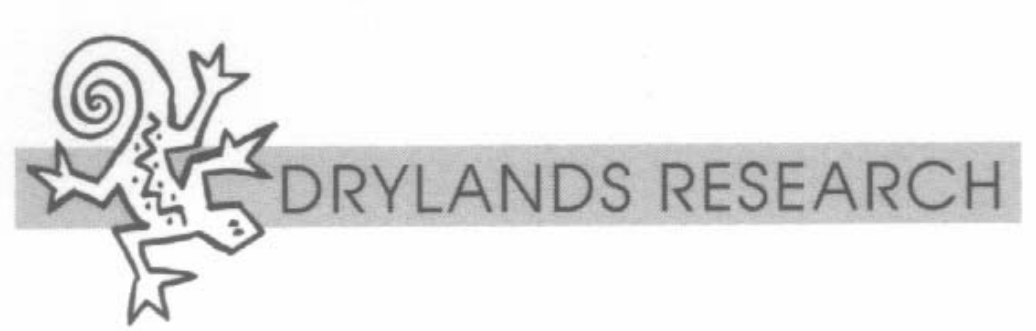


Drylands Research Working Paper 8

MAKUENI DISTRICT PROFILE: LIVESTOCK MANAGEMENT, 1990-1998

Abdou Fall

2000

Drylands Research
Crewkerne
Somerset TA18 8BJ

This paper was first presented at a workshop on Policy Requirements for Farmer Investment in Semi-Arid Africa, held on 16-17 November, 1999 at Wote, Makueni District, Kenya

ISSN 1470-9384

Typeset at Drylands Research and printed at Press-tige Print, Crewkerne.

The research reported in the working paper forms a part of a study on ***Policy requirements for farmer investment in semi-arid Africa***, which was funded by the Natural Resources Policy Research Programme of the Department for International Development (DFID), United Kingdom (Project R 7072 CA). DFID can accept no responsibility for any information provided or views expressed.

Preface

Drylands Research Working Papers present, in preliminary form, research results of studies carried out in association with collaborating researchers and institutions.

This working paper is part of a study which aims to relate long-term environmental change, population growth and technological change, and to identify the policies and institutions which are conducive to sustainable development. The study builds upon an earlier project carried out by the Overseas Development Institute (ODI) in Machakos District, Kenya, whose preliminary results were published in a series of *ODI Working Papers* in 1990-91. This led to a book (Mary Tiffen, Michael Mortimore and Francis Gichuki, *More people, less erosion: environmental recovery in Kenya*, John Wiley, 1994), which was a synthesis and interpretation of the physical and social development path in Machakos. The book generated a set of hypotheses and policy recommendations which required testing in other African dryland environments. Using compatible methodologies, four linked studies are now being carried out in:

Kenya	Makueni District	
Senegal	Diourbel Region	
Niger	Maradi Department	*(in association with ODI)*
Nigeria	Kano Region	*(in association with ODI)*

For each of these study areas, there will be a series of working papers and a synthesis, which will be reviewed at country workshops. An overall synthesis will be discussed at an international workshop in London in 2000.

The Kenya series updates the previous study of Machakos District (which included the new Makueni District) and examines this more arid area in greater depth. The Research Leader for these studies is Michael Mortimore. The Leader of the Kenya Team is Francis Gichuki of the University of Nairobi. Michael Mortimore, Mary Tiffen or Francis Gichuki may be contacted at the following addresses.

Michael Mortimore
Cutters Cottage, Glovers Close, Milborne Port
Somerset DT9 5ER, UNITED KINGDOM

Mary Tiffen
Orchard House, Tower Hill Road,
Crewkerne, Somerset TA18 6BJ,
UNITED KINGDOM

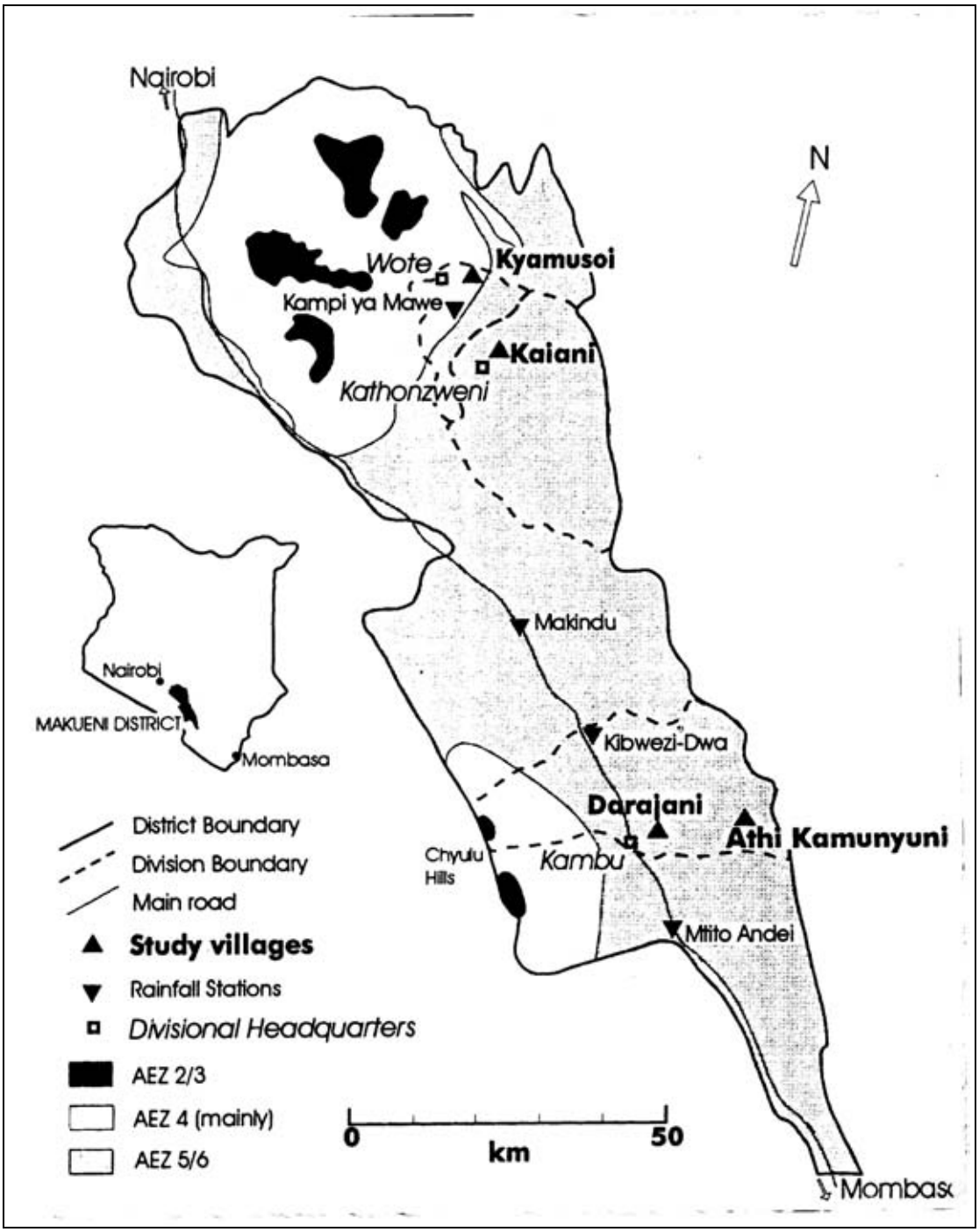
Email:
mikemortimore@compuserve.com
mary@marytiff.demon.co.uk

Website:
www.drylandsresearch.org.uk

Francis Gichuki
Department of Agricultural Engineering
UNIVERSITY OF NAIROBI
PO Box 30197
Nairobi
KENYA

Email:
fgichuki@iconnect.co.ke

Preface map


Nairobi
N
Wote
Kyamusoi
Kampi ya Mawe
Kaiani
Kathonzweni
Makindu
Nairobi
MAKUENI DISTRICT
Mombasa
Kibwezi-Dwa
Darajani
Athi Kamunyuni
Chyulu Hills
Kambu
Mtito Andei
District Boundary
Division Boundary
Main road
Study villages
Rainfall Stations
Divisional Headquarters
AEZ 2/3
AEZ 4 (mainly)
AEZ 5/6
0
50
km
Mombasa

Abstract

This profile illustrates the main changes to livestock keeping and production since 1990 in Makueni District, Kenya. Livestock play a crucial role in helping households to finance education and to purchase food during drought periods, when livestock savings are sold to generate cash. They are also valued for draught and manure. Cattle are kept in the two northern villages in the sample, where milk production from cross-breeds has expanded remarkably since liberalisation, but in the south most farmers have none. Almost all own goats. Poultry and bees are also kept and donkeys are increasing. In the low potential areas the number of cattle per farm has declined since farms were first established, while the number of goats and sheep has risen. Disease is the main constraint, and farmers experience devastating losses. Most then struggle to rebuild their herds. Since 1988 Government technical veterinary staff have been reduced and there are no private vets, although the number of shops selling veterinary supplies has increased.

When the areas were first settled, livestock used to graze freely. The land demarcation which occurred during settlement means farmers now rely on their own or rented grazing land, crop residues and grass planting. The privatisation of communal water services, which has not improved management, has led to a worsening condition of livestock water resources in the zone.

Résumé

L'objet de ce résumé est de montrer quels ont été les changements dans l'élevage du bétail et la production dans ce secteur depuis 1990 dans le district de Makueni, au Kenya, où l'élevage est une composante fondamentale des systèmes agricoles employés. Les données concernant le cheptel dans le district de Makueni indiquent que, en dépit de la sécheresse de 1995, son importance numérique s'est accrue entre 1992 et 1998 (Tableau 1). Pendant cette période, la croissance annuelle a été de six pour cent pour les vaches laitières, plus particulièrement dans les zones de potentiel moyen (Tableau 2). Dans celles dont le potentiel est faible, le nombre de bovins par exploitation a diminué depuis que ces exploitations ont été établies (Tableaux 3&4), alors que le nombre d'ovins et de caprins a augmenté (Tableaux 5&6). Celui-ci s'est accru de trois pour cent par an de 1992 à 1998, alors le nombre de bovins est resté pratiquement le même. Le nombre d'ânes a également augmenté de manière significative. Les familles d'agriculteurs font aussi l'élevage des poules et des abeilles.

Les stratégies suivies au niveau des investissements dans l'élevage ont également été analysées, et les résultats de cette étude indiquent que les éleveurs de Makueni, au moment de leur installation, afin de lutter contre les contraintes imposées par les maladies:

- Amenèrent leur troupeau dans la région au bout d'environ 5 ans;
- Vendirent leurs bêtes et achetèrent des animaux de la région qui étaient mieux adaptés aux mouches tsé-tsé ;
- Achetèrent des chèvres qui coûtaient moins chers et qui étaient plus résistantes aux mouches tsé-tsé.

De nos jours, la plupart des familles dans les zones de potentiel moyen font de l'élevage de bovins grâce à l'argent obtenu, soit par le biais d'activités non agricoles (par exemple des salaires), soit par la vente de produits agricoles ou du petit bétail (Tableaux 9&10).

L'élevage a une importance cruciale pour les familles car l'argent qu'il rapporte les aide à financer l'éducation et également à acheter de la nourriture pendant les périodes de sécheresse, le bétail épargné étant vendu pour récupérer de l'argent en espèces. Pour beaucoup d'agriculteurs, la reprise du travail cultural, après une mauvaise année, n'est possible que s'ils ont sauvegardé une partie de leur cheptel.

Mis à part l'usage de la charrue à bœufs, l'élevage remplit les mêmes fonctions à l'heure actuelle que lorsque les populations vinrent s'installer dans la région. La gestion des pâturages a subi des changements importants, à partir des années 70, lorsque les champs furent marqués et bornés. Au moment de l'installation sur les terres, au début le bétail pouvait se déplacer en toute liberté dans les zones de pâturage, mais, de nos jours, étant donné le manque de terres communes, les bêtes broutent uniquement dans des pâturages privés. Les bovins sont à l'heure actuelle très souvent utilisés en tant qu'animaux de trait pour la culture et le transport, pour la production de lait et pour obtenir de l'argent en espèces.

L'industrie laitière est en pleine croissance dans les zones de potentiel moyen et constitue une activité nouvelle remarquable dans l'évolution des systèmes agricoles du district de Makueni. L'introduction de variétés de vaches laitières, au cours de ces vingt dernières années, a été une stratégie importante employée par les agriculteurs pour intensifier leurs système agricoles. Afin d'obtenir du bétail de premier choix, les éleveurs soit les ont acheté, soit ont payé pour les services des taureaux de leurs voisins pour la reproduction ou bien les services d'insémination artificielle mis en place par le gouvernement. Depuis 1992, le coût des services gouvernementales a été multiplié par dix, aussi les agriculteurs utilisent davantage les taureaux pour la reproduction.

L'intensification de la production à Makueni en ce qui concerne l'élevage a nécessité plus de main-d'œuvre pour défricher de nouvelles terres de pâturage, des investissement pour la production de fourrage, et une utilisation accrue des intrants vétérinaires afin de limiter les maladies du bétail. Pour 84 pour cent des agriculteurs interrogés, les problèmes sanitaires sont la contrainte majeure affectant l'élevage local. La sécheresse vient en second. Quarante pour cent des éleveurs ont perdu tout leur bétail à un moment donné et 64 pour cent des éleveurs 80 pour cent de leurs animaux. Depuis 1988, les effectifs des services vétérinaires du gouvernement ont été réduits. Il n'existe pas de services vétérinaires privés bien que le nombre de magasins vendant des produits vétérinaires ait augmenté.

En général, la disponibilité des intrants agricoles est meilleure depuis la libéralisation, mais ils sont devenus plus chers, et le prix du lait a également augmenté. La privatisation des forages, plus une mauvaise gestion, ont fait que les ressources en eau dans la région sont pires qu'auparavant pour le bétail.

CONTENTS

Author's acknowledgements

I would like to express my gratitude to all farmers in Kyamusoi, Kaini, Darajani and Athi Kamunyuni in Makueni District who provided information used in this report. Special thanks are due to the Livestock Officers in Makueni District, Dr Kathumbu, Musioki, Muraya, Kituku, Nguta and Mungue for the invaluable discussions we had. Enumerators that helped during the fieldwork also deserve my thanks.

About the author

Abdou Fall is an animal scientist working with the Senegalese Institute for Agricultural Research (ISRA). He currently co-ordinates the Research and Development programme at ISRA. He is also the team leader of the Senegalese component of this study.

Contact address: ISRA, BP 3120, Dakar, Senegal
Email: abdoufal@isra.refer.sn

List of acronyms and abbreviations

AEZ:	Agro-ecological zone
ICRA:	International Course for Development Oriented Research in Agriculture
AI:	Artificial insemination
DFID:	Department for International Development (UK)
SU:	Stocking unit
CBPP:	Contagious bovine pleuropnneumonia

1 INTRODUCTION

1.1 Background

The previous 60-year longitudinal (1930-1990) study, conducted in the Machakos District, Kenya, showed that through investment in agricultural intensification it was possible to significantly increase total farm productivity per head of population and per unit area, despite rapid population growth (Tiffen, *et al.* 1994). The study also reported significant changes in livestock management in the Machakos District. Intensification of livestock enterprises took place through adoption of more productive dairy breeds and improvement in livestock management, as a response to attractive milk prices.

A major aspect of the recent history of farming systems in this area was the remarkable move of livestock population from agro-ecological zones (AEZ) 2&3 to AEZ 5&6 from the 1950s onwards, with new settlements in what is now Makueni District. The role of livestock in farming systems had also evolved to include critical inputs to cropping activities, such as manure for the restoration of soil fertility and draught animal power for cultivation and transport, in a process of intensification of mixed farming systems.

The role of livestock also became more prominent in Machakos, where harsh climatic conditions, specially variable and erratic rainfall, make cropping activities risky. It is therefore essential to gain a better understanding of the role of livestock in natural resources management, in farm investment and household income, in a context of changing population density and erratic rainfall. Thereby adequate policies can be developed to secure a decent livelihood for vulnerable farmers, through intensification, and sound natural resources management. It is also crucial to assess the impact of policies on livestock management and productivity, so that informed strategies may be designed to support the intensification process taking place in the mixed farming systems of Makueni.

1.2 Objectives of the study

The objectives of this longitudinal study of livestock management in Makueni are:

- to review the livestock production profile for the former Machakos District in light of the Makueni experience;
- to update livestock prices and analyse marketing systems;
- to investigate the role of livestock in investment strategies - ownership, financing, costs, benefits, risks;
- to investigate livestock management in drought years;
- to assess crop-livestock integration and the intensification of mixed farming systems in Makueni.

This profile focuses on the semi-arid areas, AEZ 4, 5 and 6, and not on the high potential areas AEZ 2&3.

1.3 Methodology

The primary sources of data were: (1) district interviews with officials; (2) group interviews; (3) household surveys; and (3) field surveys. Further data from literature sources and official statistics from the Makueni District Livestock Office were incorporated, in order to analyse changes that have occurred since 1990.

District interviews

Makueni District used to be part of Machakos District. In 1992, an independent district, Makueni District, composed of Makueni, Mbooni, Kilome and Kibwezi Divisions was formed out of Machakos District. At the district level, interviews with livestock district officers provided us with relevant information pertaining to:

- statistics on livestock;
- current policies concerning the supply of livestock requisites, veterinary services, artificial insemination or other means of improving breeds; changes since 1990 and the impacts of change;
- bees: government interventions to improve marketing or processing of honey since 1990;
- changes in the Government's ability to deliver advice on livestock management to farmers since 1990 (perceived effects of changes in extension organisation).

Group interviews at village level

Four sites in Makueni District were selected for this study:

- *Kamunyolo village, Kyamusoi Sublocation in Wote Location* (close to Wote Town, the headquarters of Makueni District) This village was formed as part of the original Makueni settlement scheme for retired Akamba soldiers and landless people from 1948. The area was uninhabited until 1946, due to dense vegetation, wildlife, tsetse flies and water scarcity.
- *Kaiani village, in Kathonzweni Sublocation* was first settled in 1960 by migrants coming from Kangundo, Masii, Mbooni, Kilungu and Wote.
- *Darajani village, in Kambu Sublocation* (close to Kambu town, located along the Nairobi-Mombasa highway) Settlement in Darajani started in 1963, following Kenya's independence.
- *Athi-Kamunyuni village, Kitengei Sublocation, Kambu Location* (relatively distant from Kambu town) The village is located close to the Athi River. Settlement in Athi Kamunyuni started in 1973. Most settlers are reported to have come from Makueni, Kisau and Nzaui.

The group interview with leaders identified the following points for extended discussion:

- History of herd establishment in the area and determining factors
- Changes in systems of livestock inheritance
- Means of herd reconstitution following losses due to drought
- Changes in grazing management and grazing arrangements
- Changes in health management

- Livestock owners' responses to drought (1983-84)

Household survey

In each of the 4 sites, all households were listed and 12 households were randomly selected. A structured questionnaire was designed to collect data and to address the following:

- Current inventories by species and owners
- History of herd development, ownership, costs, benefits, risks, purposes of keeping livestock, changes in breed
- Health management
- Impact of changes in government policy and services
- Feeding management and integration with crop production
- Drought policy

2 RESULTS

2.1 Review of the livestock production profile for old Machakos in light of the Makueni experience

Statistics on livestock

In general, the livestock population in the Makueni District increased from 1992 to 1995. From 1995, a decline in the livestock population is seen, though numbers in 1998 are still higher than numbers in 1992. Despite the drought of 1995, which reduced the livestock population, there was an annual increase of six percent for dairy cattle, whereas sheep and goats increased at an annual rate of three percent from 1992 to 1998. A significant increase in the donkey population was observed, with an annual growth rate of 24 percent. The drought in 1995 may have been the determining factor in the decline in livestock numbers. This trend may also be related to different methods used for estimating livestock populations by district livestock officials.

Results from the present survey show that there were no grade dairy cattle in our sample farms in Darajani and Athi-Kamunyuni. Therefore it could be concluded that the increase in the dairy cattle shown in Table 1 occurred only in the medium potential areas, such as Kyamusoi and Kaiani villages. We know there has also been an increase in dairy cattle in the high potential areas, such as Mbooni and Kilome. This had already occurred before 1990 (Tiffen *et al.*, 1994), but their introduction into AEZ 4 and the better parts of AEZ 5 is much more recent.

In 1992 changes in administrative divisions led to the establishment of Makueni, formed by Kibwezi, Makueni, Kilome and Mbooni Divisions. Now Makueni District is made up of 16 divisions. Livestock district reports do not always break down statistics of cattle population with respect to divisions. Therefore it was difficult to present livestock population by division, in order to compare cattle numbers in Kibwezi and Makueni before and after 1992.

Table 1: Livestock population in Makueni District from 1992 to 1998

	1992	1993	1994	1995	1996	1997	1998
Dairy cattle	23,458	25,180	27,700	30,700	31,000	30,000	30,000
Beef cattle	183,000	183,000	219,800	228,000	205,000	185,000	185,000
Sheep	80,000	81,000	104,900	116,000	105,000	90,000	90,000
Goat	215,000	215,000	264,500	286,000	270,000	250,000	250,000
Donkey	2,730	3,350	4,900	5,200	–	6,000	6,000
Layers	–	8,400	14,070	14,070	–	–	–
Local birds	–	539,500	569,500	597,500	540,000	500,000	500,000
Rabbits	5,460	5,600	10,400	12,060	6,000	5,200	5,200
Pigs	12	24	10	52	80	69	60
Beehives	–	–	162,720	163,889	161,800	120,240	–

Source: District Livestock Officer, Makueni.

History of herd development and management

When people first settled in Wote and Kaiani they did not have livestock with them, though some of them had livestock elsewhere. Many people delayed bringing in their animals because of the disease constraints in Makueni, only moving their livestock in five years after settlement. This delay was due to the prevalence of tsetse flies that transmit trypanosomosis. Some farmers sold their animals and bought local animals that more adapted to tsetse flies than the livestock they had before. Because goats are cheaper to buy and were tolerant to tsetse flies, a number of people started to build up their livestock with goats. Now cattle are more important than goats in these areas of old settlement.

In Darajani and Athi Kamunyuni, farmers brought in their livestock when they first settled there in 1960-80. A tentative explanation for the immediate arrival of livestock in Darajani and Athi Kamunyuni is that these new settlers owned no land in their place of origin. Most of them had been squatters on Europeans farms.

Livestock are usually acquired from purchases with money gained from a family member's salary. Other farmers may also sell farm produce or small stock to establish a cattle herd that requires heavy investment. Inheritance of livestock has been influenced by European culture. In the past only male offspring could inherit livestock. Now if a man dies, his cattle or goats are normally divided equally amongst wives, sons and daughters (though if a daughter is married, she is denied her share). The general rule is that cattle and goats are divided by the number of children. Nowadays, before a man dies, he equally divides his wealth between his wives, who then divide their portion between their children.

Evolution in livestock functions: Livestock benefit their owner in many ways. The current importance of having cattle includes the use of draught animal power for cultivation and transport, the supply of milk for home consumption, and cash generation from sales of live animals and livestock products. Except in the case of ox ploughing, livestock fulfilled the same functions when people first settled in the area. When they

first settled in the area there was no animal traction. Ploughing using oxen only started some time after initial settlement.

Also in the past cattle used to be a valuable means of settling disputes over the death of a clan member. Families and clans settle such disputes by giving cattle. Compensation is valued at 12 cattle for a male and 6 cattle for a woman. Cattle were also used for bride price, but this is no longer the case (Nzioka, 2000).

Mr William from Kaiani village said that cattle act as a bank for the Akamba people. Livestock are capital assets. In the absence of reliable financial institutions, farmers usually assure their savings in the form of livestock, which are drawn upon in times of crisis to supplement income in case of crop failure. When they first settled in the area, farmers started building up livestock by buying goats, supposedly more resistant to disease than cattle. Goats have also proved to be more adapted to the nature of pasture found in southern Makueni (characterised by browses). Reduction in disease risk and attractive animal prices have been a strong incentive for farmers to invest in cattle. Cattle ownership has also become more important because of the need to plough using oxen and attractive milk prices.

Grazing Management: When they first settled, livestock used to graze freely although land was individually owned. During this period the livestock population was not great. After land demarcation and titling (carried out at various times and locations) dramatic changes in herd management have occurred. At present there is no common land, so animals graze only on private pastures. In Kyamusoi, for example, at the time of settlement, each settler was given a piece of land. Because livestock numbers were not high, cattle could graze freely in all lands. However, as the population increased rapidly, the land was subdivided and fences were established. Now if you want to graze on someone's land you have to pay for it. These changes took place in the 1970s. There are a number of arrangements designed to assure complementarities between farmers, through the exchange of available resources. For instance, if you do not have bulls to plough, you can ask those who own oxen to graze on your land. Then you can benefit from their animals for ploughing. If you have enough grass, you can rent part of your pastureland to other farmers. Three-month rental of a piece of grazing land for four to five animals would cost about Ksh 1500-1800.

To prevent others from using your own grazing lands, fences in the form of thorn bushes, sisal and wires are established. In addition, animals are usually tended during grazing hours.

Higher potential places in Makueni such as Mbooni experienced a significant shift towards the adoption of zero-grazing, as reported by Murton (1997) in Ndueni village, where he conducted a study on the evolution of livestock and land holdings. Zero-grazing has been extensively adopted in these high potential areas since the 1950s, as a result of a gradual encroachment of cultivation into grazing lands. Despite the increasing scarcity of arable land in Mbooni Location, livestock holdings continue to increase. The livestock to people ratio has also increased, as a result of adoption of zero-grazing and full integration of crop and livestock cycles (Murton, 1997).

2.2 Livestock as investment strategies

Type of livestock and cattle herd structure

Many types of livestock are reared in Makueni, including cattle, sheep, goats, donkeys, poultry, rabbits and bees. Breeds of dairy cattle in Makueni include pure breed Friesian, Ayrshire, Guernsey and few Jerseys. Crosses between these breeds and Zebus, such as Boran and Sahiwal, are also common. Beef breeds include the Small East African Zebu, Sahiwal, Simental (mainly in ranches), Brown Swiss, Charolais, Boran and Santagertrudis.

There are two sheep breeds: Doper and Masai. Masai is used to refer to any sheep breed other than Doper, which is a synthetic breed between Dorsethorn and Black Head Persian, introduced in the late 70s.

There are a number of goat breeds in Makueni. The small East African goat presents a variety of coat colours. The Galla goat breed is good for meat. The Boer breed is spreading in ranches and to a number of small farmers. The Toggenburg dairy breed has been imported from Switzerland. Most of the goat stocks are used for meat and milk.

Table 2 shows a gradual decrease in the average number of cows, as one moves from medium to low potential areas. The number of cows per herd decreases from 1.83 in Kyamusoi, to 1.00 in Athi Kamunyuni. The number of calves and heifers follows the same pattern. This may reflect the relative importance of dairy enterprises in different locations. It is probable that this is the result of farmers investing more money in young stock to build up herds or to establish dairy herds as the potential of dairy enterprises improves. It may also be that reproductive performances are much better in medium than in low potential areas.

Table 2: Cattle herd structure

Village	Calves and heifers		Cows		Bulls		Castrated
	Herd average	Percent of crossbred heifers (percent)	Herd average	Percent of crossbred cows (percent)	Herd average	Percent of crossbred bulls (percent)	Herd average
Kyamusoi	2.33	29	1.83	27	0.91	0	0.83
Kaiani	1.82	30	1.36	33	1.73	16	0.54
Darajani	1.25	0	1.25	0	0.25	0	0.25
Athi	1.00	0	1.00	0	1.67	0	0.00
Total	1.75	15	1.42	15	1.46	4	0.50

Source: Field surveys, 1998.

In addition to feeding constraints, disease hazards may act as a significant check on the expansion of exotic, more susceptible breeds in low potential areas. This is illustrated by the fact that there are no grade dairy cattle in Darajani and Athi Kamunyuni, two drier, low potential areas.

The percentage of oxen also decreases as we move from higher to low potential areas. The use of cattle for draught purposes is more common in Kyamusoi and Kaiani than in Darajani and Athi Kamunyuni. In the two former villages one finds the extensive use of cattle draught power for land cultivation and for the transport of water (using carts). Darajani has the lowest number of bulls per herd. Limited acreage of land available there may be a serious constraint to keeping this category of cattle, especially if the services of a neighbouring bull are available.

Distribution of livestock among households

Tables 3 and 4 show cattle holdings in 1998 and when the farm was created. The establishment of farms took place at different periods of time, from the 1950s to the 1990s, depending on whether farmers happened to be original settlers, later arrivals or sons who inherited the land.

Table 3: Current distribution of cattle among households and cattle herd size, 1998

Village	Percentage households owning cattle			Maximum herd size
	No cattle	*1-5 head of cattle*	*6+ head of cattle*	
Kyamusoi	27	55	18	11
Kaiani	8	50	42	12
Darajani	67	33	0	4
Athi Kamunyuni	67	25	0	4

Source: Field surveys, 1998.

Table 4: Distribution of cattle among households and cattle herd size when farm was acquired

Village	Percentage of households owning cattle			Maximum herd size
	No cattle	*1-5 head of cattle*	*6+ head of cattle*	
Kyamusoi	57	36	7	18
Kaiani	27	45	27	46
Darajani	83	0	17	17
Athi Kamunyuni	64	18	18	19

Source: Field surveys, 1998.

The number of households with cattle is much greater in medium potential areas (Kyamusoi, Kaiani) than in the low potential areas (Darajani, Athi Kamunyuni) and this difference in cattle ownership dates back to settlement. The majority of farmers in low potential areas (67 percent) do not own cattle. This situation was, however, worse when they first acquired their farm. For instance, 83 percent of households in Darajani did not own cattle when they first established their farms.

The number of cattle owned by each household is larger in medium potential than in low potential areas, as was the case in the past (Tables 3 and 4). Maximum herd size does not exceed four head of cattle in the low potential areas, whereas up to 12 head can form cattle herds in medium potential areas.

Cattle herd size per farm has declined since farms were first established. A minority of owners of large herds has probably lost cattle but a larger proportion of farmers is now managing small herds. This seems probable, given that there is no longer unclaimed bush, and people have to manage their animals on their own land, using more labour-intensive methods. In addition to this, a reduction in holding sizes and losses due to diseases and drought were factors that led to the reduction in cattle holdings.

Table 5: Distribution of sheep and goats among households, 1998

Village	Percentage of households owning sheep				Percentage of households owning goats			
	No sheep	1 to 5 sheep	More than 6 sheep	Max. flock size	No goats	1 to 5 goats	More than 6 goats	Max. flock size
Kyamusoi	91	9	0	1	18	36	45	12
Kaiani	33	17	50	30	25	42	33	30
Darajani	100	0	0	0	25	25	50	18
Athi	73	9	18	10	18	27	55	40

Source: Field surveys, 1998.

Table 6: Distribution of sheep and goats among households when farm was acquired

Village	Percent households owning sheep (percent)				Percent households owning goats (percent)			
	No sheep	1 to 5 sheep	More than 6 sheep	Max. flock size	No goat	1 to 5 goats	More than 6 goats	Max. flock size
Kyamusoi	91	0	9	6	73	27	0	3
Kaiani	75	17	8	10	58	17	25	50
Darajani	92	8	0	12	58	17	25	30
Athi	73	27	0	5	36	36	28	30

Source: Field surveys, 1998.

Although the number of households keeping sheep has been stable, there is a significant increase in the number of households owning goats in all villages. Goat flock size has also increased in all villages. For instance, when they first acquired their farms, no farmer in Kyamusoi kept more than 6 goats. Now more than 45 percent of them own more than six goats. Modal goat flock size has also increased in Kaiani, Darajani and Athi Kamunyuni. Goats are easier than cattle to rear under conditions found in those

areas afflicted by recurrent drought, with grazing resources dominated by browses. They are also supposedly more resistant to trypanosomosis than cattle and sheep. Most importantly, for farmers with limited resources, goats are cheaper when building a herd.

Distribution of other livestock: Farmers diversify their income by holding livestock types that play a significant role in their livelihood. These include chickens, donkeys and bees. The majority of households keep chickens of local broiler type. The average number of chickens kept is 15, 20, 5 and 14 in Kyamusoi, Kaiani, Darajani and Athi Kamunyuni, respectively. Many farmers now keep bees. More than 50 percent of farmers in Kyamusoi, Kaiani and Athi Kamunyuni have beehives. The number of beehives per household is 2.4, 6.2 and 3.8 and 0.8, in Kyamusoi, Kaiani, Athi Kamunyuni and Darajani, respectively.

Donkeys are also found in about 20 percent of households in Kyamusoi, Kaiani and Athi Kamunyuni, but no households in our sample kept donkeys in Darajani. Donkeys are used to haul water and to plough lands in Athi Kamunyuni, where the number of bulls and oxen is limited, compared to other areas.

Livestock ownership and financing

The majority of cattle belong to the head of the household. In particular, the male head of the household is the principal owner of the household cattle and this has not changed over the years.

Table 7: Cattle ownership by household head and gender, 1998 (percent)

Owner	Calves	Heifers	Cows	Bulls	Castrated
Household head, male	93	80	86	94	100
Household head, female	0	20	9	6	0
Both	7	0	5	0	0

Source: Field surveys, 1998.

Table 8: Cattle ownership by household head and gender when farm was first established (percent)

Owner	Calves	Heifers	Cows	Bulls	Castrated
Head of household, male	90	100	93	92	100
Head of household, female	10	0	7	8	0

Source: Field surveys, 1998.

The majority of cows in herds have been bought in, as was the case when farms were first being established. Farmers invest money to acquire reproductive females, critical for the establishment and preservation of a herd. The money used to invest in cows comes from wages and sales of farm produce (maize, pigeon pea). The acquisition of bulls is balanced between breeding them on-farm or buying them. On the other hand, Tables 9 and 10 show that farmers prefer to draw males for castration from their herd.

Table 9: Mode of acquisition of cattle, 1998 (percent)

	Calves	Heifers	Cows	Bulls	Castrated
1. Bred on farm	100	78	15	47	77
2. Bought in		22	80	53	23
5. Inherited			5		

Source: Field surveys, 1998.

Table 10: Means of acquisition of cattle, when farm was acquired (percent)

	Calves	Heifers	Cows	Bulls	Castrated
1. Bred on farm	100	100	20	31	75
2. Bought in			80	50	25
3. Gifted				19	

Source: Field surveys, 1998.

Changes in breed

Changes in breed took place in the 1980s and 1990s. Out of 26 households sampled that owned cattle, 6 of them have changed breed since they started farming. A number of advantages were seen in changing cattle breed. Dairy breeds were introduced with a view to increasing milk output both for household consumption and for cash generation. The introduction of dairy breeds was a major strategy farmers chose to intensify their farming systems, in a context of reduced land resources. When they were asked about the advantages of changing cattle breed, farmers pointed to the big frame and high milk yield of grade cattle. The major objective was to produce more milk and therefore generate more revenues.

Most of farmers receive access to grade cattle by using the services of a neighbouring grade bull, which is mated with a local cow. Government artificial insemination services also played a great role in the diffusion of high milk yielding exotic genetic material. Few farmers resort to purchasing grade cattle.

High risks were associated with the introduction of grade cattle in local farming systems. Disease was the major constraining factor. The development of grade cattle requires effective control of external parasites, such as ticks and the diseases they transmit. Grade cattle are mainly concentrated in Kyamusoi and Kaiani, the medium potential areas. In Darajani and Athi Kamunyuni, where conditions are harsh, no grade cattle were found in the households sampled. The latter two villages face climatic, disease, and livestock feeding conditions that are less favourable to exotic breeds.

Two major investments are carried out in order to accommodate the new breeds. First the feeding systems needed to be upgraded in order to cover the higher nutrient requirements of the new, more productive breed. Improvements in grazing lands included fencing and clearing of bush to increase pasture land. These investments were secured by using funds from milk, maize or pigeon pea sales. The second main investment was related to the purchase of drugs and tick control chemicals.

Change in zebu cattle holding

The number of zebu cattle per household and zebu cattle herd size have been quite stable in Kyamusoi. In contrast, there is a significant decrease in the number of local zebu cattle per herd and per household in the low potential area. The rearing of new types of cattle breeds in Kaiani and Kyamusoi compensates for the decrease in the number of local cattle per holding. The number of grade cattle per household is 0.64 and 1.17 in Kaiani and Kyamusoi respectively.

The relative number of herds that experienced an increase in size was higher in medium than in low potential areas. The major reason for the differing numbers is loss due to disease. Sales, loss due to drought, and lack of grazing land are also given as reasons for decrease in zebu cattle herd size. The greater reduction in herd size seen in the low potential area is associated with the higher disease risks found in these areas.

Table 11: Size of zebu cattle holdings since farm was acquired

Village	Average number of zebu cattle per household (all households)		Average number of zebu cattle per household with a cattle herd	
	Now	When farm was acquired	Now	When farm was acquired
Kyamusoi	3.09	2.82	5.13	5.16
Kaiani	3.91	4.92	4.70	7.38
Darajani	1.00	1.92	3.00	11.50
Athi Kamunyuni	1.00	3.36	3.70	9.25

Source: Field surveys, 1998.

Table 12: Trends in cattle herd size

Village	Percentage of zebu cattle herds that increased in size since farm was acquired	Percentage of zebu cattle herds that decreased in size since farm was acquired
Kyamusoi and Kaiani	64	36
Darajani and Athi	33	67

Source: Field surveys, 1998.

Table 13. Trends in sheep and goats holdings (percentage)

Village	Percentage of farmers who have increased holdings	Percentage farmers who have decreased holdings
Kyamusoi and Kaiani	73	27
Darajani and Athi	56	44

Source: Field surveys, 1998.

Changes in sheep and goat holdings

Table 13 shows that a majority of farmers have been able to increase sheep and goat holdings over time. However, even with goats this process seems to have been more difficult in the two drier villages. A strong preference for goats in the dryer areas is shown in Table 14, by the higher ratio of shoats to cattle.

Table 14: Sheep and goat: cattle ratios

Village	Cattle: shoat ratio
Kyamusoi	1: 1.49
Kaiani	1: 2.89
Darajani	1: 5.00
Athi Kamunyuni	1:11.45

Source: Field surveys, 1998.

Ranching

In 1990 there were 39 ranches in the former Machakos District, but it is not known how many fell within Makueni District when it was formed. By 1994 there were 12, as shown in Table 15. There is a trend towards a higher proportion of goats and sheep in co-operative ranches. The two co-operative ranches are currently undergoing change and are being apportioned to individual ownership. One of the co-operative ranches is already subdivided, and the other is threatened. Individual ownership and companies are taking over. Company-owned ranches have the highest cattle numbers and appear to require an average of 3.2 ha per stock unit.

Table 15: Livestock on ranches, Makueni District

Type	Number of ranches	Size, ha	Cattle population		Sheep and goat population	
			1993	1994	1993	1994
Individual	8	13476	3714	3051	1183	1801
Co-operative	2	6575	1404	1280	1187	1317
Company	2	18690	5443	5394	1729	

Source: District livestock office.

Costs, benefits and risks of keeping livestock

Animals constitute capital assets in every sense of the term, providing services and income, and requiring maintenance. They can also be sold off to meet other needs, which may or may not draw down on a farmer's capital stock, depending on whether it exceeds the growth rate.

Costs: Labour is the most important input to livestock-related activities, which are time-consuming in nature. The labour demands of livestock management are associated with grazing, watering and health care. ICRA (1982) reported that in Makueni, the average time to water animals was 1.1 hours during the wet season and 2.2 hours during the dry season. Dipping to control tick borne diseases takes 2.1 hours. Labour requirements for herding and watering are estimated at 16 hours a day. A survey conducted in Kibwezi (CARE 1991) shows the household division of labour for farm activities. Forty-eight percent of labour requirements for grazing animals was met by the husband, 18 percent by the wife, two percent by both and 32 percent by children or casual labourers. Watering labour demands were met by contributions of 47 percent from wives, 15 percent from husbands, while children and casual workers gave the remaining 38 percent.

Other major costs associated with the livestock enterprise include the purchase of feed or fees to graze private grazing lands, and health inputs. Artificial insemination and bull services, crucial to the adoption of improved genetic materials for dairy enterprises, also require investments in the form of cash payment.

With a cost-sharing policy enforced from 1992, there was a remarkable increment in the cost of artificial insemination (AI) services, increasing from Ksh 40 to 400. As a result the number of AI services used fell and farmers turned to improved sires to service their cows. Bull services are now paid Ksh 100-300 per service, depending on the quality of the bull.

These policies have also made it more expensive for farmers to gain access to adequate health care for their livestock. In the past, control of tick-borne diseases was highly subsidised. With the privatisation of veterinary services farmers bare the cost of treating their livestock, although Government contributes the acaricide.

Because of high population density, the valuable grade and crossbred milking cows found in high potential areas are dipped regularly at a nearby communal dip. In medium and low potential areas, the tick problem is present but less acute, therefore farmers tend to dip occasionally when they are conscious of a build-up. Farmers with a limited number of grade or crossbred cows also spray. In AEZ 5&6 tick infestation is lower and zebu have some resistance, so dipping does not pay.

Intensification of livestock production essentially means increased inputs into the production process, and therefore, more resources being invested in order to increase output per unit of land or labour. In addition to the above considerations regarding costs, the intensification process requires the improvement of high quality feed availability and this is being achieved through the planting of grass, hence the need for access to seeds or shoots. Many farmers embarking on grade cattle enterprises had to invest in hired labour. This enabled them to clear more bush for the improvement of fodder supply.

Benefits: Many benefits accruing to farmers keeping livestock are summarised in the DFID (1998) list of functions fulfilled by livestock. These various functions are all well represented in the mixed farming systems of Makueni District, where farm animals are:

- an important source of cash income from the sale or hire of animals, or their products;
- assets that can be crucial in maintaining household survival in times of crisis;
- a central component of the farming system (source of power for cropping, transport and manure for soil fertility maintenance);
- a means to capture private benefits from common property resources (although this is now less common in Makueni);
- a source of livelihood security by diversifying risks and buffering crop yields, particularly in drought-prone environments;
- a source of food, transport, fuel, access to social support networks, cultural well-being and a variety of other functions.

The crucial role played by livestock to assure food security and to enable the education of farmers' children cannot be over-emphasised in Makueni District, where the erratic and variable rainfall is conducive to regular crop failures and critical food shortages. In fact anticipation and management of such crises is the essential factor dictating the way farmers manage their livestock: the most valuable asset at their disposal in the face of an unpredictable future. The majority of farmers interviewed stressed the need for livestock to pay for school fees. Akamba people are aware of the strong relationships between education, income and investment in agriculture. Educated children are better able to provide income for their families. Education is an essential strategy for the Akamba to anticipate livelihood security in the future. Therefore investment in education is a priority item in income expenditure (Nzioka, 2000).

Food shortages frequently result from the poor grain harvests related to drought. To cope with this farmers aim to accumulate livestock within the limits of their grazing resources during good seasons, so they can sell during droughts. The resumption of cropping after a bad year (during which time all plant materials have been consumed) is only possible for farmers who have stored savings in the form of livestock. This is a basic strategy adopted by the majority of farmers to cope with harsh conditions, especially in the low potential areas.

Risks: The major risk to livestock comes from disease. A variety of prevalent health hazards cause regular and significant livestock losses. For 84 percent of farmers interviewed, health problems are the major constraints facing the local livestock industry. Drought comes second, as only 10 percent of farmers rank it as their main problem in keeping livestock. Other minor risks include theft and wild life, though only 6 percent of farmers perceive them as a major constraint. The majority of farmers interviewed have experienced heavy losses due to outbreak of disease, at some point in their farm history. Cattle losses can reach high proportions. For instance, 40 percent of farmers have once lost all their livestock, while 64 percent have once lost 80 percent of their animals. Heavy cattle losses were reported between 1992 and 1995, and in 1997. The livestock district office in Makueni reported that severe drought occurred in 1992 and 1994, as well as epidemics of CBPP in 1992 and 1994. Outbreaks of rinderpest, East Coast fever and blue tongue were reported in 1997.

Farmers have three main responses to disease outbreaks. Many farmers (41 percent) were unable to take any action to control the situation. Reasons for this were lack of money to invest in any type of intervention and poor access to veterinary services. Many farmers (45 percent) reported that they tried to save the remaining animals by buying drugs, vaccines and sprays to treat their animals, while others attempted to save their animals by purchasing extra food to supplement their stock. Some farmers said they moved their animals into other areas. However, this may have been limited in scale because of quarantine regulations, imposed in times of epidemic. Only 10 percent of farmers confirmed that they had sold their remaining animals because they feared that those that survive would soon die as well.

Following heavy cattle losses, the majority of farmers (73 percent) decided to restock their farm, because of the critical role played by these animals to ensure their livelihood through the supply of essential farm inputs (draught animal power) and milk for home consumption and for cash generation. However, restocking usually takes time, as many farmers rely on the slow process of on-farm breeding. However, a few farmers speed up the process of herd reconstitution by buying animals. In the majority of cases, restocking is accompanied by improvements in cattle enterprise management. Many farmers adopted modern methods of health management (vaccination, spraying, buying drugs) after they experienced such huge losses. On the other hand, 27 percent of farmers who lost their stock abandoned cattle keeping, the major reason being that they were unable to gain the necessary financial resources to replenish their herd. Some farmers moved to small stock following loss of large ruminants.

Financing herd re-establishment after losses can take two main forms, both of which are equally popular with farmers. A great number of farmers building up a cattle herd following disease outbreaks or drought made use of the savings they accumulated by selling farm produce and goats. Cropping activities are therefore an important means to finance cattle enterprises (while cattle enterprises themselves provide a back up in times of crop failure). The other major way to finance cattle keeping is through wages and salaries secured from off-farm activities (the salaries of family members working in a town, small businesses, casual work etc). It is therefore apparent that the non-agricultural sector makes a significant contribution to cattle industry investment in Makueni (Nelson, 2000).

2.3 Livestock management

Feed Resources

Natural pasture forms the primary source of livestock feed. Crop residues either consumed *in situ* or collected and stored, are the second most important feed resources available to livestock. The third source of livestock feed is fodder produced on-farm. Table 16 shows the stock density in low and medium potential areas in Makueni. Since both uncropped and cropped land play an important role in supporting livestock production in the mixed farming system, total farm area was expressed relative to total farm livestock biomass in terms of stocking unit (SU, 1 SU = 1 cow = 5 shoats). The range of stock density values reported are 20.0 ha/SU in 1940s and 6.0 to 15.0 ha/SU in the 1970s, for AEZ 5 & 6 (Ackello-Ogutu, 1991). With respect to these figures, it can be hypothesised that pressure on grazing land has increased in Makueni where stock density was 3.12 and 2.25 in 1981 and in 1998, respectively.

Table 16: Hectares per stock unit in Makueni medium and low potential areas

Village	Hectare per Stock Unit (SU), 1 SU = 1 cow = 5 shoats
Medium potential areas:	
• Kyamusoi	1.8
• Kaiani	2.0
Low potential areas:	
• Darajani	1.7
• Athi Kamunyuni	3.4

Source: Own calculations from field data.

Natural pasture

Pasture productivity is dependent on rainfall, season, soil types and management strategies. The latter include stocking rates and pasture improvements such as fencing, reseeding and selective bush clearing. In areas like Athi Kamunyuni, where bush clearing was formerly assured by wildlife that have migrated, bush encroachment and the development of unpalatable and strangling grass species have resulted in reduced grass establishment and therefore lower pasture productivity.

Crop residues: Types of crop residues used as livestock feed include maize, millet, sorghum and pigeon pea stover, cow pea and groundnut leaves. These resources are either grazed in the fields after the grain harvest or they are stored for use during periods when there are shortages of fodder from natural pastures.

Grasses: A number of farmers grow grass to feed their livestock. Grass is grown on strips along terrace edges and acts as an obstacle to water run-off, which also helps control soil erosion. Improvement of feed supply within an intensification process includes the establishment of Napier grass, *Eragrotis superba* and *Panicum maximum*. The Makueni Livestock District office reports that five percent (203 km^2) of cultivated lands are planted with fodder species. There are significant differences between areas, in the extent to which grass strips are used as a soil conservation measure and the choice of this particular method may reflect the level of livestock intensification. Gichuki (2000) found that all farmers in Kaiani and 25 percent of those in Kyamusoi and Darajani used grass strips as one of their soil conservation measures in cropped land, while none were used in Athi Kamunyuni. The level of intensification of livestock enterprises is highest in Kaiani where the largest grade cattle population per farm and per herd is found. This explains why the majority of farmers in this area are growing grass to feed their animals although their farm size is the largest. On the other hand the limited availability of land in Darajani was conducive to the development of farm-grown fodder to meet livestock feed requirements. Some farmers additionally reseed parts of their pastureland from time to time if they observe denudation, protecting it from grazing until it recovers (information from farmers at the Wote workshop).

Feeding management

Because land is well demarcated in all areas, livestock keepers graze their animals exclusively on their own land. However, in Athi Kamunyuni, animals can be grazed out of farm boundaries in large bush areas with absentee management.

Feeding management differs by season, and also according to the size of grazing land available. Those with smaller farms have to practise more labour-intensive management. During the rains in Kyamusoi all farmers tether their animals on their own pastures (either on grass or on crop residues). Tethering animals on own pasture is also common in Kaiani during the rains. Here however, farmers combine this with grazing their animals on crop residues. It is a common practice to keep animals in pens during the rainy season and to feed them stored crop residues. Some farmers also resort to free grazing on own-pasture during the rains, although this practice is not seen in Kyamusoi. Average farm size is larger in Kaiani (15.0 ha) than in Kyamusoi (9 ha). Therefore more abundant pastureland in Kaiani may allow farmers to graze their animals freely without major interference with cropping activities. One farmer owning grade dairy cattle in Kaiani has engaged in improved pastureland management, with the establishment of fenced paddocks that are used in rotation. Feeding practices in this farm include providing cattle with stored crop-residues when milking is taking place. Farmers in Kaiani may also resort to renting extra grazing lands from a neighbour when their own grass is exhausted. One farmer said he pays Ksh 500 per month for eight head of cattle.

During the rains, in Darajani, animals are either tethered on own pasture or zero grazed using stored crop residues during rains. Only one farmer said he could graze his animals freely during the rains on his own pasturelands. Due to limited holding size (an average farm size of 3.3 ha) availability of pastureland may force farmers to restrict animals, movement during the rains and to feed them in a confined environment, either tethered or penned. In Athi Kamunyuni, with large farm sizes of 12.3 ha and limited numbers of cattle, all farmers are able to graze their animals freely on own pastureland during the rains.

During the dry seasons, free grazing, even on own pasture, is ruled out in Kyamusoi. Again due to large holdings size in Kaiani, free grazing is made possible. In addition to freely grazing on own pastureland or on cropland after harvest, animals may be either tethered (on certain farms) or be penned in *bomas* and fed stored crop residues. Pasture renting is also commonly practised in Kaiani.

Zero-grazing or tethering animals during the dry season is the major rule for feeding livestock in Darajani. The situation is different in Athi Kamunyuni where animals graze freely on own pasture during the dry season or on cropland. Animals in this area also have access to large areas of bush not managed by absentee owners. Therefore in low potential areas such as in Darajani, where land availability is limited, farmers make use of confined feeding systems, but the number of animals they can support is limited.

Health management

Major epidemics in Makueni include foot and mouth disease (endemic), CBPP (outbreaks in 1992 and 1994), and rinderpest (epidemic in 1997). Tick-borne diseases such as east cost fever, heartwater, anaplasmosis, trypanosomiasis, helminthiasis are also common in Makueni. Vaccination against rinderpest, blackquarter, anthrax and

rabies are routine activities. Because of changes in healthcare policies and poor extension services, control of diseases deteriorated after 1992, particularly in drier areas with more scattered populations. Not only is the cost of chemicals too high but veterinary assistance is not available when it is needed. Although the number of shops selling veterinary medicines has increased, new health policies have placed modern drugs out of the reach of most farmers, due to their prohibitive cost. As a result farmers are increasingly turning to traditional medicines.

2.4 Crop-livestock integration, intensification

Crop-livestock integration is driven by increased population pressure (McIntire *et al.*, 1992). In a context of difficult access to external inputs, crop-livestock integration is the main opportunity for farmers to intensify their farming systems. The recycling of nutrients and the use of draught animal power for cropping and transport are the two main forms of crop livestock integration in mixed farming systems, where the same household combines livestock and cropping enterprises. Interactions between crop and livestock enterprises evolve through four stages in a process of agricultural and overall economic development (Powell *et al.*, 1995); (1) a pre-intensification phase where crop-production and livestock husbandry are operationally separate enterprises; (2) an intensification phase where crop and livestock production are integrated, mostly through animal draught power and manure linkages; (3) an income diversification phase when investments are made to improve forage supply and quality, and; (4) a return to specialisation through commercialisation. The situation seen in Makueni is a mixed one that stands between the intensification (2) and the income diversification (3) phases, depending on the location in the district and farm characteristics.

A number of factors influence the efficiency of organic matter recycling for the maintenance of soil productivity in mixed farming systems. These include the presence, type and number of livestock kept by farmers, animal diet, watering regime and the spatial and temporal distribution of animals and their voiding in the landscape. Being open and using a limited amount of purchased feeds, the majority of farms in Makueni may be net exporters of nutrients in the form of live animals and milk.

Manure production and management

Manure from all livestock contributes to the nutrient pool available on farm and is valued in cropping fields. The majority of farmers that keep livestock make use of manure for the maintenance of their soil fertility. Manure builds up in the *boma* where animals concentrate their voiding during the year. Unconsumed crop residues fed to livestock add to total organic matter that accumulates in the *boma*, merging with faecal excretions and urine to form manure. Manure is collected during the dry season (either between short and long rains or between long and short rains) and transported to the fields with the use of ox-cart, wheelbarrow or bags. Cattle also spread their excretions (faeces and urine) during grazing hours on croplands. One farmer in Kaiani who keeps a relatively large number of grade cattle, said he produces sufficient quantities of manure for his croplands. However the majority of farmers recognise that the manure produced on their farm does not provide enough organic matter for the maintenance of soil productivity. Therefore they spread manure on a number of terraces each year in rotation. They also add grass and crop residues to animal excretions in order to increase the volume of organic matter.

Two farmers in the low potential areas, one in Darajani and one in Athi Kamunyuni, contended that they do not use manure. The farmer from Darajani said that household soils were fertile enough without manure. The reason given in Athi Kamunyuni seems more convincing. The use of manure is believed to be too risky for plant survival because plants benefiting from manure treatment are more vulnerable to water stress from the droughts that are recurrent in this area.

Farmers are aware of improved methods of improving manure quantity and quality, such as composting, but they contend that labour is a constraining factor. Nzioka (2000) shows the average family labour force is small, consisting of two adults, as children are mainly at school.

Use of animal traction in mixed farming systems in Makueni

Mortimore *et al.* (1991) looked at the history of the ox-plough's adoption in the Machakos District of Kenya. The Makueni-based Agricultural Mechanisation Service has promoted tillage with the ox-plough since the late 1940s. In 1975, 91 percent of farmers owned ploughs and 76 percent owned two or more oxen (Heyer 1975). The reasons behind the successful use of oxen for ploughing and weeding seen in Makueni are of a technical and economic nature. Suitable for most topography and poorly cleaned sites, the ox plough saves labour, time and drudgery, assures timely execution of farm operations in a risky environment and improves crop yield. In addition it is cheaper and more readily available than tractors. In areas characterised by recurrent drought and labour constraints, animal traction has enabled farmers to plant on dry soils and in rows allowing for inter-row weeding. These innovations are critical aspects of the intensification process that has taken place in Makueni farming systems.

Observations made during this study showed that in addition to cultivation, animal traction was also used for water transportation using both cattle and donkeys. In lower potential areas, there are few oxen. In these areas, donkeys are valued both for ploughing and for transport.

2.5 Policy changes and their implications

Major policy directions since 1992 that have impacted on the livestock industry in Makueni include liberalisation and privatisation. The implementation of these policies has yielded both positive and negative effects in extension, marketing and supply of inputs and water.

The availability of farm inputs has been positively influenced by liberalisation. For instance molasses is now more readily available and cheaper than before. However prices of inputs (concentrates) and that of milk have increased as well. Higher milk prices have contributed to the establishment of a number of small dairy units which have in turn increased milk market outlets. Increases in meat prices were the result of deregulation. Farmers responded to meat price rises by increasing production.

Privatisation of borehole management has negatively impacted on the supply of water for livestock. To improve servicing and maintaining machines, private group or community ownership and management was promoted, but this did not bring about the

expected changes. Because of inefficient new management, many water systems have collapsed.

Extension

Before 1988 all qualified graduates were employed. From 1988 very few graduates were employed. Extension based on the training and visit method is being replaced by a participatory approach. Standard extension staff in the late 1980s included subject matters specialists, technical officers and technical assistant. Since 1988, technical officers and technical assistants, who are in contact with the farmers, are no longer recruited. Therefore they are now very few in number. The Structural Adjustment Programme, imposed on Kenya by the World Bank, has negatively affected the extension system. It now covers a more limited area and is less effective than before.

Veterinary policies

A cost-sharing policy has been in place since 1992. Before this policy, immunisation was free. Now it costs Ksh 30 per cow. With new policies, veterinary services have the role to supervise, to advise and to control the animal industry in the district. Clinical and tick control services are completely privatised. However, there is not yet a private vet in Makueni. Farmers resort to chemical stores for the supply of drugs and pay the full costs of veterinary services.

For tick control farmers have organised dip committees elected by the local community. Government support for tick control activities takes the form of supplying some acaricide. However, as a result of the cost-sharing policy many dipping stations ceased to operate. There are now 128 communal dips, but only 79 are functioning. Around 1990 the dips were handed over to community management. Previously, the Government paid the dip attendant, and provided acaricide. The dip committees were formed to run the dip and pay the attendant. They were given a supply of acaricide to form the basis of a revolving fund, which would be replenished out of fees paid by cattle owners. By 1993-94 this stock had been depleted, and the committees were running on their own. By 1995-96, only 90 dips were functioning and many collapsed because farmers were not properly prepared to take over.

Artificial insemination services

The effectiveness of artificial insemination and therefore progress in breeding programmes have been seriously set back by new policies. Under the cost-sharing scheme, semen is made available and cost of transport is borne by farmers. There was a significant increment in cost of artificial insemination, from Ksh 40 to 400. As a result, farmers are turning to bull services that have developed recently. Higher demand for bull services has resulted in a rise in the cost of services. This is now between Ksh 400 and Ksh 300 per service (depending on quality), a price not all farmers can afford.

Because of high costs associated with artificial insemination, such services are difficult to privatise. Current fees for artificial insemination are Ksh 400 with 3 repeats. The real cost is about Ksh 2000 in Makueni. Therefore AI is still heavily subsidised.

Marketing

Government intervention in the livestock trade has been reduced. Since CBPP is no longer a problem, there is no quarantine to constrain livestock trade. However there is still a movement permit that costs Ksh 50 per batch and this is designed to monitor and control the spread of livestock diseases. The hide and skin trade has also been liberalised but requires a licence costing Ksh 2000/year and Ksh 20 per batch. The Kenya Meat Commission stopped operating in 1988.

Support for the bee keeping industry

Makueni District has a high honey production potential, based on the existing multiflora vegetation. In 1989-90, Canadian Co-operation started assisting the bee-keeping industry through the establishment of 11 refineries, with one in Kibwezi. In 1988-1990 the Kenya Bee Keeping Association was also formed to promote the bee industry. By 1993, 800 modern hives were distributed. A major problem facing the industry is the poor management of refineries. In addition, the recommended wooden hives covered with iron sheets were not well adapted to the environment. Adulteration of honey with molasses is also a problem affecting the marketing of honey. The Kenya Bureau of Statistics was supposed to develop standardisation of honey in order to stimulate marketing of the product. In order to control honey standards and to combat fraud, honey officers or inspectors were to be trained and institutionalised. However, the bill has not yet been passed.

3 SUMMARY AND CONCLUSIONS

- Despite the drought of 1995, the livestock population increased from 1992 to 1998. There was an annual increase of six percent for dairy cattle, whereas sheep and goats increased at an annual rate of three percent from 1992 to 1998. The beef cattle population stagnated. A significant increase in the donkey population is observed, with an annual growth rate of 24 percent.

- To build up a herd when they first settled in Makueni farmers: (1) brought in their livestock with them after about 5 years' delay (because of the disease constraints they found there); (2) sold their animals and bought local animals that were more adapted to tsetse flies; and (3) bought goats that were cheaper to buy and were more resistant to tsetse flies.

- Cattle herd establishment, which requires heavy investment, can be achieved through money gained from off-farm sources (e.g. salaries), from the sale of farm produce (e.g. cropping), or through small stock. Inheritance of livestock has been influenced by European culture.

- With the exception of ox ploughing, livestock fulfilled the same functions when people first settled in the area. The current importance of cattle includes use of draught animal power for cultivation and transport, supply of milk and cash generation. The growing dairy industry represents a remarkable development in the evolution of farming systems in Makueni.

- Important changes in grazing management were brought about by land demarcation. When first settled, livestock used to graze freely, although land was individually owned. Nowadays there is no common land, so animals graze only on own or rented pastures.

- The introduction of dairy breeds in the 1980s and 90s was a major strategy farmers opted for to intensify their farming systems, in a context of reduced land resources. Access to grade cattle was assured through purchase, use of neighbouring bulls or government artificial insemination services.

- Intensification of livestock production in Makueni required increased use of labour to clear new lands for grazing purposes, use of more veterinary inputs to control animal diseases and investment in fodder production.

- Accumulation of livestock within the limits of their grazing resources during good seasons, then selling off livestock during droughts is a basic strategy adopted by the majority of farmers to cope with harsh conditions. The resumption of cropping after a bad year is only possible for farmers who have stored savings in the form of livestock. Livestock are also an important means to invest in education and to secure food supply.

- Main sources of livestock feed include natural pastures, crop residues (either consumed *in situ* or collected and stored) and fodder produced on-farm. Depending on the season, farmers combine free grazing, tethering animals on own pastures /crop residues, or zero-grazing.

- Farmers who keep livestock make use of manure for the maintenance of their soil fertility.

- Liberalisation and privatisation policies implemented since 1992 in Makueni yielded both positive and negative effects in extension, marketing and supply of inputs and water.

Livestock play a central role in investment strategies. Farmers use them as an emergency fund in case of crop failure, both to buy food and to get cropping restarted in the next rains. They are also used to fund educational costs. However, building up livestock reserves in itself requires investment, not only to buy stock, but also to improve the feed resources available on the farm, and to buy in veterinary supplies. These investments tend to be financed out of income from non-farm activities and from crop sales, so the three activities in which the farmers are engaged (cropping, livestock rearing, and non-farm activities) are inter-dependant. There are, however, attendant risks. Of these, farmers are most conscious of the risk of disease wiping out their livestock assets, an event that many have experienced. Present veterinary and extension policies have not reduced this risk, and the private sector response is not yet adequate, particularly in the less densely settled areas with scattered populations and less accessible market centres. These areas coincide with the drier zones of AEZ 6, where livestock are more frequently stressed by drought, and where farmers find it particularly difficult to keep cattle. Goats and donkeys appear to survive better. In some parts of this zone they are also closer to game reserves and hence face more danger from trypanosomosis and other infectious diseases carried by wild animals. Farmers in AEZ 4

and parts of AEZ 5 have been able to intensify livestock keeping successfully, and in some cases to move into dairy production with breeds that require higher standards of management, but this option is less viable in AEZ 6.

REFERENCES

Ackello-Ogutu, C. (1991) 'Livestock production', in Tiffen, M. (ed.) 'Environmental change and dryland management in Machakos District, Kenya 1930-90: Production profile', *ODI Working Paper 55*. Overseas Development Institute, London.

CARE International (1991) *Kibwezi environmental management project (KEMP)*: *project proposal for period 1991-1997.* CARE International, Kenya.

DFID (1998) 'The integration of livestock interventions into a sustainable rural livelihood approach', in Diara, C. (ed.) *Sustainable rural livelihoods: What contribution can we make?* Department for International Development, London.

Gichuki, F.N. (2000) 'Makueni District profile: Soil management and conservation', *Drylands Research Working Paper 4.* Drylands Research, Crewkerne, United Kingdom.

Heyer, J. (1975) 'Preliminary report on farm surveys: Tractor and ox cultivation in Makueni and Bungoma', in Westley, S.B. and Johnston, B.F. (eds.) 'Proceedings of a workshop on farm equipment innovations for agricultural development and rural industrialisation', *Occasional Paper 16*: 68-89. Institute of Development Studies, University of Nairobi.

ICRA (1982) 'The farming system in Makueni Location, Machakos, Kenya', *ICRA Bulletin no. 8.* International Course for Development Oriented Research in Agriculture (ICRA), Wageningen, The Netherlands.

McIntire, J., Bourzat, D. and Pingali, P. (1992) *Crop-livestock interaction in sub-Saharan Africa.* The World Bank, Washington DC.

Mortimore, M. and Wellard, K. (1991) 'Environmental change and dryland management in Machakos District, Kenya 1930-90. Profile of technological change', *ODI Working Paper 57.* Overseas Development Institute, London.

Murton, J. (1997) *Coping with more people: Population growth, non-farm income and economic differentiation in Machakos District, Kenya*. PhD thesis, University of Cambridge.

Nelson, John (2000) 'Makueni District profile: Income diversification and farm investment, 1989-1999', *Drylands Research Working Paper 10.* Drylands Research, Crewkerne, United Kingdom.

Nzioka, Charles (2000) 'Makueni District profile: Human resource management, 1989-1998, *Drylands Research Working Paper 9.* Drylands Research, Crewkerne, United Kingdom.

Powell, M. and Williams, T.O. (1995) 'An overview of mixed farming systems in sub-Saharan Africa', in Powell, J.M., Fernandez-Rivera, S., Williams, T.O. and Renard, C. (1995) *Livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa (vol. II): Technical Papers.* Proceedings of an International Conference held in Addis Ababa, Ethiopia, 22-26 November, 1993. International Livestock Centre for Africa, Addis Ababa, Ethiopia.

Tiffen, M., Mortimore, M. and Gichuki, F. (1994) *More people, less erosion*. John Wiley & Sons, Chichester, United Kingdom.