



REPUBLIC OF KENYA
MINISTRY OF ENVIRONMENT AND MINERAL RESOURCES
NATIONAL ENVIRONMENT MANAGEMENT
AUTHORITY



MERU NORTH DISTRICT
ENVIRONMENT ACTION PLAN
2009-2013

EXECUTIVE SUMMARY

Economic growth and environment are closely intertwined in Kenya's development. Environmental Action Planning is a tool that aims at enhancing the integration of environment into development planning. Meru North District faces many environmental challenges with some being unique to the District. Some of the challenges include;

Poverty has led to the over-use and destruction of environment. Continued reliance on trees for fuel and wetlands for farming and its resources has led to deforestation and wetland encroachment. Annual flooding continues to destroy property and frustrate farming.

The DEAP highlights priority themes and activities for the District towards achieving sustainable development. The report is divided into eight chapters. Chapter one gives the challenges of sustainable development and also describes the rationale for and preparatory process of the DEAP. The chapter introduces the district's main profile covering the physical features, demographic, agro-ecological zones, and main environmental issues.

Chapter two describes the District's Environment and Natural resources of Land, Water, Biodiversity (forest, wildlife, and Dry lands biodiversity), wetlands and agriculture, livestock and fisheries. For each resource, major environmental issues, challenges and proposed interventions are identified.

Chapter three discusses the Human settlements and infrastructure in Meru North District covering situation analysis, challenges and proposed interventions. Environmental challenges addressed include; waste management, sanitation, pollution, diseases, land use, demand for water, energy, materials for construction, land and wetlands degradation, policy and legislation, biodiversity loss and land tenure.

Chapter four addresses environmental aspects in tourism, trade, industry and services sectors. The key issues under this chapter are high pollution levels from industrial activities and weak enforcement of relevant legislations.

Chapter five discusses environmental hazards and disasters. The major hazards covered include; drought and floods.

Environmental information, networking and technology are discussed in chapter six. It emerges that environmental information and networking technology have continued to receive scanty attention.

Governance, Policy and Legal Framework as well as Institutional arrangements are set in chapter Seven. The key issues addressed include; harmonization of environmental legislations and institutional mandates, incorporation of indigenous knowledge in environmental management. Chapter eight is the implementation Matrix

.

FOREWORD

The 1992 Earth Summit held in Rio de Janeiro came up with various recommendations, among them Agenda 21, a Global Environmental Action Plan. The theme of the Summit focused on how nations could attain sustainable development. The Government of Kenya embraced this idea by developing the first National Environment Action Plan (NEAP) in 1994.

Since independence, Kenya has continued to demonstrate her commitment to environmental management through various initiatives, among them the National Development Plans of 1974 and the National Environment Action Plan of 1994. Further, there have been a number of sectoral policies on environment in fields such as Agriculture, Livestock, Water, Energy, Food, Land, Wildlife, Forest, Industry, Trade, Arid Lands, Disaster Management and the Draft Sessional Paper No. 6 of 1999 on Environment and Development.

The Environmental Management and Coordination Act (EMCA, 1999) provides for the integration of environmental concerns in national policies, plans, programmes and projects. In this regard, EMCA 1999 provides for the formulation of National, Provincial and District Environment Action Plans every five years.

Environmental Action Planning is a tool that aims at integrating environmental concerns into development planning. The process followed in preparing this DEAP was participatory, involving various stakeholders from institutions and sectors, including the public, private, NGOs and local communities at District and Divisional levels. These consultative meetings provided the basis also for formulation of the PEAP and finally the National Environment Action Plan.

The DEAP addresses environmental issues from various sectors in an integrated manner and discusses their significance in development planning. It proposes a strategy for achieving sustainable development in line with Kenya's quest to meet the Millennium Development Goals (MDGs) Vision 2030 and Medium Term Plan (MTP2008-2012). The Plan has brought out a number of proposed interventions, legal and institutional framework to be incorporated into sectoral development plans and programmes. Its implementation will be monitored by the DEC and will be reflected in the State of the Environment Reports.

The preparation of the DEAPs for Meru North owes much to the technical and financial assistance provided by the NEMA. This support, which included innovative community and civil society

consultations, facilitation of DEC meetings, as well as final publication costs, is gratefully acknowledged

I wish to underscore that the 2009-2013 DEAP report is a broad-based strategy that will enable the District attain sustainable development as envisaged in Vision 2030

Dr Ayub Macharia

Director General (Ag)

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

ACKNOWLEDGEMENT

Environment Action Planning is a multi disciplinary, multi stakeholder and multi-sectoral participatory process. In this connection, many institutions and individuals have contributed immensely to the preparation of this District Environment Action Plan. I take this opportunity therefore, to acknowledge all those who contributed to its preparation.

I particularly acknowledge with appreciation the participation of the District technical Committee charged with the responsibility formulating this action plan for their valuable input, participation and tireless effort to accomplish this task. I further thank the different departments NGOs, CBOs, Research institutions and individual who provided information and data that was the building blocks for this plan.

I also acknowledge the support of NEMA headquarters and the board for facilitating the entire process through provision of appropriate guidance and finances respectively to complete the exercise. Together I am grateful to the Provincial Director of Environment - Eastern Province and the District Environment Officer Meru North for the inputs and commitment to the entire process of preparation of this document.

It is my belief that this plan will be implemented for the betterment of our environment in Meru North District, the province and the country at large.

Dr. Kennedy I. Ondimu
DIRECTOR, ENVIRONMENTAL PLANNING
& RESEARCH CO-ORDINATION

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LIST OF ACRONYMS

ASALs	Arid and Semi Arid Lands
CBOs	Community Based Organizations
CDM	Clean Development Mechanism
DDOs	District Development Officers
DDPs	District Development Plans
DEAPs	District Environment Action Plans
DDC	District Environment Committee
DEOs	District Environment Officers
EMCA	Environment Management Coordination Act
EMS	Environmental Management System
ERSW&EC	Economic Recovery Strategy for Wealth and Employment Creation
GDP	Gross Domestic Product
GIS	Geographical Information System
IK	Indigenous knowledge
MDGs	Millennium Development Goals
MEAS	Multilateral Environmental Agreements
MENR	Ministry of Environment and Natural Resources
MOH	Ministry of Health
NDPs	National Development Plans
NEAP	National Environment Action Plan
NEAPC	National Environmental Action Plan Committee
NEMA	National Environmental Management Authority
NEPAD	New partnership for Africa Development
NGOs	Non-Governmental Organizations
PDEs	Provincial Directors of Environment
PEAP	Provincial Environment Action Plans
PEC	Provincial Environment Committee
PPO	Provincial Planning Officer
PRSP	Poverty Reduction Strategy Paper
SEAs	Strategic Environment Assessments
TAC	Technical Advisory Committee
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Development Programme

WC	Water Closet
WHO	World Health Organization
WSSD	World Summit on Sustainable Development
IGEA	Itinerant Group for Environmental Amelioration

CHAPTER ONE

1.0 Introduction

1.1 Preamble

The United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro in 1992 had a double mandate of finding ways to protect the global environment while ensuring that economic and social concerns are integrated into development planning. The Conference underscored the need to developing modalities for integrating environmental concerns into development policies, plans, programmes and 'projects. It agreed on the guiding principles and a global plan of action for sustainable development commonly called Agenda 21

The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, reaffirmed the commitments of the international community to the principles of sustainable development contained in Agenda 21 and the Millennium Development Goals (MDGs) of 2000.

Sustainable development is commonly defined as *"development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"*. Development is also sustainable if it meets ecological, economic and social needs. This calls for the integration of environmental considerations at all levels of decision making in development planning and implementation of programmes and projects.

The Government of Kenya is committed to the achievement of sustainable development stated in Agenda 21, the Millennium Development Goals, Vision 2030 and the Johannesburg Plan of Implementation. This commitment to environmental protection and sustainable use of natural resources is well articulated in various Government policy documents including the Sessional Paper No.6 of 1999 on Environment and Development, the Economic Recovery Strategy for Wealth and Employment Creation (2003-2007) and the National Development Plan (2002-2008). These policies and plans recognize integration of environmental concerns into national planning and management processes and provide guidelines for achieving sustainable national development.

The 9th National Development Plan (2002-2008) states that *"The full integration of environmental concerns in development planning process at all levels of decision making remains a challenge to the country, the need to integrate environmental concerns in development activities should be given high priority"*. The Environmental Management and Coordination Act (EMCA) of 1999 provides for the integration of environmental concerns into the national development process. The National Environment Management Authority (NEMA) is

mandated to implement the Act and in particular coordinate the preparation of Environmental Action Plans (EAPs) at the District, Provincial and National level.

Poverty is a major challenge to the Goals of the sustainable development Sound environmental and natural resources management should contribute to poverty reduction, food security and sustainable livelihoods, enhanced environmental quality and health, promotion of sustainable energy production, minimization of pollution and waste, improvement of shelter and habitats, promotion of eco-tourism and improved standards of living.

1.2 Challenges of Environment Management

Kenya's economy primarily depends on natural resources where over 68% of the population live in rural areas and derive their livelihoods mainly from these resources. Economic activities derived from, the natural resources include agriculture, industry, tourism, energy, water, trade, and mining. The environment and natural resources have in the recent years been under, threat due to increased dependence on natural resources to meet basic needs. The situation is aggravated by the rising poverty levels from 42% in 1994 to 56% in 2002 and is currently estimated to be over 62%. The situation is even worse within the rural population. The population growth rate has over time become higher than the economic growth rate hence the pressure on these resources. This has also led to increased in-migration and over-utilization of fragile ecosystems. The immigration into marginal areas from high potential areas has contributed to unsustainable land use practices often resulting in resource use conflicts especially water and pasture.

Poverty often leads to over-use and destruction of the environment where short-term development goals and practices are pursued at the expense of long-term environmental sustainability. Once the resource base is degraded, poverty is aggravated because the capacity of the resource base to support the same population even with unchanged demand will have diminished. Therefore, there exist a close link between poverty and environment.

Rapid urbanization coupled with increased slum settlements due to rural-urban migration have resulted in urban decay, loss of environmental quality and health deterioration, water pollution, loss of biodiversity and encroachment of fragile ecosystems. In both rural and urban areas, access to safe drinking water and basic sanitation is a critical environmental and health concern. The widespread accumulation of solid wastes and poor disposal of effluents in urban areas is also an

environmental hazard culminating in air and water pollution and increased incidences of respiratory and water borne diseases.

About 88% of Kenya's land areas are classified as arid and semi arid lands (ASALs) which supports over 50% of livestock, about 30% of the population and most wildlife. Climatic variability has reduced the capacity of ASALs to support existing and emerging livelihoods thus further aggravating environmental degradation. This is evidenced by increased soil erosion, reduction in pasture and vegetation cover, food insecurity, increased conflicts and insecurity - all contributing to increased poverty

Prior to the enactment of EMCA 1999, environment management in Kenya mainly focused on administrative boundaries with little regard to trans-boundary and shared resource issues. Consequently, management of these resources has not been adequately addressed, including watersheds, wildlife and mountain ecosystems among others. The challenge is to develop integrated management plans for inter- and intra-districts, provinces, regional, national and international boundaries.

Indigenous management systems that are sustainable have largely been disregarded in the recent past leading to environmental deterioration. Sectoral regulatory instruments, which have been used to manage the environment before enactment of EMCA 1999, did not achieve the desired outcomes. This is largely attributed to lack of linkages, sectoral conflicts/overlaps, resource limitations, inadequate stakeholder involvement hence weak compliance and enforcement.

The challenge of managing environmental resources sustainably calls for the development of integrated management plans and, their implementation. Integrated planning enables harmonization of sectoral priorities, stakeholder involvement and participation, proper programming and budgeting system.

Section 38 of EMCA provides for the preparation of District, Provincial and National Environment Action plans every five years.

1.3 Provisions of EMCA on Environmental Planning

Part IV of the Environmental Management and Coordination Act (EMCA), 1999 deals with environmental planning at the national, Provincial and district level. Section 40 specifically deals with environmental planning at the district level and states in part:

Every District Environmental committee, shall every five, years prepare a district environment action plan in respect of the district for which it is appointed and shall submit such plan to the chairman of the provincial environment action plan committee for incorporation into the provincial environment action plan proposed under section 39.

1.4 Objectives of District Environment Action Plan

- To determine the major environmental issues and challenges facing the country;
- To identify environmental management opportunities;
- To create synergy and harmony in environmental planning;
- To integrate environmental concerns into social, economic planning and development; and
- To formulate appropriate environmental management strategies.

1.5 The environmental action planning process

DEAP METHODOLOGY

The process started by holding regional workshops, which the DEAP Secretariat was appointed by the Director General in 2004. That comprised of a District Water Officer, District Development Officer (DDO) and District Environment Officer (DEO) to attend an induction course on the DEAP methodology. The District Environment Committee (DEC) members gazetted in 2003 were further requested to form a District Environment Action Planning Committee (Technical Committee comprising lead agencies and representatives from other stakeholders), chaired by the DDO and the DEO is the secretary. Once the draft DEAP is prepared, the DEC approves and submits to the Provincial Environment Committee for inclusion in the Provincial Environment Action Plan.

The District Environment Action Planning Committee spearheaded the preparation of the Meru North DEAP. The committee requested for sectoral environment reports from the lead agencies and compiled the DEAP. The Meru North District Environment Action Plan was further enriched through participatory planning approach in which consultation workshops at the district

The preparation of the Meru North DEAP has been realigned with Vision 2030, Mid-Term Plan

2008-2012 as directed by the government. The current DEAP covers the period of 2009-2013 and as per EMCA shall be revised after every five years. The DEAP will be monitored by the annual preparation of the State of Environment Reports. The environmental indicators that have been developed in the implementation matrix will be monitored by the respective lead agencies on an annual basis and incorporated in the annual State of Environment Report. The National Steering Committee and the National Environment Action Planning Committee have approved the indicators.

1.6 District profile

1.6.1 Geographical Location, Size and Administrative Units

Meru North District is one of the four districts that formerly made the greater Meru District and was carved in 1993. It is one of the thirteen districts in Eastern Province of Kenya with a total area of 3,942.30 Km². It borders Meru Central District on the West side, Tharaka District on the South, Isiolo District on the North East and Tana River and Mwingi Districts on the South Eastern side.

The district lies within latitudes 0° 00' and 0° 40' North, and longitudes 37° 50' East, with the southern boundary lying along the equator. The district has fifteen (15) administrative divisions, which are further sub-divided into fifty six (56) Locations and one hundred and thirty nine (139) Sub-locations as shown in table one

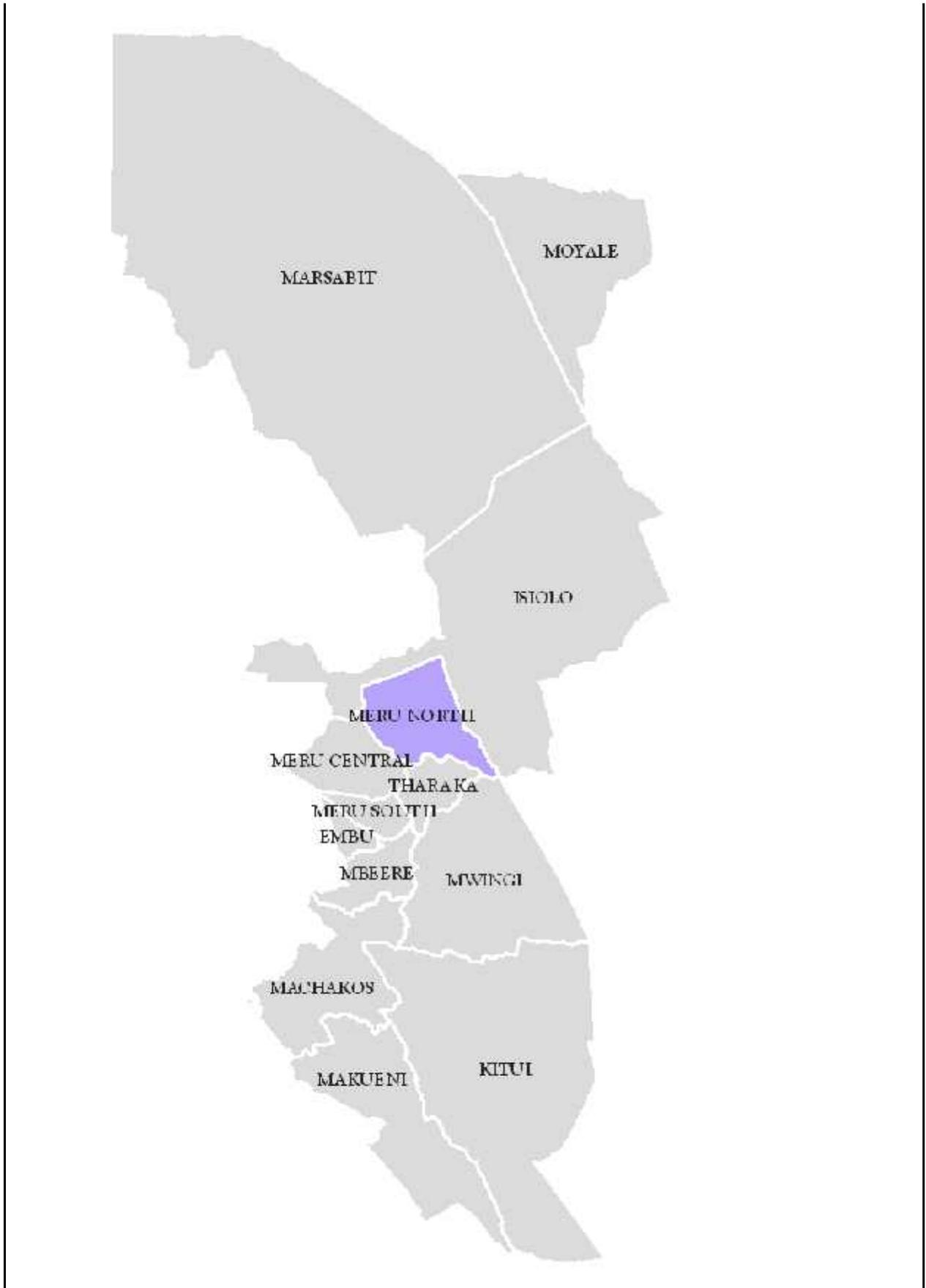


Figure 1: Location of Meru North district in Eastern Province.

Table 1: District Area by Division and Number of Locations and Sub Locations

Division	Area Km²	Locations	Sub-Locations
Igembe North	280.0	6	13
Igembe Central	47.6	6	14
Igembe South	74.1	3	8
Igembe South West	77.6	4	8
Igembe East	71.8	3	9
Igembe South East	60.4	3	6
Laare	415.0	3	6
Ndoleli	238.3	4	10
Mutuati	674.1	2	4
Tigania Central	119.4	4	9
Uringu	104.4	4	13
Tigania North	495.4	4	11
Tigania West	135.2	3	7
Tigania East	108.6	2	5
Akithi	162.2	5	16
Meru National Park	878.2		
Total	3942.3	56	139

Source: District Development Plan 2002 – 2008 1999

1.7 Climate and physical features

Altitude

The topography of the district is dominated by the great Nyambene range, which creates the diversity of the physical landscape that affects the physiographic and the entire environment of the district.

The district lies between an altitude of 2,514 M at the summit of the Nyambene range and 300M ASL in the Meru National Park bordering Tana River District. The Nyambene range is elongated from the South East to the North East and rises sharply above the surrounding plateau, with Itiene peak as the summit of this elevation at 2,514 M ASL. The slopes are very steep and rocky especially to the eastern side but the crests are much lower as very little land is above 1,829 M ASL.

The plateau runs south to north from Mt. Kenya to Nyambene Hills and is separated from the lowlands by a clear break on topography between 914 M and 1,067M ASL. The lowest altitude is 610 M ASL. There is an escarpment to the east rising between 15 M and 100 M ASL which is characterized by many springs and the land gently descends towards Tana River.

Rainfall and Temperatures

The district's climate is determined to a large extent by its topography; the relief is created by the Nyambene ranges and nearby Mount Kenya. The highlands reduce the effect of high temperatures and the rate of evaporation. Temperatures are cool-humid to hot and dry ranging from an annual mean of 24.7 °C for low altitudes (610 – 700 M) and 13.7°C for the high altitudes especially on the western slopes of the Nyambene ranges.

The lowlands thus receive low rainfall as they are on the leeward side of the range. The rainfall pattern is bi-modal with long rains coming between March and May, and the short rains from October to December. Rainfall ranges from 1,250 mm – 2,514 mm on the eastern and southern slopes of the Nyambene range, to 380 mm – 1000 mm annually in the leeward side.

1.8 Population size and distribution

The population of the district is estimated at **692,435** persons (at 2004) at a male to female ratio of 1:1.06 (100:94) and an inter census growth of 2.76 % with an average life expectancy of 62 years. The population density is estimated at 174.9 persons per Km² with Igembe Central division with the highest density and the least being Mutuati division. The youth or persons between 15 - 25 years account for about 25 % of the entire population of the district. Table 2 ,3, 4 and 5 show the demographic features of the district

Table 2: Population Size and Distribution (Density) by Division

Division	Years									
	1999		2002		2004		2006		2008	
	No.	Density								
Igembe North	58,046	207	63,057	225	66,635	238	70417	251	74,413	266
Igembe Central	41,944	881	45,565	957	48,151	1,012	50883	1,069	53,771	1130
Igembe South	18,209	246	19,781	267	20,903	282	22090	298	23,344	315
Igembe South West	21,791	281	23,672	305	25,016	322	26435	341	27,935	360
Igembe East	28,575	398	31,042	432	32,803	457	34665	483	36,632	510
Igembe South East	18,700	310	20,314	336	21,467	355	22685	376	23,973	397
Laare	65,428	158	71,076	171	75,110	181	79372	191	83,877	202
Ndoleli	54,730	230	59,455	249	62,829	264	66,394	279	70,163	294
Mututi	56,751	84	61,650	91	65,149	97	68,846	102	72,753	108

Tigania Central	45,06 1	377	48,951	410	51,72 9	433	54,66 5	458	57,76 7	484
Uringu	39,00 3	374	42,370	406	44,77 5	429	47,31 6	453	50,00 1	479
Tigania North	49,09 8	99	53,336	108	56,36 3	114	59,56 2	120	62,94 2	127
Tigania West	32,26 6	239	35,051	259	37,04 1	274	39,14 3	290	41,36 4	306
Tigania East	30,94 4	285	33,615	310	35,52 3	327	37,53 9	346	39,66 9	365
Akithi	43,09 6	266	46,816	289	49,47 3	305	52,28 1	322	55,24 8	341
Meru National Park	408	1	443	1	468	1	495	1	523	2
Total	604,0 50	153	656,1 94	166	693,4 35	176	732,7 88	186	774,3 75	196

Source: District Statistics Office, Maua, 2001

Table 3 : Population Distribution by Gender and Age

	Years									
	1999		2002		2004		2006		2008	
Age	Male	Female								
0-4	51,552	51,370	56,002	55,805	59,180	58,972	62,539	62,318	66,088	65,855
5-9	45,883	45,730	49,844	49,678	52,673	52,497	55,662	55,476	58,821	58,625
10-14	42,989	44,064	46,700	47,868	49,350	50,584	52,151	53,455	55,111	56,489
15-19	34,247	38,971	37,203	42,335	39,315	44,738	41,546	47,277	43,904	49,960
20-24	25,278	31,769	27,460	34,511	29,019	36,470	30,665	38,540	32,406	40,727
25-29	19,996	22,328	21,722	24,256	22,955	25,632	24,258	27,087	25,634	28,624
30-34	14,584	14,911	15,843	16,198	16,742	17,117	17,692	18,089	18,696	19,115
35-39	13,266	14,315	14,411	15,551	15,229	16,432	16,093	17,366	17,007	18,351
40-44	9,731	10,823	10,571	11,757	11,171	12,425	11,805	13,130	12,475	13,875
45-49	8,835	8,548	9,598	9,286	10,142	9,813	10,718	10,370	11,326	10,958
50-54	7,162	7,100	7,780	7,713	8,222	8,151	8,688	8,613	9,182	9,102
55-59	4,612	4,312	5,010	4,684	5,294	4,950	5,595	5,231	5,112	5,528
60-64	4,402	4,947	4,782	5,374	5,053	5,679	5,340	6,001	5,643	6,342
65-69	3,043	3,279	3,306	3,562	3,493	3,764	3,692	3,978	3,901	4,204
70-74	2,802	3,096	3,044	3,363	3,217	3,554	3,399	3,756	3,592	3,969
75-79	1,770	1,633	1,923	1,774	2,032	1,875	2,147	1,981	2,269	2,093
80+	2,425	2,572	2,634	2,794	2,784	2,953	2,942	3,120	3,109	3,297
Age NS	808	897	878	974	928	1,030	980	1,088	1,036	1,150
Total	293,385	310,665	318,711	337,483	336,799	356,636	355,912	376,876	375,312	398,264

Source: District Planning Unit, Maua, 2001 – DPP (2002 – 2008) Note: Age NS =Age not shown)

Migration

About 96% of the population within the district live in the rural areas, while the remaining 4% is concentrated in mainly in the two main urban centres of Maua and Laare. Nevertheless an increasing number especially of young people are migrating to the urban centres within and without the district.

Net migrants

Male: -1.3%

Female: 15.7%

Density and Distribution in Urban and Rural Areas

Table 4: Number of Urban Centres by Actual Population

Urban Centres	Estimated Population (2002)
Maua	53,739
Laare	25,429
Mukinduri	Over 500
Mutuati	Over 500
Muthara	Over 500
Kiengu	Over 500
Kianjai	Over 500
Karama	Over 500
Muriri	Over 500
Ngundune	Over 500
Nchiru	Over 500
Kangeta	Over 500
Maili Tatu	Over 500
Murera	Over 500 – mainly Informal Settlement
Miathene	Over 500

Source: Population Census 1999 Projections- District Statistic Bureau

Table 5: District Population Projections

Age	2009		2010	
	Males	Females	Males	Females
0-4	42,339	41,136	41,735	40,333
5-9	50,861	48,986	51,189	49,073
10-14	56,831	54,757	57,951	55,608
15-19	50,035	50,125	51,258	51,123
20-24	33,346	38,385	34,248	39,156
25-29	25,911	31,327	26,655	32,004
30-34	21,067	24,844	21,634	25,441
35-39	17,386	20,100	17,864	20,590
40-44	14,719	15,899	15,166	16,246
45-49	12,053	12,963	12,415	13,242
50-54	9,345	10,795	9,600	11,066
55-59	7,269	8,492	7,436	8,674
60-64	5,072	5,550	5,122	5,551
65-69	4,164	4,704	4,203	4,713
70-74	3,725	4,564	3,789	4,641
75-79	3,754	5,131	3,879	5,334
80+	6,495	7,513	6,726	7,750
Total	364,372	385,271	370,870	390,545

Source: Kenya 1999 Population and Housing Census

1.9 Social, cultural and economic characteristics

Social and Economic Characteristics

Agriculture is the main stay of the people of Meru North. Its climatic setup and the resultant vegetation can be grouped into two major zones divided roughly by the Meru Kangeta Laare road.

The zone to the southern side of the road is highly influenced by the Nyambene range, which rises over 2400 meters above sea level and is a source of several medium size rivers that flow to the Tana and Uaso Nyiro Rivers. This zone receives sufficient rainfall in two seasons from April to June from September to December. The Zone produces several high value cash crops including coffee and miraa. It also produces food crops including maize, beans yams, and bananas.

The northern side of the road comprises of drier and semi-arid parts of the District characterized by savannah grassland, low-density population and pastoralist activities. The zone gets sporadic rainfall with characteristic ample harvest when the rain is sufficient and little to zero harvest when the rain fails. This is the poorest zone of Meru North District and does not have any meaningful cash crop. The inhabitants survive on subsistent farming and keep zebu cattle in nomadic environment that is vulnerable to vagaries of weather, disease and cattle rustling.

Poverty Levels and Distribution

According to the Second Report on Poverty in Kenya (November 2000) the distribution of household members by sex and poverty shows that 340,856 members were classified as poor of which 51% were male and 49% female. Those classified as non-poor were 408,723, 46% being male and 53.8% female. The average household of the poor was 6.5% while that of non-poor was 6.3. The District performs very poorly when compared with the national averages in terms of polygamy and school attendance at all levels. The majority of the children do not go to school in the District (30%) compared with the national average of 7.8%.

Poverty Impacts on the Environment

Over time the interaction between man and the environment have evolved into the development of some beliefs, practices and norms that are meant to safeguard and protect the environment. In the Meru culture the supreme authorities' rests with Nchuri Ncheke (council of elders) and have some protected shrines in the Nyambene Hills and other sacred sites. The community have for a long time respected the catchment areas and some indigenous tree species important for conservation, water catchment and the environment at large.

The use of agro-chemicals and fertiliser in production of some food crops and Miraa is also restricted by the cultural belief that they are harmful to the soil and human health.

Most of families engaged in the production of food do so as peasant farmers at a very subsistence level, and there is a deficit in production and the district imports most of its food requirements. In the process of trying to eke a living from land, the farmers have cleared most the vegetation cover and encroached on very fragile environments resulting in massive soil erosion and general land degradation. Draining of swamps and diversion of river courses to gain farmland and do irrigation

respectively has disrupted important ecosystems and affected the general environment of those areas.

Most of the poverty reduction strategies in place are geared towards economic recovery and creation of employment. At this level production of food crops for sustenance and daily struggle relegate environmental issues to the back seat. It's not until some basic needs are met that people will respond to conservation measures. The strategies attempt to link economic development with environment for sustainability but in place it is becoming increasingly difficult to implement conservation measures among the poor, who solely depend on the natural resources to make a living.

CHAPTER TWO

2.0 Environment and natural resources

2.1 Land use and soils

The soils are varied mostly influenced by the Nyambene range and the underlying bed rock. The upper areas of the district have friable clay soils, which are of medium depth in most areas with moderately high fertility, and suitable for coffee and tea growing, while in lower areas the soils are sandy, shallow and generally of poor quality, suitable only for cotton growing and ranching (livestock). Most of the landscape on the North and North East is punctuated by rocky outcrops that make even communication very difficult

The main soils are basically volcanic with specific derivatives from the parent rock. The main derivatives include:

- i) Cambisols (clay loam to clay) which occupy about 40 % of the district
- ii) Friable clays which occupy about 30 % of the district
- iii) Lithosols, xerosols, ferrasols and aeronosols cover the rest 30% of the district.

Table 6 shows the types of soils and their distribution in the district.

Table 6: Types of Soils and their Distribution in the District

Type of Soils	Part of the District	Position in the District
Nito-humic cambisols	Igembe Central division and part of Nyambene Forest	Central Part
Friable clays	Tigania and Igembe divisions	Area surrounding the central part and the slopes of Nyambene ranges.
Cambisols	Mutuati division	Northern Part
Cambisols and with some pockets of calcic chernozems	Akithi, Tigania North and parts of Igembe North divisions	North Western.
Lithosols and calcic xerosols	Ndoleli and Mutuati divisions	North Eastern
Friable clays with some	Uringu and Tigania West	Western

pockets of verto-luvic phaeozems		
A strip/zone of nitro-rhodic ferralsols with pockets of calcic chernozems on the east	Cuts across Tigania East and South Igembe divisions	Southern
Cambisols		South eastern
Arenosols		Southern

Source: District Agriculture Office – Farm Management Plan 2003

Ecological zones

The major land potential classifications in the district are as follows:

- i) High potential - 329 km²
- ii) Medium potential - 268 km²
- iii) Low potential - 181 km²
- iv) Semi-arid - 587 km²
- v) Arid - 57km²

The specific ecological zones and area coverage are classified in table 7 below

Table 7: The Area Covered by Each Agro-Ecological Zone

Agro-Ecological Zone	Area (km²)
Upper Midland (UM1)	37
Upper Midland (UM2)	95
Upper Midland (UM3)	148
Upper Midland (UM4)	47
Upper Midland (UM5)	30
Lower Midland (LM1)	
Lower Midland (LM2)	
Lower Midland (LM3)	268
Lower Midland (LM4)	208
Lower Midland (LM5)	149
Lower Midland (LM6)	518

Source: District Agriculture Office – Farm Management Plan 2003

2.2 Land and land use changes

Land is the basic natural resource. It forms the basis for the country's socioeconomic development. It supports agriculture, livestock, forestry and wildlife. With increasing population, poverty levels and demand for the resources, instances of over exploitation and degradation of natural resources are common.

Pressure on land continues to increase with increase in population mainly due demand for land for settlement and food production. Following this trend more and more land is being cleared for agricultural and settlement purposes including land that was traditionally not intended for such purposes like swamps, steep slopes and hill tops. Land also previously utilised as grazing areas is now being cultivated in the endeavour to meet the growing demand for food. Irrigation projects are also changing the usage of land as previously utilised due the availability of water and markets for horticultural products. Changes in farming and grazing systems are also influencing land use changes, even as more trading centres continue to sprout in areas that were previously considered as purely rural in nature due to the influence of urbanisation.

Impacts of Land Use Changes

The pressure on land due to population increase and economic situations in the district has led to land use changes that have far reaching environmental impacts

- The encroachment of marginal lands and vulnerable areas for cultivation and settlement
- Land degradation and soil erosion
- Encroachment of wetlands and forest land
- Settlement on environmentally vulnerable areas that were previously conservation areas

Table 8 indicates the district's land use potential according to their agro-ecological zones.

Table 8: Land Use Potential

Agro-Ecological Zone	Current land use	Potential land use	Division	Constraints / Challenges	Proposed interventions
LM2, LM3, LM4	Miraa, Coffee, Maize, Beans, Bananas, Millet, Cowpeas	Horticulture Floriculture Wildlife conservation	Mutuati	<p>Food Production</p> <ul style="list-style-type: none"> • Declining soil fertility due to Mono-cropping • Fertility maintenance 	<ul style="list-style-type: none"> • Crop rotation • Agro forestry • Conservation measures on all farms
LM3, LM4	Coffee, Tobacco, Cotton, Maize, Beans, Bananas, Millet, Cowpeas and Beef cattle	Horticulture Floriculture Eco-tourism	Tigania West	<ul style="list-style-type: none"> • Little use of manure in land preparation • Poor farming practices • Burning of crop residue • Grazing on crop residue 	<ul style="list-style-type: none"> • Enforce forest protection • Train on safe use of agrochemicals • On farm storage • Training on Post harvest management and values adding in food preservation
LM2, LM3, LM4, LM5	Miraa, Tea, Coffee, , Maize, Beans, Dolichos, Beef and Dairy cattle	Horticulture Floriculture	Igembe South	<ul style="list-style-type: none"> • Land degradation due to soil erosion caused by • Cultivation on steep slopes • Deforestation • Poor siting of roads • Poor farming methods • Increase <i>in</i> PH due excessive use of fertilisers and chemicals in Tea/Coffee zones 	<ul style="list-style-type: none"> • Intensive use of land resources • Legislation on land sub-division

<p>UM2, LM2, LM3</p>	<p>Tea, Coffee, Maize, Beans and Beef cattle</p>	<p>Horticulture Floriculture</p>	<p>Tigania North</p>	<ul style="list-style-type: none"> • Leading of nutrients without replenishing • Use of manures/compost • Poor choice/use of crop protection chemical • Training on safe use of agrochemicals • Low crop and livestock yields due to • Poor choice of finisher • Use of uncertified seeds • Low/poor use of inputs • Post harvest losses • Decrease in farm sizes Institutional • Poor road net work in especially coffee zone • Electricity • Credit • Bank collaterals • Poor landing terms • High cost of inputs Social • Literacy of levels • Gender disparity • Poverty
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UM1, UM2, LM1	Miraa, Macadamia, Tea, Maize, Beans, Bananas	Horticulture Floriculture	Igembe Central		
LM2, LM3, L4	Miraa, Coffee, Macadamia, Maize, Beans, Peas, Dairy and Beef cattle	Horticulture Floriculture	Laare		
LM2, LM3, LM4	Coffee, Cotton, Maize, Beans, Sorghum, Millet, Sheep, Goats and Local Zebu beef cattle and their crosses	Wildlife conservation Eco-tourism	Akithi		
LM2, LM3, LM4	Coffee, Miraa, Maize, Beans, Bananas and Dolichos	Horticulture Floriculture	Ndoleli		
LM2,LM3 LM4, LM5	Tea, Coffee, Miraa, Beans and Bananas	Horticulture Floriculture	Igembe South West		
LM2, LM3, LM4, LM5	Coffee, Miraa, Maize, Sorghum, Beans and Cotton	Horticulture Floriculture	Igembe South East		

LM2, LM3, LM4	Tea, Coffee, Miraa, Beans and Maize	Horticulture Floriculture	Igembe East		
LM1, LM3, LM4, UM2, UM3	Coffee, Tea, Maize, Beans, Dolichos, Njahi, Sorghum and Millet	Horticulture Floriculture	Tigania Central		
LM3, LM4	Tobacco, Cotton, Coffee, Millet, Beans, Maize, Miraa, Njahi, Dolichos, Millet, Sorghum and livestock animals	Horticulture Floriculture Tourism	Tigania East		

Source District Agriculture Office - 2004

Dry Lands

The district has a total area of 3,942.30 km² that is distributed into the following uses as per the data available in 2001 as indicated in table 9 below.

Table 9: Distribution of Land Uses in the District

Land use	Area (Km ²)
Arable land	1,832
Non-arable land	2110.3
Rangeland – Northern Grazing Area	1,002
Meru National Park	878.2
Gazetted forest	110
Wetlands – Swamps, Marshy land etc	120.3
Urban area	44.6

Source: District Development Plan 2002 -2008

Extent and Status

The dry lands of Meru North district cover an area of about 1,002 km² and are expansive grazing areas for both livestock and wildlife. The grasslands are home to a number of tree and shrubs. The status of the NGA is not yet quantified. The main activities in the dry lands of Meru North district is grazing of livestock animals. The area also serves as a Diaspora for the wildlife in both Meru Conservation area and those in the Mt. Kenya region.

The NGA has a carrying capacity of 1 to 3 hectares per livestock unit. The capacity continues to decrease due to land degradation and as more land is converted into agricultural use or for settlement. There are about seven ranches in the district with an average of 40,000 acres each, in addition to the communal trust land where most people do graze their animals.

Dry lands include arid, semi-arid and dry-sub humid areas. It occupies about 88 % of the total land surface in Kenya mostly in ecological zones IV to VI. These areas are mainly utilized for pastoralism and agro - pastoralism. The dry lands support over 75% of wildlife resources and over 50% of the livestock in the country thereby contributing significantly to national economic development. Further the dry lands are home to over 30% of the national population. However, potential productivity of the dry land is threatened by increasing land degradation due to human related activities and adverse climatic factors. This calls for strategic interventions to minimize and mitigate negative impacts of land degradation in the dry lands.

Major Causes of Land Degradation

- Overgrazing
- Cultivation
- Deforestation
- Wild fires
- Droughts
- Conflicts
- Charcoal burning

Key Environmental Issues

- Human wildlife conflicts
- Insecurity and cattle rustling
- Prolonged and extended drought leading to severe shortage of water and pasture
- Overexploitation and negligence of the dry lands – no man’s land and therefore no conservation measures are put in place.
- Overstocking and overgrazing
- Land degradation

Proposed Interventions

- Provision of water to enhance regeneration and productivity of the dry lands
- Providing security to curb cattle rustling and loss of both animals and human life.
- Provision of technical advice on stocking to avoid overgrazing and the resultant environmental degradation
- Reduce human wildlife conflict and promote coexistence of wildlife and human beings

Table 10 shows the districts land use systems with regard to the agro-ecological zones

Table 10: Land Use Systems

Agro-ecological zone	Land tenure	Land use type	Area (km ²)area
Upper Midland (UM1)	Freehold - some areas under adjudication	Agriculture Livestock	37
Upper Midland (UM2)	Freehold - some areas under adjudication	Agriculture Livestock	95
Upper Midland (UM3)	Freehold - some areas under adjudication	Agriculture Livestock	148
Upper Midland (UM4)	Freehold - some areas under adjudication	Agriculture Livestock	47
Upper Midland (UM5)	Freehold - some areas under adjudication	Agriculture Livestock	30
Lower Midland (LM1)	Freehold - some areas under adjudication	Agriculture Livestock	
Lower Midland (LM2)	Freehold - some areas under adjudication	Agriculture Livestock	
Lower Midland (LM3)	Freehold - some areas under adjudication	Agriculture Livestock	268
Lower Midland (LM4)	Freehold - some areas under adjudication	Agriculture Livestock	208
Lower Midland (LM5)	Freehold - some areas under adjudication	Agriculture Livestock	149
Lower Midland (LM6)	Freehold - some areas under adjudication	Agriculture Livestock	518

Source: District Agriculture Office – Maua 2007

Key Environmental Issues

- Reduction of cases involving land disputes
- Poor policy and legal framework
- Land degradation and soil erosion
- Encroachment of conservation areas
- Poor management of wetlands and catchments areas

- Lack of proper utilization of land in urban areas

Proposed Intervention

- Increase the number of personnel in lands office
- Elect credible elders in land adjudication committees
- Hasten the process of issuing title deeds

2.3 Agriculture.

Agriculture and livestock are the main sources of livelihoods for rural populations. The three broad agricultural production systems are crop cultivation, livestock rearing and fisheries. Each of the production system has the potential to significantly affect human and environmental health.

Types of Agricultural Systems

- Subsistence farming
- Cash crop farming
- Commercial farming
- Horticulture

Status and Trends of Agricultural Development

The following trend shows the agricultural development and production of some of the documented crops in the district as shown in table 11.

Table 11: Status and Trends of Crop Production

	Maize	Sorghu m	Beans	Pigeo n Peas	Dolich os	Tea	Coffee
1993 Acreage(H a)	29,740	3,130	28,230	4,727	2,050	3,306	7,360
Yields (Bags)	258,58 0	31,120	268,76 0	56,688	12,300	18,545,40 0	3,227,02 5
1997 Acreage(H a)	50,000	5,550	44,300	5,400	4,600	3,300	7,360
Yields (Bags)	600,00 0	38,850	177,20 0	27,000	27,600		537,917

1999	51,270	5,150	45,290	4,650	4,550	3,676	7,360
Acreage(Ha)							
Yields (Bags)	545,270	36,050	271,740	32,100	31,850	29,040,400	1,538,734
2002	50,500	5,800	46,860	3,580	4,700		7,360
Acreage(Ha)							
Yields (Bags)	762,500	53,000	448,000	35,800	47,000		3,725,733
2004	51,000	5,400	46,600	3,550	4,250	3,683	7,360
Acreage(Ha)							
Yields (Bags)	408,000	27,600	169,225	16,750	35,500	29,108,429	3,700,008

Source: District Agricultural Office 2007e- Meru North District

Constrains to crop production

Agricultural activities often contribute to a large extent to environmental degradation. Some of the ways in which this occurs is in **Soil erosion**.

Wind erosion - especially in the lowlands of Tigania division where the vegetation cover is low and

Sheet erosion - most common in the district on the slopes of more than 12% gradient

Channel flow erosion (rill, gully and river bank erosion) caused by reducing vegetation due to human activities and settlement, poorly placed roads, overgrazing etc

Acidification – This is caused mainly by the use of acidifying fertilisers, burning of vegetation and leaching of bases.

Salinity - this is localized in small areas

Disposal of agricultural waste in rivers and encroachment of water catchment areas and water sources by individuals who undertake agricultural activities and destroy the fragile environment

Key Environmental Issues

- Decreasing land size
- Decreasing soil fertility
- Unpredictable and over reliance on rain fed agriculture
- Miraa growing culture
- Pests developing resistance to common pesticides
- Invasion of new pests e.g. Osama
- Irrigation potential not tapped
- Lack of diversification

Proposed Interventions

- Use of organic fertiliser and manure
- Use of legumes to improve soil fertility
- Use of IPM and bio pesticides
- Adoption of appropriate farming methods and technologies
- Water and soil conservation measures

Table 12 documents the types and status of farming systems in the district.

Table 12: Types and Status of Farming Systems

Type of farming systems	Agricultural products	Challenges	Proposed interventions
Cash crop farming	Coffee, Tobacco, Cotton, Miraa, Tea, Macadamia,	Unpredictable marketing system and exploitation by middlemen	Unpredictable marketing system and exploitation by middlemen
commercial farming	Tea, Macadamia,	Unpredictable marketing system and exploitation by middlemen	Encourage farmers to produce for the market Encourage farmers to form groups for better bargaining power Encourage improved packaging of Processed agricultural products
Horticulture	Tomatoes Kales, Cabbages, Okra, Dudhi, Valore, Biannual Chillies, Onions, Asian Vegetables Citrus	Poor infrastructure and communication facilities Inefficient water use Low seedling production for crops such as fruit trees Poor husbandry High pest and disease incidences	Repair and properly maintain access roads Train farmers in proper use of water Carry out training and demonstrations Encourage use of certified seeds and better crop husbandry

Source: District Agricultural Office 2007- Meru North District

Types of Pollutants and Wastes

- Agrochemicals
- Inorganic fertilisers and residual material
- Pesticides residual

Environmental issues

- Eutrophication
- Water and air pollution
- Killing other organisms (plants & animals) not specifically targeted
- Alteration of the soil balance – pH, microbes, aeration and the general underground ecosystem.

Proposed Interventions

- Training farmers on the safe and effective use of pesticides.
- Training stockists on safe handling of pesticides.
- Training farmers on IPM (integrated Pest Management)
- Sensitise farmers on pest / disease and growing of tolerant varieties.
- Advise farmers to grow crops within the recommended agro-ecological zones to avoid susceptibility.

2.4 Livestock production

The main livestock enterprises in the district are zebu cattle, Local chicken, local goats, hair sheep and bee keeping .The table 13 below shows Status and Trends of Livestock Production

2.4.1 Types of Livestock Production Systems

Table 13: Status and Trends of Livestock Production

	Type	Productivity
Cattle	Dairy	
	Pure and high grade crosses <ul style="list-style-type: none"> • Friesian • Ayrshire • Jerseys • Sahiwals 	1830 litres of milk per lactation
	Zebu	600 litres of milk per lactation
	Beef (also provide draft power)	
	Zebu mature bulls	300-350 kgs live weight
	Borans mature bulls	450-500 kgs live weight

Goats	Dairy	1 litre per day (though milking goats is not common practice, its becoming popular with time)
	<ul style="list-style-type: none"> • Toggenburgs Other breeds for slaughter <ul style="list-style-type: none"> • Somali goat • Small East African goat 	18-22 Kgs live weight
Sheep	<ul style="list-style-type: none"> • Dorper • Red Maasai • Black head Persian 	15-18 Kgs live weight
Rabbits	<ul style="list-style-type: none"> • New Zealand White • California White • Chinchilla 	1.5-2.0 Kgs live weight
Pigs	<ul style="list-style-type: none"> • Hand race • Large white • Black Hampshire • And crosses 	70-80 Kgs live weight
Poultry	Chicken	
	Exotic layers	220-240 eggs per year per bird
	<ul style="list-style-type: none"> • Brown Issa • Leghorn crosses 	
	Indigenous layers	50-60 eggs per year per bird
	Indigenous (for table)	1.5-2.0 Kgs live weight
	Turkeys and Ducks	
Donkeys		Provide draft power
Bees	A. Mellifera	15 Kgs of honey per hive per year

Source: District Livestock Production Office 2007- Meru North District

Key Environmental Issues

- Competition for resources and land use changes
- Lack of gainful market for agricultural and livestock products
- Low productivity and poor breeds

- Pests and diseases
- Overstocking and the resultant overgrazing have led to soil erosion either by wind or water.
- Conflicts and insecurity
- Land degradation
- Inadequate extension facilities

Proposed Interventions

- Promotion of the dairy goat keeping– produces more milk and consumes less forage, thus making it less expensive to keep.
- Cross breeding to upgrade some of the local breeds like Zebu
- Construction of water pans to store storm water to create more watering points
- Enhancing and safeguarding security to curb cattle rustling and loss of both animals and human life.
- Supporting emerging alternative livestock like bee keeping and fisheries to encourage diversification.
- Provision of technical advice on stocking to avoid overgrazing and the resultant environmental degradation
- Survey for viable markets to facilitate farmers to sell their animals profitably
- Encourage appropriate and sustainable land uses to can be easily supported by the fragile environment
- Promote peace and security in the area to curb cattle rustling
- Promote water and soil conservation measure to curb soil erosion.

Table 14 indicates the types and status of livestock production systems in the district.

Table 14: Types and Status of Livestock Production Systems

Type	Location	Livestock Products	Challenges	Proposed Interventions
Beef farming		Beef, Hides & skins	Poor livestock breeds	Improve the beef quality by enhancing animal husbandry
			Lack of proper marketing channel for livestock products	Improve the marketing of both livestock and livestock products
			Inappropriate land tenure system, sub division of range areas makes the units unsuitable for livestock enterprises	Ensure that the land tenure system of the Northern Grazing Area is properly addressed to stop subdivision to unviable sizes
			Few numbers due to drought and theft	Stop cattle rustling
			Lack of processing of livestock products	Establish plants for hygienic processing of the livestock products
			Invasion of tsetse	Disease search and treatment
Dairy farming		Milk	Lack of processing (value adding) of livestock products	Establish plants for hygienic processing of the livestock products
			Lack of proper marketing channel for livestock products	Improve the marketing of both livestock and livestock products
Rearing of smaller		Milk, Meat, Skins	Poor breeds	Improve the breed quality by enhancing animal husbandry

livestock – goats, sheep			Lack of proper marketing channel for livestock products	Improve the marketing of both livestock and livestock products
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Source: District Livestock Production Office 2007 - Meru North District

Key Environmental Issues

- Over stocking and overgrazing leading to land degradation
- Competition for resources like water and pasture
- Conflicts over resource use and cattle rustling
- Disease spread and infection

Proposed Interventions

- Promotion of the alternative livestock e.g. dairy goat – produces more milk and consumes less forage, thus making it less expensive to keep.
- Construction of water pans to store storm water to create more watering points
- Enhancing and safeguarding security to curb cattle rustling and loss of both animals and human life.
- Supporting emerging alternative livestock like bee keeping and fisheries to encourage diversification.
- Provision of technical advice on stocking to avoid overgrazing and the resultant environmental degradation
- Survey for viable markets to facilitate farmers to sell their animals profitably
- Adoption of other methods of rearing livestock e.g. zero grazing where applicable
- Disease research and treatment especially where there is migration of animals.

2.5 Fisheries resources

Table 15: Types and status of fisheries production systems in the district

Table 15: Types and Status of Fisheries Production Systems

Type of production system	Status		Challenges	Proposed interventions
	Current production level	Potential production level		
Aquaculture (Fish farming)	0.152 tons p.a.	25,000 tons p.a.	<p>Competition for water resources</p> <p>Pollution of water sources</p> <p>Incomplete land adjudication process hindering investment in fish ponds</p> <p>Competition for land space with other uses</p>	<p>Training of farmers and staff on management techniques</p> <p>Construct demonstration ponds/fingerlings multiplication centres in selected areas of the district</p>
Capture fisheries	0.465 tons p.a.	Approximately 7 tons p.a.	<p>Poor harvesting techniques</p> <p>Little adoption of new fisheries techniques</p>	<p>Training of farmers and staff on management techniques</p>

Source: District Fisheries Office 2007 – Meru North District

Key Environmental Issues

- Competition for water resources
- Pollution of water sources
- Competition for land space with other uses
- Poor harvesting techniques

Proposed Interventions

- Training of farmers and staff on management techniques
- Construct demonstration ponds/fingerlings multiplication centres in selected areas of the district
- Training of farmers and staff on management techniques

2.6 Water resources

Kenya has been classified as water deficit area yet water is vital for the sustenance of all life.

Adequate quantity and quality of water is recognized as a basic requirement for economic growth.

2.6.1 Types of Water Sources

There are about twenty seven (27) protected rivers, seventy (70) and eighty eight (88) protected and unprotected springs respectively in the district. There are also five (5) dams in the Northern Grazing Zone and several wetlands e.g. the Mporoko, Mbututia, Matiru and Amwamba swamps.

On ground water sources, there are 135 wells and 126 boreholes although only 25 are in operation.

Table 16 below indicate the main water sources in the district.

Table 16: Main Water Sources

Water Sources	Numbers
Protected rivers	27
Protected springs	70
Unprotected springs	88
Dams	5
Wetlands and swamps	4
Wells	135
Boreholes	126 – Only 25 are operational

Source: District Water Office 2007 - Meru North District

WATER CATCHMENTS AND DRAINAGE AREAS

To the north of Nyambene ranges, many rivers drain into the Uaso Nyiro river basin. They include Kathima, Murompa, Kalibiuri and Liliaba. To the south west and south east of the crest, the rivers drain into river Tana. They include Thangatha, Thanantu, Thiiti, Ura, Thungu and several others.

Nyambene Hills form the main catchment area in the district, with two drainage areas namely, the Tana and the Uaso Nyiro basins.

To the south of the Nyambene ranges several seasonal rivers drain to the Uaso-Nyiro River. These rivers include Lathima, Murompa, Kalibu Liliaba Likiundu and Buathumara. These rivers are of more permanent nature. They include; Thangatha, Thanantu, Thiiri, Ura, Thungu, Kanjoo, among others

2.6.2 Status and Trends of Water Resources

Among the total population of the district 49% have access to portable water (safe drinking) and 46% of them are served with piped water supply. The others get their water mainly from the rivers, streams and spring as well as boreholes. More than 95% of population in the district are within an average distance of 2 KM to the nearest portable water source. The demand for water is still less than its supply for high potential agricultural zones while in the rangelands the demand surpasses supply during the dry seasons.

2.6.3 Main Water Uses

Domestic

The main domestic uses of water include washing, drinking, cooking and watering of livestock. On extension some homesteads have kitchen gardens for growing common vegetables for family use and use some of water within the home to water the gardens.

Industrial

The only industrial use of water in the district is in the coffee factories in the pulping process, the very first stage in the processing of coffee after which it is dried and sent to millers for milling.

Agricultural

There are a number of irrigation schemes (about 50) both major and minor serving farmers at different locations and levels.

2.6.4 Impacts of Water use and Demand on the Environment and Natural resources.

Water pollution

Main sources of pollutants to Water resource are

- Urban wastes – plastic papers, garage wastes e.g. oils, kitchen wastes
- Human waste – sewage and domestic waste
- Agro based chemicals and fertilizers
- Coffee factories effluent from the pulping process
- Dissolved solids from erosion during rainy seasons

Key Environmental Issues

- Conflicts between people living downstream and those who are upstream when water is on a limited supply especially between the months of Sept – Oct.
- Human - wildlife conflict is also reported as animals from the parks encroach on peoples' land in search of water.
- Inter-district human conflicts have also arisen in some cases e.g. Meru North and Isiolo on River Likiundu especially concerning livestock watering points.
- Polluting the water or over abstracting by individuals who use the water resource in a manner that infringes on the right of others to derive benefits from the river

Proposed Interventions

- Improve storage facilities
- Improve on harvesting techniques
- Facilitate access to these technologies to the communities
- Reduce soil erosion and siltation levels of the dams and pans
- Disseminate the information on sustainable rain water harvesting to the community

Table 17: Sources and Status of Water Resources

Source	Usage	Management system	Key Environmental	Proposed Interventions
Surface water – rivers, streams	Domestic Irrigation Industrial - few	Community based projects	Drought Siltation Pollution Encroachment of the catchment areas Destruction of the riparian reserves Inadequate community capacity to manage the projects. Over abstraction of river water	Community training and capacity building for management committees Continuous rehabilitation to reduce the cost of maintenance
Ground water - boreholes	Domestic Livestock	Community based projects	Salinity Cost of maintenance and rehabilitation	Community training and capacity building for management committees Continuous rehabilitation to reduce the cost of maintenance
Rainwater	Domestic	Individual initiative to harvest rain water	Cost of rain water harvesting Lack of appropriate technologies and materials	Avail the necessary technology and skills

Source: District Water Office 2007 - Meru North District

Key Environmental Issues

- Reduced volume of water flow
- Water use conflicts
- Pollution
- Collapsed projects and unused infrastructure
- Projects mismanagement and collapse

Proposed Intervention

- Regulation and monitoring abstraction and flow volumes
- Conservation of water catchment areas and the riparian reserves
- Formation of water users associations
- Improvement of management and utilization of existing water resources
- Community mobilisation
- Rehabilitation of existing water projects
- Water Users Associations
- Empowerment of the communities to manage water projects in their areas

2.7 Forestry

There are three categories of forests in the district classified according to the legal status on the land upon which they stand and they are mainly covered with indigenous trees and vegetation.

- Government gazetted forests
- Trust land forests
- Private forests

Area under Forestry Cover

There are five (5) government gazetted forests within Meru North district, covering a total area of 11,018.30 Ha, out of which indigenous protected forest covers a total area of 10,912.4 Ha, while the exotic plantations cover a total area of 105.9 Ha (about 1 % of the total gazetted forests). These forest lands are shown in table 19 below.

Table 18: Government Gazetted Forest

Name of the Forest	Acreage (Ha)
Nyambene / Kilimantiiri	5391.2
Thuuri	734.5
Ngaya	4139.9
Kibithewa	206.4
Kieiga	546.3
Total	11,018.3

Source: District Development Plan 2002 - 2008

2.7.1 Trust Land Forests

These are forests vested under Nyambene County Council by the virtue of the fact that the Council is the custodian of all trust land in the district. They cover the hill tops scattered all over the district covering a total area of 359.6 Ha as shown in table 19 and 21

Table 19: Trust Land Forests

Name of the Forest Land	Acreage (Ha)
Muthungutha	13.0
Kibilaku	15.0
Kithelemwa (Mukuani)	20.0
Nchura	37.6
Ithai	4.0
Lukununu	127.0
Tamani	15.0
Kithetu	40.0
Tiiri	35.0
Ntonyiri	38.0
Kwani	7.5
Kieni	7.5
Total	359.6

Source: District Forestry Office 2007- Meru North District

2.7.2 Status and Trends of Forest Resources

Table 20: Types and Status of Forests

Type of forest	Extent (Ha)	Distribution (% of total)	Location	Forest uses	Status	% of Degradation	Proposed interventions
Indigenous Forests	10,912.4	95.3%	Ndoleli Tigania East Uringu Igembe Central Igembe S. West Tigania North Mutuati Laare	Conservation Purposes	Gazetted	6.2%	Rehabilitation of degraded areas
Exotic Forests	105.9	0.9%	Tigania East Tigania North Igembe Central Uringu Igembe S. West	Industrial Purposes	Gazetted		
Trust land Forests	359.6	3.1%	Mutuati Igembe Central Tigania North Akithi	Conservation Purposes	Trust land		

			Uringu				
Private Forests	76.4	0.7%	Igembe S. West Tigania East	Commercial Purposes	Private		More area to be put under exotic plantations

Source: District Forestry Office 2007– Maua

Key Environmental Issues

- Forest encroachment
- poaching
- Forest fires
- Illegal cultivation
- Over exploitation

Key Interventions

- Protect the indigenous tree cover
- Conserve the water catchment areas
- Rehabilitation of degraded sites,
- Tree planting initiatives to be developed and implemented
- Promote on farm tree planting and agro forestry
- Gazettement of trust land forested hills

2.8 Wildlife resources

Different animal species are found in a variety of places such as on trees, rocks, rivers, swamps, caves, and other microhabitats situated in Meru North. Most of the wildlife is found in the protected areas. Outside the protected areas where human activities have destroyed wildlife habitat, wildlife is minimal and mostly birds. They are comprised of mammals, birds, reptiles, insects, amphibians and mollusks. Of major importance, however, is the mammalian and bird life.

2.8.1 The Area under wildlife

Meru National Park (in Meru District) covers an area of 870 km² MNP, Kora National Park and the

two National Reserves of Mwingi in Mwingi District and Bisanadi (in Isiolo District) constitute an important conservation area in Kenya and cover an area of 4008 sq. km

The following areas are gazetted as protected areas and are management by KWS as part of the wider Meru Conservation Area.

- i) Meru National Park within which there is the Rhino Sanctuary
- ii) Kora National Park
- iii) Bisinadi National Reserve
- iv) Mwingi Natonal Park – Mwingi district

The following table 22 shows the number of endangered animals found in Meru National Park

Table 21: Type and Number of Endangered Animals

	Name of the Animals	Numbers in the Park
1	Elephant	450
2	Rhino	18
3	Reticulated giraffe	225
4	Reedbuck	128
5	Buffalo	3000
6	Impala	400
7	Grevy Zebra	9

Source: Kenya Wildlife Service 2007 - Meru National Park

Vegetation

The vegetation of the park can subjectively be characterised into four communities:

- i) *Acacia* wooded grassland,
- ii) *Combretum* Wooded grassland,
- iii) *Acacia-Commiphora* bushland and
- iv) A unique riverine vegetation consisting mainly of stands of *Hyphaene* and *Raphia* palms, and a network of *Ficus* trees (Ament, 1975).

2.8.2 Types of Wildlife Species

A large population of resident herbivores is a feature of Meru Conservation Area together with the high density of wild fauna including carnivores, rodents and insectivores. Elephants, Rhinos, Rheed buck, Lion, Cheetah, can all be seen along with Kudu, Eland, Waterbuck, Grant's and Thomson's gazelle, Oryx, Buffalo, Reticulated Giraffe and Impala. Also common are the Monkeys, Crocodiles

and a plethora of bird species (including the Palm nut Vulture and Marshall Eagle) in the dense vegetation alongside watercourses, of which Ura and Tana rivers on the southern boundary are the most dramatic. It has over 280 bird species of which 5 of them are regionally threatened; it is also listed as one of important bird areas in Kenya (IBAs, 2000).

Status and Trends of Wildlife Resources

Wildlife numbers (of some species) have been on the increase from the year 1990. This has been shown by the steady increase of some wildlife species that were reintroduced in the park i.e. elephants were 413 in the year 2002 and by 2004 they were 450.

Regulatory and Management Arrangements

- Erection of an electric fence- rhino sanctuary
- Documenting competition and predation of the plains and the grevy's zebras
- Monitoring the impact of the top predators on the other restocked and introduced species
- All adult animals fitted with horn transmitters to assist in post-release monitoring
- Determining factors that limit population growth in the introduced species
- Assessing practical conservation measures for the restocked and introduced species
- Monitoring of the introduced species as well as the already existing ones
- Determining elephant movement patterns
- Aerial surveys

2.8.3 Exploitation of Wildlife Resources

KWS has initiated a community programme in which there are components of community involvement in sharing the benefits from the park and the wildlife at large. This was mooted to sensitise the community on the need to conserve wildlife as their heritage and also to mitigate against the impacts of human wildlife conflict. This programme involves community education, support for community projects and limited access to the national park by the community either to supply foodstuffs or collect some firewood.

There is however no evidence of voluntary sharing of losses. Cases in which this may occur is when crops are destroyed when animals get astray or in case a fire breaks out and destroys property next to the park. The resources are also being exploited sometime illegally through

- Charcoal burning

- Bush meat
- Harvesting of medicinal plants
- Harvesting of trees for poles and ropes.
- Honey harvesting
- Livestock grazing

Key Environmental Issues

- Encroachment into the park and grazing of the livestock.
- Charcoal burning around the park and in Ngaya forest
- Water diversion from river flowing into the park leaving very little for the wildlife downstream
- Environmental degradation through overgrazing and occasional breakdown of security

Proposed Interventions

- Sensitise the communities on conservation issues
- General research to establish wildlife carrying capacity of the park, requirement behaviour, distribution patterns, relative abundance level and absolute densities for key species
- Erection of an electric fence on some parts of the park to reduce cases of stray animals and reduce cases of human wildlife conflict
- Community education and awareness programme for their involvement in wildlife conservation activities
- Establish community benefit sharing schemes
- Establishment of a migratory corridor to Ngaya forest (the breeding ground for the elephants) to reduce cases of human wildlife conflict
- Development of conservancies to promote community involvement and eco tourism
- Promote conservation of the catchment areas and other important ecosystems to wildlife survival
- Undertake holistic and integrated natural resource management strategies.

Table 22 shows the types and status of wildlife in the district.

Table 22: Types and Status of Wildlife

Type of wildlife area	Extent (Sq. Km)	% of the district area	Location	Wildlife Uses	Status	Threats	Proposed interventions
Meru National Park	878.2	22%	Meru Conservation Area Meru National Park	Tourism	Protected/Gazetted	Poaching Encroachment Invasion by livestock	Community sensitisation Erection of an electric fence Establish community benefit sharing schemes Undertake holistic and integrated natural resource management strategies.

Source: District Development Plan 2002-2008

Key Environment Issues

- National Park and Forest encroachment
- Deforestation and loss of vegetative cover
- General land degradation
- Human wildlife conflict

Proposed Intervention

- Forest patrols to reduce illegal felling of trees
- Protection of the indigenous tree cover
- Conservation of the water catchment areas
- Rehabilitation of degraded sites
- Promotion of on farm forestry
- Enhance community participation and create awareness
- Curb charcoal burning activities
- Protect the indigenous tree cover

- Tree planting initiatives to be developed and implemented
- Promote on farm tree planting and agro forestry
- Gazettement of trust land forested hills
- Patrols
- Protection of the gazetted area
- Community sensitisation
- Community education and awareness programme for their involvement in conservation activities
- Establish community benefit sharing schemes
- Development of conservancies to promote community involvement and eco tourism
- Promote conservation of the catchment areas and other important ecosystems
- Undertake holistic and integrated natural resource management strategies.
- Re-forestation and afforestation
- Soil and water conservation
- General research to establish wildlife carrying capacity of the park, requirement behaviour, distribution patterns, relative abundance level and absolute densities for key species
- Electric fence constructed in some areas
- Community education on the behaviour and movement of animals
- Game patrols
- Erection of an electric fence on some parts of the park to reduce cases of stray animals and reduce cases of human wildlife conflict
- Establishment of a migratory corridor to Ngaya forest (the breeding ground for the elephants) to reduce cases of human wildlife conflict

2.9 Biodiversity conservation

This chapter covers issues on marine, inland aquatic and terrestrial ecosystems, species diversity, and other cross-cutting issues. However, some aspects of biodiversity have been covered under forestry, wildlife agriculture, livestock and fisheries

2.9.1 Biodiversity Data and Information

Environmentally significant areas that has most of the biological biodiversity in the district include:

- Ngaya forest reserve,
- Nyambene forest reserve,
- Swamps –Mbututia, Mporoko and Amwamba

Threatened and Invader

Invader species

Pennisetum mezianum,

Tarconanthus camphorates,

Ocimum suave,

Solanum in anum,

Pennisetum mezianum,

Cymbopogon laesius,

Utica massaica,

Eragrostis tenuifolia,

Sida schimpheriana,

Aparchne shimperi,

Bidens pilosa,

Oxygonum sinuatum,

Cynodin dactyolon,

Penssisetum mezianum,

Leonotis spp.

Threatened Species

- *Doum palm*
- *Rhino's - black.*
- *Grevy's zebra*

2.9.2 Species Conservation Status

In the year 2000, IFAW helped the KWS trans-locate 10 elephants to MNP from the Laikipia area, 6 from Ol Pejeta ranch and 4 from Lewa Downs's ranch. Later in 2001, 56 elephants were trans-located from sweet-waters in the Ol Pejeta ranch in Laikipia to MNP. In addition to the elephants, 103 common zebra and 18 reticulated giraffe were introduced to the park from Lewa Downs.

Lewa Wildlife Conservancy further donated 51 reticulated giraffes while Laikipia Wildlife Forum together with Kruger farm donated 504 plains zebra and 144 Bohor reedbucks respectively. It is hoped that the introduction of viable breeding population achieved in these translocations will boost the animal numbers and diversity of species. The current lion population in Meru National Park is over 100 and this is having a great impact by preying on the trans-located animals particularly zebras.

KWS seeks to restore progressively balanced animal population in terms of species and numbers which is compatible with the habitat's potential; build sufficient numbers of the famous species in

order to attract tourists; maintain and if possible improve or restore the quality of the habitat by setting up an adoptive system to manage the plant cover and the animal populations; and reduce poaching and ensure security for wildlife.

To date the following animals have been trans-located during the first phase implemented in the year 2003. Nine white rhinos (*Ceratotherium simum*) were trans-located to Nakuru National Park where a rhino sanctuary has been established. 50 reticulated giraffe (*Giraffa camelopardalis reticulata*), 500 plains zebra (*Equus burchelli*) and 400 impala (*A. melampus*) were trans-located from Lewa Wildlife Conservancy. Plans are under way to translocate about 15 black rhinos (*Diceros bicornis*) and 5 white rhinos (c. *simum*), and approximately 1000 - 1200 plains zebra (*E. burchelli*), 100 Beisa oryx (*Oryx beisa*), 50 Grevy's zebra (*E.grevyi*) and 150 kongoni (*Alcelaphus buselaphus cokii*).

Table 23: Types and Status of Biological Resources

Ecosystems		Location	Size (Ha)	Key species	Threats	Status	Proposed interventions
Gazetted Forests	Indigenous	Ndoleli	10,912.	Ocotea	Illegal	Threatened	Policing
		Tigania	4	usambares	exploitation and		Community sensitisation
		East		is	poaching		Enrichment planting
		Uringu		Newtonia	Fire		
		Igembe		buchanani			
		Central		i			
		Igembe S.		Prunus			
		West		africana			
		Tigania		Vitex			
		North		kenyinesis			
Mutuati		Croton					
Laare		megalocorpus					
				pus			
				Trichilia			
				roka			

	Plantation	Tigania East Tigania North Igembe Central Uringu Igembe S. West	105.9	Eucalyptus saligna Eucalyptus globulus Cupressus lusitania Grevillea robusta	Illegal exploitation and poaching Fire	Threatened	Policing Community sensitisation Enrichment planting
	County Forests	Mutuati Igembe Central Tigania North Akithi Uringu	359.6	Newtonia buchanani Acacia species Ficus natalensis Mukumbu species Grevillea robusta Eucalyptus saligna	Illegal exploitation and poaching Fire	Threatened	Policing Community sensitisation Enrichment planting Gazettement
	Community Forests	None					
	Private Forests	Igembe S. West Tigania East	76.4	Eucalyptus ssp Grevillea robusta			Increase the area under exotic species
	Agricultural				Mono cropping		
	Wildlife areas	Meru National Park	878 km ²		Poaching Illegal invasion		

Source: District Forestry Office – Maua KWS - Meru Conservation Area

Major Threats

- Increasing use of inorganic fertilisers and pesticides
- Mono cropping and demand for specific crops – traditional food crops systematically being ignored
- Demand for more farmland leading to more areas being opened up for cultivation
- Soil erosion and general land degradation

Key Environmental Issues

- Pollution of air and water
- Encroachment of environmentally significant and conservation areas e.g. wetlands, hill tops, forest land
- Ecosystems disruption and habitat destruction by human activity

Proposed Interventions

- Training farmers in making and using of organic fertilisers
- Discourage burning of crop residues and encourage their incorporation into the soil
- Training of farmers on crop protection and enterprise development
- Emphasis on soil and water conservation
- Encourage farming of traditional food crops
- Promote agro-forestry into the current cropping pattern
- Training farmers on safe use of agro-chemicals to avoid misuse, resistance and emergence of other pests foreign to the environment.
- Training on integrated pest management to reduce use of agro chemicals
- Awareness creation on the protection of wetlands and marshlands, and discourage draining them
- Discourage cultivation and opening up of the fragile environments.
- Encourage diversification even in our farming system

CHAPTER THREE

3.0 Human settlement and infrastructure

Human settlements and infrastructure are physical articulations or form of the social, economic, political and environmental interaction of people living in communities. The communities can either be urban or rural. The development of these communities involves changing the environment from its natural state to a built one. These activities are significant agents of environmental change and economic development.

3.1 Human settlement and planning

Human settlements and infrastructure influence the location of investment, which provides employment, generates revenue for and creates demand for materials and services. This includes education, commercial, industrial, recreational, residential, agriculture, public utility (services include supply of water, waste disposal, sanitation, telephone, power and services including supply of water, sewers, etc.). Public purpose will include (religious institutions) and protected land (public parks, national parks and reserves, forests). Transport (roads, railways, airways, lake/sea ports). These activities can have negative or positive impacts on the environment. Table 25 indicates land tenure systems and area (ha) in the district

Table 24: Land Tenure Systems and Area (Ha) in the district

Tenure Type	Area (sq. km)	
	2005	Remarks
Freehold		
Trust land		
Gazetted Forest	110	
Un gazetted Forest	359.6	Ha
National Parks	878.2	
Land currently under demarcation	70,059.33	Acres
Wetlands	120.3	
Total		

Source: District Development Plan 2002 – 2008

3.1.1 Planning Human Settlement

Settlements with over 500 people are considered urban, and they include:

Maua, Laare, Mukinduri, Mutuati, arama, Muriri, Ngundune, Nchiru Muthara, Kiengu, Kianjai, Kangeta, and Maili Tatu.

The only planned urban settlement in the district is Maua Town. Table 26 shows Planned Urban Areas.

Table 25: Planned Urban Areas

City / Municipality	Local Plans		Regional Plans
	1980s	1990s	2005
Maua Town	First planned in 1983	Plan revised in 1992	
Greater Meru Region			Commenced, but incomplete

Source District Physical Planning Office 2007 - Maua

3.1.2 Urban areas needing urgent planning services

- Maua – revision of the existing plan
- Laare
- Mukinduri
- Mutuati
- Muthara
- Kianjai
- Ngundune
- Kangeta

Record of some of the district population parameters

Inter census growth of 2.76 %

- Crude birth rate 45.6/1,000
- Crude death rate 10.7/ 1000
- Total fertility rate 5.8/Woman
- Infant mortality rate 37.3/1,000 live births
- Under 5 mortality rate 70/1,000 live births
- Life Expectancy Male: 58.4
Female: 63.3
- Net migrants Male: -1.3% Female: 15.7%

Housing

There are many types of houses in the district representative of the different economic classes of the people ranging from the very rich to the very poor. The demand for housing is relatively high in the urban areas especially Maua town due to the migration from the rural areas. This pressure reduces the supply levels because the rate of urban growth is not at par with the rate of urban population growth. Table 27 indicates households by main type of roofing, wall and floor material in the district

Table 26: Households by main type of roofing, wall and floor material in the district

No. of households by main type of roofing material		No. of households by main type of wall material		No. of households by main type of floor material	
Iron sheets	82.4%	Stone	4.0%	Cement	18.7%
Tiles	0.6%	Brick / Block	2.5%	Tile	0.2%
Concrete	0.2%	Mud / Wood	49.1%	Wood	1.4%
Asbestos	0.8%	Mud / Cement	1.3%	Earth	79.4%
Grass	14.3%	Wood only	40.5%	Other	0.3%
Makuti	0.2%	Gras / Reeds	1.7%		
Tin	1.2%	Tin	0.1%		
Other	0.3%	Iron sheets	0.4%		

Source: Kenya 1999 Population and Housing Census

3.1.3 Informal Settlements

Most of the population lives in the rural areas where there is adequate land, although some parts are yet to be demarcated. There are cases in some of the trading centres where development has taken place in the absence of a development plan, but those are yet to be qualified as informal settlement because apart for their haphazard nature they still meet some basic requirements and offer minimum essential services. There are some places in the district where people have settled in clusters informally due to various factors like access to basic amenities and services, security reasons and market for labour, goods and services.

3.2 Land adjudication and settlement process

Areas Already Adjudicated / Registered Sections

Table 27: Areas Already Adjudicated / Registered Sections

• Nturene	• Antuamburi	• Kiegoi
• Njoune	• Akithi 1	• Akithi 11
• Thananga	• Antuanduru	• Kirima
• Kirimachuma	• Mituntu	• Thau
• Mikinduri / Athwana	• Burieruri	• Kinyanka
• Auki	• Liburu	• Athwana / Akithi
• Njia cia Mwendu	• Kirindine	• Thau mumui
• Uringu 111	• Mbeu 11	• Mbeu 111

Source: District Land Adjudication Office – 2007

Table 28: On-Going Adjudication Sections

A/R stage	Demarcation Stage
• Kianjai	• Amugenti 'A'
• Amwathi / Maua	• Akirang'ondru 'B'
• Akirang'ondru 'B'	• Antubetwe Kiongo
• Kiguchwa	• Amwathi Mutuati 11 'A'
• Akithi 111	• Amwathi Mutuati 11 'B'
• Atinga Athanja	• Karama
• Kitheo	• Uringu 11
• Kangeta	• Anntamburi
• Athiru Ruujine	• Akaiga
• Kitharene	• Ankamia
• Uringu 1	

Source: District Land Adjudication Office - 2007

Table 29: On-Going Adjudication Sections

A/R Stage	Demarcation Stage
• Old Kiare	• Kiengu Kanjoo
• Mbeu 1	• Amungenti 'B'
• Naathu	• Upper A / Gaiti
• NdoleliA / Kiongo	• Lower A / Gaiti
	• Amwathi 1
	• Kirindire 'B'
	• Ndoleli A / Ruujine
	• Buuri

Source: District Land Adjudication Office - 2007

Not Adjudicated Since 1960

Dormant Adjudication Sections

- Nturene 11
- Akirangondu 11
- Antuamburi 11
- Igarie

3.3 Impact of land tenure on environment

Individuals have therefore been allocated land on very unsuitable places like on wetlands, steep slopes, hill tops and degraded sites. This impedes on preservation / conservation of these environmentally fragile areas. There is no elaborate land policy that would govern and harmonise the various land laws to cover all sectors. Trust land vested under the county council is not adequately protected and conservation measures are sometimes hard to implement due to interference, unplanned settlement and improper allocation. The tendency to hire land from absent landlords does not impose any obligation of part of the farmer to implement conservation measures and many are reluctant to invest on conservation on a land they know does not belong to them.

Factors Influencing Type of Shelter and Settlement Patterns

- Poverty and income levels
- Locality and availability of materials

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Environmental Impacts

- Waste management among the poor and unplanned settlements
- Lack of / inadequate supportive infrastructure leading to pollution of both air and water

Proposed Interventions

- Review policies on settlement of the landless.
- Review and restructure the land allocation committees
- Plan ahead of time to encourage proper settlement and development
- Review land ownership and housing legislation to ensure affordable and decent housing.
- Promote investment in middle and low cost housing.
- Enforce building codes and by-laws

3.4 Human and Environmental Health

The following are the common diseases influenced by environmental factors reported for the year 2004.as indicated in Table 31

Table 30: Disease Incidences and Distribution:

Diseases	No of Reported Cases (Year 2004)
Malaria	241,270
Diseases of the Respiratory System	142,066
Intestinal worms	55,916
Pneumonia	22,005
Diarrhoeal diseases	20,197
Typhoid fever	3,093

Source: MOH Nyambene District Hospital - 2004

Intervention Measures to Address the Prevalence of Diseases

- Provision of treated nets to curb the spread of malaria
- Improve sanitation and general hygiene
- Vaccination and immunisation
- Public education and awareness/sensitisation programs

Pollution and Waste Generated From Human Settlement

Types of waste

- Agro chemicals and fertilisers
- Domestic waste – human waste

Key Impacts of the Pollutants and Wastes to the Environment

- Pollution of water, land and air
- Inhibit natural processes and cause disruption of the eco-systems
- Cause death of animals and plants
- Alters the aesthetic value of the polluted environment
- Increases the incidence of diseases

Proposed Interventions

- Improve the sewerage and drainage systems
- Adopt more appropriate methods of solid waste disposal
- Plan human settlement to avoid haphazard development and ease waste collection and disposal

3.5 Communication Networks

The district is partially served with Telkom Kenya landline telephones on the divisions along the tarmac, but mobile phone services both for Zain and Safaricom are more accessible and used by the people who can afford them.

KBC and Nation Television network broadcasts are received fully and in some parts of the district respectively. The district is also covered by most of FM Radio transmission considering that most have their boosters at the top of Nyambene Hills.

Postal services are also readily available for use by the members of the public. Other services to facilitate communication are as the ones offered by the Securicor group and EMS speed post for faster and efficient delivery of mails.

Road transport is the main form of transport in the district where the people use different means that include motor vehicle, motor cycles, bicycles, and animal driven carts or by foot to move from one place to another and also move their goods.

There are several classified and unclassified roads, but only two of them are tarmac roads (Maua – Meru Rd, and Maili Tatu – Mutuati Rd). The Farm to Meru National Park road is currently under construction. The other places (the bigger portion of the district) are served with earth roads which are inadequate and impassable during the rainy season. Due to the rugged and hilly terrain of the district, the road are so rough that only four wheel drive vehicles access the hinterland even during the dry season.

**Extent of Communication Network in the District
Road Transport (2002)**

Total kilometres of roads	664.8 km (exclude unclassified Roads)
Bitumen	57.0 km
Gravel	95.6 km
Rural Access Roads (50% earth)	102.3 km
Earth roads	409.9 km
Unclassified roads	865.0 km
Number of Public service vehicles:	
Buses, Mini-buses	10
Others: (Nissan, Pick-ups, Matatus, Station Wagons, Land-Rovers)	62
Petroleum filling stations	9

Source: District Development Plan 2002 - 2008

Communication

Number of households with:

Telephone connections (Landline)	I, 669
Maua Exchange	1,402
Kiania Exchange	201
Mikinduri Exchange	66
Number of private and public	
Organizations with telephone Connections	379

Source: District Development Plan 2002 - 2008

3.6 Social economic services and infrastructure

The district has several types of water facilities ranging from boreholes, furrow, rivers, wells and springs as well as piped water.

3.6.1 Major Water Sources

The water services are not evenly distributed with some areas only depending on surface run off or underground water. The water facilities in the district are not adequately developed for agricultural growth and homestead requirements with accessibility to safe drinking water at 49% of the total population.

Major Sources of Water Pollution

The major sources of pollution in the district include

- Agricultural activities
- Industrial processing – coffee & tea
- Jua kali activities – garages, welding & furniture workshops
- Domestic activities

Mitigation measures

- Involvement of all stakeholders in water provision and sanitation
- Commercialize water sector operations

3.7 Sanitation

The sanitation situation in the district is most wanting, where none of the urban settlements including Maua town is served with a sewerage system. The towns mainly depend on septic tanks, soak pits and pit latrines that are emptied whenever full, even though the Municipal council does not have an exhauster. The district has latrine coverage of 75%, with a share of VIPS (Ventilated Improved Pit Latrines) of 25% and ordinary pit latrines at 55% respectively,

Key Environmental issues

- Incidences of water borne diseases
- Water pollution

3.7.1 Health Facilities

The health facilities in the district are not adequate and some divisions like Ndoleli and Tigania East have no facilities at all. Even the existing facilities are usually poorly equipped with low staffing levels to cope with the increasing demand for health services. Some people also seek medical help from herbalists and traditional medicine men and there are a number of chemists in the urban centres. Table 32 and 33 shows number of health and educational facilities in the district

Table 31: Number of Health Facilities in the District

Category	Number
Hospitals	3
Sub Hospital	1
Health centres	18
Nursing Homes / Maternity	8
Dispensaries	21
Clinics (Private)	6

Source: District Development Plan 2002 - 2008

Table 32: Number of Educational Facilities in the district (2002)

Pre-primary		
Number of pre-primary schools		354 (Public = 325, Private = 29)
Total enrolment rates	Boys	32%
	Girls	29%
Teacher/Pupil ratio		1:43
Average years of school attendance		2 years
Primary		
Number of primary schools		354
Total enrolment rates	Boys	79%
	Girls	78%
Total drop-outs rates	Boys	48%
	Girls	43%
Teacher/pupil ratio		1:35
Average years of school attendance	Boys	6 years
	Girls	6 years
Secondary		
No. of Secondary Schools		40 (Public 36, Private 4)
Total enrolment rates	Boys	12%
	Girls	12%
Total drop out	Boys	19%

rates	Girls	19%
Teacher / Pupil ratio		1:15
Average years of school attendance	Boys	13 years
	Girls	13 years
Tertiary		
Main type of training institutions		1 – College of technology 6 – Youth Polytechnics Secretarial & Commercial colleges
Enrolment in college of technology	Male	95
	Female	71
Enrolment in youth polytechnics	Male	130
	Female	319
Adult Education		
Number of adult education classes.		164
Enrolment	Women	1,707
	Men	714
Drop-out rates	Women	67%
	Men	77%
Literacy levels	Women	58%
	Men	64%

Source: District Development Plan 2002 - 2008

3.8 Energy sector

Kenya relies on two forms of energy namely: renewable and non-renewable. The raw materials for energy include biomass, fossil fuel, and radioactive minerals. Other sources of energy include hydro, geothermal, solar and wind.

The Government recognizes that alternative renewable energy sources hold tremendous potential, especially for reducing heavy dependence on woody biomass. Exploitation of these energy sources creates opportunities for income and employment generation, both of which have a positive impact on improving the quality of life while reducing poverty.

3.8.2 Types and Status of Energy Sources

Different types and sources of available energy sources ranked according to their availability and utilisation levels within the district.

- Wood fuel (Firewood and charcoal)
- Fossil fuels e.g. kerosene and LPG
- Electricity
- Solar energy
- Bio gas

Firewood and Charcoal

Almost all households in the district use firewood or/and charcoal as their main source of energy thus recording a whopping 100% inclusive of those households that use other sources of energy supply for specific purposes but still use wood related sources simultaneously. Firewood is a key source of energy and even used by the two tea factories in the processing of tea. This places the forestry (trees and shrubs) resources at a critical position in the provision of the energy needs within the district and places enormous pressure on them due to the increasing demand for energy as firewood or charcoal.

Electricity

Even though important to spur economic growth, the district is inadequately covered by the electricity network. Only **27** trading centres out of a total of more than **200** are connected with electricity. These centres act as the main focus areas of trade and rural development by providing market for and access of products and services in the rural areas of the district

Only 540(Five-forty) households are connected to the electricity supply, which represent about 0.4% of the total households in the district. Electricity is mainly used for lighting purposes while fuel wood provides energy for other purposes, like cooking and heating.

Solar

This is the least utilised yet most abundant energy resource. The use of solar energy is limited to a few households especially within the urban and trading centres, while zero percent of the rural households are recorded to use solar power. This is mainly due to inaccessibility of the necessary technology to the majority of the population and lack of promotion of solar energy as alternative energy source especially to electricity.

Biogas and Fossil Fuels

There is a recorded 1% of the households using bio gas and fossil fuels (kerosene and LPG), which translates into about 1,300 households and represents mainly those within the urban centres. Bio gas utilisation extends to some rural areas where it is mainly generated using bio mass and livestock dung among livestock farmers.

Other products like petrol are mainly sold to the motor vehicles in the transport sector. There are an estimated one hundred vehicles plying the roads within the district that mainly sustain a network of 10 petroleum filling stations.

3.8.3 Trends in Energy production, consumption, costs and projections.

There is a record increasing demand of energy considering the increasing population and urbanisation rate. The increasing demand is for all the energy sources from wood fuel to petroleum products. Consequently the market forces of demand and supply dictate the increasing cost of energy in the district. This has put a lot of pressure especially on wood lots outside the gazetted areas.

The supply especially of wood fuel will soon be overtaken by the demand unless intensive re-afforestation and reforestation is undertaken in the farmlands to help bridge the gap. Alternative sources of energy like wind and solar need to be developed to achieve full potential.

There are no major or land scale hydro power, geothermal, biomass, solar, or wind generation of power in the district, but only very scale utilisation of biomass, wind and solar energy at the household level at 0.1% of the population. Table 33 indicate energy consumption and costs

Table 33: Energy Consumption and Costs

Source of Energy	Point of Production	Point of Consumption	Unit cost (Kshs)	Environmental Impacts
Wood fuel	Within the district	Within the district	50	Deforestation Land degradation
Fossil fuels	Outside the district	Within the district	65	Vehicular air pollution
Electricity	Outside the district	Within the district		
Solar	Within the district	Within the district		
Bio gas	Within the district	Within the district		

Source: District Environment Office 2007 - Meru North District

3.8.4 Energy Supplies

Energy supplies include electricity, wood fuel, solar, wind and petroleum based fuels. Electricity supply is connected in urban centres such as Mutuati, Maua, Mikinduri and all the towns along the tarmac. Mainly it is used in the tea and coffee factories and also in the markets for small businesses as welding and in the households for lighting.

Wood fuel is the most commonly used form of energy mainly in the rural households, by jua kali fabricators who use a lot of charcoal and for curing tobacco in places like Tigania East, Uringu and Igembe Central. This land led to significant environmental degradation.

Petroleum products are mainly used in the transport sector although products like kerosene are also consumed in great quantities by the households. These products are readily available in the markets. Energy sources like wind and solar are not fully utilised although there is a high potential mainly because of lack of appropriate technology especially in the rural interior. Table 35: shows status of energy supply in the district.

Table 34: Status of Energy Supply in the District - 2002

Number of trading centres with electricity	27
Number of households with electricity connections	540
Percentage of rural households using solar power	0%
Percentage of rural households using firewood/charcoal	100%
Percentage of households using kerosene, gas or biogas	1%

Source District Development Plan 2002-2008

Types of Pollutants and Waste

The major pollution emanating from energy usage in the district includes both air and water pollution and manifested in the following:

- Smoke emissions from automobile and kitchens
- Oil spills especially in petroleum outlets and sometimes on the road
- Used oil from vehicle either on the roads or at garages

3.8.5 Factors Influencing Trends in Energy Consumption

- Population growth
- Economic growth rate
- The rate of urbanisation
- Adoption of technologies

Key Environmental Issues

The major pollution emanating from energy usage in the district includes:

- Both air and water pollution and manifested from Smoke emissions from automobile and kitchens
- Oil spills especially in petroleum outlets and sometimes on the road
- Used oil from vehicle either on the roads or at the garage
- Deforestation and loss of vegetative cover
- Low adoption of alternative sources of energy and technologies to harness the same
- Ever increasing demand for energy
- Inefficient systems and utilisation leading to wastage

Proposed Interventions

- Expand the electricity grid coverage to the rural areas and all market centres
- Promote use of alternative sources of energy
- Environmental Impact Assessment and Audit(factories – tea and coffee Petrol stations and Garages)
- Expansion of the electricity coverage
- Intensify afforestation programmes
- Explore and expand alternative energy sources to generation of solar, wind and hydro power.

CHAPTER FOUR

4.0 Industry, trade and services

Industries, trade and services can benefit a lot by adopting environmental management systems that not only address production processes but also promote waste minimization, treatment and disposal.

4.1 Industrial sector

There are only a few agro based industries in the district and they include:

- Kiegoi and Micii Mikuru Tea Factory
- Mukululu Vineyard Camp - wine press operated by the Catholic Church and
- 52 coffee factories (Including private ones)

Other forms of industrial activities are found in the small scale informal sector (Jua Kali) and include such trade as:

- Carpentry and Metal workshops
- Automobile garages

4.1.1 Trends in Industrial Development in the District

Considering the agricultural potential of the district, agro-based and other industrial activities may be developed to include:

- Fruit processing
- Processing of herbal products
- Processing of nuts
- Dairy and livestock products
- Industries to support eco tourism
- Wood and forest products
- Alternative energy provision
- Processing of Miraa

There is a proposed Igembe Tea Factory to be constructed to ease the pressure of the tea produce at Kiegoi Tea Factory.

Table 35: Type and Trends in Industrial Development

Type of industry	1963	1982	Projections for 2010	Remarks
Agro-based	Micii Mikuru Tea factory	Kiegoi Tea Factory	One (1)	Proposed Igembe Tea Factory

Source: District Environment Office 2007 - Meru North District

Types of Pollutants and Wastes

- Oils and greases
- Waste water

Key Environmental Issues in the Industrial Sector

- Air and water pollution
- Waste management
- Lack of supportive infrastructure
- Waste and effluent management
- Occupational safety
- Air pollution
- Lack of detailed analyses of the impact

Proposed Interventions

- Provide an enabling environment for industrial development. (Power, roads, sewerage systems)
- Improve micro/small enterprise regulatory framework
- Adopt more appropriate disposal methods
- Employ more cleaner technologies
- EIA and EA for upcoming projects and existing industrial concerns

4.2 Trade sector

Kenya's domestic and international trading patterns revolve around trading in agro-based goods and other products from the industrial and manufacturing sectors. Due to lack of industrial activities in the district the impacts of trade on the environment is limited to sales of goods, consumption, waste generation and disposal. The environment has faithfully supported the business venture in the tourism and agricultural sector.

4.2.1 Types of Trade in the District

- Retail and wholesale
- Hawking

Main Traded Goods in the district

- Miraa
- Consumer goods
- Textiles
- Pharmaceuticals
- Construction materials
- Plastics
- Household goods
- Electronics
- Electrical appliances
- Auto spares
- Horticultural products
- Dairy products
- Petroleum products

Table 36: Impacts of Trade on Environment

Type of Trade	Products	Wastes	Key environmental impacts	Mitigation measures
Retail and wholesale	Consumer goods, Pharmaceuticals, Construction materials, Textiles, Plastics, Household goods, Electronics, Electrical appliances, Auto spares, Petroleum products, Horticultural products, Dairy products	Solid	Accumulation of solid waste – garbage – which interferes with the environment Water and land pollution	Increase waste collection activities Adopt proper solid waste management systems
Hawking	Miraa Textiles	Solid	Garbage accumulation	Increase waste collection activities Adopt proper solid waste management systems

Source: District Environment Office 2007 - Meru North District

Key Environmental Issues related to Trade

- Lack of access to credit for small-scale entrepreneurs in order to enhance growth and sustainability
- Lack of managerial skills and relevant information among entrepreneurs
- Inadequate infrastructure to support business initiatives

- Lack of organisation among traders
- Solid waste accumulation – garbage
- Polythene paper bags and plastics off-loaded to the environment

Proposed Interventions

- Strengthening the small- scale and Jua Kali enterprises by facilitating use of available resources
- Provision of business finance by joint loan credit scheme and identification of alternative sources of finance
- Organise traders and business people along speciality line to form Small organised and self help groups
- To enhance training for Self improvement at an individual basis to skills upgrading and entrepreneurial training
- Providing technical and managerial skills to the enterprises
- Collection, analysis and dissemination of relevant trade data
- Application of efficiency technology to limit waste handling and disposal
- Improve the infrastructural development to accommodate more business initiatives

4.3 Services sector

The services sector plays an important role in creating and supporting an enabling environment that facilitates private sector investment, growth and job creation. The provisions of adequate services, coupled with macroeconomic stability and a long-term development strategy, are essential preconditions for sustainable economic and social development.

4.3.1 Major Service Sectors in the District

Transport Services

Road transport, which provides services through private and public service vehicles

There is one airstrip in the process of being expanded to facilitate air travel especially for the transportation of goods.

Hospitality Services

Number of tourist class hotels in the district:

- 3 Hotels in Maua Town
- 2 Hotels in Meru National Park
- 2 Self-Service Bandas
- 718 registered hotels (i.e. eating houses, restaurants, bars, lodges)

Telecommunication Services

Communication services in the district are provided mainly by Telkom Kenya through the Maua, Kianiai Mikinduri telephone exchange centres and the two Mobile phones service providers – Safaricom Communications and Zain companies. In addition there are two Cyber cafes to provide internet connectivity.

Banking Services

There are two main commercial banks in the district: Consolidated Bank of Kenya and Kenya Co-operative Bank .Other financial institutions include - Nyambene Arimi SACCO, Maua Methodist SACCO and Meru North Farmers SACCO. While Micro-finance institutions includes-BIMAS, Kenya Women Finance Trust and Faulu Kenya

Table 37: Impacts of Service Sector to the Environment

Service Sector	Impacts to Environmental degradation	Proposed interventions
Telecommunications	Use of poles in the transmission leading to deforestation The erection of transmission stations near residential areas and the resultant health risk	Alternative transmission method Re-forestation Precautionary approach in dealing with radio transmission
Hospitality	Solid waste and effluent disposal	EA for all the facilities Upgrade the disposal infrastructure and systems
Transport	Air pollution from vehicles emission Oils and greases from garages	Regular vehicle inspection and maintenance

Source: District Environment Office 2007- Meru North District

4.4 Tourism

The tourism industry is heavily dependent on the vast and abundant natural resources in the country; these include: wildlife, beaches, landscapes, and diversity of cultural, historical and archaeological resources.

Since the natural and cultural resources are unique, fixed in location and often irreplaceable, it is important to control the degree and manner in which they are exploited and to anticipate the effect on the sustainability of tourism by different methods of exploitation. Tourism, if properly planned will contribute to the conservation and management of the environment.

4.4.1 Tourism Attractions

The main tourist attraction in the district is wildlife due to the presence of the Meru National Park within the Meru Conservation Area, which is currently undergoing rehabilitation after years of dilapidation caused by conflicts and cattle rustling activities.

After the rehabilitation of the park and provision of necessary infrastructure the trend in tourism activities are expected to increase with time.

Other tourist attractions include cultural monument sites, crater lakes, forests, craters (volcanic) and beautiful scenery.

Table 38: Tourism Attraction Sites in the district

No.	Attraction	No. of facilities	Geographical Location	Environmental Impacts
1.	Wildlife	2	Meru National Park	Pressure on the existing facilities
		3	Maua Town	Waste management problems

Source: Kenya Wildlife Service 2007- Meru National Park

Key Environmental Issues

- Solid and effluent disposal – this is complicated by lack of adequate sewerage and waste collection and disposal facilities.
- Insecurity
- Human wildlife conflicts
- Poor infrastructure e.g. roads going to the park
- Cattle influx into the protected area
- Diversion of river waters to individual farms
- Dependency on wildlife tourism

Proposed Interventions

- Enhance the solid and liquid waste disposal and treatment capacity to accommodate the increasing demand for tourist services and human settlement.
- Enhancement of security measures for safety of both visitors and wildlife

- Increased routine security patrols/operations and aerial surveillance
- Enhanced animal control activities
- Erection of the electric fence
- Curb the human-wildlife conflict in areas surrounding the Park
- Create a wildlife corridor - more protected area- consider Ngaya forest for this purpose
- Promote wildlife and environmental conservation awareness.
- Maintenance of the road network and airstrip in the park for ease of mobility
- Controlling the invasion of livestock into the protected area
- Enforcement of the legal requirements and curbing illegal abstraction from the rivers
- Regulate and inspect water flow volume
- Aggressive marketing so as to increase the number of tourists
- Encourage and initiate more tourism activities, camping, game walking, night game drives, sundowners, rafting etc

4.4 Mining

Kenya has great potential for mineral resources exploration and exploitation for economic development. Mining methods involve some disturbance of the earth surface and the underlying strata including aquifers. Some potential adverse impacts on the environment from mining and quarrying activities are likely to occur.

4.4.1 Minerals

There are no minerals of any significant value which have been identified in the district. It's hard to tell the mining potential of the district considering that no mineral exploration has been done and the current indigenous knowledge does not indicate existence of minerals anywhere in the district. There are cases of sand harvesting in the district.

Key Environmental Issues

- Carry out mineral prospecting surveys to determine whether there are any minerals of economic value in the district
- Protection of environment in the prospecting process
- Over-exploitation of the sand reserves.

Proposed Intervention

- Carry out prospecting surveys
- Control sand harvesting

4.5 Quarrying

Types of Stones and Status of Quarrying Activities in the District

Quarrying activities are limited in the district due to the nature of the soil and the terrain. The stones are of volcanic origin and either too soft or too hard and rugged to be of any building value. The lack of minerals of any significant monetary or cultural value limits mining activities to quarrying of building materials especially

- Hardcore
- Sand (limited to riverside sources)
- Ballast and
- Murram

Most of building materials used in the district is imported – sand from Isiolo and stones from Meru Central or Meru South districts. There are about ten small quarries in the district mainly producing murram to grade rural access roads within the district.

The mineral contribution to GDP is very minimal because quarrying activities are localised to very small pockets within the district.

Table 40 indicates the status and location of quarries and material quarried

Table 39: Status and Location of Quarries and Material Quarried

Name of the quarry	Material Quarried	Location	Status
Kwani Hill	Stones	Tigania North	On-going
Micii Mikuru	Murram		On - going
Nturuba	Murram	Near Kangete	On-going
Antuanduru	Murram	Near Karama	On-going
Kithelemwa Hill	Stones	Kithelemwa	On-going
Nkinyang'a	Murram	Nkinyanga	On-going
Kamuciere hill	Murram	Near Liliaba	On-going
Kimachia	Sand		On-going
Mzalendo	Murram	Laare road	Not exhausted, but no current quarrying activity
Farm – Mulika road	Murram	Farm – Mulika road	On-going
Kiinji (2)	Sand	Next to Mwamba river	Ongoing Landslide prone area

Source: District Environment Office 2007- Meru North District

Trends and Extent of Quarries

Quarrying activities are limited due to the availability of materials, but the demand for construction materials has continued to give pressure to the little materials available especially murrum and sand.

Key Environmental Issues

- Lack of rehabilitation efforts leading to gaping and dangerous holes
- Collapsing river beds in case of murrum harvesting
- Destroy infrastructure especially for roadside quarrying
- Increased erosion of the loose soil and chippings and the resultant effects
- Makes the land susceptible to land slides

Proposed Interventions

- Rehabilitation of all quarrying sites
- EIA / EA for all quarrying activities in the district
- Regulation and monitoring of quarrying activities

Table 41 indicates types of quarries and methods of extraction in the district.

Table 40: Types of Quarries and Methods of Extraction

Type of Quarry	Methods of Quarrying and Purifications	Area Affected	Geographic Location	Size of Quarry (Ha)	Environmental Impacts
Sand/Murram	Excavation by hand	Riparian reserve	Kiinji	Small scale	Collapsing river beds in case
Murram	Excavation by hand	Hilly grassland	Nkinyanga	Small scale	Destroy infrastructure especially for roadside quarrying
Murram / Ballast / Hardcore	Excavation by hand	Steep hillside	Maua	Small scale	Increased erosion of the loose soil and chippings
Murram / Hardcore	Excavation by hand	Steep hillside	Maua	Small scale	Makes the land susceptible to land slides

Source: District Environment Office 2007 - Meru North District

Types of Pollutants and Wastes

- Dust and air suspended materials
- Noise pollution.

Key Environmental Issues

- Land degradation
- Destruction of the riparian reserve

- Air pollution - dust
- Abandoned quarries
- Lack of regulatory framework.

Proposed Intervention

- Soil and water conservation measures
- Reclaim the collapsed riverbanks
- Control dust and suspension released to the atmosphere
- Rehabilitation of abandoned quarries
- Development and enforcement of regulations.

4.6 Sand harvesting

4.6.1 Status of Sand Harvesting Activities

Due to lack of significant sand deposits in the district there is very limited sand harvesting activities, and most of the building sand is imported from other districts like Isiolo and Meru Central.

CHAPTER FIVE

5.0 Environmental hazards and disasters

Most environmental disasters are climate/weather and tectonic movements related. Environmental disasters have a tendency to retard and erode gains made in building meaningful livelihood and economic development

Hazard: A potentially damaging physical event, human activity or phenomenon with a potential to cause loss of life or injury, property damage, social and economic disruption of life, environmental degradation among other effects. And few cases of Environmental disasters have been reported in the district.

Disaster: A disaster can be defined as a serious disruption of the functioning of the society causing widespread human, material or environmental damage and losses which exceed the ability of the affected community to cope using their own resources

5.1 Extent and trends of environmental hazards and disasters

This section describes environmental hazards and disasters, their extent and trend including geological, climatic, biological, and technological hazards as well as existing mitigation measures, physical, indigenous knowledge.

5.1.1 Environmental Hazards and Disasters

The terrain in some parts of the district is steep, rugged and prone to disasters like landslides, especially on the slopes of the Nyambene ranges. The Nyambene ranges also influences the soils and the underlying bed rock. Most of the landscape on the North and North East is punctuated by rocky outcrops that make even communication very difficult. The most frequent hazards and disasters experienced in the district are landslides and drought with the resultant famine. Most of the area affected by landslides includes the steep rugged slopes of the Nyambene Hills, and those areas most vulnerable

to drought are the ASALs where pastoralism takes place. The main hazards in the district are droughts which occur at an interval of 3 to 7 years and landslides which occur during heavy downpour. These hazards result in loss of life and property to the community.

5.1.2. Traditional Coping Mechanisms

There are some traditional coping mechanisms that even though not so popular today used to work for the benefit of the community and the environment. Some of these include:

- De-stocking in anticipation of an imminent drought
- No settlement on areas perceived to be prone to landslides. These areas were out of bound and were left out as conservation areas.
- Food preservation for consumption during dry spells

5.1.3 District Environmental Response Mechanisms

There exists a District Disaster Management Committee whose main responsibility is to respond to disaster occurrences and organise for relief to ease the impacts of disaster on the lives of the people.

This committee should be empowered to have the necessary capacity to develop and implement systems and mechanism not only to react to disaster situation but also to proactively act on the causative factors of the most occurring disaster situation.

5.1.4 Status of Early Warning and Preparedness

Capacities to mitigate and recover from disasters are often constrained by lack of early warning systems and preparedness, keeping in minds the social dimensions and livelihood options that hamper the building of resilience from external shocks.

Table 41: Sector Capacities for Disaster Preparedness and Response

Sector	Type of Disaster	Human Resource	Lead agency
Agriculture	Drought	Extension workers	
Health	Epidemics	Social workers, doctors and public health officers	Public health
Security	Conflicts	Security agencies	Provincial Administration
Wildlife	Drought / Conflict / Fire	Warders	KWS
Forestry	Fire	Forest guards	Forest Dept
Water	Drought	Hydrologists	WRMA

Source: District Environment Office 2007 - Meru North District

Key Environmental Issues

- Lack of preparedness
- Lack of appropriate early warning systems and technologies
- Inadequate capacity and resources to handle disasters

Proposed Interventions

- Adoption of environmental early warning systems and preparedness strategy
- Development of response plans

- Establishment of food reserves
- Plan and stock up and be ready for any disaster
- Develop appropriate warning systems for each disaster
- Ad hoc arrangements and response
- Allocate more resource for disaster response
- Acquire skill in disaster management

CHAPTER SIX

6.0 Environmental education and technology

As Kenya aspires to achieve sustainable development, there is need to educate the public on the importance to participate in environmental conservation and application of appropriate technology while addressing their socio-economic development concerns.

6.1 Status of Environmental Education

In the endeavour to participate in conservation efforts, there are a number of initiatives started by various groups to promote environmental educational programmes in the district. An environmental group called Itinerant Group for Environmental Amelioration (IGEA) has been involved with about 10 schools in Ntonyiri and Igembe in nursery establishment and tree planting programmes.

Various schools, both secondary and primary have initiated clubs like Wildlife Clubs of Kenya, 4K clubs and Environmental clubs to promote conservation of the environment in and around their schools. There are over 50 schools with such initiatives and the District Environment Officer is co-ordinating their activities. Table 42 documents the environmental programmes and challenges in the district

Table 42: Environmental Programmes and Challenges in the District

Environmental Programmes	Key players	Challenges	Proposed Interventions
Environmental Amelioration	IGEA, Forest Dept, Schools, NEMA	Lack of materials to sensitise the public	Develop appropriate materials for sensitisation
Tree planting and nursery establishment	IGEA, Forest Dept, Schools,	Lack of appropriate seeds and technical capacity	Training farmers Extension services

Source: District Environment Office 2007 - Meru North District

Key Environmental issues

- Lack of awareness creation materials (resource / documentation centre)
- Poverty and ignorance and lack of awareness
- Poor infrastructure.

Proposed Interventions

- Develop materials for awareness creation
- Collect and gather materials that are appropriate to priority environmental issues
- Share and disseminate pertinent information among the stakeholders
- Improve infrastructure.

6.3 Public awareness and participation

When information on the environment is made available to the public it enhances internalization of values that support sustainable environmental management.

Key Players

Some of the key players in environmental awareness and public participation in the district include:

- Community self help groups –IGEA, Nyambene Mazingira
- Provincial administration – organise public meetings

- Forest department – collaboration with farmers and stakeholders
- Ministry of Agriculture – provision of extension services
- NEMA – environmental awareness and sensitisation

6.3.1 Challenges in Creating Environmental Awareness

- Lack of awareness creation materials (resource / documentation centre)
- Incomplete adjudication process and land disputes creating conflict zones
- Poverty and high levels of illiteracy
- Community apathy
- Transport and accessibility
- Politicisation of some key environmental resources

6.4 Technologies

Technologies can contribute to economic development and environmental conservation when used appropriately. The level of application of modern technology in the management of the environment is limited, and includes construction of gabions and other modern structures. People still largely depend on indigenous technologies, innovations and practices which include that are diverse and include soil and water conservation structures like trenches, benches and lining up crop residue, rotational cropping, preservation technologies and others.

Key Environmental Issues

- Lack of awareness creation materials (resource / documentation centre)
- Poverty and high levels of illiteracy
- Community apathy

- Poor infrastructure
- Low adoption of appropriate technology

Proposed Interventions

- Development of relevant materials
- Development of a resource centre
- Poverty alleviation programmes and education
- Community sensitisation and awareness
- Reach out to people in accessible area
- Infrastructure rehabilitation
- Community training and education
- Enhance technology transfer through demonstration
- Provision of extension services

6.5 Environmental Information Systems

The broad challenge in harnessing environmental information and communication technology include inadequate resources and capacity for information collection, analysis, storage and dissemination; inadequate awareness among environmental managers and the public; and lack of knowledge sharing networks at grass root level.

6.5.1 Types and Sources of Environmental Information

Most of the information available in the district is scattered among the different organisations and institutions and in different forms and types and is available mostly as:

- Research and surveys reports

- Departmental progress reports
- Population Census data and household surveys results
- Maps and drawings
- Books

Some information is not documented at all, especially that which relates to indigenous conservation knowledge and natural resources utilisation among others.

Institutions where the data is available

- GOK departments on sector specific information and data
- Institutions like schools and hospitals
- Among the civil society organisations and community groups

All documented data and information is freely accessible to the public, the only hindrance being the level of literacy among the population. Access to digitalised information is limited .

Table 43: Information and data types in the district

Sector	Type of Information	Form of Information	Institutions	Access conditions/ policy	Users	System Of updating
Agriculture	Crop development and husbandry Agro-chemicals Agro industries Soil and water conservation Marketing	Reports Posters Maps Leaflets	Dept of Agriculture	Free	CBO Farmers Extension workers Staff	Annual
Land	Land adjudication Land registration process Land sizes Parcel numbers Conservation areas	Maps Reports Plans and drawings	Land Adjudication	Consultation	Farmers Planners Surveyors Staff Business people	Periodical
Health	Prevalence of diseases	Hospital reports	Hospitals Health centres Dispensaries and clinics	Restricted	Health workers	Manual and periodical
Forestry	Forest types	Maps	Forest Dept	Free and	Community	Periodical

	Gazetted forest Non gazetted forests Plantations Exotic species Biodiversity Catchments	Reports		accessible	Staff Other departments Industries CBOs NGOs	
Industry	Types Processing Raw materials Products Waste and by-products	Reports Diagrams	Industries	Free	Staff Interested persons Government officials Farmers	
Wildlife	Conservation areas Wildlife dispersal areas Cases of conflicts Animal numbers, status, behaviour	Maps, Reports,	KWS	Free	Staff Tourists Conservationists Planners Environmentalists Community	Periodical
Quarrying	Quarry sites Rehabilitated quarries Abandoned quarries		NEMA	Free	Local Authorities Contractors Quarry owners	

	Materials quarried					
Fisheries	Types of fish Fishing areas Marketing of fish Rivers with fish Fish ponds Fish farmers	Maps Magazines reports	Fisheries Dept.	Free	Fish farmers Staff	
Water	Rivers Water accessibility Boreholes Drainage patterns Water availability Irrigation schemes Water uses Abstraction levels	Maps Reports Diagrams	Water Dept	Free	Water users association Water projects Community Staff Other dept Industries Farmers	
Climate and weather	Rainfall and temp	Tables Reports		Free	Staff Farmers Community	Regular

Source: District Respective Departments 2007 - Meru North District

6.5.2 Status of Environmental Information Management Systems

The sharing of information among institutions/lead agencies communities, taskforces is complicated due to the nature in which this information is stored. There are bulks of filed reports and booklets that contain different pieces of information and data and this can be cumbersome and time consuming.

Though the channels are open most information is not available to end users in a form that is easily consumable. Stakeholders usually organise meetings to share out information on specific issues and this ought to be encouraged.

There is also very limited capacities among institutions to generate analyse and store data and information in a form that can easily be shared out among the stakeholders. This is mainly due to inadequate skills in information technology among the producers of data and the users of the same. There are also limited skills the use of computers and other information management skills as well as lack of equipment and expertise in the same.

There is no centralised documentation centre, archive or library in the district, information is scattered in different places depending on sectors and issues of interest.

There are a number of newspapers, local publications and magazines in circulation in the district that help in the dissemination of information.

Key Environmental Issues

- The high level of illiteracy
- Limited skills in environmental information management
- Inadequate ICT infrastructure
- Low level of adoption of IT
- Lack of central information dissemination centre

Proposed interventions

- Enhance training in ICT
- Construct and equip the DIDC
- Facilitate access to internet services for schools, hospitals, institutions and government departments
- Create an environmental information database

6.6 Indigenous knowledge

Kenya has over 42 different ethnic communities with a very rich indigenous knowledge (IK) base unique to each community. This cultural diversity offers potential information that can be exploited to contribute positively to national development and environmental sustainability. Information on IK has not been well documented and properly packaged to allow effective dissemination, hence contributing to the massive loss of IK from one generation to the next

Table 44: Types of IK, Key players and Challenges

Sector	Types of IK	Form (Oral, Music, artefact)	Institution / individual holding	Access conditions / policy	Users
Agriculture	Food crops Crop and Animal husbandry Preservation of food	Oral	Community elders	Free	Community Farmers
Land	Ownership Extent Succession Fertility Land use	Oral	Community elders	Free	Farmers
Health	Diseases Herbal medicine Processing and preservation of medicine	Oral	Community elders	Free	Parents Community Patients Herbalists Elders
Information and communication	Literature Forms of communication	Oral Music Artefact	Community elders	Free	Community

ication	Tools	(horn)			
Trade	Forms of trade Currency development	Oral and practice	Community elders	Free	Traders Community
Energy	Forms of energy Uses of energy Availability Preservation and conservation	Oral and practice	Community elders	Free	Community
Forestry	Uses Herbal value Conservation Worship status Shrines	Oral and practice	Community elders	Free	Community Herbalists Conservationists
Industry	Tools development Processing techniques Preservation techniques	Oral	Community elders	Free	Community
Wildlife	Wildlife movement Habitat Migration Animal behaviour Preys and predators	Oral	Community elders	Free	Community Conservationists
Water	Availability Accessibility Uses Therapy	Oral	Community elders	Free	Community
Climate and weather	Drought Weather cycles Historic Climatic Changes	Oral	Community elders	Free	Community Farmers Traders

Source: District Respective Departments 2007 - Meru North District

6.6.1 Constraints/challenges in the utilization, documentation and dissemination of indigenous knowledge (IK)

- Most of the IK is not documented
- There exists a gap between the custodians of IK and the elite who have the skills and the capacity to collect and document this data and information
- The general altitude of looking down upon IK as inferior by the elite in society
- Some IK has been overtaken time and therefore not practical
- Some IK is not scientific in nature (belief – based) and therefore cannot be verified and authenticated and therefore not applicable across the board or replicated elsewhere.

Proposed interventions

- Construct and equip the DIDC
- Enhance training and create opportunities for people to gain IT skills
- Facilitate access to internet services for schools, hospitals, institutions and government departments
- Emphasize on the importance of generating, sharing and disseminating relevant information
- Offer training and education opportunities

Key Environmental Issues

- Lack of central information dissemination centre
- Limited skills in environmental information management
- Lack of IT equipment like computers and internet connectivity
- Low level of adoption of IT
- The high level of illiteracy

Proposed interventions

- Inter-sectoral sharing of information
- Construct and equip the DIDC
- Enhance training and create opportunities for people to gain IT skills
- Facilitate access to internet services for schools, hospitals, institutions and government departments
- Emphasize on the importance of generating, sharing and disseminating relevant information
- Offer training and education opportunities

CHAPTER SEVEN

7.0: Environmental governance and institutional arrangements**7.1 Overview**

There are many institutions involved in the management of the environment in the district. They range from government departments, Non-governmental organizations, private sector, associations community based organization and others. With that range of institutions there is bound to be operational conflicts and duplication of roles and responsibilities. The problem is compounded by poor co-ordination, inappropriate and incoherent legislation, lack of adequate institutional frameworks for dealing with governance issues and a lack of understanding of the importance of these ecosystems for human health, well-being and prosperity¹.

Promotion of awareness among the public and policy-makers of the importance of proper management of resources and the integration of environmental issues in the development agenda remains a key priority. Other important priorities include promoting legislation to take up and implement relevant multilateral environmental agreements, harmonizing legal frameworks that address these issues, developing appropriate guidelines, standards and procedures for strategic environmental assessments (SEA) and environmental impact assessments (EIA), developing model legislation for sectors such as local councils, tourism, agriculture, and engaging with relevant organizations to promote sustainable business practices.

7.2 EMCA structures for environmental management

Environmental governance in Kenya involves major players who are coordinated by National Environment Management Authority. There are also sectors of the government who have aspects of environmental management in their programmes and are referred to as lead agencies in the EMCA. Environmental Impact Assessment and Environmental Audit are tools used for planning for upcoming and existing projects respectively

¹*This upholds the Principle of Sustainable development; the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

Some of the Lead Agencies in the district

- Ministry of Water and Irrigation
- The Kenya Forest Service
- Water Resources Management Authority and related Companies and Boards
- Ministry of Works
- Ministry of Housing
- Ministry of Labour and Human Development
- Mines and Geology Department
- Ministry of Education, Science and Technology Development
- Ministry of Medical Services
- Ministry of Public Health and Sanitation
- Ministry of Energy
- Ministry of Agriculture
- Ministry of Local Government
- Kenya Wildlife Services
- Ministry of Livestock Development
- Ministry of Fisheries development

EMCA Committees

- Public Complaints Committee
- National Environment Tribunal

- District and Provincial Environment Committees

7.3. Status of Environmental Governance & Institutional Arrangements

Key issues on governance, legal framework and institutional arrangements and policies are: inadequate capacity to interpret and enforce environmental legislations; conflict of environmental legislations and institutional mandates; undefined pre-existing ownership rights and utilization of natural resources; use of incentives to strengthen compliance for environmental management; introduction and acceptance to pay for ecosystem services and goods; over reliance on elaborate and lengthy court systems and formal institution in deliberating environmental cases. The government departments that collaborate with NEMA (District Environment Office) are Forest, Agriculture, Fisheries, Livestock, Health, Education, Development Office, Water Resources and Management Authority, Local Authorities as indicated in the table this also includes International organizations NGOs and CBOs.

Active Environmental NGOs / CBOs / Private Sector Organization

There is no fully fledged environmental NGO in the district, but there are a number of active Community Self Help Groups mainly dealing with environmental conservation through efforts to establish tree nurseries and planting trees.

A few are involved in mobilising people to undertake environmental conservation through public education and community participation.

The tables 45 and 46 below indicate the policies and legislations that impact on environment in the district.

Table 45: Policies that Impact on Environment

Title of policy	Year of formulation	Aspects of environment addressed by policy	Implementing agency (ies)	Coordinating mechanisms	Challenges in enforcement	Areas on overlaps & conflicts with EMCA
Forest policy	2005	Tree planting, poverty reduction, soil, water & biodiversity conservation, conservation of catchment areas, forest research, training	Forest Dept	Participatory community forest protection, participatory tree planting, reporting forest pest & diseases to KEFRI, research and dissemination of findings by KEFRI,	-Inadequate funds. -Poor coordination-political interference s- inadequate law enforcement	<i>Overlaps</i> -Research -Training -Public participation
Diagnosis, treatment & prevention of malaria	2003	Prevention/control of vectors	Ministry of Health	Seasonal calendar Data compiled at Medical Dept	-Inadequate funds	

Source; District Forest Office, 2006 & District Public Health Office,

Table 46: Legislation that Impact on Human Health & Environmental Quality

Title of legislation	Year of enactment	Aspects of environment addressed by Act	Implementing Agency (ies)	Coordinating mechanisms	Areas on overlaps & conflicts with EMCA
Forest Act	2005	-Management of all state forests -Management of all provisional forests in collaboration with the owners -Protection of forests -Promotion of forestry education and training -Community participation -Prohibited activities in the forest -Presidential protection of trees	Forest dept,	Formation of PFM Formation of user groups Education through barazas	
Water Act	2002	-Management and conservation water resources Protection of water catchments	Water Resources Management Authority	Formation of water users associations and river user associations	
Public Health Act		-Sanitation and hygiene	Public Health Dept		
Fisheries Act	1989	-Pollution prevention zones -Ecological zones where fishing is prohibited	Fisheries Dept		
Agriculture Act		Soil conservation River bank protection	Agriculture Dept		
Pest Control	1984	Safe use of chemicals	PCPB		

Product Act		Disposal of containers & obsolete chemicals Quality control/persistence			
The Local Government Act	1978 and revised in 1998	-Control factories/industries/which by smoke, chemical fumes, gases, noise, vibration to neighbours -Control planning of specific areas	Local Authority		

Source, District Forest, Agriculture, Public Health, Fisheries & Water Offices, 2006

Environmental Impact Assessment (EIA) and Environmental Audit (EA)

These are the regulatory tools applied in the districts for activities listed in the first schedule of EMCA. . Other facilities such as the agro based processing industry; filling stations also undertake annual EA to ensure compliance. Due to the complicated nature of Land use activities as well as sensitivity of wetland management, the District Environment Committee through the District Environment Officer keeps itself informed of the on going activities. There are various mechanisms in place in the district that ensure that the environment is conserved.

EMCA 1999 provided for the establishment of the District Environmental Committees. The DEC is already constituted and gazette. The Local Authority (Town Council) has an Environment Division to ensure that the environment’s integrity is maintained. The level of domestication of MEAs is very low. There is an urgent need for the public to be informed on the contents of these MEAs.

7.4 Environmental Issues

- Overlaps in enforcement
- Inadequate research on local Environmental issues
- Inadequate capacity for enforcement
- Inadequate public participation

- Low level of domestication and implementation of MEAs

7.5 Proposed Interventions

- Harmonization of regulations
- Enhanced research on environmental issues
- Enforcement of EMCA and other relevant regulations and guidelines
- Enhance public participation through Barazas and field days
- Domesticate and create awareness on MEAs locally

Key Issues in Compliance and Enforcement

- Lack of established environmental standards
- Lack of mechanisms to establish and measure the extent of environmental damage
- Conflicting legislation
- Weak institutional linkages

Proposed interventions

- Increase co-operation and strengthen institutional linkages
- Enforcement of EMCA (1999) regulations

CHAPTER EIGHT

8.0 Implementation strategy

8.1 Overview

The objective of this Environmental Action Plans is to integrate environmental concerns in development planning and implementation and this chapter focuses on the monitoring and evaluation system that will be used to assess the project implementation process during the plan period. It also presents implementation, monitoring and evaluation matrix, that the district will put in place to ensure that the implementation of the plan is carried out to achieve the objectives.

Environmental concerns are cross-cutting in nature and their impacts are felt at the local level, district, regional, national and global level. Their integration in development process at all levels is essential hence the preparation of the DEAPs, PEAPs and NEAP. Their preparation and implementation is a statutory requirement under EMCA (1999) Section 38.

8.2 Stakeholders involvement

The implementation Strategy of the Environment Action Plans should involve as many stakeholders as possible. These include all Government Departments, agencies, State Corporations and any other organ of Government as well as Civil Society Organizations, private sector and individuals.

The participation of stakeholders in the implementation is guided by their statutory mandate, their capacities and priorities. They should be involved at all stages of preparation and implementation including monitoring and evaluation. Participatory approaches to their involvement may be applied.

8.3 Monitoring and evaluation

The Monitoring and Evaluation of the implementation of the Environmental Action Plans will be carried out using participatory approaches where

stakeholders are involved at all stages. Monitoring will mainly be undertaken on continuous basis through meetings and field visits. Reports will be discussed at all stages but quarterly reports will be prepared and reviewed. Evaluation will be undertaken periodically preferably on annual basis in line with the Performance Contracting period in the Public Service.

The purpose of Monitoring and Evaluation of the Environmental Action Plans is to ensure their efficient and effective implementation as well as ensuring that environmental concerns have been addressed and integrated in development process. It will involve documentation of "Best Practices" for purposes of replication.

Table 47: implementation matrix for Meru North district

Division	Location	Issue Category	Problem Statement	Action No.	Actions Needed	Stakeholders	Timeframe 2009-2013
District Wide	District Wide	Air	Air pollution	1	Control burning garbage	Min. of Public Health and Sanitation, Local Authorities	
				2	Promote recycling of waste	Local Authorities	
				3.	Apply and enforce Public Health and Sanitation Act on disposal of dead animals	Min. of Public Health and Sanitation, Local Authorities	
				4	Sensitize communities on waste management	Min. of Public Health and Sanitation, Local Authorities	
				5	Afforestation and Re-afforestation	KFS	
		High prevalence of T.B	6.	Improve housing ventilation	Min. of Public Health and Sanitation, Local Authorities		
			7	Conduct air pollution monitoring	Min. of Public Health and Sanitation, Local Authorities		
		Climate & related environmental hazards	Frequent Drought /Famine	8	Irrigate crops where possible	WRMA	

				9	Plant drought tolerant crops	Min. of Agriculture	
				10	Plant early maturing crops	Min. of Agriculture	
			Frequent Drought /Famine	11.	Afforestation and Re-afforestation	KFS	
				12.	Promote storm water harvesting e.g construct water pans	WRMA	
				14.	Promote fish farming	Min. of Fisheries	
District Wide	District Wide	Climate & related environmental hazards	Flooding				
				16.	Afforestation and Re-afforestation	KFS	
				17.	Initiate appropriate soil conservation measures	Min. of Agriculture	
				18.	Improve farming methods	Min. of Agriculture	
				19.	Peg river banks	Min. of Agriculture	
				20.	Construct drainage channels	Min. of Agriculture	
				21.	Introduce new crops such as rice	Min. of Agriculture	
	Crop Production & Soils	High rate of soil erosion	22.	Initiate appropriate soil conservation measures	Min. of Agriculture		

				23.	Afforestation and Re-afforestation	KFS	
				25.	Construct proper drainage on roads	Min. of Roads	
				26.	Build gabions	Min. of Agriculture	
				27.	Plant cover crops	Min. of Agriculture	
				28.	Promote roof water catchment	Min. of Agriculture	
				29.	Promote use of mulching	Min. of Agriculture	
			Poor crop yields	30.	Promote use of certified seeds	Min. of Agriculture	
				31.	promote timely land preparation and planting	Min. of Agriculture	
				32.	Initiate appropriate soil conservation measures	Min. of Agriculture	
				33.	Plant early maturing crops	Min. of Agriculture	
District Wide	District Wide	Crop Production & Soils	Poor crop yields	34.	Promote use of idle fertile land for farming	Min. of Agriculture	
				35.	Practice crop rotation	Min. of Agriculture	
				36.	Plant drought tolerant crops	Min. of Agriculture	
				37.	Promote use of farm yard manures	Min. of Agriculture	
				38.	Promote irrigation along the rivers	Min. of Agriculture, WRMA	
				39.	Promote Agro-forestry	Min. of Agriculture	

				40.	Promote indigenous crops	Min. of Agriculture	
				41.	Sensitize communities to abandon cultural beliefs that contribute low crop production	Min. of Culture and social Services	
				42.	Conduct frequent soil sampling	Min. of Agriculture	
				43.	Use push pull technology to reduce <i>striga</i> weeds	Min. of Agriculture	
				44.	Diversify crops	Min. of Agriculture	
		Energy	Shortage of wood fuel	45.	Promote planting of quick maturing trees	KFS	
				46.	Promote use of energy saving devices	Min. of Energy	
				47.	Promote use of alternative sources of energy eg biogas, solar	Min. of Energy	
		Environmental Education & Awareness	Low level of awareness on environmental education	48.	Educate the public through electronic and print media, drama and songs	Min. of Information	
District Wide	District Wide	Environmental Education & Awareness	Low level of awareness on environmental education	49.	Promote public participation in environmental plans, programmes and activities	Min. of Public Health and Sanitation, Local Authorities	

				50.	Sensitize communities/opinion leads to abandon cultural beliefs that inhibit environmental conservation	Min. of Culture and social Services	
				51.	Disseminate environmental information	Min. of Public Health and Sanitation, Local Authorities	
				52.	Integrate environmental issues in Schools & Adult/Public Institutions and literacy Centres	Min. Education	
				53.	Increased awareness on environmental laws through <i>Barazas</i> , seminars, workshops	Min. of Public Health and Sanitation, Local Authorities	
District wide	District wide	Fish & Fisheries	Shortage of fish	54.	Apply and enforce fisheries act	Min. of Fisheries	
				55.	Promote manual removal of water hyacinth and put it into economical use	WRMA	
				56.	Promote fish farming	Min. Fisheries	
				57.	Afforestation and Re-afforestation	KFS	
				58.	Monitor and ban use of chemicals for fishing	Min. of Fisheries	

				59.	Rehabilitate and restore water catchment areas	WRMA, Min. Agriculture	
District Wide	District Wide	Forests & Trees	Deforestation	69.	Afforestation and Reforestation	KFS	
				70.	Promote agro forestry	KFS	
				71.	Conserve herbal medicinal plants	KFS	
				72.	Promote use of energy saving devices	Min. of Energy, Min. of Agriculture	
District Wide	District Wide	Forests & Trees	Deforestation	73.	Sensitize communities against traditional beliefs that hinder environmental conservation	Min. of Public Health and Sanitation, Local Authorities	
				74.	Promote community education and awareness on good forestry practices	KFS	
				75.	Plant drought tolerant crops	Min. of Agriculture	
				76.	Gazette existing forests		
				77.	Enforce the Forest Act	KFS	
				78.	Promote public awareness on the need to conserve and protect forests and catchments	KFS	
				79.	Establish tree nurseries	KFS	

				80.	Identify hilltops prone to soil erosion and rehabilitate them	KFS, Min. of Agriculture	
		Health	Prevalence of waterborne diseases	81.	Apply and enforce Public Health and Sanitation Act	Min. of Public Health and Sanitation, Local Authorities	
				82.	Promote treatment of drinking water	WRMA	
				83.	Protect water sources	WRMA, Min. Agriculture	
				84.	Apply and enforce waste management regulations	Min. of Public Health and Sanitation, Local Authorities	
				85.	Construct a proper drainage and sanitation facilities	Min. of Public Health and Sanitation, Local Authorities	
District Wide	District Wide	Health	Prevalence of waterborne diseases	86.	Construct latrines	Min. of Public Health and Sanitation, Local Authorities	
				87.	Create awareness on proper hygiene	Min. of Public Health and Sanitation, Local Authorities	
				88.	Promote use of treated mosquito nets	Min. of Public Health and Sanitation, Local Authorities	

		Industry & Other Business Activities		89.	Apply and enforce Water quality and Waste management regulations	Min. of Public Health and Sanitation, Local Authorities	
				90.	Enforce air control regulations	Min. of Public Health and Sanitation, Local Authorities	
				91.	Promote use of environmentally friendly sources of energy	Min. of Energy	
				92.	Promote use of cleaner production technologies	Min of Industry	
				93.	Recycle polythene materials	Local Authorities, Min of Industry	
				94.	Promote use of EFB	Min of Industry	
				95.	Protect springs	WRMA, Min. Agriculture	
		Livestock & Grazing	Low livestock productivity	96.	Control animal diseases	Min of Livestock	
				97.	Control tsetse through suppression, spraying and traps	Min. of Livestock	
District Wide	District Wide	Livestock & Grazing	Low livestock productivity	98.	Upgrading of indigenous cattle breeds/crossbreeding	Min. of Livestock	
				99.	Undertake research on tsetse fly control	Min. of Livestock	

				100.	Train the communities on tsetse fly control	Min. of Livestock	
				101.	Train farmers on good animal husbandry	Min. of Livestock	
				102.	Plant fodder crops/trees	Min. of Livestock	
				103.	Construct water points	Min. of Livestock	
				104.	Make hay for use during the dry season	Min. of Livestock	
				105.	Reduce the stocking rate	Min. of Livestock	
				106.	Promote zero grazing	Min. of Livestock	
		Mining & Quarrying	High incidences of malaria	107.	Rehabilitate and restore quarried areas	Mines and Geology Dept. Local Authorities	
			Open mining pits	108.	Fence mining areas and pits	Mines and Geology Dept. Local Authorities	
		Settlements & Infrastructure	Diseases	109.	Construct latrines	Local Authorities	
				110.	Apply and enforce waste management regulations	Min. of Public Health and Sanitation, Local Authorities	

District Wide	District Wide	Settlements & Infrastructure	Diseases	111.	Promote community education on good hygiene and sanitation	Min. of Public Health and Sanitation, Local Authorities	
				112.	Apply and enforce Public Health and Sanitation Act	Min. of Public Health and Sanitation, Local Authorities	
			Unplanned settlements	113	Improve existing roads	Local Authorities	
				114	Promote land use planning	Min of lands	
				115.	Prepare urban development plans	Min of Lands, local Authorities	
				116.	Apply and enforce Physical Planning Act and Council Bylaws	Min. of Public Health and Sanitation, Local Authorities	
				117.	Construction of sewerage system	Min. of Public Health and Sanitation, Local Authorities	
				118.	Construct pit latrines	Min. of Public Health and Sanitation, Local Authorities	
			Poor sanitation	119	Apply and enforce waste management regulations	Min. of Public Health and Sanitation, Local Authorities	

				120	Designate waste disposal sites	Min. of Public Health and Sanitation, Local Authorities	
				121	Apply and enforce Physical Planning Act and Council by-laws	Min. of Lands	
District Wide	District Wide	Water Resources	Inadequate clean drinking water	122.	Afforestation & Re-afforestation of water catchments including hill tops	WRMA, KFS	
				123	Treat drinking water	WRMA	
				124	Dig boreholes/shallow wells	WRMA	
				125	Protect and conserve water sources	WRMA	
				126	Promote roof water catchments	WRMA	
				127.	Regulate river water abstractions	WRMA	
				128.	Construct pit latrines	Local Authorities, Min of Public Health and Sanitation	
			Water pollution	129	Undertake Public education on good hygiene	Local Authorities, Min of Public Health and Sanitation	

				130	Construct latrines	Local Authorities, Min of Public Health and Sanitation	
				131	Promote proper waste management	Local Authorities, Min of Public Health and Sanitation	
				132.	Treat drinking water eg. Using chlorine	WRMA	
				133	Promote proper application of agrochemicals	Min. of Agriculture	
District Wide	District Wide	Water Resources	Water pollution	134	Undertake appropriate soil conservation measures	Min. of Agriculture	
				135	Divert run offs far from the boreholes	Min. of Public Works, WRMA	
				136	Construct sewage systems	Local Authorities,	
				137.	Designate waste disposal sites	Local Authorities, Min of Public Health and Sanitation	
				138.	Protect water sources	WRMA	
			Receding of lake water levels	139.	Plant trees on the water catchment areas		
		140.	Provide piped water	WRMA			

		Wetlands	Degradation of wetlands	141	Regulate the usage of wetlands resources	WRMA, Min. Agriculture	
				142	Educate communities on the importance of conserving wetlands	WRMA, Min. Agriculture	
				143	Draw management plans for wetlands	WRMA, Min. Agriculture, Min of Lands	
				144	Map and protect wetlands and other fish spawning areas	WRMA, Min. Agriculture, Min of Lands, Min of Fisheries	
		Wildlife, Biodiversity & Tourism	Human – wildlife conflict	145	To preserve the biological diversity in the district	KWS	
				146.	Establish wildlife buffer zones	KWS	
District Wide	District Wide	Wildlife, Biodiversity & Tourism	Human – wildlife conflict	147	Strengthen District Compensation Committee	KWS	
				148	Sensitize communities to appreciate the importance of conserving wildlife	KWS	

				149.	Involve the communities in wildlife management	KWS	
			Loss of biodiversity	150	Plant indigenous trees	KFS	
				151	To stop illegal logging		
				152.	Preserve indigenous tree species	KFS	
				153.	Protect natural ecosystems	KFS, KWS	
			Untapped eco-tourism potential	154	Carry out an inventory of existing/potential tourism sites	Min. of Tourism	
				155	Apply and enforce EMCA	Min. of Tourism	
				156.	Promote and market existing tourism activities	Min. of Tourism	
				157	Use media to promote local tourism	Min. of Tourism, Min of Information	

Table 48: Monitoring and Evaluation Matrix

Activity	OVI (objectively verifiable indicators)	MoVs (Means Verification)	Reporting schedule	Implementers	Responsible institutions for M&E	Remarks
Forest patrols	Increased vegetation cover Reduced cases of logging	No of patrols Illegal cases of logging reported Reports	Quarterly	D.F.O	Forest Dept K.W.S	
Establishment of tree nurseries	Number of seedlings raised	No. of tree nurseries established	Quarterly	Forest Dept Community	Forest department	
Tree Planting and re-forestation programmes	No. of hectares afforested	No. of trees planted	Quarterly	Forest Dept Community	Forest department	
Community sensitisation and awareness on wetland conservation	No of people sensitised	No. of trainings conducted Reports	Quarterly	Tana Water Board WRMA	Tana Water Board WRMA	
Curb charcoal burning and transportation	Reduced cases of charcoal burning	No. of cases reported	Quarterly	Forest Dept KWS Police Provincial Administration	Forest Dept KWS	
Identify and inventorise the existing Wetlands	No. of wetlands identified	No. of inventories (entry)	Quarterly	D.E.C Tana Water Board WRMA Ministry of land and settlement		
Reclamation and rehabilitation of wetlands	No. of wetlands reclaimed & rehabilitated	No. of wetlands identified and surveyed (functional)	Quarterly	Forest Dept	Forest Dept D.E.C County council	

	No of wetlands covered with trees	No of seedlings planted			Water boards	
Gazettement of wetlands	No. of wetlands gazetted	No. of gazette notices	Quarterly	D.E.C Tana Water Board WRMA Ministry of land and settlement	D.E.C	
Inventory of wetlands	No of inventories	Reports	Quarterly	D.E.C	N.E.M.A	
Hilltops survey	No of hills surveyed	Survey Reports	Quarterly	N.E.M.A County Council	N.E.M.A	
Hilltops rehabilitation	No. of Hectares planted	No. of hills planted with seedlings	Quarterly	Forest Dept. N.E.M.A Nyambene County Council	N.E.M.A	
Re allocation of people from landslide prone areas	Landslide prone areas identified and persons living there notified	No of people reallocated	Quarterly	County Council Ministry of lands and settlement D.D.C	Ministry of lands and settlement D.D.C	
Gazettement of important catchments and hills	No. of hills and catchment areas gazetted	No. of gazette notices	Quarterly	D.E.C Tana Water Board Forest Dept Nyambene County Council Ministry of land and settlement	D.E.C	
Afforestation and re-afforestation of catchments areas		No. of hectares re-afforested	Quarterly	Tana Water Board NEMA KWS	Forest Dept Tana Water Board WRMA	

				Forest Dept		
Protection of spring, streams, riverbanks and the riparian reserves		No. of streams and springs protected No. of riparian reserves protected	Quarterly	Tana Water Board WRMA NEMA KWS Forest Dept Community	Forest Dept Tana Water Board WRMA	
Survey and rehabilitation of catchment areas and riparian reserves.		No. of catchment areas surveyed No. of riparian reserves rehabilitated	Quarterly	Tana Water Board WRMA NEMA KWS Forest Dept Min of Lands & Settlement Community Water Users association	Forest Dept Tana Water Board WRMA	
Inspection of river water abstractions and water flow volumes	Reduced illegal Abstraction	Increased volume of water in the Rivers	Quarterly	Tana Water Board C.B.O	Tana Water Board	
Curb water diversions		Increased volume of water in the Rivers	Quarterly	Tana Water Board C.B.O	Tana Water Board	
Establish the cyclic nature of drought in the area	Established and verified cycle	Study reports Precautionary measures taken	Annual	DEC Provincial Administration	Provincial Administration	
Identify areas that suffer most from the effects of drought	Areas identified and defined	No. of areas identified Extent defined	Quarterly	DEC Provincial Administration	DEC Provincial administration Min. of Agriculture	

Identify landslide prone areas	Areas identified and defined	No. of areas identified Extent defined	Quarterly	DEC Provincial Administration		
Re-allocate people from landslide prone areas	Precautionary measures taken to avert landslides disaster	No. of families re-located	Annual	DDC Provincial Administration	DDC Local Authorities Provincial administration	
Making of conservation Structures (e.g. gabions)	Reduced soil erosion	No. of conservation structures constructed	Quarterly	Min of Agriculture Public Works	Min of Agriculture	
Refilling of abandoned and exhausted quarries	Rehabilitated Quarries	No. of Queries Refilled	Quarterly	C.B.O NEMA Maua Municipal Council Nyambene County Council	N.E.M.A	
Electric fencing around wildlife conservation areas	Reduced human/wildlife Conflicts cases	Kms of electric fence elected	Annual	K.W.S Community	K.W.S	
KWS patrols	Reduced reported cases of poaching Reduced reported cases of human wildlife conflict	No. of patrols	Quarterly	KWS	KWS	
Creation of a migratory corridor between the Meru National Park and Ngaya forest	Reduced reported human/wildlife Conflicts cases	Establishment of the corridor progress	Annual	KWS Community Nyambene County Council NEMA Min. of Lands and Settlement	KWS	
Introduction of dustbins	Reduced solid waste	No of dustbins installed	Quarterly	Maua Municipal	Maua Municipal	

in towns	load garbage in towns	Collection trucks available		council	Council D.E.C	
Construct standard septic tanks in residential and commercial estates	Reduced over flow of sewerage into the open	No. of standard septic tanks and soak pits constructed	Annual	Maua Municipal council	Maua Municipal council D.E.C	
Regularly inspect waste disposal techniques	Improved efficiency in solid waste collection	No. of inspection visits	Quarterly	Maua Municipal council	Maua Municipal council D.E.C	
Plan for implementation of standard sewerage systems	Proper liquid waste and effluent disposal	Progress report on the level of planning and implementation	Annual	Maua Municipal council	Maua Municipal council D.E.C	The high cost of constructing a sewerage and drainage system is a limiting factor.
Slaughter houses & other effluent source points surveillance	Reduced and well disposed effluent	No. of surveillance and inspection visits	Quarterly	Maua Municipal council Public Health	Maua Municipal council D.E.C	
Construction of sanitary landfills	No. of landfills constructed Properly disposed solid waste	No. of landfills properly used	Annual	Maua Municipal council	Maua Municipal council D.E.C	
Intensify collection of garbage	Reduced garbage accumulation in the town centres	No. of times solid waste is collected per week	Monthly	Maua Municipal council	Maua Municipal council D.E.C	
Identify alternative dumping site for Maua Municipality	Site identification and survey	Site identified	Annual	Maua Municipal council Min. of Lands & Settlement	Maua Municipal council D.E.C	

REFERENCES

- GOK (2004) -Economic Recovery Strategy for Wealth and Employment Creation
GOK (2001) -Poverty Reduction Strategy Paper (PRSP) 2001 - 2004
GOK (2002) -District Development Plans 2002-2008
NEMA 2004 & 2005 -NEMA State of Environment Reports for the years 2003 and 2004.
GOK (2002) -Economic survey
GOK (2000) -Statistical Abstract
GOK (2004 & 2005) Departments Annual Plans – Meru North District
GOK (1999) Population and Housing Census

APPENDIX

PART IV OF THE ENVIRONMENTAL MANAGEMENT AND COORDINATION ACT (1999) - ENVIRONMENTAL PLANNING (Extract from EMCA)

37. National Environment Action Plan Committee

1. There is established a committee of the Authority to be known as the National Environmental Action Plan Committee and which shall consist of:
 - a) The Permanent Secretary in the Ministry for the time being responsible for national economic planning and development who shall be the chairman;
 - b) The Permanent Secretaries in the Ministries responsible for the matters specified in the First Schedule or their duly nominated representatives;
 - c) Four representatives of the business community to be appointed by the Minister;
 - d) Representatives of each of the institutions specified in the Third Schedule;
 - e) Five representatives of non-governmental organisations nominated by the National Council of Non-Governmental Organizations;
 - f) Representatives of specialised research institutions that are engaged in environmental matters as may be determined by the Minister; and
 - g) A Director of the authority who shall be the secretary.

2. The National Environment Action Plan Committee shall, after every five years, prepare a national environment action plan for consideration and adoption by the National Assembly.

38. Provisions of the National Environment Action Plan

The national environment action plan shall:

- a) Contain an analysis of the natural resources of Kenya with an indication as to any pattern of change in their distribution and quantity over time;
- b) Contain an analytical profile of the various uses and value of the natural resources incorporating considerations of intergenerational equity;
- c) Recommend appropriate legal and fiscal incentives that may be used to encourage the business community to incorporate environmental requirements into their planning and operational processes;
- d) Recommend methods for building national awareness through environmental education on the importance of sustainable use of the environment and natural resources for national development;
- e) Set out operational guidelines for the planning and management of the environment and natural

resources;

- f) Identify actual or likely problems as may affect the natural resources and the broader environment context in which they exist;
 - g) Identify and appraise trends in the development of urban and rural settlements, their impacts on the environment, and strategies for the amelioration of their negative impacts;
 - h) Propose guidelines for the integration of standards of environmental protection into development planning and management;
 - i) Identify and recommend policy and legislative approaches for preventing, controlling or mitigating specific as well as general adverse impacts on the environment;
 - j) Prioritise areas of environmental research and outline methods of using such research findings
 - k) Without prejudice to the foregoing, be reviewed and modified from time to time incorporate emerging knowledge and realities; and
- l) be binding on all persons and all government departments agencies, state corporations or other organs of Government upon adoption by the National assembly

39. Provincial Environment Action Plans

Every Provincial Environmental Committee shall, every five years, prepare a provincial environment action plan in respect of the province for which it is appointed, incorporating the elements of the relevant district environment action plans prepared under section 40 and shall submit such plan to the chairman of the National Environment Action Plan Committee for incorporation into the national environment action plan.

40. District Environment Action Plans

Every District Environmental Committee shall, every five years, prepare a district environment action plan in respect of the district for which it is appointed. and shall submit such plan to the chairman of the Provincial Environment Action Plan committee for incorporation into the provincial environment action plan proposed under section 39

41. Contents of Provincial and District Environmental action Plans.

Every provincial environment action plan and every district environment action plan prepared under section 30 and 40 respectively shall contain provisions dealing with matters contained in section 38 (a), (b), (c), (d), (e), (f), (g), (h), (i), and (j) in relation to their respective province or district.