Lymphoid follicle formation and aggregates of eosinophils were present in the portal areas and tracts. An occasional granuloma was present within portal areas. Vasculitis related to intraluminal parasites was occasionally seen. Splendore-Hoeppli reactions had formed around a number of dead parasites.

Spleen

Congestion only.

Lung

No significant lesions.

Heart

Moderate numbers of sarcocysts and mild interstitial myocarditis was present.

Abomasum

No significant lesions.

Rumen

No significant lesions.

Kidney

Multifocal lymphoid aggregates had formed adjacent to blood vessels or glomeruli.

Case Nyal 4

Date: 12/6/99

Species: Bovine

Age: 12 years

Sex: M

Location: Nyal village.

History

Sick for 9 months with gradual weight loss. Treated with oxytetracycline once in October 1998.

Clinical examination

An emaciated bull with poor skin condition and slight bilateral tearing. ~ 30 *Amblyomma* ticks.

Gross pathology

A cachectic carcass. Superficial lymph nodes were enlarged and oedematous. Pale striations were present in the myocardium and left ventricular hypertrophy was evident.

Small numbers of paramphistomes were present in the rumen and large numbers of *Haemonchus* were present in the abomasum. The abomasal mucosa was thickened.

Hepatic lymph nodes were grossly enlarged. Severe and typical fluke lesions and flukes were present, with bile duct thickening, and diffuse calcified foci.

Mesenteric lymph nodes were enlarged and schistosomes were easily detected in mesenteric vessels in large numbers. Proximal thickening of mesenteric veins was evident.

No other lesions/parasites detected.

Further tests

PCV 14%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear –ve
lymph node smear -ve

Examination of faeces
epg – 200

Abomasal worm count - 5000 *Haemonchus* sp.

Histopathology

Small intestine

There was a marked hypercellularity of the lamina propria as a result of infiltration by lymphocytes and eosinophils. The villi were truncated or lost. Muscular hypertrophy affected the vessels of the submucosa and there was a slight perivascular infiltration of mixed inflammatory cells in the serosa.

Heart

A single sarcocyst was present and mild interstitial myocarditis.

Spleen

There was a marked increase in the number and extent of the lymphoid tissue.

Lymph node

Both portions of node were very active with good germinal centres. In section 1 the lymphoid coronas of small lymphocytes and around the germinal centres were narrow.

Abomasum

There was limited cellular infiltration of the mucosa and an occasional gland was dilated.

Forestomach

There were no significant lesions.

Kidney

Numerous small, mineralised deposits were present in the medullary tubules. Occasional small lymphocytic foci had formed in the cortex.

Liver

Widespread, marked portal fibrosis was a feature. Portal infiltration by lymphocytes and some granulocytes was also widespread. Some mixed inflammatory cell foci had formed in the parenchyma.

Lung

No significant lesions.

Case Nyal 5

Date: 14/6/99

Species: Bovine

Age: 6 years

Sex: F

Location: Nyal village.

History

Aborted 10 months ago and treated with oxytetracycline. Weight loss since then and intermittent diarrhoea.

Clinical examination

A very thin cow with poor skin condition, bald tail and bilateral tearing. Moderate diarrhoea. ~ 50 *Amblyomma* ticks.

Gross pathology

A cachectic, watery carcass with patches of gelatinous fat. Superficial lymph nodes were moderately enlarged.

Small numbers of paramphistomes were present in the rumen and abomasum.

Hepatic lymph nodes were moderately enlarged and moderate, typical fluke lesions were evident. Small numbers of fluke were present, with bile duct thickening, and diffuse calcified foci.

Mesenteric lymph nodes were enlarged and schistosomes were easily detected in mesenteric vessels in large numbers. Proximal thickening of mesenteric veins was evident and calcified foci of 2-3mm were present in the small intestine.

No other lesions/parasites detected.

Further tests

PCV 20%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

Examination of faeces

epg - 0

Histopathology

Small intestine

A chronic parasitic lesion had formed in the wall and submucosa. The lamina propria was hypercellular with lymphocytes and eosinophils.

Heart

Moderate numbers of sarcocysts were present in the myocardium.

Kidney

Mineralised deposits were found in the tubules of the medulla. A limited number of small but intense perivascular lymphoid cuffs had formed.

Spleen

This section was very congested but showed no other lesions:

Lung

A nematode was present in the parenchyma. The identity of the parasite was not established but it was surrounded by an intense inflammatory response consisting of neutrophils, eosinophils, macrophages and lymphocytes.

Liver

Multifocal infiltration of the portal areas by lymphocytes and eosinophils was present. The portal areas showed fibrosis. An occasional parasite was present within portal blood vessels.

Case Nyal 6

Date: 15/6/99

Species: Bovine

Age: 8 years

Sex: F

Location: Pasil cattle camp, 45 minutes walk south west of Nyal village.

History

Progressive weight loss for 8 months. Treated with Ethidium to no effect.

Clinical examination

A thin cow with poor skin condition, bald tail and corneal ulcer and tearing of the left eye.

Gross pathology

A thin carcass with yellow, gelatinous fat deposits.

Large numbers of paramphistomes were present in the rumen, covering ~ 40% of the dorsal sac mucosa and extending into the reticulum; ~ 100 paramphistomes were present in the abomasum.

Schistosomes were easily detected in mesenteric vessels in large numbers. Proximal thickening of mesenteric veins was evident and calcified foci of 2-3mm were present in the small intestine.

No other lesions/parasites detected.

Further tests

PCV 22%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

Examination of faeces

epg - 0

Histopathology

Small intestine

The mucosa was hypercellular with lymphocytes and eosinophils. There was loss of villi and the submucosa was thickened as a result of fibrosis, infiltration by eosinophils and by limited numbers of mononuclear cells and plasma cells.

Heart

Moderate numbers of sarcocysts were present.

Spleen

The follicles and sheaths were well developed. Moderate haemosiderin deposition was found.

Kidney

Small foci of lymphocytes were present in the interstitium adjacent to blood vessels.

Lymph node

Some autolysis was present but the paracortex appeared enlarged in some areas.

Lung

No significant lesions.

Liver

Small foci of hepatocyte loss were accompanied by infiltration by macrophages, eosinophils and neutrophils. Portal fibrosis was irregularly present and parasites were found within portal vessels sometimes accompanied by multinucleated cells.

Case Nyal 7

Date: 17/6/99

Species: Bovine

Age: 7

Sex: F

Location: Pasil cattle camp, 45 minutes walk south walk of Nyal village.

History

Progressive weight loss for 9 months. Had diarrhoea and tearing but this cleared. Treated with oxytetracycline some months ago to no effect.

Clinical examination

A moderately thin cow (similar body condition to other apparently normal, but thin animals). A few patches of poor skin condition and hair loss. Small numbers *Amblyomma* ticks.

Gross pathology

A thin carcass. Slight enlargement and oedema of superficial lymph nodes. The spleen was enlarged and friable.

Large numbers of paramphistomes were present in the rumen, covering ~ 40% of the dorsal sac mucosa and extending into the reticulum; ~ 50 paramphistomes were present in the abomasum.

Small numbers of schistosomes were detected in mesenteric vessels. Some proximal thickening of mesenteric veins was evident.

No other lesions/parasites detected.

Further tests

PCV 23%

Examination of smears for trypanosomes

thin smear -ve

buffy coat smear -ve

lymph node smear -ve

Examination of faeces

epg - 400

Histopathology

Small intestine

Excess numbers of eosinophils and lymphocytes were present in the lamina propria.

Large intestine

The lamina propria showed some increase in cellularity but this was less marked than in the small intestine.

Lung

No significant lesions.

Spleen

Congestion only.

Lymph node

This node was active with well formed germinal centres and primary follicles.

Rumen

No significant lesions.

Kidney

A small number of mineralised deposits were found in the tubules of the medulla. Few, loose mononuclear cell collections had formed adjacent to blood vessels in the cortex.

Liver

Vasculitis was related to *Schistosoma* infection and was accompanied by portal fibrosis and infiltration by eosinophils and lymphocytes.

Case Nyal 8

Date: 19/6/99

Species: Bovine

Age: 8

Sex: F

Location: Pasil cattle camp, 45 minutes walk south west of Nyal village.

History

Aborted last year and didn't conceive again. Progressive weight loss and tearing. No treatment.

Clinical examination

A thin cow with pale mucus membranes and jugular pulse. Superficial lymph nodes were enlarged. Small numbers *Amblyomma* ticks. Bilateral corneal scarring.

Gross pathology

A thin carcass with enlargement of superficial lymph nodes. The myocardium was 'flabby' with pale striations. The spleen was enlarged.

Moderate numbers of paramphistomes were present in the rumen and ~ 100 paramphistomes were present in the abomasum. Large numbers of *Haemonchus* were seen in the abomasum and the abomasal mucosa was thickened and reddened.

Massive fluke infection and associated lesions were evident in the liver; severe bile duct thickening and occlusion, fibrosis and calcification. Marked lymph node enlargement and swollen gall bladder; the duodenum was packed with adult flukes.

Large numbers of schistosomes were easily detected in mesenteric vessels. Proximal thickening of mesenteric veins was evident.

No other lesions/parasites detected.

Further tests

PCV 15%

Examination of smears for trypanosomes

thin smear +ve, *T. congolense*

buffy coat smear +ve, *T. congolense*

lymph node smear -ve

Examination of faeces

epg - 300

Abomasal worm count - 8000 *Haemonchus* sp.

Histopathology

Small intestine

The lamina propria was hypercellular and *Schistosoma* eggs were present within the mucosa. Several granulomatous lesions affected the submucosa with a number of blood vessels being obliterated. *Schistosoma* were also present in vessels in the serosa.

Large intestine

The lamina propria showed moderate hypercellularity.

Lymph node

This node had a rather bland appearance but was well populated. A small number of follicles were present at the margins of the section but the bulk gave the appearance of a relatively homogenous sheet.

Spleen

Congestion only.

Liver

The first section showed liver flukes in the bile ducts. There was also portal fibrosis and parasitic vasculitis associated with *Schistosoma* eggs in portal vessels. The second portion of liver showed extensive injury with scarring, haemorrhage, bile duct replication, mononuclear cell infiltration of the portal areas and vasculitis. The extent of the portal fibrosis gave rise to pseudolobulation of the liver. An occasional hyperplastic nodule of swollen regenerating liver cells was present.

Kidney

Limited perivascular lymphoid aggregations were present.

Case Nyal 9

Date: 20/6/99

Species: Bovine

Age: 8

Sex: F

Location: Nyal village

History

Gradual weight loss over six months. Animal doesn't graze well and milk yield is reduced.

Clinical examination

An emaciated cow with bottle jaw, raised pulse and muffled heart sounds.

Gross pathology

A cachectic, oedematous with small amounts of yellow, gelatinous fat. Superficial lymph nodes enlarged and oedematous. The spleen was enlarged.

Marked pleural and pericardial effusions were evident and the myocardium was flabby; a few focal pleural adhesions were also seen.

The rumen was small and underfed with small numbers of paramphistomes. ~ 50 paramphistomes were present in the abomasum and massive numbers of *Haemonchus* were seen. The abomasal mucosa was congested with focal haemorrhages.

Small numbers of fluke were present in the liver and bile ducts were slightly thickened. The gall bladder was enlarged.

Large numbers of schistosomes were easily detected in mesenteric vessels, which were distended and thickened proximally. The intestines were empty; small numbers of *Trichuris* were seen in the large intestine.

No other lesions/parasites detected.

Further tests

PCV 10%

Examination of smears for trypanosomes

thin smear +ve *T. congolense*

buffy coat smear +ve *T. congolense*

lymph node smear +ve *T. congolense*

Faeces

epg - 1200

Abomasal worm count - 12,400 *Haemonchus* sp.

Histopathology

Small intestine

Schistosomes were present in the serosal blood vessels. Proliferative changes and recanalisation of damaged vessels were also present. A number of mesenteric vessels were also involved. The submucosa was very deep in places as a result of oedema and increased vascularity. The lamina propria was hypercellular with eosinophils and mononuclear cells but this change was not so severe as seen in some earlier cases.

Spleen

Congestion and well developed follicles.

Kidney

Numerous, dense mononuclear cell aggregates had formed adjacent to blood vessels in the cortex. In some foci there were acute and degenerative changes to the tubule epithelium at the corticomedullary junction.

Liver

Portal fibrosis was accompanied by some mixed inflammatory cell infiltration, occasional parasitic eggs within blood vessels and hypertrophy of blood vessel walls. The centrilobular hepatocytes showed fatty change.

Heart

Moderate numbers of sarcocysts were present. Very mild interstitial non-suppurative myocarditis. Chronic epicarditis was characterised by mononuclear cell infiltration, thickening of the epicardium and the formation of fibrous tags.

Lymph node

This node was active but showed no significant lesions.

Abomasum

Lymphocytic infiltration had occurred in the basal mucosa and there was an excess of lymphocytes in the lamina propria of the superficial mucosa. Parasites could be found in blood vessels in the outer mucosa.

Lung

Areas of interstitial proliferative pneumonia were characterised by increased numbers of macrophages and other small mononuclear cells.

Skeletal muscle

Small to moderate numbers of sarcocysts were present in this section.

Case Nyal 10

Date: 20/6/99

Species: Bovine

Age: 3

Sex: M

Location: Pasil

History

Sick for 3 months. Weight loss and reduced appetite. Treated with oxytetracycline 3 months ago to no effect.

Clinical examination

Small for age and 'poor doer' appearance. Superficial lymph nodes enlarged and sunken left eye with tearing; small wound on lower lid. ~ 20 *Amblyomma* ticks.

Gross pathology

A thin carcass with patches of yellow, gelatinous fat. Marked superficial lymph node enlargement.

Small numbers of paramphistomes were present in the rumen and ~ 50 paramphistomes were present in the abomasum. Large numbers of *Haemonchus* were seen in the abomasum and the abomasal mucosa was thickened.

Moderate numbers of fluke were present in the liver. Bile ducts were thickened and moderate fibrosis and calcification was evident.

Moderate numbers of schistosomes were easily detected in mesenteric vessels. No gross lesions were evident.

No other lesions/parasites detected.

Further tests

PCV 18%

Examination of smears for trypanosomes

thin smear -ve.

buffy coat smear -ve.

lymph node smear -ve.

Examination of faeces

epg - 100

Abomasal worm count - 3000 *Haemonchus* sp.

Histopathology

Small intestine

There was some increase in eosinophils and mononuclear cells in the lamina propria. Two small lymphoid collections had formed in the mesentery.

Large intestine

Lymphoid follicles had developed in the outer mucosa. Otherwise there were no significant lesions.

Heart

Moderate numbers of sarcocysts were accompanied by mild to moderate interstitial non-suppurative myocarditis.

Skeletal muscle

Thick walled and thin walled sarcocysts were present in this section.

Lung

Small areas of alveolar collapse were present but there appeared to be no significant lesions.

Liver

Foci of intense, sub-acute hepatitis characterised by neutrophils, eosinophils, macrophages and loss of hepatocytes were distributed through the section. Bile duct walls appeared considerably thickened and fibrotic.

Lymph node

This node was active and there was an excess of neutrophils in the medulla.

Kidney

Small perivascular aggregations of lymphocytes affected the cortex.

Spleen

The red pulp was congested and well developed follicles and perivascular sheaths had developed. A focus of necrosis accompanied by infiltration by neutrophils and macrophages and haemorrhage around the margin had formed.

Case Thiet 1

Date: 26/01/00

Location: Cuei-cok cattle camp

Species: bovine

Sex: F

Age: 8 years

History

Owner says has become thin because it is old. Treated with oxytetracycline capsules (human) orally, oxytetracycline injection and albendazole (in September/October 1999).

Clinical examination

Very thin cow with bilateral corneal opacity, though not blind. Coat normal and tail normal. Moderately enlarged superficial lymph nodes. Otherwise NAD.

Gross pathology

Very thin carcass with no subcutaneous fat. Superficial lymph nodes enlarged. Only major lesion/parasite was heavy fluke infection in bile ducts. Enlarged and thickened bile ducts and hepatic fibrosis. Heavy filaria infection in peritoneum. Few paramphistomes in abomasum. No other parasites detected.

Further tests

PCV 22%

Examination of smears for trypanosomes

Buffy coat -ve

Histopathology

Small intestine

There was considerable lymphocyte and eosinophil infiltration of the lamina propria.

Large intestine

The lamina propria was hypercellular with lymphocytes and eosinophils. Some crypt damage was present with a mixed inflammatory cell infiltrate of the lumina. A number of lymphocytic infiltrations had occurred between the muscular coats of the wall.

Heart

Moderate to heavy sarcocyst infiltration was accompanied by perivascular lymphocytic infiltration. Generally there was mild interstitial myocarditis and lymphocytic infiltration of the epicardium.

Liver

Multifocal lymphocytic and neutrophilic hepatitis was present. Periportal lymphocytic infiltration accompanied portal fibrosis which was very marked in the second section. Occasional chronic inflammatory cell responses characterised by multinucleated cells around a central space were scattered in the parenchyma. Fluke eggs were found in the second section.

Lymph node

A number of primary follicles and germinal centres were present but, overall, the impression was of general blandness.

Spleen

This section was congested. The perivascular sheaths and follicles are well developed.

Lung

The small arterioles were surprisingly muscular and occasional aberrant 'inhaled' ciliates and protozoa were present within some alveoli. These appeared to be the result of terminal inhalation. Moderate quantities of pigment and crystalline material were present within macrophages adjacent to the large bronchioles.

Case Thiet 2

Date: 30/01/00
Location: Thiet village
Species: Bovine
Sex: F
Age: 7 years

History

Owner trying to sell cow at Thiet market to pay fine. Therefore, doesn't admit that cow is sick.

Clinical examination

Emaciated cow with bald tail. Otherwise NAD.

Gross pathology

Emaciated carcass with patches of gelatinous fat.

Diffuse pinpoint white foci throughout myocardium.

Mild *Haemonchus* infection in abomasum and small areas of paraphistomes in rumen.

Mild fluke infection with some thickening of bile ducts but no gross parenchymal pathology.

Heavy schistosome infection in small and large intestine; widespread pimpling of gut.

Further tests

PCV 22%

Examination of smears for trypanosomes

Wet smear -ve

Histopathology

Small intestine

The lamina propria was hypercellular as a result of infiltration by eosinophils and lymphocytes. A single, large chronic inflammatory reaction was present in the submucosa. A parasite was present in the centre of this lesion and was surrounded by a Splendore-Hoeppli reaction.

Heart

Considerable numbers of sarcocysts were present in the myocardium. Limited lymphocytic interstitial myocarditis was present.

Liver

Peri-biliary lymphocytic infiltration was a feature. Portal fibrosis was also seen and a small number of chronic inflammatory reactions surrounded Schistosoma-like eggs.

Lymph node

The outer medulla contained more histiocytes/macrophages than might be expected.

Kidney

Limited lymphocytic perivascular/interstitial infiltration affected one area of the deep cortex.

Lung

No significant lesions were present although some peribronchiolar macrophages were laden with pigmented material.

Spleen

Congestion. The white matter was well developed with active germinal centres. There was some excess of macrophages and lymphocytes in the sinusoids.

Case Thiet 3

Date: 1/2/00

Location: Thiet village

Species: Bovine

Sex: F

Age: 8 years

History

Started losing weight last rainy season, September-October 1999. Treated with albendazole and ethidium to no effect. Continued to lose condition.

Clinical examination

Thin cow with normal tail. Otherwise NAD.

Gross pathology

Thin carcass.

Diffuse pinpoint white foci throughout myocardium and thickened left atrioventricular valve.

Small areas of pleural adhesions.

Evidence of past fluke infection - thickening of bile ducts, calcification, stones and a few abscesses ~ 1-2cm.

No schistosomes seen.

Further tests

PCV 24%

Examination of smears for trypanosomes

Wet smear -ve for tryps

Histopathology

Small intestine

The lamina propria was hypercellular with lymphocytes and eosinophils.

Heart

Moderate numbers of sarcocysts were present. Locally there were areas of heavy infestation. Interstitial non-suppurative myocarditis was present and lymphocytes were also invading the endocardium.

Lung

Peribronchiolar macrophages contained pigment. Similar cells were present in some alveolar septa.

Liver

There was extensive chronic inflammatory injury characterised by fibrosis, infiltration by neutrophils and lymphocytes and by recent hepatocyte necrosis. Chronic responses were present around parasites or parasitic eggs.

Spleen

The spleen was congested and the sheaths and germinal centres well developed.

Kidney

No significant lesions.

Lymph node

A number of collections of pale macrophages containing yellow pigment and sharp crystals were present in the medulla and cortex.

Appendix 6.1

PP Plots to assess Normal distribution of disease incidence variables used in proportional piling with Orma informants (n=50)

Each of four cattle age groups (*jabie*, *waela*, *goromsa* and *hawicha*) was assessed according to five disease categories (*gandi*, *hoyale*, *buku*, *somba* and 'other diseases'). PP Plots for the disease *madobesa* were not produced because on three (out of 50) informants reported this disease.

Figure A6.1.1
PP Plot for *gandi* in the *jabie* age group

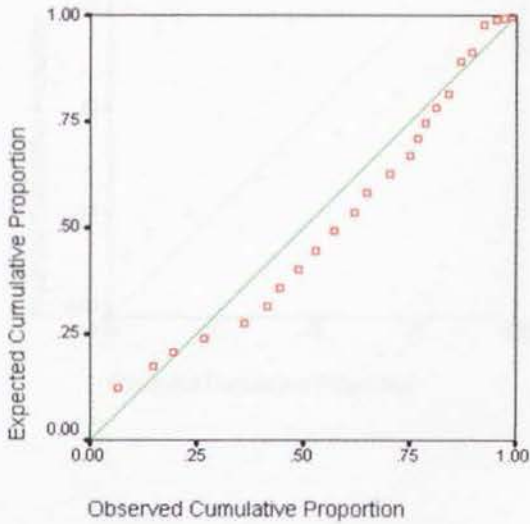


Figure A6.1.2
PP Plot for *hoyale* in the *jabie* age group

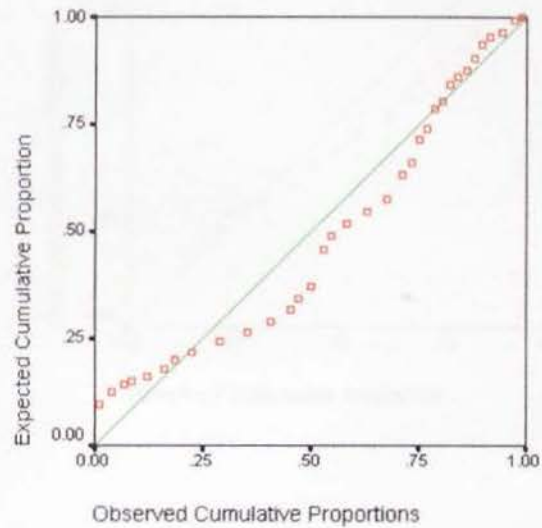


Figure A6.1.3
PP Plot for *buku* in the *jabie* age group

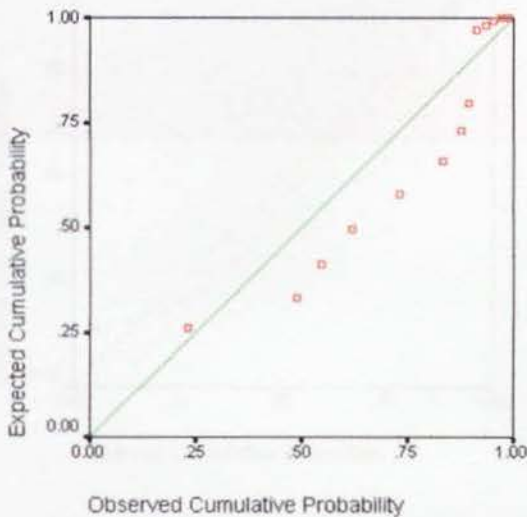


Figure A6.1.4
PP Plot for *somba* in the *jabie* age group

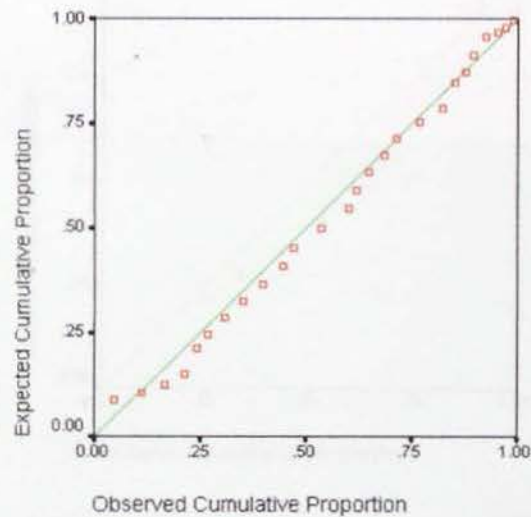


Figure A6.1.5
PP Plot for other diseases in the *jabie* age group

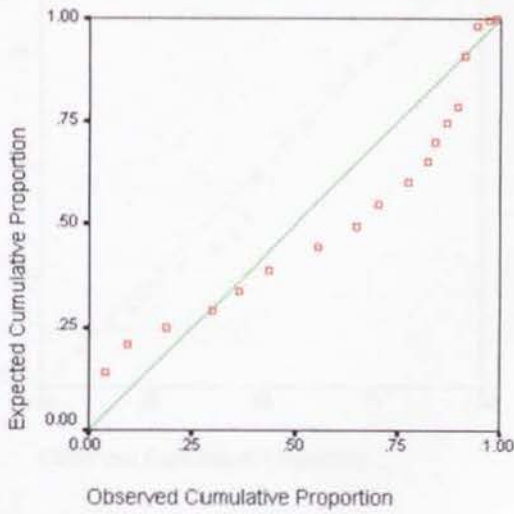


Figure A6.1.6
PP Plot for *gandi* in the *waela* age group

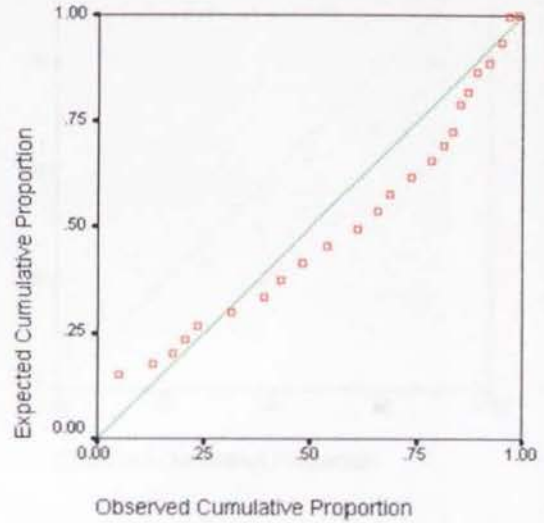


Figure A6.1.7
PP Plot for *hoyale* in the *waela* age group

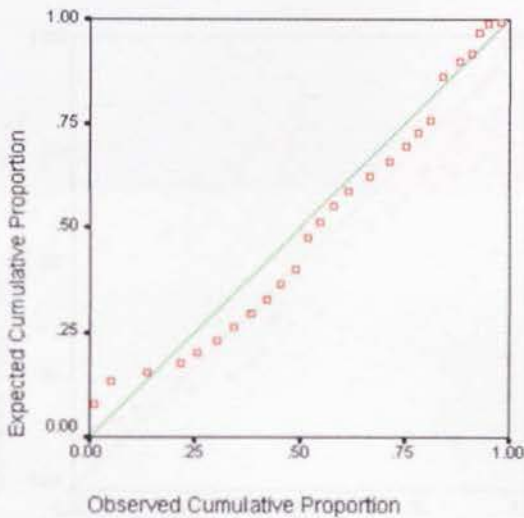


Figure A6.1.8
PP Plot for *buku* in the *waela* age group

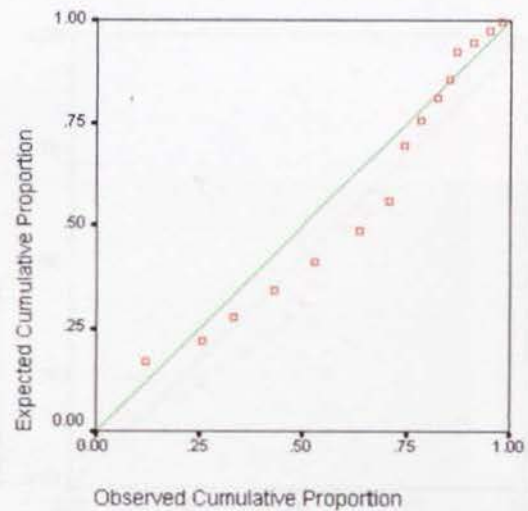


Figure A6.1.9
PP Plot for *somba* in the *waela* age group

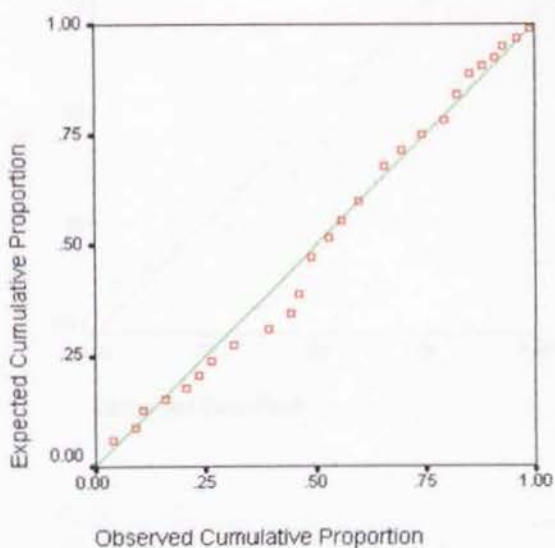


Figure A6.1.10
PP Plot for other diseases in the *waela* age group

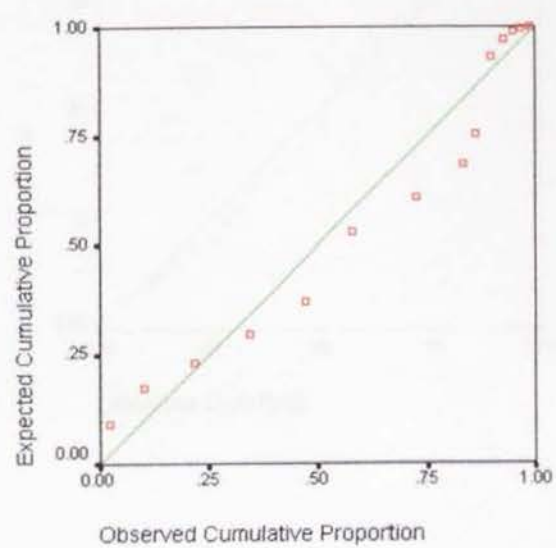


Figure A6.1.11
PP plot for *gandi* in the *goromsa* age group

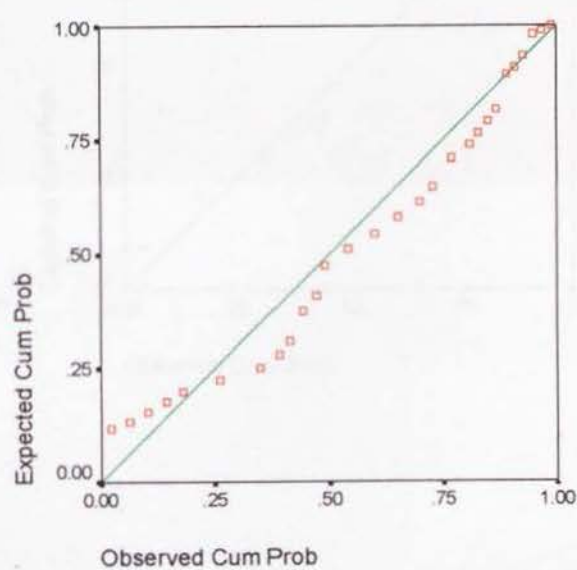


Figure A6.1.12
PP plot for *hoyale* in the *goromsa* age group

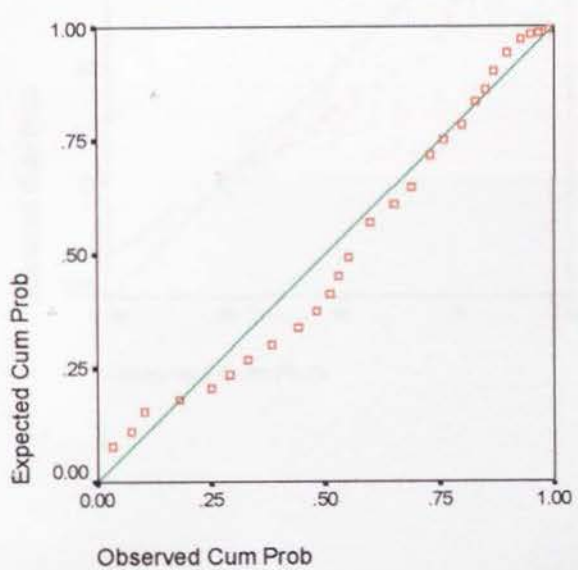


Figure A6.1.13
PP Plot for *buku* in the *goromsa* age group

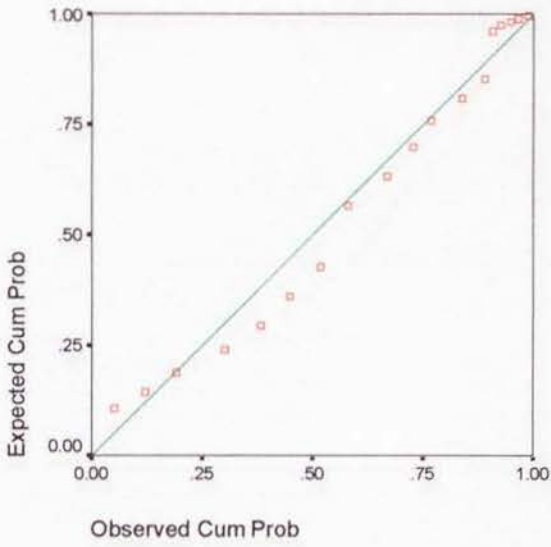


Figure A6.1.14
PP Plot for *somba* in the *goromsa* age group

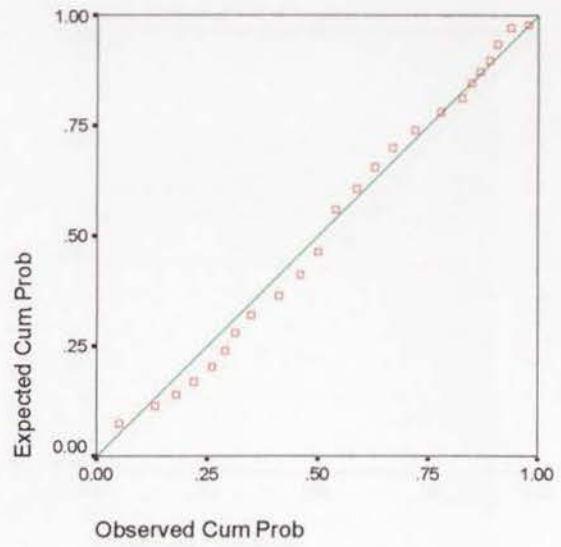


Figure A6.1.15
PP Plot for other diseases in the *goromsa* age group

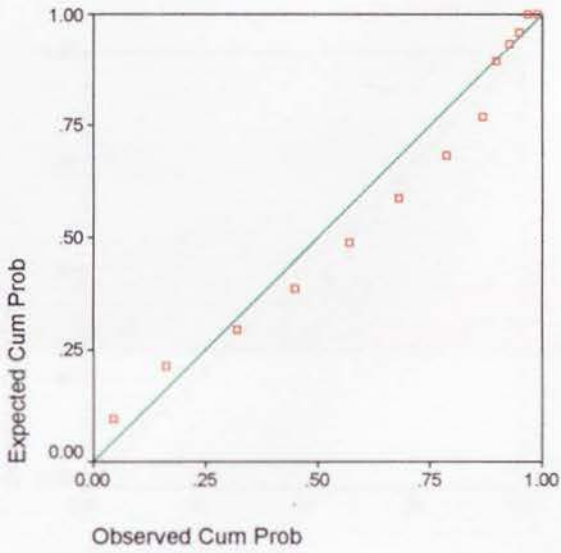


Figure A6.1.16
PP Plot for *gandi* in the *hawicha* age group

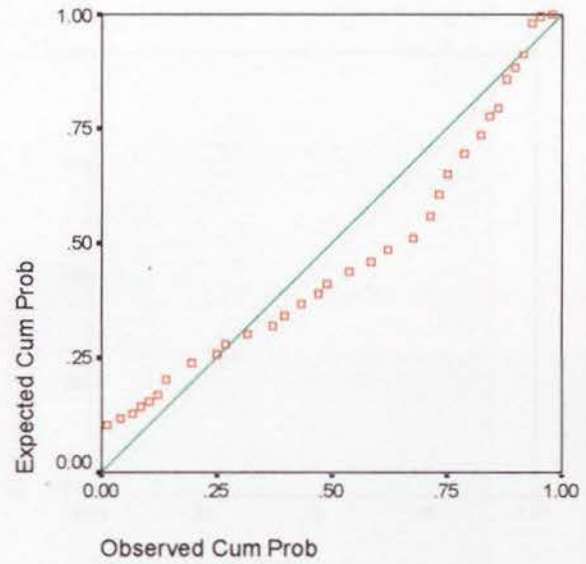


Figure A6.1.17
PP Plot for *hoyale* in the *hawicha* age group

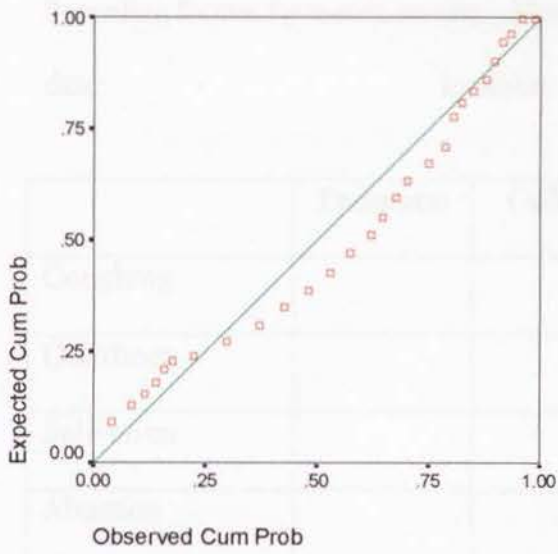


Figure A6.1.18
PP Plot for *buku* in the *hawicha* age group

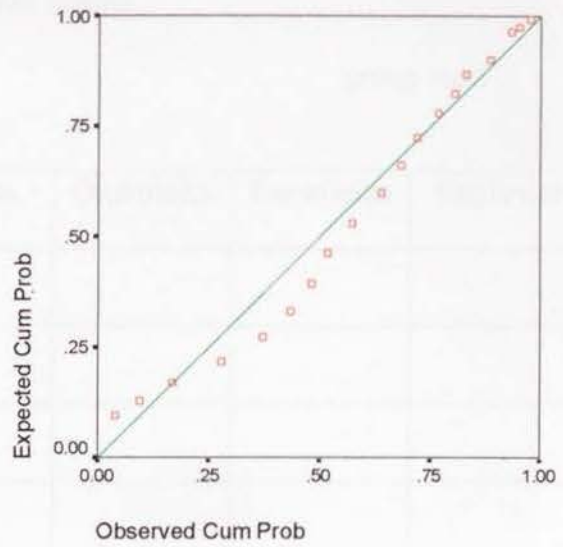


Figure A6.1.19
PP Plot for *somba* in the *hawicha* age group

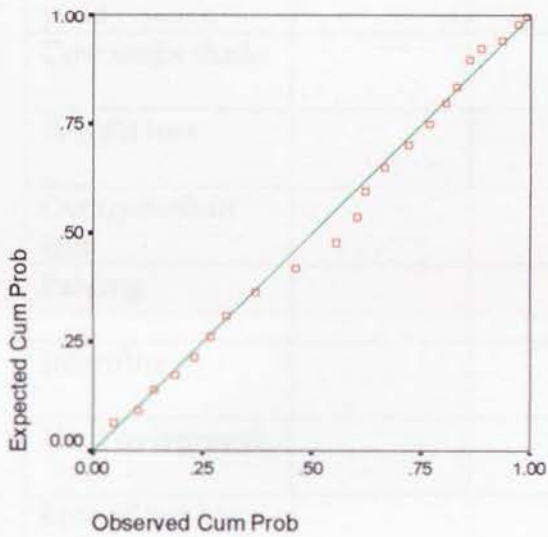
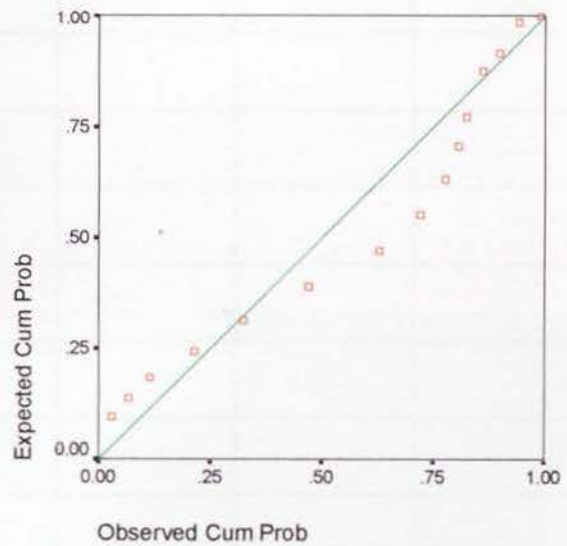


Figure A6.1.20
PP Plot for other diseases in *hawicha* age group



Appendix 8.1**Example of a reporting format used for matrix scoring**

Recording format for matrix scoring - Morogoro Region

date:

location:

group size:

	Endorobo	Otikana	Olukuluku	Emwilalas	Engluwet
Coughing					
Diarrhoea					
Salivation					
Abortion					
Enlarged lymph nodes					
Lameness					
Disease causes death					
Reduced milk yield					
Cow seeks shade					
Weight loss					
Overgrowth of hair					
Panting					
Infertility					
Hoof overgrowth					
Loss of tail hair					
Wallows in water					

Additional questions:

1. If the signs 'cow seeks shade', 'overgrowth of hair', 'panting' etc. are highly scored under the disease olukuluku, ask the Maasai name for cattle showing these signs (i.e. the Maasai name for heat intolerance).

Maasai name(s) for heat intolerance:

.....

2. When do the signs of heat intolerance appear relative to the episode of FMD?
3. During the FMD episode, can we predict which cattle will develop HI? (e.g. are animals showing severe FMD signs more likely to develop HI?).
4. What happens to the calves produced by cows suffering from HI? Which, if any, diseases do they suffer from? If these calves have HI, when do the signs appear?
5. How do people treat HI? List the different treatments and rank their effectiveness.

Use reverse of form to record other notes and comments from the matrix scoring exercise.

Appendix 8.2

Example of a reporting format used for proportional piling

Proportional piling in Morogoro Region

Date:

Location:

Name of informant:

(Start with 100 stones)

Record the number of stones in the spaces

	Endorobo	Oltikana	Olukuluku	Emwilalas	Engluwet	Other
Calves Incidence						
Mortality						
HI						
Young stock Incidence						
Mortality						
HI						
Adults Incidence						
Mortality						
HI						

Mortality – record only the number of stones in the ‘died’ pile

HI – record only the number of stones in ‘HI’ pile

Possible additional questions (record answers on reverse of form):

What do you do when your animals get HI?

If a treatment is named, explore the success of treatment

Why do HI cases come from the disease? (Depending on the diseases named)

Appendix 8.3

PP Plots to assess Normal distribution of disease incidence variables used in proportional piling with Maasai informants (n=50)

Each of three cattle age groups (*lohok*, *lenok/endawowa* and *engeshulapowa*) was assessed according to six disease categories (*endorobo*, *oltikana*, *olukuluku*, *emwilalas*, *engluwet* and 'other diseases').

Figure A8.3.1
PP Plot for *endorobo* in the *lohok* age group

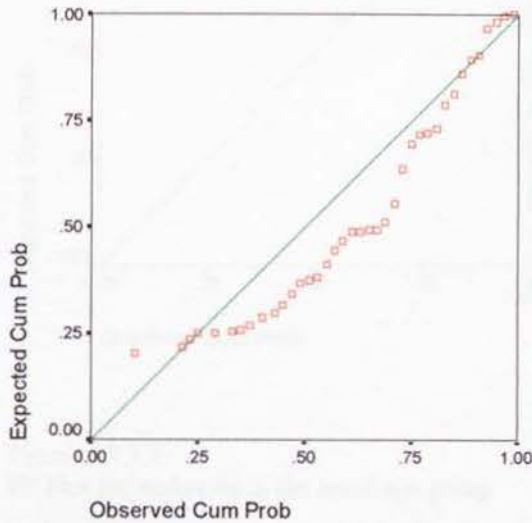


Figure A8.3.2
PP Plot for *oltikana* in the *lohok* age group

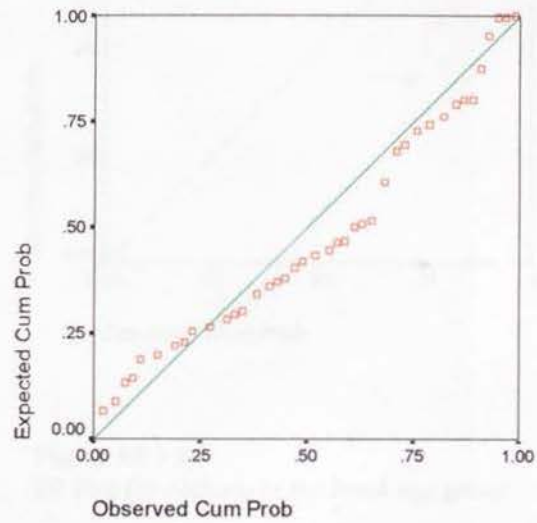


Figure A8.3.3
PP Plot for *olukululu* in the *lohok* age group

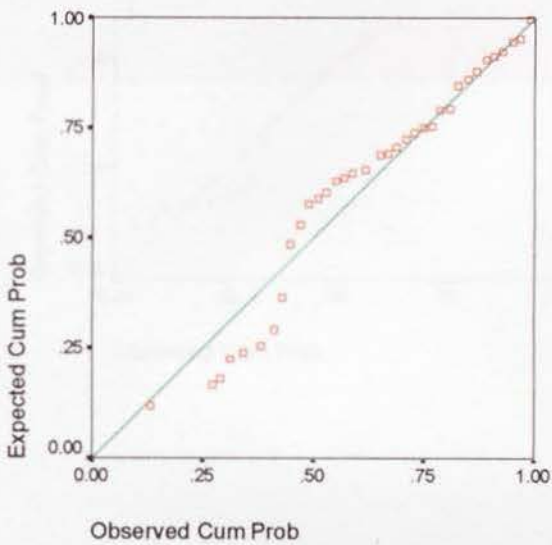


Figure A8.3.4
PP Plot for *emwilas* in the *lohok* age group

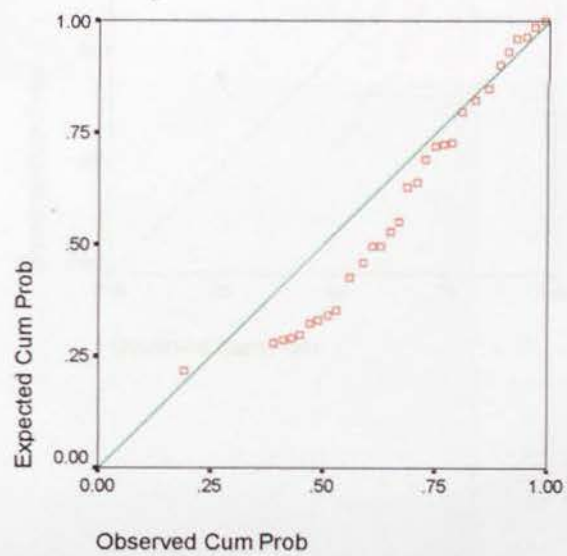


Figure A8.3.5
PP Plot for *enguwet* in the *lohok* age group

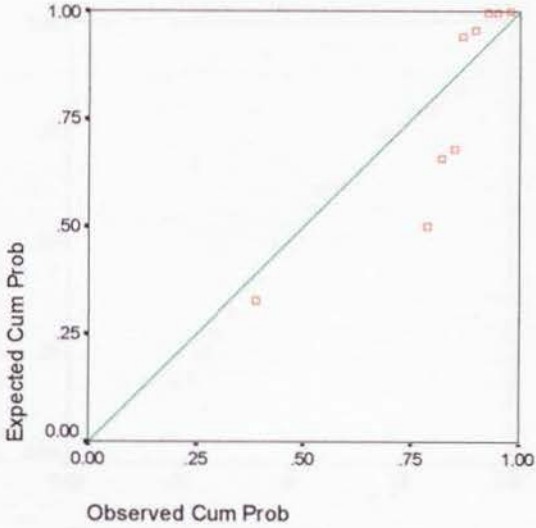


Figure A8.3.6
PP Plot for other diseases in the *lohok* age

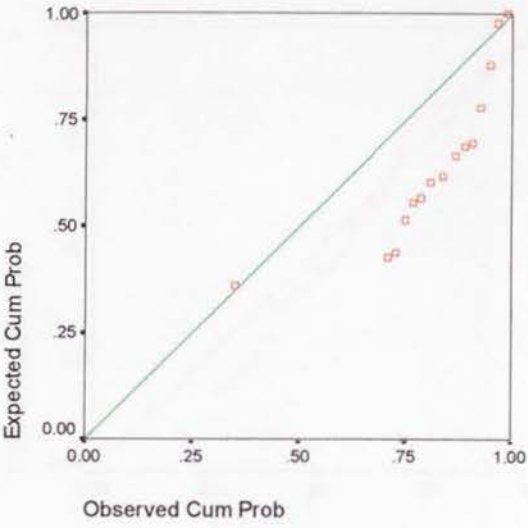


Figure A8.3.7
PP Plot for *endorobo* in the *lenok* age group

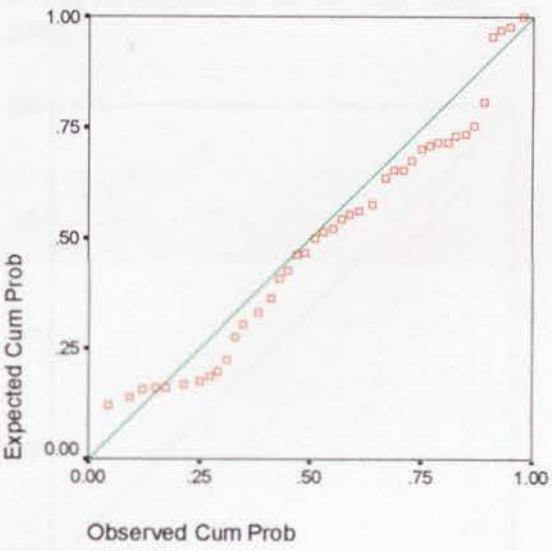


Figure A8.3.8
PP Plot for *oltikana* in the *lenok* age group

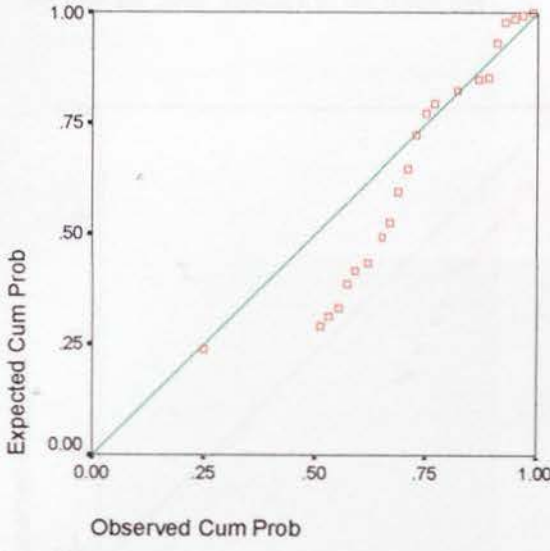


Figure A8.3.9
PP Plot for *olukuluku* in the *lenok* age group

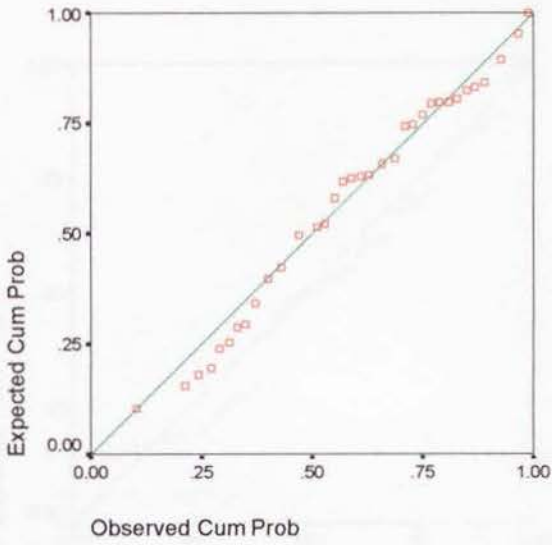


Figure A8.3.10
PP Plot for *emwilalas* in the *lenok* age group

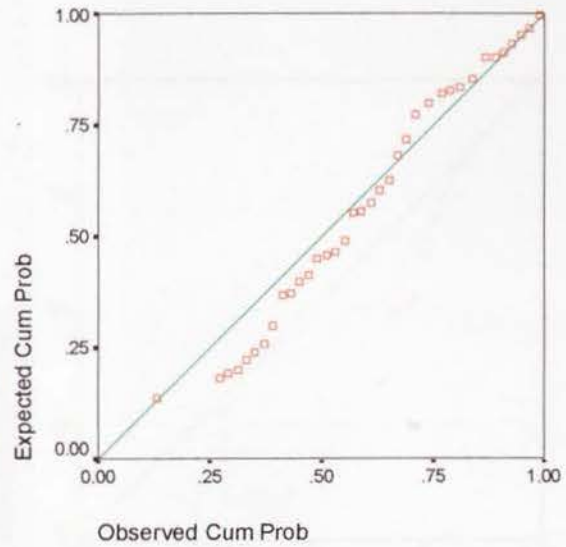


Figure A8.3.11
PP Plot for *enghwet* in the *lenok* age group

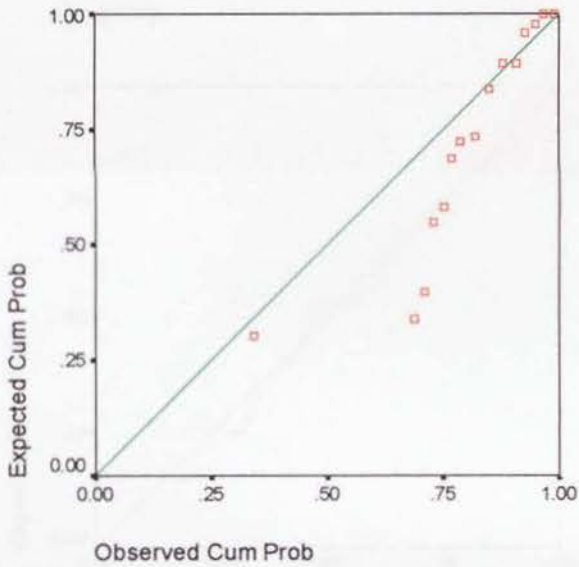


Figure A8.3.12
PP Plot for other diseases in the *lenok* age group

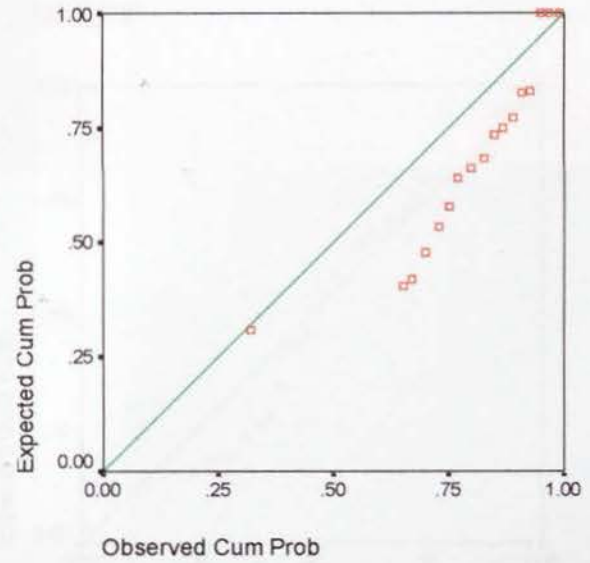


Figure A8.3.13
PP Plot for *endorobo* in the *engesholopowa*
age group

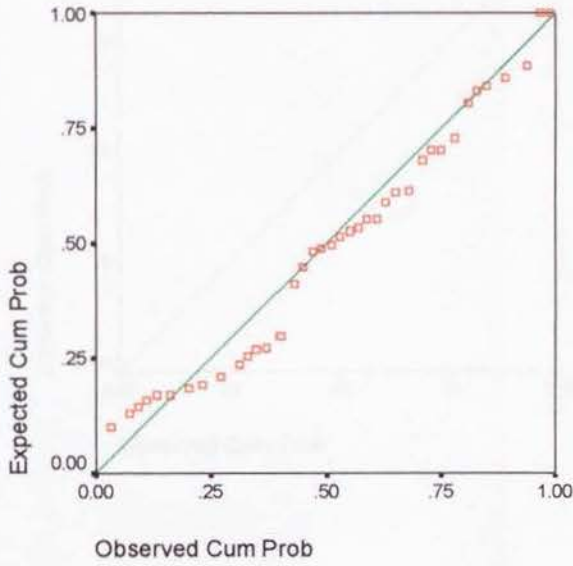


Figure A8.3.14
PP Plot for *oltikana* in the *engesholopowa*
age group

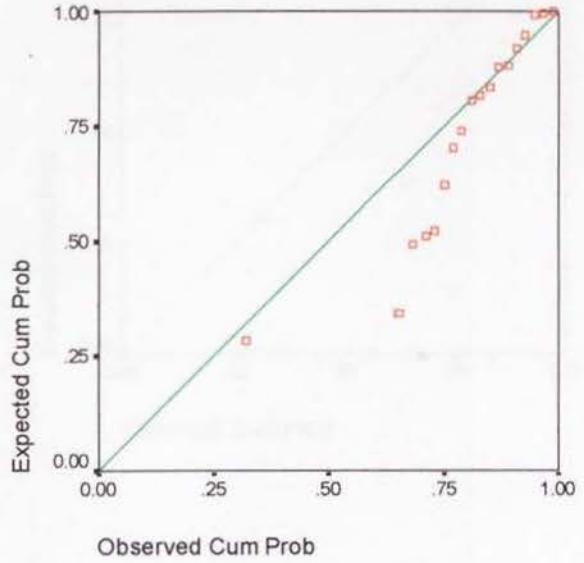


Figure A8.3.15
PP Plot for *olukuluku* in the *engesholopowa*
age group

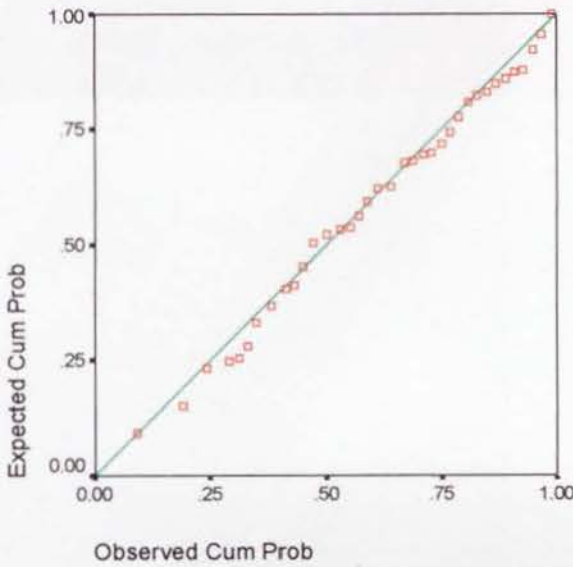


Figure A8.3.16
PP Plot for *emwilalas* in the *engesholopowa*
age group

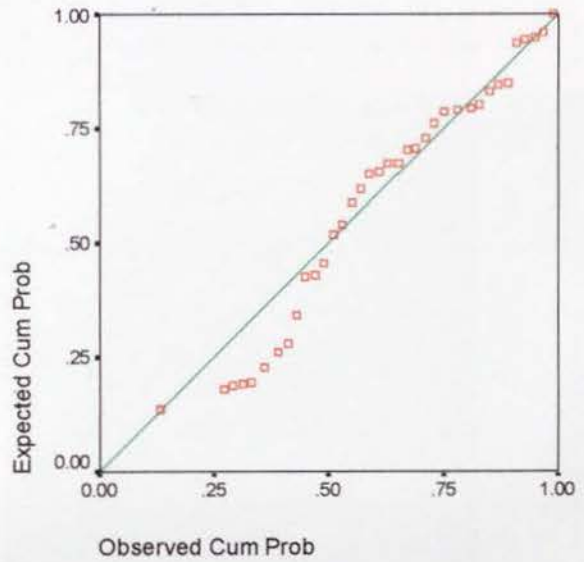


Figure A8.3.17
PP Plot for *endorobo* in the *engesholopowa*
age group

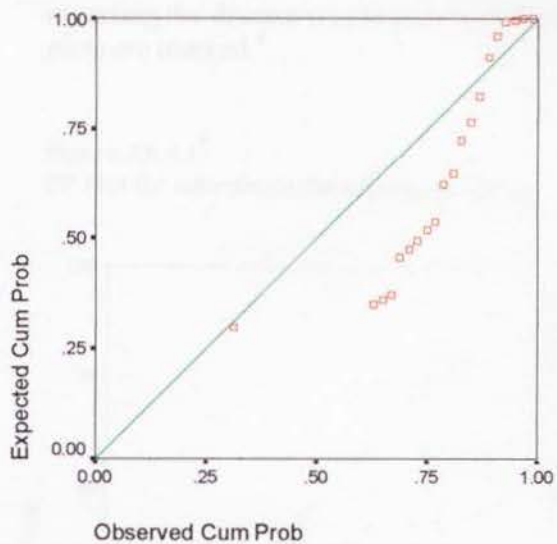
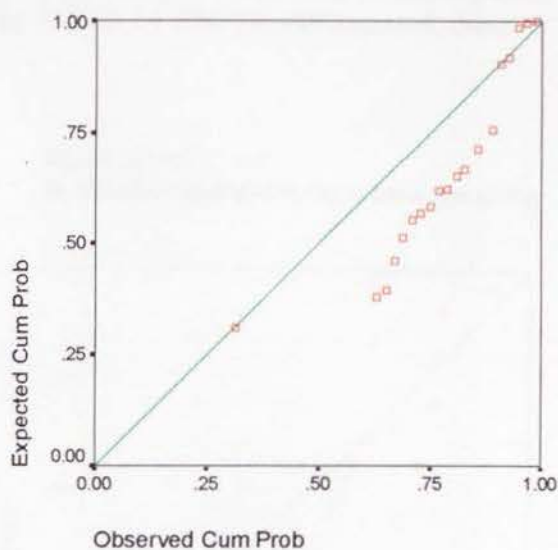


Figure A8.3.18
PP Plot for *oltikana* in the *engesholopowa*
age group



Appendix 8.4

PP Plots to assess normal distribution of disease incidence variables used in proportional piling with Sukuma informants (n=73)

Each of three cattle age groups (*ndama*, *ndogosa/kayagamba-kanyabuka* and *mbogoma/nzagamba*) was assessed according to six disease categories (*ndorobo*, *madundo*, *bugigi*, *mabuupu*, *lyoho* and other disease). For some diseases, the number of respondents reporting the disease was low (< 15 informants) and the PP Plot was not assessed; these plots are marked †.

Figure A8.4.1†
PP Plot for *ndorobo* in the *ndama* age group

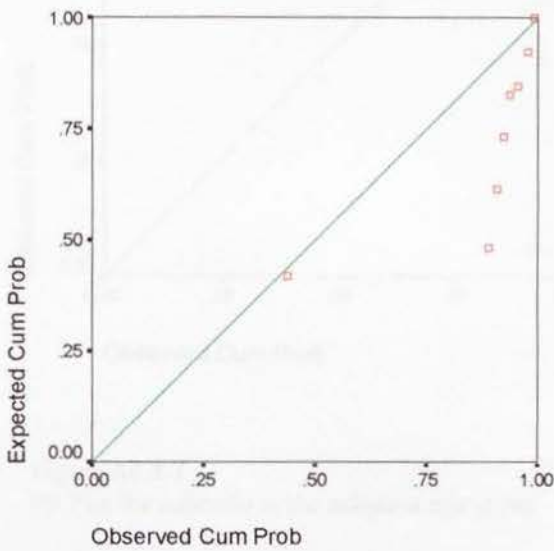


Figure A8.4.2
PP Plot for *madundo* in the *ndama* age group

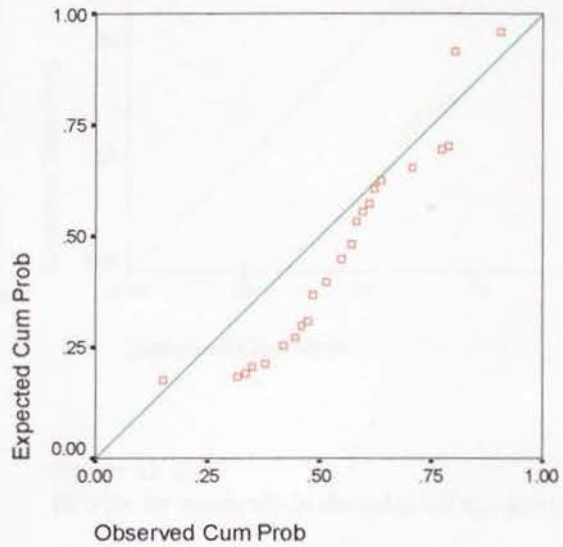


Figure A8.4.3†
PP Plot for *bugigi* in the *ndama* age group

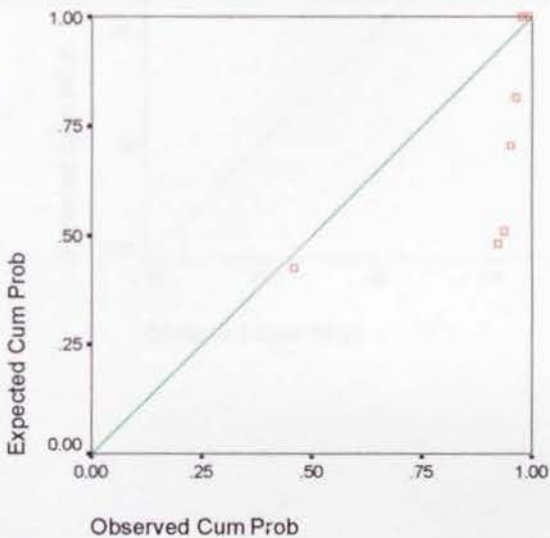


Figure A8.4.4†
PP Plot for *mabuupu* in the *ndama* age group

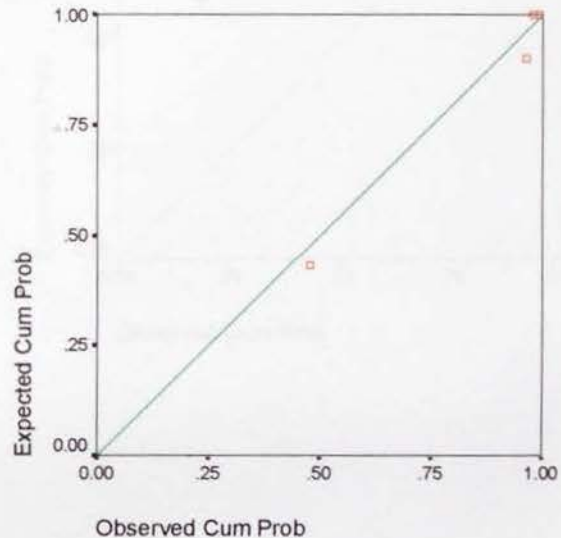


Figure A8.4.5[†]
 PP Plot for *lyoho* in the *ndama* age group

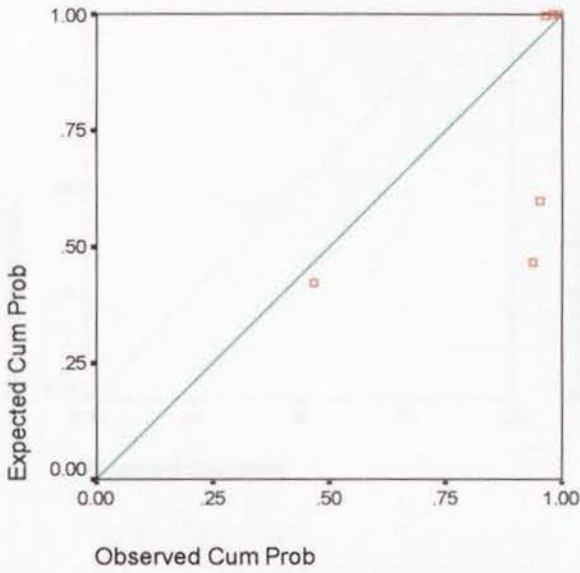


Figure A8.4.6
 PP Plot for other diseases in the *ndama* age

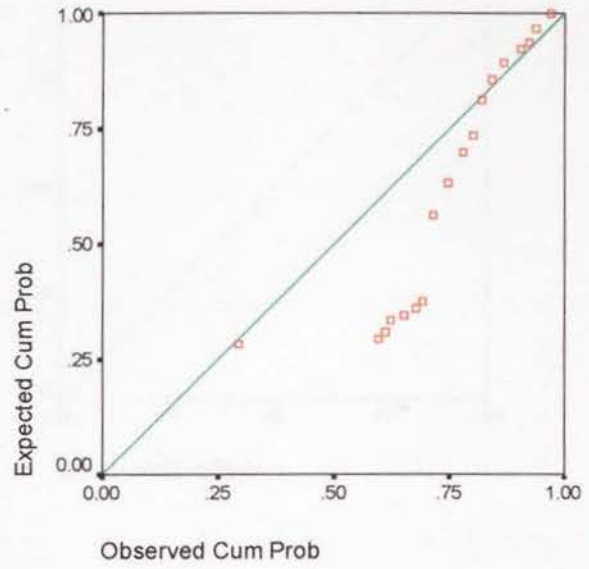


Figure A8.4.7
 PP Plot for *ndorobo* in the *ndogosa* age group

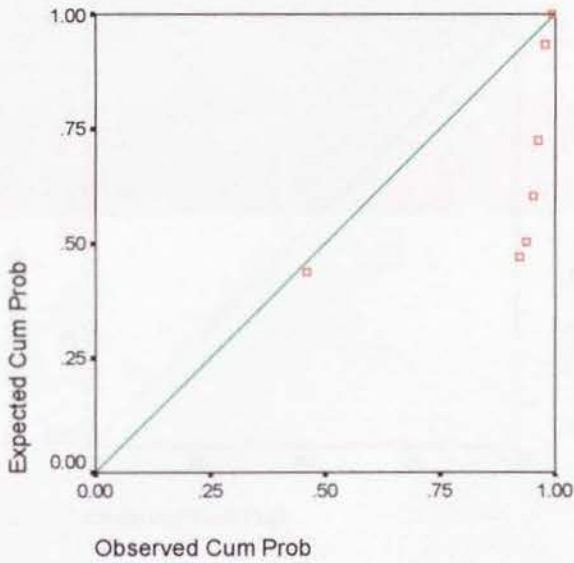


Figure A8.4.8[†]
 PP Plot for *madundo* in the *ndogosa* age group

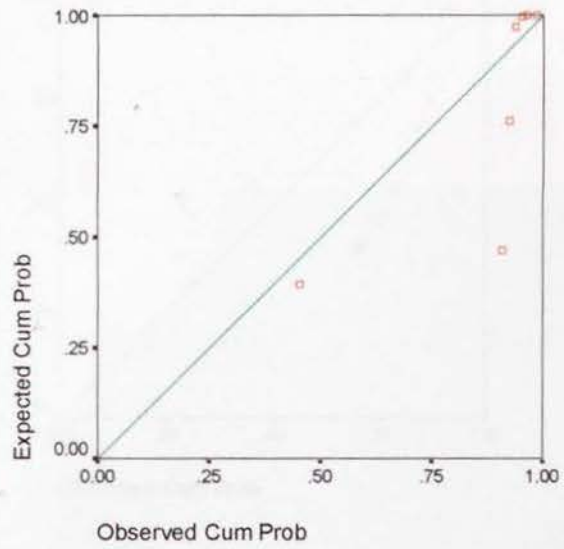


Figure A8.4.9
PP Plot for *bugigi* in the *ndogosa* age group

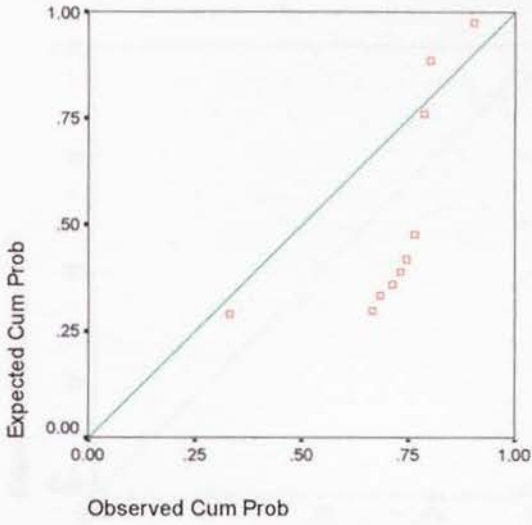


Figure A8.4.10
PP Plot for *mabuupu* in the *ndogosa* age group

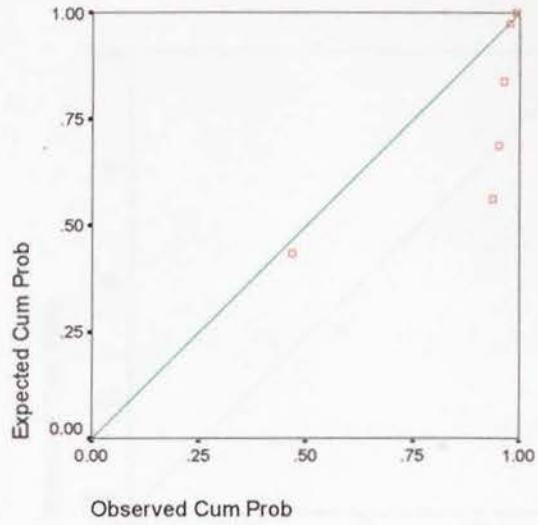


Figure A8.4.11
PP Plot for *lyoho* in the *ndogosa* age group

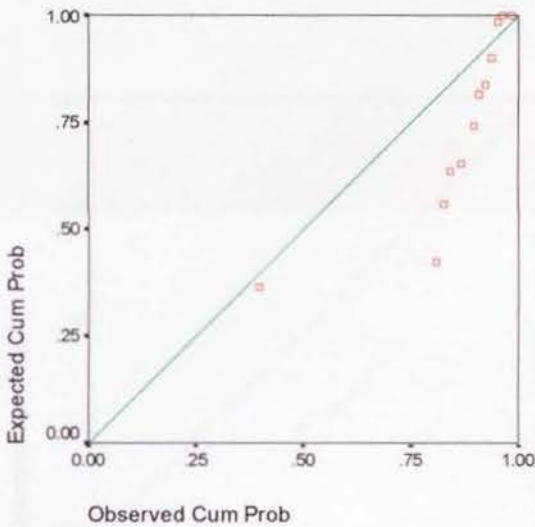


Figure A8.4.12
PP Plot for other diseases in the *ndogosa* age group

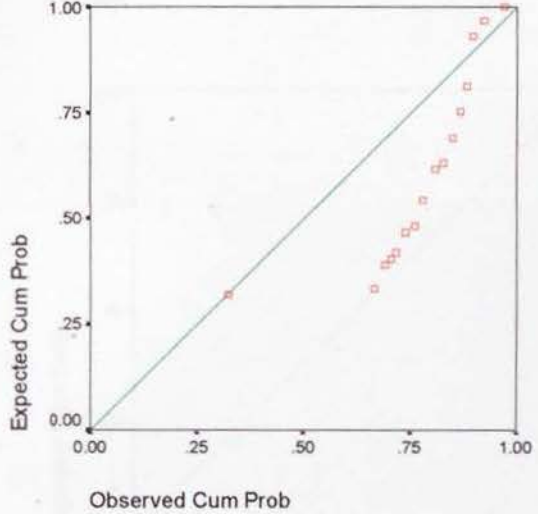


Figure A8.4.13[†]
 PP Plot for *ndorobo* in the *mbogoma* age group

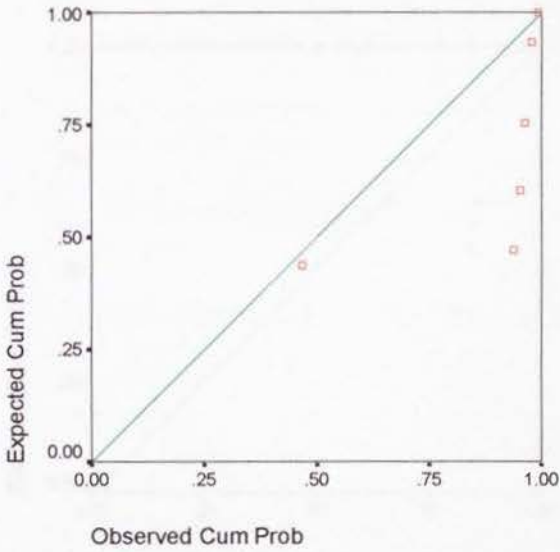


Figure A8.4.14[†]
 PP Plot for *madundo* in the *mbogoma* age

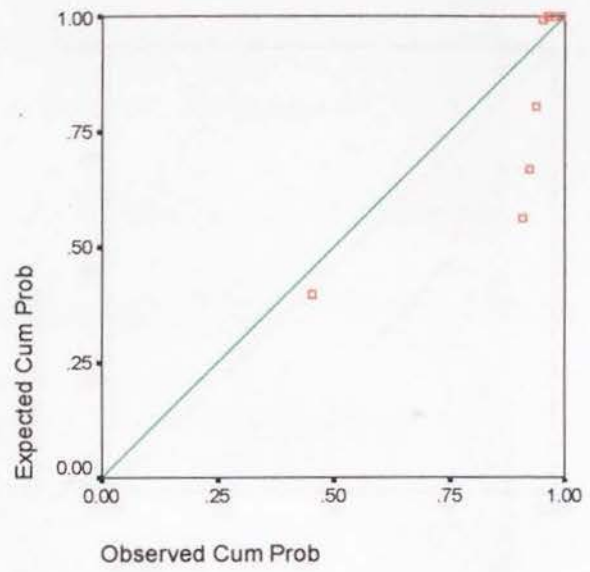


Figure A8.4.15
 PP Plot for *bugigi* in the *mbogoma* age group

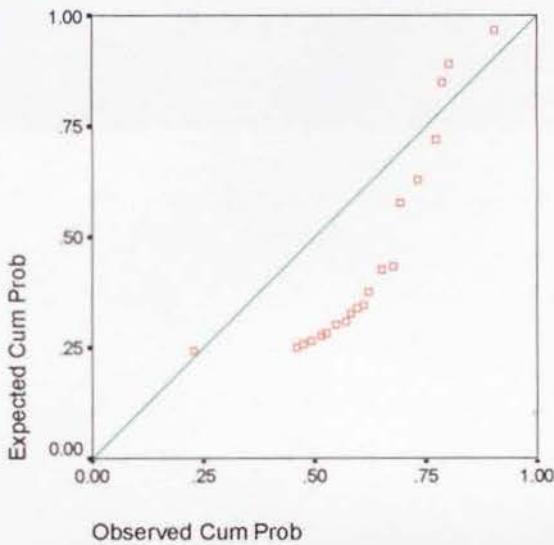


Figure A8.4.16[†]
 PP Plot for *mabuupu* in the *mbogoma* age group

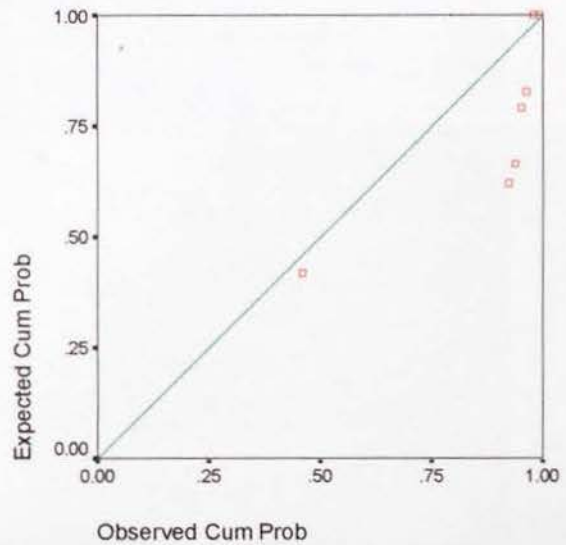


Figure A8.4.17[†]
 PP Plot for *typho* in the *mbogoma* age group

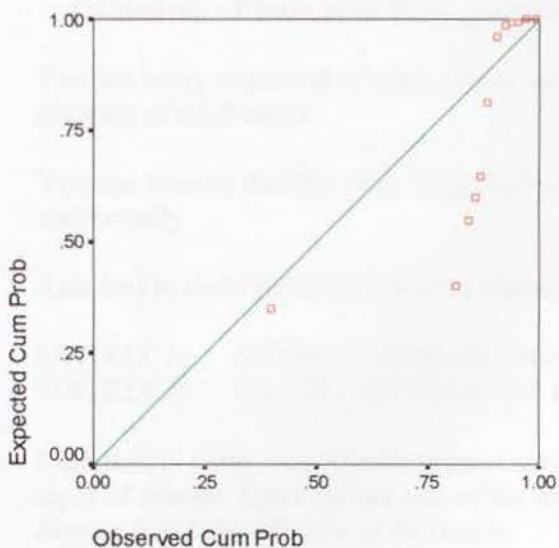
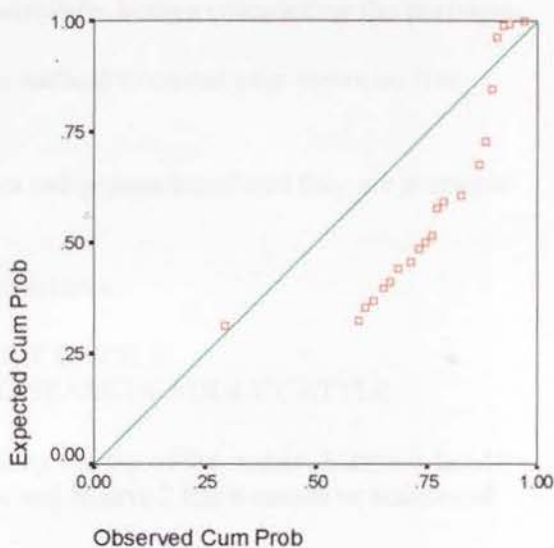


Figure A8.4.18
 PP Plot for other diseases in the *mbogoma* age group



Appendix 9.1

Guidelines and paper versions of scoring matrices used with veterinarians

a. Veterinarians from Kenya

THE USE OF MATRIX SCORING TO RECORD PERCEPTIONS OF SIGNS AND CAUSES OF DISEASE IN ADULT CATTLE

Guidelines - Please read these guidelines carefully before completing the matrices.

You are being requested to use a matrix scoring method to record your views on five diseases of adult cattle.

You can assume that the cattle in question are an indigenous breed and they are managed traditionally.

Attached to these guidelines are two matrices as follows:

MATRIX 1: SIGNS OF DISEASE IN ADULT CATTLE

MATRIX 2: CAUSES OR SOURCES OF DISEASE IN ADULT CATTLE

Each matrix comprises five diseases of cattle along the top of the matrix. Matrix 1 has 10 signs of disease down the left side of the matrix and Matrix 2 has 8 causes or sources of disease down the left side of the matrix.

Start with Matrix 1 and look at the first disease-sign row which is labeled 'chronic weight loss'. From a total score of 20, assign scores to each infection according to the relative importance of 'chronic weight loss' as a sign of infection for each infection. The sum total of scores for 'chronic weight loss' should equal 20.

To assist you, there is a packet of 20 counters enclosed with the matrix. Some people find it easier to use the counters and divide them among the infections. To record the scores you have allocated to each infection, simply enter a number in the appropriate space in the matrix.

Note that:

- If you decide to allocate scores to one or more of the 5 diseases, *the sum total of scores for the row must equal 20.*

E.g.

<u>Signs</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Trypanosomiasis	Foot-and-mouth disease	Haemonchosis	CBPP	Fascioliasis	
Chronic weight loss	1	12	3	2	2	20 or 0

- If you feel that none of the 5 infections is associated with chronic weight loss, allocate a score of 0 to each of the five infections.

E.g.

<u>Signs</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Trypanosomiasis	Foot-and-mouth disease	Haemonchosis	CBPP	Fascioliasis	
Chronic weight loss	0	0	0	0	0	20 or 0

Repeat the scoring procedure for the second sign of infection 'acute fever' listed down the left side of the matrix. Again, use the counters provided if this makes the process easier.

Repeat the scoring for each row. Always use a total score of 20; if there are no associations between the sign of infection and the five infections, allocate a score of 0 to each infection.

4. Repeat the above scoring procedure with Matrix 2.
5. When you have finished the scorings, Matrix 1 and Matrix 2 should contain numbers from 0 to 20 in each of the spaces. ***The numbers in each row of the matrices should total either 20 or 0.***
6. Please do not confer with colleagues when completing the matrices or consult the literature.
7. Please return the completed matrices to Dr

MATRIX 1: SIGNS OF DISEASE IN ADULT CATTLE

<u>Signs</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Trypanosomiasis	Foot-and-mouth disease	Haemonchosis	CBPP	Fascioliasis	
Chronic weight loss						20 or 0
Acute fever						20 or 0
Diarrhoea						20 or 0
Sudden reduced milk yield						20 or 0
Coughing						20 or 0
Loss of appetite						20 or 0
Gradual loss of tail hair						20 or 0
Bilateral tearing						20 or 0
Excess salivation						20 or 0
Death						20 or 0

MATRIX 2: CAUSES OR SOURCES OF DISEASE IN ADULT CATTLE

<u>Causes or sources</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Trypanosomiasis	Foot-and-mouth disease	Haemonchosis	CBPP	Fascioliasis	
Liver flukes seen in the liver at post mortem						20 or 0
<i>['Contact with a sick cow causes infection']</i>						20 or 0
Paramphistomes seen in rumen or abomasum at post mortem						20 or 0
Worms seen in stomach at post mortem						20 or 0
Flooding or heavy rainfall						20 or 0
Biting flies (including Tabanids, Stomoxys or tsetse).						20 or 0
Ticks (any species)						20 or 0
Snails on pasture or in water points						20 or 0

b. Veterinarians from Tanzania

THE USE OF MATRIX SCORING TO RECORD PERCEPTIONS OF SIGNS AND CAUSES OF DISEASE IN ADULT CATTLE

Guidelines - Please read these guidelines carefully before completing the matrices.

You are being requested to use a matrix scoring method to record your views on five diseases of adult cattle.

You can assume that the cattle in question are an indigenous breed and they are managed traditionally.

Attached to these guidelines are two matrices as follows:

MATRIX 1: SIGNS OF DISEASE IN ADULT CATTLE

MATRIX 2: CAUSES OR SOURCES OF DISEASE IN ADULT CATTLE

Each matrix comprises five diseases of cattle along the top of the matrix. Matrix 1 has 10 signs of disease down the left side of the matrix and Matrix 2 has 8 causes or sources of disease down the left side of the matrix.

Start with Matrix 1 and look at the first disease-sign row which is labeled 'coughing'. From a total score of 20, assign scores to each infection according to the relative importance of 'coughing' as a sign of infection for each infection. The sum total of scores for 'coughing' should equal 20.

To assist you, there is a packet of 20 counters enclosed with the matrix. Some people find it easier to use the counters and divide them among the infections. To record the scores you have allocated to each infection, simply enter a number in the appropriate space in the matrix.

Note that:

- If you decide to allocate scores to one or more of the 5 diseases, *the sum total of scores for the row must equal 20.*

E.g.

<u>Signs</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Chronic trypanosomiasis	Foot-and-mouth disease	Acute haemorrhagic trypanosomiasis	Contagious bovine pleuropneumonia	Rinderpest	
Coughing	1	12	3	2	2	20 or 0

- If you feel that none of the 5 infections is associated with coughing, allocate a score of 0 to each of the five infections.

E.g.

<u>Signs</u>	<u>Diseases</u>					<u>Total scores by row</u>
	Chronic Trypanosomiasis	Foot-and-mouth disease	Acute Haemorrhagic trypanosomiasis	Contagious bovine pleuropneumonia	Rinderpest	
Coughing	0	0	0	0	0	20 or 0

Repeat the scoring procedure for the second sign of infection 'animal seeks shade' listed down the left side of the matrix. Again, use the counters provided if this makes the process easier.

Repeat the scoring for each row. Always use a total score of 20; if there are no associations between the sign of infection and the five infections, allocate a score of 0 to each infection.

4. Repeat the above scoring procedure with Matrix 2.
5. When you have finished the scorings, Matrix 1 and Matrix 2 should contain numbers from 0 to 20 in each of the spaces. *The numbers in each row of the matrices should total either 20 or 0.*
6. Please do not confer with colleagues when completing the matrices or consult the literature.

MATRIX 1: SIGNS OF DISEASE IN ADULT CATTLE

<u>Signs</u>	<u>Diseases</u>				<u>Total scores by row</u>
	Chronic trypanosomiasis	Foot-and-mouth disease	Acute haemorrhagic trypanosomiasis	Contagious bovine pleuropneumonia	
Chronic weight loss					20 or 0
Animal seeks shade					20 or 0
Diarrhoea					20 or 0
Haemorrhagic carcass					20 or 0
Coughing					20 or 0
Reduced appetite					20 or 0
Loss of tail hair					20 or 0
'Death is sudden'					20 or 0
Oedematous carcass					20 or 0

MATRIX 2: CAUSES OR SOURCES OF DISEASE IN ADULT CATTLE

<u>Causes or sources</u>	<u>Diseases</u>				<u>Total scores by row</u>
	Chronic trypanosomiasis	Foot-and-mouth disease	Acute Haemorrhagic trypanosomiasis	Contagious bovine pleuropneumonia	
Sick cow entering herd					20 or 0
Ticks					20 or 0
<i>Tabanids</i>					20 or 0
Tsetse					20 or 0
Contact with buffalo					20 or 0

c. **Veterinarians from Ethiopia, Eritrea, Somalia, Sudan and Uganda**

Use of matrix scoring to record veterinarians' perceptions of signs of disease

Please read these guidelines carefully before completing the matrix

You are being requested to use a matrix scoring method to record your views on the clinical signs of five diseases of adult cattle. You can assume that the cattle in question are indigenous types under traditional management in a pastora area.

The matrix

Attached to these guidelines is a matrix comprising five diseases of cattle along the top of the matrix, and 16 signs of disease down the left side of the matrix. The signs of disease are grouped into acute signs and chronic signs as follows:

Acute signs are signs that are observed at an early stage in a disease event. For the purpose of this exercise, acute signs can be regarded as those that occur within 10 days on the start of the disease.

Chronic signs are signs that are observed weeks or months after the acute disease event. For the purpose of this exercise, chronic signs can be regarded as those observed at least three months after the acute disease episode.

Please ignore the possibility that some disease signs may be evident during both acute and chronic stages of a disease.

How to do the scoring

1. Look at the first disease sign labelled 'coughing'. Imagine that you have a pile of 20 counters (e.g. stones, bottle caps or seeds) in front of you, and that you should divide these counters against the five diseases to show the relative importance of 'coughing' as a sign of disease for each disease. The sum total of scores for 'coughing' should equal 20.

To record the scores you have allocated to each disease, simply write a number in the appropriate space in the matrix.

Note that:

If you decide to allocate scores to one or more of the 5 diseases, *the sum total of scores for the row must equal 20*

For example,

	Trypanoso miasis	ECF	FMD	CBPP	Blackleg	
Coughing	8	0	0	0	12	=20 or 0

Alternatively, you may feel that only one of the five diseases is associated with

coughing. In this case, you should allocate all 20 counters to that disease.

For example,

	Trypanoso miasis	ECF	FMD	CBPP	Blackleg	
Coughing	0	0	0	0	20	=20 or 0

- And finally, if you feel that none of the 5 diseases is associated with coughing, allocate a score of 0 to each of the five infections as follows:

	Trypanoso miasis	ECF	FMD	CBPP	Blackleg	
Coughing	0	0	0	0	0	=20 or 0

2. Repeat the same scoring procedure for the second sign of disease 'diarrhoea' listed down the left side of the matrix.
3. Repeat the scoring for all the other disease signs. Always use a total score of 20 per row; if there are no associations between the sign of disease and the five disease, give a score of 0 to each disease.
4. When you have finished the scorings, the matrix should contain numbers from 0 to 20 in each of the spaces. *The numbers in each row of the matrices should total either 20 or 0.*
5. Please do not confer with colleagues when completing the matrices or consult textbooks or other teaching materials.

Matrix for scoring disease signs for diseases affecting adult, indigenous cattle

		Trypanosomiasis	ECF	FMD	CBPP	Blackleg	
Acute signs	Coughing						=20 or 0
	Diarrhoea						=20 or 0
	Salivation						=20 or 0
	Abortion						=20 or 0
	Enlarged lymph nodes						=20 or 0
	Lameness						=20 or 0
	Disease causes death						=20 or 0
	Reduced milk yield						=20 or 0
Chronic signs	Cow seeks shade						=20 or 0
	Weight loss						=20 or 0
	Overgrowth of hair						=20 or 0
	Panting						=20 or 0
	Infertility						=20 or 0
	Hoof overgrowth						=20 or 0
	Loss of tail hair						=20 or 0
	<i>'Cow likes to wallow in water'</i>						=20 or 0

Appendix 9.2

Comparing perceptions of livestock keepers and veterinarians: proximity matrices and agglomeration schedules from hierarchical cluster analysis

Nuer livestock keepers verses Kenyan veterinarians

Table A9.2.1.1

Proximity matrix of squared Euclidean distances

Case	Matrix File Input									
	Liei	Tryps	Dat	FMD	Maguar	PGE	Dop	CBPP	Maceuny	Fluke
Liei	0									
Tryps	12163	0								
Dat	26829	15462	0							
FMD	21157	14958	7166	0						
Maguar	17983	12722	21072	15432	0					
PGE	16807	14642	20226	16756	9240	0				
Dop	20113	13422	16578	12316	14202	13442	0			
CBPP	16977	13394	14578	13722	13704	13676	5484	0		
Maceuny	20261	14898	21632	17794	13798	10232	14632	15016	0	
Fluke	19775	17368	22904	19942	12824	15372	15980	16760	6874	0

Note: the lower the proximity, the closer the pairs of diseases in the matrix

Table A9.2.1.2

Agglomeration schedule for clustering of diseases

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	7	8	5484.0	0	0	7
2	9	10	6874.0	0	0	6
3	3	4	7166.0	0	0	7
4	5	6	9240.0	0	0	6
5	1	2	12163.0	0	0	8
6	5	9	13056.5	4	2	8
7	3	7	14298.5	3	1	9
8	1	5	16807.0	5	6	9
9	1	3	17311.8	8	7	0

Orma livestock keepers verses Tanzanian veterinarians

Table A9.2.2.1
Proximity matrix of squared Euclidean distances

Case	Matrix File Input									
	Tryps	Gandi	FMD	Hoyale	T.vivax	Buku	CBPP	Somba	RP	Madob
Tryps	0									
Gandi	7430	0								
FMD	9778	12856	0							
Hoyale	11403	15333	2811	0						
T.vivax	10965	12363	8521	10396	0					
Buku	13797	16179	10411	13714	5104	0				
CBPP	11058	13600	5576	6701	10773	12937	0			
Somba	10663	14311	6427	9130	11936	14236	2237	0		
RP	12908	14830	6166	7129	10723	10389	8568	9759	0	
Madob	9595	13747	4519	6232	10200	11568	7585	8864	2839	0

Note: the lower the proximity, the closer the pairs of diseases in the matrix

Table A9.2.2.2
Agglomeration schedule for clustering of diseases

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	7	8	2237.0	0	0	7
2	3	4	2811.0	0	0	5
3	9	10	2839.0	0	0	5
4	5	6	5104.0	0	0	8
5	3	9	6011.5	2	3	7
6	1	2	7430.0	0	0	9
7	3	7	7826.3	5	1	8
8	3	5	11317.0	7	4	9
9	1	3	12711.6	6	8	0

Maasai livestock keepers verses veterinarians from the Horn of Africa region

Table A9.2.3.1

Proximity matrix of squared Euclidean distances for comparison of acute disease signs

Case	Matrix File Input									
	Endorob	Oltikana	Olukuluk	Emwilila	Engluw	Tryps	ECF	FMD	CBPP	Blackleg
Endorob	0									
Oltikana	6100	0								
Olukuluk	10384	12470	0							
Emwilila	5081	5261	9409	0						
Engluw	4935	5499	8907	3054	0					
Tryps	3048	3654	8038	2829	2311	0				
ECF	3779	3999	12197	7430	8250	6533	0			
FMD	7742	8800	2348	6243	5517	5902	10591	0		
CBPP	4402	4778	9108	6990	2583	2324	7497	6336	0	
Blackleg	4873	5291	6779	2976	926	2261	8204	4727	2595	0

Note: the lower the proximity, the closer the pairs of diseases in the matrix

Table A9.2.3.2

Agglomeration schedule for clustering of diseases according to acute disease signs

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	4	9	699.0	0	0	5
2	5	10	926.0	0	0	3
3	5	6	2286.0	2	0	5
4	3	8	2348.0	0	0	9
5	4	5	2726.8	1	3	7
6	1	7	3779.0	0	0	8
7	2	4	4896.6	0	5	8
8	1	2	5862.7	6	7	9
9	1	3	8321.9	8	4	0

Table A9.2.3.3

Proximity matrix of squared Euclidean distances for comparison of acute disease signs, excluding the disease sign 'diarrhoea'

Case	Matrix File Input									
	Endorob	Oltikana	Olukuluk	Emwilila	Engluw	Tryps	ECF	FMD	CBPP	Blackleg
Endorob	0									
Oltikana	3224	0								
Olukuluk	7805	11611	0							
Emwilila	2502	4402	9409	0						
Engluw	2356	4640	8907	3054	0					
Tryps	991	2949	7776	2567	2049	0				
ECF	3027	2159	9360	4593	5413	4076	0			
FMD	5163	7941	2348	6243	5517	5640	7754	0		
CBPP	2074	3906	9087	678	2562	2075	4843	6315	0	
Blackleg	2294	4432	6779	2976	926	1999	5367	4727	2574	0

Note: the lower the proximity, the closer the pairs of diseases in the matrix

Table A9.2.3.4

Agglomeration schedule for clustering of diseases based on acute disease signs and excluding the disease sign 'diarrhoea'

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	4	9	678.0	0	0	7
2	5	10	926.0	0	0	5
3	1	6	991.0	0	0	5
4	2	7	2159.0	0	0	8
5	1	5	2174.5	3	2	7
6	3	8	2348.0	0	0	9
7	1	4	2548.0	5	1	8
8	1	2	4239.3	7	4	9
9	1	3	7502.1	8	6	0

Table A9.2.3.5

Proximity matrix of squared Euclidean distances for comparison of chronic disease signs

Case	Matrix File Input									
	Endorob	Oltikana	Olukuluk	Emwilila	Engluw	Tryps	ECF	FMD	CBPP	Blackleg
Endorob	0									
Oltikana	5589	0								
Olukuluk	25533	20642	0							
Emwilila	6778	1441	21089	0						
Engluw	5648	41	20779	1400	0					
Tryps	5831	5660	18834	5899	5719	0				
ECF	6709	1502	17350	2471	1461	6086	0			
FMD	8460	3393	15511	4432	3402	7883	4059	0		
CBPP	6853	3190	18442	3379	3359	6684	3522	5841	0	
Blackleg	5577	90	20268	1449	49	5572	1348	3297	3258	0

Note: the lower the proximity, the closer the pairs of diseases in the matrix

Table A9.2.3.6

Agglomeration schedule for clustering of diseases based on chronic disease signs

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
1	2	5	41.0	0	0	2
2	2	10	69.5	1	0	3
3	2	4	1430.0	2	0	4
4	2	7	1695.5	3	0	5
5	2	9	3341.6	4	0	6
6	2	8	4070.7	5	0	8
7	1	6	5831.0	0	0	8
8	1	2	6365.5	7	6	9
9	1	3	19827.6	8	0	0

Appendix 9.3

Comparing perceptions of livestock keepers and veterinarians: stress data and coordinates for configurations derived from multidimensional scaling

Stress values are derived from Kruskal's stress formula 1 (Kruskal and Wish, 1978) and average values are presented for the entire data matrices. Configurations were derived in two dimensions.

Nuer livestock keepers versus Kenyan veterinarians

Stress = 0.277

Disease Number	Disease Name	Disease Coordinates	
		Dimension 1	Dimension 2
1	LIEI	0.909	1.606
2	TRYPS	0.088	1.331
3	DAT	-1.764	0.243
4	FMD	-1.435	0.361
5	MAGUAR	1.149	0.209
6	HAEM	1.159	-0.142
7	DOP	-0.889	-0.776
8	CBPP	-0.906	-0.432
9	MACEUNY	0.751	-1.129
10	FLUKE	0.938	-1.269

Orma livestock keepers versus Tanzanian veterinarians

Stress = 0.250

Disease Number	Disease Name	Diseases Coordinates	
		Dimension 1	Dimension 2
1	TRYPS	1.337	-1.001
2	GANDI	1.566	-0.893
3	FMD	-0.907	-0.058
4	HOYALE	-1.256	-0.037
5	T.VIVAX	1.103	1.246
6	BUKU	1.009	1.643
7	CBPP	-0.695	-0.843
8	SOMBA	-0.491	-1.199
9	RINDERPEST	-0.839	0.852
10	MADOBESA	-0.828	0.291

Maasai livestock keepers verses veterinarians from the Horn of Africa region

a. Comparison of diseases according to acute disease signs

Stress = 0.078

Disease Number	Disease Name	Disease Coordinates	
		Dimension	
		1	2
1	ENDOROBO	0.816	-0.647
2	OLTIKANA	1.424	0.166
3	OLUKULU	-2.452	-0.994
4	EMWILILA	0.262	0.858
5	ENGLUWET	-0.079	0.746
6	TRYPS	0.061	0.027
7	ECF	1.590	-1.461
8	FMD	-1.647	-0.049
9	CBPP	0.268	0.856
10	BLACKLEG	-0.243	0.497

b. Comparison of diseases according to acute disease signs and excluding the disease sign 'diarrhoea'

Stress = 0.044

Disease Number	Diseases Name	Disease Coordinates	
		Dimension	
		1	2
1	ENDOROBO	0.433	0.169
2	OLTIKANA	1.286	0.723
3	OLUKULU	-2.754	0.405
4	EMWILILA	0.825	-0.581
5	ENGLUWET	0.208	-0.908
6	TRYPS	0.434	0.050
7	ECF	0.774	1.393
8	FMD	-1.917	0.107
9	CBPP	0.784	-0.619
10	BLACKLEG	-0.072	-0.740

c. Comparison of disease according to chronic disease signs

Stress = 0.079

Disease Number	Disease Name	Disease Coordinates	
		Dimension 1	Dimension 2
1	ENDOROBO	1.263	-0.838
2	OLTIKANA	0.532	0.054
3	OLUKULU	-3.764	-0.305
4	EMWILILA	0.544	0.499
5	ENGLUWET	0.531	0.041
6	TRYPS	0.211	-1.042
7	ECF	0.219	0.410
8	FMD	-0.224	0.659
9	CBPP	0.207	0.468
10	BLACKLEG	0.482	0.052