

ARY



JICA LIBRARY



1100258(1)

24179





**REPUBLIC OF KENYA**  
**MINISTRY OF WATER DEVELOPMENT**

**THE STUDY**  
**ON**  
**THE NATIONAL WATER MASTER PLAN**



**SECTORAL REPORT**  
**(F)**  
**LIVESTOCK, WILDLIFE AND FISHERY**

JULY 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

## **LIST OF REPORTS**

### **EXECUTIVE SUMMARY**

### **MAIN REPORT**

1. Vol.1 Water Resources Development and Use Plan towards 2010
2. Vol.2 Master Action Plan towards 2000  
Part 1 : National Water Master Action Plan
3. Vol.3 Master Action Plan towards 2000  
Part 2 : Action Plan by Province/District

### **SECTORAL REPORT**

1. A Socio-economy
2. B Hydrology
3. C Groundwater Resources
4. D Domestic and Industrial Water Supply
5. E Agriculture and Irrigation
6. F Livestock, Wildlife and Fishery
7. G Flood Control Plan
8. H Dam Development Plan
9. J Dam Geology
10. K Topographic Survey of 11 Damsites
11. L Power Development Plan
12. M Integrated Water Resources Development Planning
13. N Environmental Conservation
14. P Laws and Institutions
15. Q Database
16. R Remote Sensing Analysis
17. S GIS-based Analysis

### **DATABOOK**

1. DB.1 Hydrological Data (Study Supporting Data)
2. DB.2 Groundwater Data (Aquifer Test and Well Survey)
3. DB.3 Groundwater Data (Study Supporting Data)
4. DB.4 Topographic Survey Data
5. DB.5 Inventory of Irrigation/Drainage Schemes
6. DB.6 Project Sheet for Urban Water Supply

## PREFACE

### Interpretation of Report

The original objective of this NWMP Study is to propose a nationwide framework for orderly planning and development of water resources in the country. The Study also deals with the formulation of individual development schemes. However, it should be noted that the plans formulated in this Study remain at a national level and do not provide complete details at local level. Further details should be examined in subsequent studies on each river basin, district, and project basis which are separately recommended in this Study.

### Administrative Division of Districts

In this Study, the original 41 districts were considered and various statistical data, particularly socio-economic information, were collected for these districts. During the progress of the Study, six districts were detached from the original ones and established as new districts. In the report, the data on these new districts are grouped together with the corresponding original districts as shown below.

	<u>Original Districts</u>	<u>New Districts</u>	<u>Data included in:</u>
1.	Machakos	Makueni	Machakos/Makueni
2.	Kisii	Nyamira	Kisii/Nyamira
3.	Kakamega	Vihiga	Kakamega/Vihiga
4.	Meru	Tharaka-Nithi	Meru/Tharaka-Nithi
5.	Kericho	Bomet	Kericho/Bomet
6.	South Nyanza	Migori	South Nyanza/Migori

(Note: The last three Districts were established very recently.  
The report refers only to the names of the original 41 districts.)

The administrative boundary map used in this Study is the latest complete map set covering the whole country (41 Districts, 233 Divisions and 976 Locations), prepared in 1986 by the Survey of Kenya, Ministry of Land, Housing and Physical Planning.

### Data and Information

The data and information contained in the report represent those collected in the 1990-1991 period from various documents and reports made available mostly from central government offices in Nairobi and/or those analyzed in this Study based on the collected data. Some of them may be different from those kept in files at some agencies and regional offices. Such discrepancies if any should be collated and adjusted as required in further detailed studies of the relevant development projects.

### Development Cost

The cost and benefit estimate was based on the 1991 price level, and expressed in US\$ equivalent according to the exchange rate of US\$1 = KShs25.2 prevailing at that time. The same exchange rate was used in calculating the development cost in K£/KShs currency.





## **Note**

**This Sector Report presents the results of sector study of Livestock, Wildlife and Fishery, conducted as a part of the Study on the National Water Master Plan. The Study has been based primarily on the existing study reports and information which was obtained from officials concerned and through a socioeconomic survey carried out by the Study Team. The analysis has been made without any contribution of specialists for this sector. Nevertheless the results of this study are believed to satisfy the requirement of this sector's objectives, namely estimation of water consumption at present and in future at a master plan level covering whole country.**



# THE STUDY ON THE NATIONAL WATER MASTER PLAN

## SECTORAL REPORT (F) LIVESTOCK, WILDLIFE AND FISHERY

### TABLE OF CONTENTS

	Page
<b>F1. LIVESTOCK</b> .....	F-1
1.1 Present Condition.....	F-1
1.1.1 Livestock population.....	F-1
1.1.2 Livestock production.....	F-1
1.1.3 Present livestock development.....	F-2
1.2 Projection of Livestock Population.....	F-2
1.2.1 Method of projection.....	F-2
1.2.2 Demand trend.....	F-2
1.2.3 Population projection.....	F-3
1.2.4 Livestock unit.....	F-3
1.2.5 Estimation of carrying capacity.....	F-3
1.3 Water Demand.....	F-4
1.4 Livestock Development.....	F-4
1.4.1 Development policy.....	F-4
1.4.2 Needs of water exploitation for livestock development.....	F-5
1.4.3 Water supply development.....	F-5
<b>F2. WILDLIFE</b> .....	F-7
2.1 General.....	F-7
2.2 Distributional Patterns of Wildlife.....	F-7
2.3 General Ecology of Major Species.....	F-8
2.4 Daily Water Consumptions for Major Species.....	F-13
2.5 Water Demand for Wildlife.....	F-13
2.6 Needs and Issues.....	F-14
<b>F3. FISHERY</b> .....	F-15
3.1 Present Situation.....	F-15
3.1.1 Production and value.....	F-15
3.1.2 Export and import.....	F-15
3.1.3 Aquaculture.....	F-15
3.1.4 Fish pond.....	F-16
3.1.5 Demand.....	F-16
3.2 Fish Farming Potential.....	F-16
3.3 Water Demand.....	F-17
3.3.1 Present water use.....	F-17
3.3.2 Demand projection.....	F-17
3.3.3 Water demand.....	F-17

<b>3.4</b>	<b>Fishery Development.....</b>	<b>F-18</b>
3.4.1	Government policy .....	F-18
3.4.2	Current development plan .....	F-18
3.4.3	Future development plan.....	F-18

<b>References.....</b>	<b>F-20</b>
------------------------	-------------

## LIST OF TABLES

Table No.	Title	Page
F1.1	Livestock Population .....	FT-1
F1.2	Present Livestock Development Projects .....	FT-2
F1.3	Projected Livestock Population .....	FT-3
F1.4	Average Live-weight.....	FT-5
F1.5	Projected Livestock Unit .....	FT-6
F1.6	Stocking Rate of Managed Pasture and Grassland.....	FT-7
F1.7	District Average Carrying Capacity .....	FT-10
F1.8	Estimated Crop Residue Area and Carrying Capacity.....	FT-11
F1.9	Estimated Carrying Capacity in Each District.....	FT-12
F1.10	Balance of LU between Projected and Total Carrying Capacity.....	FT-13
F1.11	Sub-basin Livestock Water Demand.....	FT-14
F1.12	Livestock Water Demand .....	FT-15
F2.1	Population of Major Species .....	FT-16
F2.2	Estimated Water Consumption of Each Species.....	FT-18
F2.3	Water Demands for Major Species.....	FT-19
F2.4	Present Condition of Wildlife Watering in National Parks and Reserves.....	FT-23
F3.1	Fish Landing in Kenya .....	FT-28
F3.2	Fresh water and Marine Fish Catches by Species, Weight and Value ....	FT-29
F3.3	Fish Production Value in Kenya.....	FT-30
F3.4	Exports and Imports of Fish and Fishery Products .....	FT-31
F3.5	Number of Fish Ponds .....	FT-32
F3.6	Per Capita Consumption of Fish .....	FT-33
F3.7	Estimated Water Demand for Fish Ponds .....	FT-34
F3.8	Project List and Budget of Fishery Department.....	FT-35

## LIST OF FIGURES

Figure No.	Title	Page
F1.1	Marketed Production at Current Price.....	FF-1
F1.2	Livestock Survey Area.....	FF-2
F1.3	Distribution of Cattle Population .....	FF-3
F1.4	Distribution of Sheep/Goat Population .....	FF-4
F1.5	Cattle Dip Numbers in Kenya.....	FF-5
F3.1	Fish Landing in Kenya .....	FF-6
F3.2	Fish Landing from Lakes.....	FF-7
F3.3	Fish Landing from Marine and Fish Farming.....	FF-8
F3.4	Annual Inland Fish Catches by Species .....	FF-9
F3.5	Fish Pond Density.....	FF-10
F3.6	Fish Farming Zones.....	FF-11
F3.7	Trend of Fish Farming.....	FF-12

## **F1. LIVESTOCK**

### **1.1 Present Condition**

The livestock sector has played an important role in the agricultural sector of the Kenyan economy. As shown in Figure F1.1, about a quarter of total marketed agro-products was produced by livestock and livestock products. The major products are milk, meat, eggs, skins and wool. About 12.8 million cattle produce about 85% of the total income of K£248 million. In 1989, this sector gained foreign earnings of about K£ 7.2 million with K£ 7.254 million export and K£ 0.032 million import.

#### **1.1.1 Livestock population**

Livestock population data in each District is available from the following three sources:

1. District Development Plan (DDP)
2. Livestock and Wildlife Data Summary 1987-1988 for Kenya Rangelands
3. Annual Report prepared by Ministry of Livestock Development

Annual report and DDP have the same data source, i.e. MOLD officer in each District, however there is some differences between the two Reports. The Data Summary prepared by DRSSRS provides livestock and wildlife population from an aerial survey carried out during 1987 to 1988. It is the most accurate information, but does not cover whole country as shown in Figure F1.2.

For this Study, an average of above three data is employed to estimate present livestock population in each District. Table F1.1 shows livestock population cited from the above three Reports together with estimated population in each District.

#### **1.1.2 Livestock production**

Livestock production in 1988 was estimated by MOLD as shown below.

Milk (Cattle)	1,550,492,099 kg
Milk (Camel)	609,866,398 kg
Milk (Sheep Goat)	3,125,927 kg
Meat (Bovine)	225,500 tons
Meat (Camel)	1,250 tons
Meat (Sheep Goat)	64,528 tons
Meat (Poultry)	40,519 tons
Eggs	840 million

### 1.1.3 Present livestock development

Ministry of Livestock Development (MOLD) is the agency responsible for establishing an efficient livestock production and marketing system over the country. MOLD is endeavoring to achieve ;

- appropriate livestock production technology for animal species for dairy, beef, white meat, honey etc.
- access to suitable land and water resources for enhancement of animal production
- development of supportive institutional framework for pastoralists in ASAL areas, which includes infrastructures necessary for optimum production of livestock

A total of 59 livestock development projects are being implemented. Some of these projects are districts specific and others are nationwide projects. Of these, 17 projects are Government funded, 22 are jointly funded by the Government and various donors, while 20 projects are donor funded projects. Table F1.2 shows a list of these projects, which will outline the present MOLD's development activities.

## 1.2 Projection of Livestock Population

The accuracy of livestock population data is not high compared to that of human population census and livestock population varies depending on the demand for meat, desire of farmer to breed livestock and Government policy. Then the following projection was made by using many assumptions.

### 1.2.1 Method of projection

Simple projection methods were employed to this Study, namely, livestock population will increase in accordance with demand of milk and meat. Since this projection disregards the land carrying capacity information at all, projected livestock population was examined by estimated carrying capacities.

### 1.2.2 Demand trend

By applying per capita consumption rates and estimated human population, the annual growth rate of milk and beef consumption were determined as shown below :

	1988 Production (million ton)	Per capita consumption (kg)		Population in 2010 (million)		2010 Production (million ton)	Growth Rate %
		Urban	Rural	Urban	Rural		
Milk	2.163	88.6	72.1	12.698	27.607	3.116	1.67
Beef	0.227	11.9	6.8			0.339	1.84



### **1.2.3 Population projection**

Assuming, that dairy cattle and camel populations increase at the same rate as the milk production trend and beef cattle and sheep/goat populations increase with the beef production trend, then district by district livestock population are estimated for 1990, 2000 and 2010 as shown in Table F1.3. Figures F1.3 and F1.4 show cattle and sheep/goat distribution for these three years, respectively. Present livestock of 11.5 million Cattle, 15 million Sheep/Goat and 0.7 million Camel will increase to about 17 million Cattle, 22.5 million Sheep/Goat and one million Camel in 2010.

### **1.2.4 Livestock unit**

Generally speaking the amount of consumption of water and foods for mammals is in accordance with their body weight. Applying this concept, the LU (Livestock Unit) or TLU (Tropical Livestock Unit) system has been introduced to discuss those matters of water consumption or forage consumption in general. In this Study to convert livestock population into livestock unit, average live-weight of each livestock and unit weight of 1LU of 450 kg were used. Average live-weight is estimated from MOLD information of herd composition and standard weight. Table F1.4 present the calculation and the results.

Total livestock units in Kenya are expected to increase from a present figure of 6.6 million LU to 9.3 million LU in 2010. District total livestock unit is calculated and shown in Table F1.5.

### **1.2.5 Estimation of carrying capacity**

The carrying capacities of natural grassland and managed pastures in the country are key factors for estimation of potential livestock population in each District and Sub-basin. Based on the present stocking rates information and area of agriculture land, the carrying capacities are estimated in each District. The stocking rate is reciprocal number of carrying capacity, which is the area requirement of grasslands and pastures that can sustain one livestock unit (LU) expressed in the unit of hectare per LU (ha/LU). The Farm Management Handbook provide the stocking rates for each agro-ecological zone and for each district as tabulated in Table F1.6. Since this Handbook covered 33 Districts, the carrying capacities of another seven Districts were estimated by using a new AEZ map prepared by the Study Team. From this information, the average carrying capacity in each District is estimated as shown in Table F1.7.

Future land carrying capacity in 2010 was estimated based on the land use plan (see Sector Report E) and estimated average carrying capacity with the following assumptions.

- Priority order for using land is;
  - first for crop land
  - second for managed pasture for grade cattle
  - third for grassland for other livestock.

- crop residues remained in harvested areas (maize, sorghum, beans and potatoes) can be counted as supplemental feed sources with 0.3 LU/ha (see Table F1.8)
- Livestock may move over within crop and grass land

Table F1.9 presents the estimated future land carrying capacity in each District and Table F1.10 compares the projected livestock unit and district carrying capacity. A negative figure in Column "Balance LU" of Table F1.10 means overgrazing, however the whole of Kenya has enough capacity to feed all projected livestock in 2010. In this report, projected LU in each District was applied to estimate livestock water demand in each District and location disregarding this discussion of livestock distribution.

### 1.3 Water Demand

Livestock water demand is mainly for drinking and for cattle dips. A unit water requirement of 50l/day /LU which is MOWD standard, was used to estimate water demand for cattle, sheep, goat and camel. Water consumption by other stocks like poultry, donkey, pigs etc. are assumed negligible.

#### Cattle Dip

According to the infrastructure inventory prepared by MOPND in 1987, there are about 3800 cattle dip in the country and most of them are in high potential zone as shown in Figure F1.5 Water consumption by these cattle dips is assumed to be included in the above livestock water demand, since no information of consumption rate, volume of each dip etc. are available.

About 142 million tons of water will be required per year in 2000 and 170 million in 2010. Table F1.11 presents livestock water demand for each sub-basin and Table F1.12 shows district wise water demand.

### 1.4 Livestock Development

#### 1.4.1 Development policy

The "National Livestock Development Policy, 1980 " has asserted a development policy of livestock industries, wherein the objectives of livestock development are set forth as follows:

- 1) to increase meat and milk production to contribute to self-sufficiency in food supply;
- 2) to alleviate poverty by creating employment at all stages of development ;
- 3) to improve nutritive status of people;
- 4) to contribute to foreign exchange earnings/savings; and
- 5) to provide raw materials for processing industries.

Since the existing "National Livestock Development Policy, 1980" is now being updated by MOLD, the above policy may alter.

### 1.4.2 Needs of water exploitation for livestock development

The Government places great emphasis on the development of milk and meat production. Annual growth rate is estimated to be more than 5% for both milk and meat consumption, then by 2000 total production requirement will have to be more than double as depicted below.

	Production		Consumption	
	1984	2000	Total	Unmet demand
Milk (mn. litres)	1600	3,600	3,600	0
Meat ('000 tons)	190	420	540	120

Note : Ref. F.2

Growing livestock production will be in need of more water development, especially groundwater developments, since livestock development will be deployed mostly in ASAL regions where surface water is scarcely available. Simply speaking, need for water exploitation will be double or even more in the ASAL regions. The same will occur in other high potential areas.

### 1.4.3 Water supply development

In general, groundwater, river water and springs are major water sources for livestock water development. Natural water sources of lake, springs, river etc. have development priority for low cost development. ASAL areas require groundwater development for livestock since there are no natural water sources. According to the groundwater analysis described in Sectoral Report C, groundwater availability was estimated at 20.6 m<sup>3</sup>/sec for the whole country (see Table E.2.19 of Sectoral Report E). Using these results and projected livestock unit in 2010, groundwater availability in ASAL regions was estimated as shown below.

District	Borehole potential (m <sup>3</sup> /day)	Projected LU 1000	Water Demand 50l/day/LU (m <sup>3</sup> /day)	Water Availability
Baringo	7,623.69	196.31	9,815.51	78%
Garissa	30,872.00	397.29	19,864.37	155%
Isiolo	19,766.49	173.09	8,654.74	228%
Kajiado	18,019.76	468.66	23,432.87	77%
Laikipia	9,360.95	201.40	10,069.87	93%
Mandera	39,541.41	211.28	10,564.02	374%
Marsabit	76,741.89	456.77	22,838.75	336%
Narok	13,327.14	735.46	36,772.84	36%
Samburu	17,759.40	149.13	7,456.29	238%
Tana River	42,083.16	231.22	11,561.22	364%
Turkana	61,936.03	427.71	21,385.48	290%
Wajir	88,025.29	351.35	17,567.68	501%
West Pokot	7,876.23	137.78	6,888.77	114%
Meru	12,173.31	363.37	18,168.43	67%

As can be seen in above Table, all ASAL districts have good enough groundwater potential for livestock except Narok. According to the Sectoral Report M, these area required about 3,300 borehole development and about 20,200 shallow well development as shown in the following table.

Number of Wells in ASAL Area			
District	Borehole	Shallow well	Total
Baringo	86	155	241
Garissa	91	1,305	1,396
Isiolo	182	1,241	1,423
Kajiado	328	1,311	1,639
Laikipia	206	358	564
Mandera	94	1,875	1,969
Marsabit	471	2,128	2,599
Meru	171	331	502
Narok	369	2,326	2,695
Samburu	242	1,287	1,529
Tana River	56	649	705
Turkana	796	5,765	6,561
Wajir	98	1,040	1,138
West Pokot	38	417	455
	3,228	20,188	23,416

source: Appendix M.9

## F2. WILDLIFE

### 2.1 General

Kenya is blessed with abundant wildlife, one of the most valuable natural resources in the country. Wildlife viewing is a major component of the tourism industry which is an important source of foreign exchange for her national economy.

As shown in Figure F.2.1 the tourism industry got foreign exchange earnings of K£ 533 million in 1990 or 17 % of total balance of payment. Tourism was, nevertheless, the leading foreign exchange earner.

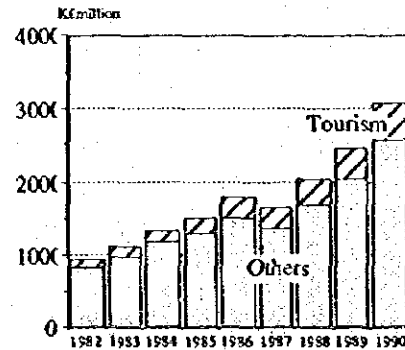


Figure F.2.1 Current Account in Balance of Payments

There are many varieties of animal species in the country some of which are monitored and assessed in their distributions and abundances by the Department of Resource Surveys and Remote Sensing(DRSRS) in the Ministry of Planning and National Development. According to DRSRS's Data Summary 1987-1988, information on distribution and quantities of the following 20 major species is available :

Elephant, Giraffe, Burchell and Grevy Zebra, Thomson's and Grant's Gazelle, Gerenuk, Impala, Coke's and Hunter's Hartebeest, Topi, Waterbuck, Eland, Orix, Wildebeest, Lesser and Greater Kudu, Warthog, Buffalo, Ostrich.

In addition to the above major herbivores, there are many carnivores, small mammals and birds but DRSRS has not quantified those mammals and birds with their distributions through nationwide remote sensing surveys yet. Accordingly, descriptions in the following sections will be concentrated on the above-listed major herbivores due to the data availability.

### 2.2 Distributional Patterns of Wildlife

DRSRS has been conducting a detailed survey of livestock/wildlife population over rangelands of 15 districts since 1977. The survey output presented area-wise distribution of actual livestock/wildlife breedings in 5km x 5km meshes, which provide very useful information for the Study in assessing water exploitation need by area. Fig F1.2 shows the location of areas where the DRSRS's survey has been completed and surveyed area is given below.

Surveyed Districts, 1987-88

District	Area(km <sup>2</sup> )	District	Area(km <sup>2</sup> )
Baringo	10,732	Garissa	43,623
Isiolo	25,322	Kajiado	21,852
Kilifi	12,478	Laikipia	9,666
Lamu	6,153	Mandera	25,965
Marsabit	75,971	Narok	17,832
Samburu	21,095	Tana River	39,072
Turkana	63,921	Wajir	56,714
West Pokot	9,305		
Total Area		439,701 km <sup>2</sup>	

Source : Ref. E.11

Total area assessed in 1987-88 is about 439,700 km<sup>2</sup> which is about 75% of total national land, 592,000 km<sup>2</sup>. The estimated numbers and distributions of the major species in the above-listed 15 districts are given in Table F2.1 and the total numbers are summarized as follows :

Numbers of Major Species

Major Species	Numbers
African Elephant	7,500 Nos.
Giraffe	40,300
Burchell Zebra	128,000
Grevy Zebra	4,300
Thomson's Gazelle	107,000
Grant's Gazelle	121,000
Gerenuk	23,500
Impala	104,000
Coke's Hartebeest	9,500
Hunter's Hartebeest	2,000
Topi	103,000
Waterbuck	7,500
Eland	12,900
Orix	24,200
Wildebeest	67,600
Lesser Kudu	5,500
Greater Kudu	200
Warthog	10,600
African Buffalo	31,400
Ostrich	24,000

Source : Ref. F.11

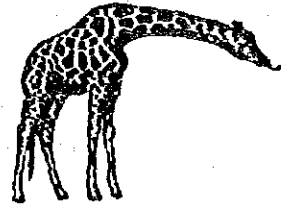
### 2.3 General Ecology of Major Species

Water required by wildlife is only for drinking except some aquatic species such as hippopotamus crocodile etc. Some wild mammals such as eland and impala can live without drinking water for a long periods, while some animals such as elephant and rhino cannot live for long without water. To estimate water demand by wildlife, their habitat, feeding, drinking and weight of the respective major species are required and explained as follows :

- 1) African Elephant (*Loxodonta africana*):  
Weight 2,720-5,440 kg; Living in a variety of habitats from savannah/semi-arid bush to mountain forests; They spend much of the time feeding on grass, leaves, reeds, seed pods, wild fruits, bark and roots; They eat 90-270 kg and drink 140-270 litres daily.



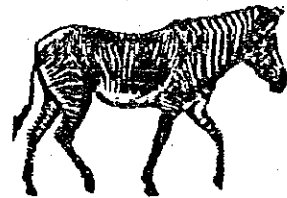
- 2) Giraffe (*Giraffa camelopardalis*):  
Weight 700-1,270 kg; Living in open acacia woodlands, desert grass-bush & scrub and coastal forests; They can exist for a number of days (a month) without drinking if succulent vegetation available.



- 3) Burchell Zebra (*Equus burchelli*):  
Weight 230-320 kg; Living in open grassy plains, savannah grasslands and semi-arid grass-bush; They usually drink daily and never wander very far from water.



- 4) Grevy Zebra (*Equus greveyi oustalet*):  
Weight 355-430 kg; Living in sub-desert steppe and arid bushland; They are grazers but may take some foliage; They seem less dependent on water than Burchell's Zebra.



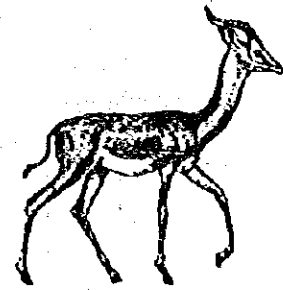
- 5) Thomson's Gazelle (*Gazella thomsoni*):  
Weight 20-30 kg; They prefer areas of short grass rich in protein and does not have to drink daily if grazing is lush; Living in open plains with a certain amount of bush and also in thick bush country, but never in long grasses.



- 6) Grant's Gazelle (*Gazella granti*):  
Weight 35-80 kg; Living in a variety of terrain from open plains and tree-grassland to arid grass-bush and desert scrub; They feed on leaves, shoots and grass and usually do not drink, obtaining sufficient water from vegetation.



- 7) **Gerenuk (*Litocianius waleri*):**  
Weight 34-50 kg; Large gazelle; Living in dry thin-bush country, and arid or semi-desert scrubs, and even in desert; They feed by browsing on leaves, twigs, shoots, but do not eat grass; They can stay without water for long periods, obtaining their water requirement from foods.



- 8) **Impala (*Aepyciros melampus*):**  
Weight 45-65 kg; Their habitat is in acacia savanna and light woodlands, often near water; They feed according to available vegetation, they browse on leaves of trees and bushes and also feed on grasses; They are very dependent upon water but can survive on dew for long periods.



- 9) **Coke's Hartebeest/Kongoni (*Alcelaphus buselaphus cokii*):**  
Weight 135-180 kg; Living in grassy plains, tree-grasslands and dry scrub-bush up to Elevation 1,980 m; They can go without drinking for extended periods but usually drink daily.



- 10) **Hunter's Hartebeest/Hirola (*Damaliscus hunteri*):**  
Weight around 75 kg; Living in open grassy plains and scattered thorny bush in dry country; They are grazer.



- 11) **Topi (*Damaliscus lunatus jimela*):**  
Weight 115-135 kg; Living in open savanna and park woodlands and sometimes found in very dry country; They feed on grass and herbage; They often thrive on dry grass not eaten by other antelopes; Although they drink and are specially fond of extensive flood plains, they can go without water for long periods if lush pasture is available.





12) Waterbuck (*Kobus ellipsiprymnus*):

Weight 160-270 kg; Living in woodlands, clearings, flood plains, even in stony hills; They usually live near water and take refuge in it, but they are not aquatic; They may wander considerable distances from water to feed; They are almost entirely grazers and feed on tender shoots and drink very freely.



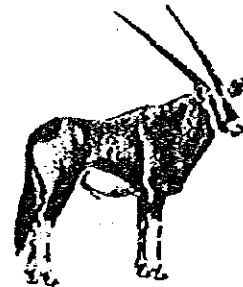
13) Eland (*Tragelaphus oryx*):

Weight 500-800 kg; Living in grassland, semi-desert and mountain grassland up to Elevation 4,250 m; They are browsers rather than grazers and feed on grass and plants and also browse on foliage; They drink daily when available but can go without water if succulent vegetable matter is available.



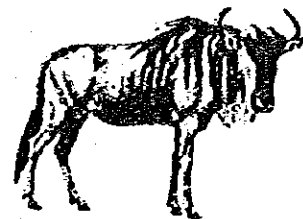
14) Oryx (*Oryx beisa* or *Oryx gazella*):

Weight 160-205 kg; a large antelope; They inhabit arid, semi-desert bush or scrub and also in open grass/woodlands; They often wonder very far from water and may survive long periods without drinking but drink everyday when water is available; They feed mainly on grass, also browse on trees and bushes.



15) Wildebeest (*Connochaetes taurius*):

Weight 160-250 kg; Living in open grassy plains, savannah-bush and scattered woodlands in relative dry areas; They follow favorable conditions of food and water; They feed on grass and drink daily if water is available, but can live for 5 days without drinking; They show more rigid water requirements than other animals living in the same area.



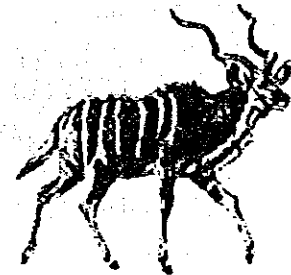
16) Lesser Kudu (*Tragelaphus imberbis*):

Weight 55-105 kg; Living in acacia thickets, dense scrub and semi-arid bush country and seldom in open grass plain; Essentially browsers, they feed on leaves, young shoots and twigs; They drink regularly when water is available, but may dispense with liquid for long periods during the dry season, often inhabiting much drier land than the Greater Kudu.



17) Greater Kudu (*Tragelaphus strepsiceros*):

Weight 180-320 kg; Living in light forests or fairly thick bush and often in rocky mountainous or hilly country; They are seldom far from water and drink regularly, but sometimes they occur in waterless regions; Essentially grazers, they feed on shoots and leaves of very wide variety of plants; In the driest areas they obtain the greater part of liquid nutriment from wild water melon.



18) Warthog (*Phacochoerus aethiopicus*):

Weight 50-110 kg; Living in savannah, open grasslands and semi-arid bush, particularly where water is available for drink and wallow, but also they are found in very dry areas where water is not available during 6 months of the year; They feed largely on short grasses.



19) African Buffalo (*Syncerus caffer*):

Weight 500-800 kg; Staying close to water and never in the driest areas; Water is essential to them and they must drink everyday like cattle; They have a wide range of ecological adaptation, living from the dense forest to open plains and also in mountains up to Elevation 4,000 m; They feed on grass and may also browse on leaves, small twigs and, young shoots, particularly in forest areas.



20) Ostrich (*Struthio camelus*):

Weight around 80 kg; They are widely distributed in grassland and open savannah and dry bushland.



## 2.4 Daily Water Consumptions for Major Species

Water consumptions for animals vary species by species as well as depend upon their surrounding conditions such as water availability or vegetation. Some mammals like elephants and buffalos require fairly large amount of water frequently. Another like giraffe sometimes live long without drinking water for a month if succulent vegetation is available. In order to assume the water consumption, the above-listed species are grouped i.e. Group-A for the species which require relatively much water and Group-B for those which require relatively less water.

Group-A: Elephant, Zebra, Waterbuck, Wildebeest, Kudu, Warthog, Buffalo,

Group-B: Giraffe, Gazelle, Gerenuk, Impala, Hartebeest, Topi, Eland, Orix, Ostrich

Water consumption for one livestock unit(450 kg) is 50 liter per day (see Section 1.3) and that for elephant is said to be 140-270 liter per day (Ref.F.15). Generally actual water consumption for wildlife has not been made clear. Accordingly, water consumption for respective species are assumed as follows:

- 1) Water consumption of species is directly proportional to their average body weight.
- 2) Species in Group-A require water at the rate of about 50 % of standard water consumption of one livestock unit. Accordingly, the daily consumption is to be 5.0 litre/100kg-weight.
- 3) Species in Group-B require water at the rate of about 25 % of standard water consumption of one livestock unit. Accordingly, the daily consumption is to be 2.5 litre/100kg-weight.

On the basis of the above assumption, daily water consumptions of respective species have been estimated as presented in Table F2.2.

## 2.5 Water Demand for Wildlife

On the basis of the above estimated water consumptions and the estimated numbers, water demands for the major species have been calculated in respective 15 districts which are given in Table F2.3 and summarized as follows :

Estimated Daily Water Demand					
District	W.Demand	District	W.Demand	District	W.Demand
Baringo	7	Garissa	427	Laikipia	1,122
Isiolo	310	Kajiado	1,099	Mandera	36
Kilifi	82	Samburu	265	Narok	2,730
Lamu	431	Turkana	73	Tana River	616
Marsabit	331	West Pokot	5	Wajir	178
Total Daily Water Demand				7,710 m3	

As given in the above table, total daily water demand for 20 major species is about 7,700 m<sup>3</sup> in the above 15 districts. The land in the 15 districts is equivalent to 75 % of the national land and there are many other species of wildlife in Kenya in addition to the listed 20 major species. Taking those conditions into consideration, total daily water demand for wildlife would be more than 21,000 m<sup>3</sup> of fresh water.

## 2.6 Needs and Issues

In view of tourism, wildlife is the most important tourism resources in Kenya. Especially wildlife inhabiting the National Park or Game Reserve area need to be conserved. According to the information from Kenya Wildlife Service (KWS), present condition and issues in each National Park/Reserve in terms of water development are summarized in Table F2.4.

As seen in this Table, about half of the National Parks/Reserve have their own water development plans for supplying water to wildlife. These development plans are;

- rehabilitation of existing water source
- drilling of new boreholes
- construction of new dams

Major water source for wildlife is river water as a matter of course. To keep the average normal flow in dry season, water development plan in the upstream should consider the impact of the plan to the wildlife downstream. Those rivers which call for careful attention in order for them to cater for the wildlife water demand are:

### Rivers which need wildlife conservation

Amboni	Kimakia	Mathioya	Ongorit
Bisanadi	Kindani	Mderit	Rojewaro
Bwatheroagi	Kinna	Mulika	Rombo
Chania	Kiolu	Murubara	Rupingazi
Dawa	Kipsonoi	Mwatate	Sandai
Ewaso Ngiro	Kirtiget	Mzima	Saoumua
Hembe	Kogou	Naishi	Seiya
Irati	Kurera	Narok	Syapci
Isiolo	Lamuriak	Ngare Karoh	Tsavo
Itake	Loolfuresh	Ngare Mars	Tana
Kakungu	Magura	Ngeny	Thiba
Kanjoo	Makalia	Ngosorr	Turkwell
Kamar	Malewa	Njangiri	Tuthu
Katundu	Mara	Njoro	Wanjohi
Kerio	Maragwa	Nyamindi	Wei Wei
Kesup	Maringato	Olambwe	

Source: KWS

## **F3. FISHERY**

Fishery activities in Kenya are broadly categorized into two, namely marine fishery and inland fishery. This Study concentrated on inland fishery especially fish farming in pond and reservoir with the following major objectives;

- to clarify the present condition of fishery activities
- to estimate the present and future freshwater demand
- to identify the problems and needs required for the fishery development

Without complete statistics, data and information, followings are made which need updating as more information or data becomes available.

### **3.1 Present Situation**

#### **3.1.1 Production and value**

According to the statistics of Fisheries Department of Ministry Regional Department, fish landing from fresh water have remarkably increased as shown in Table F3.1 and Figure F3.1. Especially landing from Lake Victoria soared since 1980 as shown in Figure F3.2. While landing from marine and fish farming increased gradually (see Fig. F3.3).

The fish production from inland fisheries shared more than 90% of total fish production in the recent ten years. Production amount increased from 42,300 ton in 1980 to 138,800 tons in 1989.

After introducing Nile perch (*Lates niloticus*) in 1960's, composition of fish species has drastically changed. Nile perch and Dagaa (*Engraulicypris*) shared 70% to 80% of total inland fish production in recent five years. Table F3.2 gives the fish landing in Kenya by species, and Figure F3.4 shows inland fish landing composition by species.

The share of the fisheries sector in GDP is small. According to the CBS's Economic Survey 1991, the share is about 0.4% of the total GDP in Kenya and has a value of K£ 35.8 million. Table F3.3 gives the trend of production value in the recent twenty years.

#### **3.1.2 Export and import**

Export of fishery products account for about 7,300 tons or Kshs 307 million in 1989 while import was 2,200 tons or Kshs 7.9 million. The share of foreign exchange earnings was about 2% in 1989. The net balance of export and import in fish and fish products was positive. Table F3.4 present export and import amount and value in years of 1977 ~ 1989.

#### **3.1.3 Aquaculture**

Fish culture in Kenya started with the sport fish hatcheries during early 1900's.

Introducing fish culture, mainly with Tilapia, took place principally in 1950's. The fish pond culture started in the late 1940's and spread over to various part of Kenya as of today. Today, fish culture is practiced mainly in small ponds on small-holder farms.

The species farmed in those small ponds are Tilapia, Carp, Trout, Black bass, shrimp and catfish.

### 3.1.4 Fish pond

Recent information from the Department of Fisheries indicates the presence of 8,500 fish ponds having a total water area of 440 ha. While Socioeconomic survey results shows the name and location of those ponds, but it does not cover the whole of Kenya. Estimated pond number and average water area were calculated from these information. Table F3.5 present the number of ponds and area for each District together with average water area and Figure F3.5 shows the pond intensity based on the estimated pond numbers.

### 3.1.5 Demand

Fish consumption in the country can be estimated by the following formula:

Fish consumption = Total Fish Landing + Imported Fish - Exported Fish

From Table F3.4 (Export and Import) and Table F3.1 (Fish Landing), fish consumption during 1980 - 1988 was estimated as shown in Table F3.6. Applying estimated population in 1983 - 1988, average per capita fish consumption was estimated at 5.5kg per capita per annum. This corresponds to about 57% of the fish protein requirement in the country (9.5 kg/capita/annum, FAO guideline). It is assumed that the per capita consumption ratio will be sustained in future to forecast future demand. Then the total demand for fish in whole Kenya is calculated at about 222,000 tons in year 2010.

## 3.2 Fish Farming Potential

Various factors have influenced fish farming. Those factors are water availability, water quality, soils, topographic conditions etc. Potentiality in Kenya was generally assessed in terms of water temperature and availability by FAO. According to the this FAO's classification, there are four zones in Kenya as shown in Figure F3.6.

These are:

Lake area	: altitude = average 1157m annual rainfall = 1000-1300 mm temperature = 14-34 °C, hot and wet year round
Highland area	: altitude = average 1661m annual rainfall = 750-1000 mm temperature = 10 - 26 °C, temperate climate
Arid and semiarid lands	: annual rainfall = 255-519 mm temperature = 220 - 34 °C, hot and dry
Coastal area	: annual rainfall = 1000-1250 mm temperature = 22-30 °C, warm and humid

### 3.3 Water Demand

#### 3.3.1 Present water use

There is no information about water consumption amount or rate for fish farming at all. Hence, the following assumptions were made to estimate present water use:

- water will be changed once a year
- average water depth is 1 m
- water in compensation for evaporation and percolation will be supplied with amount of 5 mm for evaporation and 1 mm for percolation respectively.

Based on these assumption, total amount of water use is estimated at about 16 million tons in whole Kenya. Table F3.7 presents the water use in each sub-basin and summarized below.

	Basin 1	Basin 2	Basin 3	Basin 4	Basin 5	Total
Amount	3.4	0.3	0.8	8.1	3.6	16.2

#### 3.3.2 Demand projection

Future fish production demand was estimated at 222,000 tons in year of 2010 (see section 3.1.5), however this amount of demand projection can hardly be allocated to three fishery activity, ie. marine fishery, lake fishery and fish farming. Then the fish farming activity in future was estimated by trend of fish farming production as given in Figure F3.7. From this figure, fish farming will produce about 2,240 tons in 2010.

#### 3.3.3 Water demand

Assuming it is possible to achieve a national production of 2.5 t/ha (Ref.F.14) in future, 896 ha of ponds would be required to produce 2,240 tons of fish. This total area of pond and assumption set forth above, total amount of fish farming water use was estimated at about 28.6 MCM or 0.906 m<sup>3</sup>/sec.

### **3.4 Fishery Development**

#### **3.4.1 Government policy**

Although the current national development plan such as SP1 or DP, contain no specific goals for aquaculture development, it can be presumed to fall under the agriculture sector, foreign exchange earnings, and contribution to national economic growth. The agricultural sector strategy is to raise the quality and value of agricultural output through :

- increased intensity of application of current production techniques without a major increase in area cultivated;
- improved genetic potential of crops/livestock;
- diversification into high value activities.

Meat, which includes fish, is one of the major commodities to be improved.

#### **3.4.2 Current development plan**

In the wake of the Government strategies to exploit the fisheries potential in both marine and inland fisheries, many projects have been carried out by not only the Department of Fisheries but also LBDA, TARDA and KVDA. Table F3.8 lists projects of the Department of Fisheries and its budget in 1990/91 fiscal year.

#### **3.4.3 Future development plan**

Recent study on Review of the Fisheries Sector in Kenya prepared by FAO/GOK revealed the issue and prospective development plans on fisheries activity in Kenya. According to this review report, aquaculture sub-sector should have the following strategies for achieving the national development objectives.

1. Consolidate technical base and upgrade public sector effectiveness
2. Intensify production of small- and medium-scale fish pond units
3. Demonstrate/extend improved techniques to small-, medium- and large-scale farmers and minimize initial risk of using them
4. Open up markets for farmed fish from small-holders as industry expands
5. Develop small reservoir exploitation
6. Encourage production of high-value stock (trout, shrimp, oyster) and popular species (tilapia, carp)

To implement the above strategies, the review report proposed the following six project ideas

##### **1. Coordination of Institutional Activities**

A number of Government and parastatal institutions are active in fish farming development, but their activities need coordination. Many of these Institutions have larger functions of which aquaculture forms only a small part. Therefore



a major institutional restructuring is not realistic. Rather, the individuals responsible for aquaculture in each institution need to communicate more effectively and regularly on aquaculture development issues and activities.

## 2. Aquaculture Information Database

Aquaculture practices are diverse and widespread in Kenya. Information on the extent, size, production, and fish farmer characteristics is not readily available. Such data, updated regularly, is needed to plan development interventions, measure progress, and evaluate performance.

## 3. Rationalization of Extension Services

Fish farming extension services are provided by Department of Fishery nationally and LBDA in Western Kenya. Their function is to provide information and some inputs to small-scale subsistence farmers. There is scope to improve these services at the institutional level by rationalizing the geographic coverage, using extension methods tailored to the scale of farming practiced. The existing agricultural extension services should be used to deliver fish farming advice to small-scale farmers. An advisory service for medium-and large-scale farmers should be established.

## 4. Upgrading of Sagana Fish Farm

The Sagana Fish Farm has facilities for technical trials, fry production, and table fish production which are underutilized. This farm is located in the area of central Kenya with widespread small-scale tilapia and carp farming and potential for larger-scale fish farming. Demand for fingerling is strong, and technical improvements in fish farming packages for farmers are needed.

## 5. Kiganjo Fish Farm

Kiganjo Fish Farm started as a trout research station but recently has been more involved with fry and table fish production. The trout industry is characterized by vertically integrated companies and a few small growers. Trout farming techniques are well established and the main problems encountered are lack of eggs for hatching and deteriorating water quality. Eggs are imported periodically at an estimated annual foreign exchange cost of US\$10,000 per one million eggs.

## 6. Lake Basin Fish Farm

Although LBDA has recently constructed a number of District-level fry production centres, the low-lying areas of the Lake Basin region are not served by a fish farm capable of carrying out substantial technical trials. In the early 1980's, Department of Fishery proposed such a centre for construction at Kabonyo near Kisumu. The land has been obtained and tested, and designs prepared, but financing collapsed before construction could commence.