transfer payments such as tax, subsidies, and interests are deducted from all prices. The ratio of transfer payment to financial cost is assumed to be 10% of financial cost.

The benefits of water supply for domestic, municipal, livestock and industrial demand are estimated applying the maximum affordable water value. A water deficit in a specific area is calculated as a difference of water demand such as domestic needs and industrial needs of municipal, livestock and manufacturing production and a present water supply capacity. A construction schedule of water resources development schemes is basically settled to meet the deficit. The costs of the schemes such as reservoirs and the recommended intake, conveyance, treatment, and distribution system are estimated in the previous Section.

For irrigation projects, economic farm gate price of major crops during the evaluation period were estimated (see Section 6.8.3 (2)). Unit yield, gross value, production cost and net value were estimated by with- and without-conditions. Then the irrigation benefit is obtained as the incremental net production value.

Hydropower benefit is estimated as a product of electric power output and the long-run marginal cost (LRMC). The LRMC was estimated at US$ 0.055/KWh, following the value used in the latest KPLC study.

In the flood mitigation schemes, the annual benefit is estimated as a difference in net damage reduction value under with- and without conditions. Property value in flood prone areas is counted under the present conditions in 1990 and under the future conditions in the target year 2010.

For economic evaluation, Internal Rates of Return (IRR) of respective projects are calculated to verify economic viability in the national economy. In calculation of other economic indices such as Net Present Value (NPV) and Benefit-Cost Ratio (B/C), costs and benefits are discounted at the rate of 10% for the respective project lives.

6.8.2 Parameters and preconditions for economic evaluation

In estimating the economic cost and benefit, the economic values are estimated applying the following conditions and assumptions for every sector related to water.

(1) Price level

For economic evaluation activities, the basic price level for cost and benefit estimates was set at the end of February, 1991. Foreign exchange rate was set at KShs.25.2 to US$1.00 in obedience to the official exchange rate at the same time.

(2) Opportunity cost of capital

Opportunity cost of capital represents the permissible economic rate of return for development projects. In Kenya, 10% of this opportunity cost of capital is applied

as a discount rate for assessing economic viability of proposed projects, which is also used by IBRD.

(3) Economic value

In economic analysis, all goods and services applied in the project costs and benefits are estimated on the basis of real economic value. In terms of non-tradable goods and services in local market, the following points have to be considered in the case of converting their financial values to economic ones: (a) internal transfer payment and (b) shadow wage of unskilled labour in particular because of taking unemployment and underemployment conditions into account. On the other hand, the tradable goods and services are estimated based on the international market prices, so their values reflect real economic ones. In this current report, however, economic values are estimated to be 90% of total financial values of both local portions and foreign portions.

(4) Economic life

The economic life of the projects is taken as follows for respective schemes: 35 years for water supply facilities; 50 years for irrigation, hydropower and flood mitigation facilities. However, a part of mechanical facilities is considered as 20 years, so it would be replaced within the above main economic life. The economic life begins just after completion of the construction works.

6.8.3 Economic benefit and efficiency

The structure and distribution of benefits is induced through the parameters and preconditions mentioned in the previous sections. Economic values of benefit at present and even in the future are mainly estimated under the social and economic conditions in February, 1991 for economic evaluation. Future socioeconomic changes were discussed in Chapter 4 and the their details should be referred to in Sectoral Report A.

(1) Water supply scheme

Basic idea of economic benefit for domestic water supply schemes is based on the maximum affordable value. It is generally adopted for water supply project as the traditional rule, i.e., commonly 3 to 5 per cent of household income. In this master plan study, the benefit for water supply system are estimated to be 5% of income for all water supply schemes. Applying this rule, the total annual benefit in the country could be estimated at US$461 million in the year 2000, distributed as US$289 million in urban areas and US$172 million in rural areas, as shown in Table 6.8.1.

For industrial use, economic benefit is also based on the maximum affordable payment for water consumption, which is basically estimated through water cost in industrial final products. In this study, a percentage of water cost to value added of all manufacturing products is adopted for benefit estimation, from the point of view

of data availability. The rate of maximum affordable value for water is assumed to be 1.5% referring to the data of input-output table for Kenya in 1986, as estimated in Table 6.8.1. As a result, the annual economic benefit for industrial water in the country is estimated at US$27.5 million in total in 2000. In the same manner, the annual benefit for municipal water is expected to be US$16.5 million, and the one for livestock breeding is US$12.3 million, as shown in the table.

The financial construction costs of the proposed projects in urban and rural areas are shown in Section 6.7. The costs are converted to economic costs by making adjustments based on the aforesaid conversion method. For economic evaluation activities, the construction schedule is assumed to be divided into two phases. The construction works of the first phase are assumed to start in 1994 and to end in 1997, of which the capacity fully covers the 2000 water demand. Those of the second phase are between 2001 and 2004, covering the 2010 water demand. This is a tentative assumption to be limitedly applied to this economic evaluation.

The O&M costs are annually required during the economic life of the projects just after completion of the construction works. The costs are assumed to be 5% of the total construction costs.

While the economic life is assumed to be 35 years, some mechanical facilities such as pumps have shorter life than the civil and plumbing works. It is assumed to be 20 years for such mechanical equipment for water supply system. The replacement costs are assumed to be 5% of the total construction costs.

The entire urban schemes of 158 systems are examined in economic efficiency through factors of NPV, B/C and IRR, as mentioned in Section 6.8.1. Table 6.8.2 shows the results of the examination. Of 158 schemes, only 4 schemes exceeded 10%, the opportunity cost of capital mentioned above. They are Embu, Thika, Mariakani and Nairobi, in order of economic efficiency. In addition to these four schemes, 36 schemes were worked out to have positive IRR, as shown in Table 6.8.3. The other 118 schemes resulted in negative efficiency.

The economic efficiency of rural water supply is examined as a district form covering all Locations in the District. No Districts, excluding Nairobi and Mombasa, have a positive IRR, as shown in Table 6.8.4. Incidentally, the total costs for the entire schemes in the country aggregated to US$5,520 million. On the other hand, the benefits of the rural water were estimated at US$172 million in 2000. Thus, the benefits accounted for only 3% of the total costs.

(2) Agricultural development

The annual benefit of agricultural development schemes is estimated as a difference of net production values under with- and without-project conditions. The net production values for major crops are estimated as a difference of products' value and production cost at 1991 economic prices. The products' values are estimated by

a product of unit yield and unit price under with- and without-project conditions. The production costs under without-project condition are derived from the production costs through the present cropping pattern. The production costs under with-project condition are estimated on the basis of projected cropping patterns.

The total benefit of 18 irrigation schemes proposed in the agricultural development plan is expected to aggregate US$177.8 million per annum at the time whole schemes will be matured. It is broken down as shown in Table 6.8.5.

Project costs of the 18 irrigation schemes are estimated at US$1,015.5 million in total. Their respective initial costs are shown in the table.

The entire irrigation schemes of 18 systems are examined for economic efficiency. Table 6.8.6 shows the results of the examination. Of 18 schemes, the IRRs of 10 schemes exceeded 10%, the opportunity cost of capital. In addition the other 8 schemes excluding Yala swamp scheme were worked out to have positive IRR, as shown in the table. Incidentally, the combined IRR of all 18 schemes is expected to be 9.6% as shown in the table.

(3) Hydropower development

The annual benefit of hydropower development schemes is estimated as a product of the average annual power output (GWh) and LRMC. LRMC is quoted from the latest KPLC report, i.e., "1990 Interim Update of National Power Development Plan (NPDP) 1991 to 2010, draft Final Report, April 1991, Acres". According to the report, the LRMC is estimated at US$0.055/KWh, as illustrated in Table 6.8.6. The average annual energy production will gradually increase according to development of the proposed schemes and reach 3,156 GWh per annum as the total output of the new five schemes excluding Gitaru #3 extension scheme. Then, the annual benefit is estimated at US$156 million per annum.

Project costs of the five hydropower schemes are estimated at US$969 million in total (according to the estimate in NPDP). The respective costs are shown in the table. To examine their economic efficiency in the same conditions, they are assumed to be disbursed as follows: (a) two years for engineering and administrative arrangement and (b) succeeding three years for construction works of the proposed facilities.

Table 6.8.7 shows the results of the examination. Of five schemes, the IRRs of four schemes exceeded 10%, the opportunity cost of capital. Although IRR of Magwagwa scheme was worked out to 9.1% under the preconditions mentioned in Sectoral Report "L", the recent feasibility report of Magwagwa scheme evaluated the project to have 13.5% of IRR under new design criteria proposed in the report. Incidentally, the combined IRR of the five schemes is expected to be 14.1% as shown in the table.

(4) Flood mitigation

The annual benefit of the flood mitigation project is estimated as the difference in net damage reduction value under with- and without-project conditions. The damage value is estimated as the product of the following three figures: (a) inventory of damageable properties in flood prone areas; (b) unit value of respective properties; and (c) damage rates for respective properties in proportion to inundation depth and duration. Damageable properties in flood prone areas consist of the following four categories: (a) agricultural products, represented by maize; (b) housing units, represented by permanent houses in urban areas and thatched houses in rural areas; (c) infrastructures such as roads, railways, irrigation channels, utilities, and public buildings; and (d) indirect losses, such as losses of business opportunity and costs for rescue and relief activities.

Inventory of damageable properties is enumerated through sight inspection and information given through topographical maps in flood prone areas. Their unit values and preconditions are tabulated in Table 6.8.8. In addition to the conditions in the year 1990, the table includes the future conditions in the target year 2010. For the future conditions, it is assumed that the damageable value in the flood prone areas will increase at an annual growth rate of 2.5%.

Project costs of the proposed five flood control schemes are estimated at US$ 62.5 million in total at 1991 prices, as shown in Table 6.8.9. The respective costs are shown in the table. To examine their economic efficiency in the same condition, they are assumed to be disbursed as follows: (a) one year for engineering and administrative arrangement and (b) succeeding four years for construction works of the proposed facilities.

The economic efficiency of the proposed flood control schemes of five systems were examined. The table shows the results of the following two cases of benefit estimation: (a) the benefits are constant under 1990 conditions and (b) the benefits between 1990 and 2010 are assumed to increase in proportion to the increment of damageable properties in the flood prone areas. Under the former conditions, the two schemes of Kano Plain and Nairobi city had the highest priority among the five schemes. Under the latter conditions, the IRRs of three schemes exceeded 10%, the opportunity cost of capital. Other two schemes could also have high economic efficiency, considering a social welfare project of flood mitigation. Incidentally, the combined IRR of all the five schemes is expected to be 10.1% as shown in the table.

The Study presumes that, in evaluating the economic efficiency of the project, a reduced IRR criterion may be applied to the flood control sector (similar to the water supply sector), in view of social well-being improvement object and other unaccountable secondary benefits accrued from undertaking flood control. In this context, three schemes having an IRR value of less than 10% are also worthy of future implementation.

6.8.4 Socioeconomic impacts

(1) Changes of social well-being

Increase of income and employment opportunity, induced effect of investment by proposed projects, health improvement, life saving and reduced risk in water supply and flood mitigation, etc. are counted as the indirect beneficial effects from the viewpoint of social well-being. The adverse effects are relocation of people and properties because of submergence by proposed projects such as reservoir and river reservation.

(2) Indirect linkage effects of capital investment

As discussed in Section 2.5.2, once one unit is invested in the national market in the construction sector, 2.18 units of investment effects would be induced in the national economy, as shown in Table 2.5.5. For instance, if the 158 urban water supply schemes were constructed in the country, of which the total cost aggregates to US$5,644 million, the final demand of US$12,304 million would be induced in the national market. Of this total, US$5,644 million accrues for the construction sector as direct effects and US$6,660 million would be procured through the other economic sectors as indirect effects.

Furthermore, based on the input-output tables, of the total investment, approximately 56.2% of intermediate goods and services would be procured from the domestic market. Of this total domestic procurement, 17.7% is from the manufacturing sector of chemical and petroleum products, and 13.7% is from the manufacturing sector of basic metal and machinery. The rest, 43.8%, constitutes the procurement (8.4%) from imports and value added (35.4%).

Thus, these components show direct and indirect positive economic effects on respective production sectors. In order that this investment is implemented soundly, it is essential to cultivate and to promote industries related to the main industry. On the contrary, if the relative sectors do not reserve production power to support the new investment, it would be feared as inflation that the investment simply raises prices of construction materials.

(3) Inequality of water distribution and cost-sharing policy

Water supply coverage does not seem to be equal regionally in the country, although it is quite difficult to obtain definite coverage. In addition, household income in rural areas is low compared with that in urban areas. Thus, it would be economically difficult to cover the entire rural people by the proposed rural water supply projects. In fact, as seen in Section 6.8.3 (1), the benefits from rural water supply projects does not seem to cover even O&M costs. Because they account for only about 3% of the project costs in spite of the assumption that O&M costs are estimated at 5% of the total costs.

Yet, from the viewpoint of basic human needs and public hygiene, the rural water systems should be introduced as the national target. Despite this basic policy, however, it would be difficult to attain the project targets, i.e., to cover all people by safe and sustainable water by the year 2010, without the promotion of cost-sharing policy from the financial point of view. Thus, it is quite important for people to bring about a better understanding regarding the difficulty and importance of water supply systems.

(4) Effects of rural community development

In accordance with the implementation of the projects, the supporting social systems for improving the living conditions of the local societies will be enhanced in rural areas in the future. For instance, water supply systems will cover all the people in the country by the target year in spite of the poor coverage situation of less than 40% in rural areas in the country in 1990. Conditions of natural disaster will be improved by 2010 despite the present unfavourable conditions in some areas because of the lack of flood control facilities. In addition, medical and educational conditions will be improved in rural areas in particular. Thus, these supporting infrastructure systems will considerably be improved by the end of the target year.

The improvement of these systems makes people identify with a community and to change their consciousness from a tribe to a local society. In general the tribe problem poses big difficulties to resolve and impedes the promotion of economic development activities. Accordingly, establishment of a well served community might function as an incentive to rectify tribal problems. Furthermore, it might work to ameriorate the plight of the cultural minorities by introducing them into communities.

(5) Consideration for "Women in Development"

In rural areas, in particular, women as well as men are essential participants in and beneficiaries of economic and social development. Besides, women are affected in various ways by development projects. Thus, taking women's social positions and roles in societies into consideration, the following issues should be examined to harmonize the proposed projects with the role of women in the project areas at the stage of implementation.

(a) Women generally play a major role in securing safe potable water. Thus, water supply facilities such as hand pumps should be installed for women to operate with ease. Measures being adopted should ensure that they are able to obtain water without any impediments.

(b) In most rural areas, women are engaged in the operation and maintenance of on-farm irrigation facilities. Thus, they should be able to get an opportunity to receive technical guidance for new women's works and roles. In addition,

measures should be taken for women to account for possible changes in the nature and quality of women's work such as extension services and training.

(c) Rivers are often used for washing and bathing in areas where water supply systems are not adequately provided. In the implementation of irrigation projects, adequate and safe water for washing, cooking and bathing should be ensured in project and/or downstream areas.

CHAPTER 7 FUTURE DEVELOPMENT POTENTIAL

7.1 Large Scale Water Transfer Plan

7.1.1 Water transfer scheme for domestic water supply

Groundwater exploitation and various water harvesting measures will remain to be the main sources for supplying domestic water to urban centers in semi-arid and arid areas. With the increase of demand in the future, however, additional water sources may be required in some areas. The following describes a tentative plan of alternative water sources for four selected towns, which would be worthy of future consideration:

(1) Marsabit water supply

In the Study, the development cost was tentatively estimated for the case of borehole development as the first approach. Maximum development of small dams within Marsabit hill area and subsurface dams at the foothill area should be surveyed for the second approach. The last alternative solution may be water transfer from a subsurface dam on the Malgis River or potential well field near Laisamis.

(2) Wajir water supply

The development cost was tentatively estimated for the case of borehole development meeting the whole demand for the first approach. If the exploitable groundwater source is limited, the solution may be water transfer from the Ewaso N'giro River. The development cost for water supply was roughly estimated at US$46 million. The feasibility study should be initiated to examine this plan. Potential groundwater sources in Griftu and Habasweni areas (identified in earlier preliminary studies) should also be examined.

(3) Kapenguria water supply

Construction of a small dam on the Kapenguria River was proposed for augmentation of the supply capacity, though the water yield should be assessed in a detailed hydrological study. Alternatively water transfer from the Kapolet River appears to be prospective.

(4) Isiolo water supply

Groundwater will be exploited to a maximum extent and the construction of a small dam on the Isiolo River or two major springs which are located 14 km north from Isiolo town will supply the remainder. As an alternative to the latter, water conveyance from the Meru water supply system may be considered.

7.1.2 Multipurpose water transfer plan

In the country, more than two-thirds of the total land area is arid and semi-arid where effective and efficient agricultural irrigation is at present not possible in view of unavailability of local water. If some inter-basin water transfer is planned between basins where adequate water is available and where insufficiency is experienced, some possibilities of development of irrigation as well as domestic and livestock water supply and hydropower generation will be realised.

In this Section, several damsites for inter-basin water transfer scheme are introduced based on plans proposed in previous studies.

(1) Greater Rift Water Transfer Plans

This is a plan envisaged by NWCPC. The plan has examined three (3) damsites identified on a map of 1:50,000 scale, but no detailed information and study reports are available except for Nyando dam scheme.

(a) Hemsted Bridge Dam Scheme: water transfer from Nzoia River to Kerio Valley.

(b) Kimondi Dam Scheme: water transfer from Kimondi River to Kerio Valley.

(c) Nyando Dam Scheme: water transfer from Nyando River to Greater Nakuru through Timboroa .

(2) Nzoia-Suam and Nzoia-Kerio Water Transfers (Ref.25)

This is a double water transfer plan; (i) from the Nzoia River to the Suam river basin and (ii) from the Nzoia River to the Kerio River for multipurpose development. The proposed damsite is Moi's Bridge Dam which is located on the Nzoia River just downstream of the confluence of the Koitobos River with the Nzoia River. According to a preliminary report on this double water transfer project, the following are concluded:

(a) Through a tunnel 17 km long to the Suam river basin and another tunnel 42.5 km long to the Kerio River, total power generation of 500-760 MW and more than 140,000 ha of irrigation development will be expected both in the Suam and Kerio basins.

(b) The project consists of four stages adopting their construction to the growth of electric power demand.

(c) Before adopting a decision on this project, the following are recommended:

- to study this project at a preliminary design level with hydrological and geological investigation.
- to complete the energy and irrigation development studies at the feasibility level for this multipurpose project.
- to clarify the amount of water that can be transferred to both the Suam and Kerio rivers without any future detriment to the Nzoia basin, the origin of the water.

In this Study, approximately 15 cms of water was estimated to be transferrable to the basins at a maximum development scale of the dam. Therefore, the scheme is regarded to be technically viable (hydrological aspect). The economic viability is to be examined in future studies.

(3) Water transfer from Amala River to Ewaso N'giro North River

This plan is still at a preliminary stage. The plan envisages building a dam on the Amala River (Amala dam) for supplying water to Oldorko dam reservoir through Ewaso N'giro River. No detailed information is available.

The scheme will cause reduction in the Mara river waters and hence have a great impact on the ecology of wildlife in two world-wide famous parks (Masai Mara and Serengeti) situated in the downstream part of the Mara river basin. The planning should take this into account.

(4) Water transfer from Tana River to Ewaso N'giro North River Basin

This is an idea of inter-basin water transfer from an intake weir on the Tana River at Mbalambala to the lower basin of the Ewaso N'giro North River through a tunnel of about 50 to 70 km for the development in the lower Ewaso N'giro North river basin. This water transfer will reduce future development potential in the lower basin of the Tana River. This aspect should be examined further.

Besides the above mentioned inter-basin water transfer plans, there are also some plans identified in previous studies which transfer water from Lake Victoria basin to Rift Valley basin. They are summarized in Appendix H.10 of Sectoral Report H.

All the plans listed above are huge projects requiring extensive investment. In the present Study, these were not included in the list of implementation project towards year 2010. The first approach to these plans would be to look into more detail of technical and economic viabilities. The Study presumes that, among the plans, the Nzoia-Suam/Kerio Double Water Transfer Plan may be accorded a priority of further study in the future.

7.2 Dam Development Plans

28 dam schemes were selected as candidate schemes to be implemented towards the year 2010. On top of those, there are a number of schemes worthy of further consideration as alternatives to the selected schemes and/or schemes to be added in the development programme when new demands arise or if the economic viability is justified in further studies. Table 7.2.1 lists those potential schemes.

7.2.1 Multipurpose dams

Some of the dam schemes listed in Table 7.2.1 have the potential of multipurpose development, out of which eight major dams, i.e., Nyando and Nandi Forest dams in the Lake Victoria drainage area, Kimwarer and Sererwa dams in the Rift Valley drainage area, Munyu dam in the Athi river basin, High Grand Falls, Adamson's Falls and Kora dams in the Tana river basin are briefly discussed hereunder.

(1) Nyando Dam

This site is located on the Nyando River about 5 km upstream of Muhoroni. The dam scheme was proposed in previous studies (Refs.26 and 27) for domestic and industrial water supply, irrigation and flood control, and also as well as a dam for Greater Rift Water Transfer Plan by NWCPC.

An investigation of the "Scheme of Muhoroni Reservoir on the Nyando River and Water Supply to Timboroa" was carried out in 1990 and the report was completed in July 1991 by NWCPC (Ref.28). This scheme was studied primarily for water supply purpose for the Greater Nakuru through Timboroa. According to the report, it was concluded as follows:

(a) The suitable scale of development is to build a 85 m high dam (3.6 million m3 of dam embankment volume) which creates a reservoir having a gross storage capacity of 250 MCM.

(b) The water transfer pipeline is to be 63 km long, with a gross lift of 1,537 m. To pump up 5 m3/s, about 114 MW of power is necessary.

(c) The construction of water transfer system appears to be very difficult because of mountainous topography in the area, a large quantity of water to be pumped and a high head.

(d) More investigation is required in further study, particularly to determine an optimum water quantity to be pumped up.

As concluded in the report, a further detailed study on the Nyando multipurpose dam scheme is required, focussing on:

(a) determination of the adequate quantity of water to be pumped,

(b) provision of cheap power source and reduction of power capacity required for pumping water. The presently designed 144 MW is nearly equal to the output capacity of Magwagwa hydropower scheme(120 MW). A great investment is required for the provision of power source,

(c) study on the other development potentials such as irrigation and flood control purpose.

(2) Nandi Forest Dam

This potential site is located within the Nandi Forest area just downstream of the confluence of two major tributaries of the Yala River; Kimondi and Sirua rivers. The dam is planned for multi-objectives; hydropower generation of 45 MW utilizing about 500 m head via a 15 km tunnel from the reservoir (183 mcm in storage capacity) to the Nyando river basin, irrigation of 15,000 ha of mainly sugarcane in the Kano Plain and water supply to Kisumu (Ref.26).

For further study on this dam scheme, the following are conceived:

(a) In principal, the priority of water use should be given to meeting the water demand in the downstream areas. Preliminary water balance calculation in this Study presumed that maximum transferrable water may be 11 m^3/s in terms of average reservoir yield.

(b) This dam will cause loss of valuable and irreplaceable indigenous forest (refer to Sectoral Report N). This aspect should be assessed in more detail.

(3) Kimwarer Dam

The site is located on the Kimwarer River which is a tributary of the Kerio River and situated in the upper part of the Kerio Valley. The preliminary design of the dam was made for the purposes of hydropower generation, rural water supply and small scale irrigation schemes near the damsite by KVDA (Ref.29).

A rockfill dam 40 m high with 21.3 mcm of gross storage capacity was proposed for the above purposes. KVDA intends to proceed with a further study on this dam for multipurpose development.

(4) Sererwa Dam

The site is located on the Arror River. Feasibility study of the dam for hydropower generation, Arror irrigation scheme and rural water supply was completed in 1990 (Ref.30). A 97 m high dam with 58 mcm of live storage capacity is planned for 70 MW of power generation and 1,340 ha of irrigable area through pipelines from tailwaters of the power station.

This dam scheme was not selected in the Updated National Power Development Plan for 1991 to 2010, but it seems to be the most promising project forthcoming next to the selected five schemes (Section 6.5) in the future hydropower development programme.

(5) Munyu Dam

This site is located on the main stream of the Athi River about 2 km downstream of the confluence of Athi and Ndarugu rivers. The site has a catchment area of 5,590 km^2 which covers all the upper drainage area of the Athi river basin including Nairobi city area.

This dam has been formulated for multipurpose development comprising water supply to Nairobi and environs, hydropower generation and Kanzalu irrigation scheme (Ref.31). Munyu dam and Ndarugu dam on the Ndarugu River are mutually exclusive and the selection between them is one of the most important decisions to be taken in the development of the Athi river basin.

In this Study, Ndarugu dam was selected for the above development purposes, and Munyu dam was considered as an alternative to Ndarugu dam, because of some advantages of Ndarugu dam as follows:

(a) higher water quality of the Ndarugu River; i.e., lower water purification requirement, while Munyu dam receives effluents from Nairobi area,

(b) larger number of resettlement and land acquisition due to submergence by the reservoir of Munyu dam, and

(c) lower construction cost of Ndarugu dam: it was assessed that the construction cost of Munyu dam would be more expensive by about 35 % than that of Ndarugu dam to store an active storage of 190 mcm for water supply to Nairobi areas and to Kanzalu irrigation scheme.

(6) High Grand Falls Dam

This scheme is mutually exclusive with the developments of Low Grand Falls and Mutonga dam. The dam is proposed chiefly for hydropower generation of 177 MW by a 117 m high dam with 22 mcm of dam embankment volume and 5,325 mcm of gross reservoir storage capacity (Ref.32).

As this dam scheme was excluded from the Updated National Power Development Plan towards year 2010, it was not selected as a prospective hydropower scheme in this Study. It is, however, recommended that a further detailed study on High Grand Falls dam scheme be taken up to examine the merit of multipurpose development aiming at irrigation schemes, flood control, augmentation of river flow, stability of river course and so on in the downstream area of the Tana river basin.

(7) Adamson's Falls and Kora Dams

These damsites are located on the main stream of the Tana River, downstream of Low/Grand Falls damsite. Adamson's Falls dam is planned as a dam 50 m high having 1,009 mcm of gross storage capacity for installed generation capacity of 80 MW, while Kora dam is of 55 m high with 1,172 mcm of gross storage capacity for power generation of 92 MW (Ref.32). These dams are also potential multipurpose schemes to be noted in a long-term development in the lower basin of the Tana River.

7.2.2 Water supply damsites

There are a number of damsites for water supply purpose still needing further investigation and study. They will be alternatives to or addition to the schemes selected in Chapter 6. The list of damsites and their purposes are enumerated in Table 7.2.2.

In the Kitui district, there are plans for three (3) potential damsites around Kitui town for water supply to Kitui town and environs (proposed by MOWD). These are Mutui, Kitimui and Umaa sites. Mutui and Kitimui were planned at a master plan level, while Umaa scheme is under investigation of prefeasibility study level but no detailed information is available. In this Study these are considered to belong to a group of small dams for water supply development in the area (Ref.33).

In the Ewaso N'giro North River drainage area, some potential damsites including small damsites and pans which are proposed by MOWD are conceived for water supply to towns and environs situated near the sites.

7.2.3 Flow augmentation by dam

Water use in upstream areas tends to reduce the water yields in the downstream areas. A primary measure for avoiding this adverse effect is to exercise water use management in the upstream area. Nevertheless, there will still be great concern for water shortage arising in the downstream area. More positively, the development in the downstream area could be achieved with augmentation of river flows in the area. This is particularly important in rivers in relatively dry area, where, however, the development need and/or potential are foreseen.

The following dam schemes are envisaged for future development of flow augmentation by dams in view of its large undeveloped downstream areas for irrigation and water supply.

(a) Kerio River: Kamukuny dam for the downstream development potential of the Kerio river basin. The site is located on the main stream of the Kerio River, the river is seasonal during the dry season. The site is also conceived as a subsurface damsite.

(b) Athi River: Yatta dam for the downstream development potential of irrigation in the middle and lower basin of the Athi River and water supply to the coast area.

(c) Ewaso N'giro North River: Kihoto dam and Achers Post dam for downstream development potential of irrigation, water supply and hydropower in the middle (including Isiolo) and lower basin of the Ewaso N'giro North River.

7.3 Hydropower Development

At Present, hydroelectric generation plays a key role in the supply of electric power to the country. The importance of the role played by hydropower will remain unchanged in the future.

In the Study, evaluating results of the least cost generation expansion sequence were adopted in the National Water Master Plan towards the year 2010.

Other than the projects proposed in this Study, additional potentially economic hydroelectric projects exist in the country. However, on the basis of power benefit alone, these projects are less economical than other generation candidates such as thermal combustion and coal-fired steam power plants. These projects are;

- Nandi Forest Project as a part of the Nandi Forest-Kano Plain Transfer multi-purpose project
- *Sererwa Project in the Kerio Valley*

In order to these projects attractive, a further study should be done to evaluate more exactly these hydroelectric potential sites.

7.4 Flood Control Plan

Some of the flood protection projects accorded Priority-C in the Study (Section 6.6), which have relatively low economic return and low social requirement, may come to require more attention depending on the rise of social development needs in the area. They include;

- Sondu Rivermouth,
- Middle Turkwel, and
- Downmost Athi River

CHAPTER 8 ENVIRONMENTAL ASPECTS

The Study looked into environmental issues relevant to the proposed water development plans. The findings are presented in detail in Sectoral Report N. The Sectoral Report N examined the issues in two ways; (i) overview of the state of the Kenya environment (Part 1 of the Report) and (ii) initial environmental examinations of the proposed dam schemes and irrigation schemes. In addition, preliminary notes on environmental issues involved in the proposed flood control schemes and water transfer schemes are included in Sectoral Reports G and M, respectively. In general, the depth of the studies remains at a preliminary level just to meet the requirement of this master plan study.

The descriptions in this Chapter are limited to only the outline of major findings, leaving further details in respective Sectoral Reports.

8.1 Overview of Environmental Issues

Through overview on the general state of Kenya environment, the Study noted various issues to be incorporated in future environmental conservation programmes. The main items, which are supposed to require future action, are described below.

(1) Kenya population

Since rapid population growth is the crux of the problems of economic growth and social development in Kenya today, it is recommended that increased financial and manpower support be provided to the existing family planning and birth control programmes.

(2) *Environmental consequences of irrigated agriculture*

There are potentially very many physical and social environmental impacts which may attend further irrigation development in Kenya and the following recommendations are designed to mitigate the adverse impacts as much as possible. It is recommended that:

(a) agricultural development be prioritized as follows -

- improvement of yield and economics of existing rain fed agriculture,
- reduction of post harvest losses through improved storage conditions and facilities,
- rehabilitation and modernization of the existing irrigation schemes,
- development of new irrigation schemes.

(b) several restrictions be placed on the conversion of medium and high potential areas in ASAL regions from dry season refuge pastures to permanent irrigation (see also (8) below).

(c) monitoring of return water quality be undertaken in all existing schemes to assess the impact on the receiving water course.

(d) where applicable, eg. Kano and Nyando Plains, the return water from proposed schemes be passed through existing Papyrus swamps to reduce the pollution impact on the receiving water.

(e) the procedures for compensation provision to people adversely affected by the development of irrigation schemes be improved to provide, among other things, the option for land-for-land compensation, relocation, and resettlement costs.

(f) further investigations be carried out to assess the present feasibility of integrated pest control and management rather than the current sole reliance on chemical control.

(g) greater consideration be given to the tenants, especially on rice paddy irrigation schemes, for the provision of land for food crop production to avoid problems of malnutrition in monoculture agriculture systems.

(3) Environmental impacts of dams and reservoirs

(a) The procedures for compensation for people displaced or adversely affected by the construction of dams and reservoirs be streamlined and improved especially with regards to the provision of the option for land-for-land compensation.

(b) Where power bores will be produced by intermittent power generation, the public be fully protected and made aware of the hazard involved.

(c) Adequate compensation flow be returned to the river to maintain its utility to downstream users and its ecology; this is especially important in rivers likely to be used as receiving waters for effluent discharges where dilution is required.

(4) Environmental impacts of deforestation

(a) The rate of reforestation must be increased to exceed the rate of forest removal if a fuelwood and charcoal crisis is to be avoided; new fuelwood plantations in the vicinity of urban centres must be given high priority, as must private-or-farm free management.

(b) The conservation and maintenance of sensitive forested water catchments must be given high priority to protect vital water resources.

(5) *Soil erosion and conservation*

(a) The implementation of existing soil conservation policies should be speeded up through the provision of greater support for existing government institutions and NGO's.

(b) Funding for agroforestry research and implementation should be increased.

(6) Water quality and water pollution

(a) Monitoring of principal surface and groundwater resources needs to be improved and decisions made on the location and frequency of sample collection to ensure the resulting data suitable for long term management of these resources.

(b) Similarly, monitoring of effluent discharges must be improved to avoid pollution of the national water resources.

(c) The ongoing improvements to the Water Act must be supplemented with active enforcement of legislation; legislation alone does not prevent pollution.

(e) With regard to effluent quality guidelines or standards, it is recommended that the relevance of the existing well-prepared standards (eg. British Royal Commission 20:30 standards) is re-evaluated and alternative, and more relevant, guidelines proposed for adoption in Kenya.

(7) Closed basin lakes

(a) Regular environmental monitoring, including water and effluent quality monitoring, should be implemented as a matter of urgency in those closed basins identified as being under threat from development; these lakes include Naivasha, Nakuru, Winam Gulf and Lake Turkana. Lakes Baringo and Bogoria should also be paid attention.

(b) The threat from the Malewa-Nakuru water transfer scheme Phase 2 appears to be a major threat to Lake Nakuru especially. It is recommended that to mitigate the probable impacts of Phase 2 all present and additional effluent generated in the lake catchment is fully and properly treated to a high standard and that the final effluent is discharged outside the lake catchment.

(8) Arid and semi-arid lands

(a) Two major assumptions concerning ASAL must NOT be made namely:-

- that the ASAL constitute a major reserve of productive land available to accommodate overspill population from the high potential areas of Kenya,

- that water is the main constraint on production in ASAL areas, it is not, vegetation is the primary limiting factor.

(b) ASAL development should concentrate on livestock production and wildlife-tourism as the main production bases; these areas cannot compete economically with the high production areas in arable farming.

(c) Great care must be taken when developing water resources in upland (and usually productive) areas which denies water to the lowland ASAL areas down river. This may be best achieved by straightening the existing river basin authorities to ensure planning on a whole catchment basis.

(d) The expansion of water harvesting techniques in appropriate areas is to be recommended.

(e) Key production areas used by pastoralists livestock and wildlife must be protected from further conversion to arable agriculture and settlement. Without these dry season refuges, wildlife and pastoral populations will suffer and decline. If migrant populations are denied access to these vital dry season areas of refuge, the wet season grazing potential of the rangelands will be wasted, and the range degraded through over-exploitation in the dry season.

In addition, the following are also noteworthy:

(i) physical access corridors to key production areas must be open to both migrant livestock and wildlife.
(ii) access to wet season dispersal areas must also be kept open and these areas not adjudicated.

8.2 Environmental Aspects of the Proposed Development Schemes

8.2.1 Dam schemes

The construction works of dams and reservoirs bring various social and environmental problems in general, but 28 dams proposed in Subsection 6.4.1 might not involve such serious influence on social and environmental conditions as affecting the dam schemes. At the time of implementation, however, it is important to minimize the adverse effects of the schemes as much as possible. The potential issues needing due attentions may be;

(a) Compensation for submerged lands and resettlement of people: Magwagwa and Ndarugu dams
(b) Submergence and deforestation in forest areas: Itare, Mukulusi and Upper Narok dams
(c) Water quality and sanitation problems: Oldorko, Mwachi, Pemba, and Rare dams
(d) Consideration for water utilization in downstream: Oldorko, and Malewa dams

8.2.2 Irrigation schemes

In irrigation schemes, there prevail common environmental problems prevail in most schemes rather than problems peculiar to a specific individual scheme. Nevertheless, specific issues needing attention in respective schemes will be;

(a) Problems of public health:
Kano, Kanzalu, Kimira, Ewaso N'giro, Mwea and Tana Delta schemes, in particular

(b) Problems of water utilization in downstream areas:
Ewaso N'giro and Turkwel schemes, in particular

(c) Water quality problems in downstream areas:
Kano, Kimira, Kuja and Tana Delta schemes, in particular

(d) Influence to vegetation in ASAL areas:
Ewaso N'giro and Turkwel schemes

Of the 18 irrigation schemes, Ewaso N'giro and Turkwel schemes are noticeable for having peculiar problems such as the above (b) and (d). Therefore, careful consideration should be given to these two schemes before implementation, although these problems are not so serious as to leave the schemes out.

8.2.3 Flood control schemes

Social and environmental problems brought about by the five flood control schemes proposed in Subsection 6.6.1 would be considered to be relatively small. Because, the construction works of the schemes are built in the existing river courses or the construction itself is a repair work of the existing river dikes. Even in the case of new dikes, the problems would not influence the surrounding areas because there are few inhabitants along the rivers.

8.2.4 Water transfer schemes

(1) General problems

Environmental problems by water transfer schemes are classified into the following two aspects.

(i) Decrease of river flow downstream of source rivers

(ii) Change of water environment (quality and quantity) in receiving rivers and lakes by transferred water

These problems occur within a closed basin remarkably. In this Study, therefore, the following points were taken into consideration.

(i) The source rivers for water transfer were restricted to rivers which have affluent water flow and little difficulty of water shortage in downstream areas such as Nzoia, Yala, Nyando, Sondu and Tana rivers.

(ii) Water must not be transferred from closed basins in principle, although water from Malewa River is transferred as an exception (discussed later). This point is quite important for rivers which function as water resources for key production areas in ASAL regions, such as Turkwel, Kerio, Ewaso N'giro North, and Ewaso N'giro South rivers. Also, Mara River is added as the same characteristic river, though its basin is not closed.

(iii) Water transfer into closed basins is, in some instances, necessary from the point of view of satisfying the basic human needs in water deficit areas. The potential problem is that the transferred water makes the water catchment areas, i.e., lakes and marshes, contaminated as the secondary water pollution problem. However, this problem does not always deny the introduction of water transfer plan. On condition that the maximum volume of transferred water is taken into consideration from the point of ecological balance, water transfer plans should carefully be introduced in water shortage areas.

(2) Water transfer schemes to closed basin
(Example of Nakuru water transfer scheme)

Nakuru water transfer plan is under planning as an urgent scheme to solve the water shortage problem in Nakuru town. The Phase I scheme (already completed) is foreseen to involve no serious environmental issues, while however the Phase II schemes will encounter different conditions. In the Phase II schemes, the water is supplied from Malewa dam and Itare dam in bulk, which may bring about significant environmental problems; particularly deterioration of water quality of the Lake Nakuru. It is imperative to promote the countermeasures. The following countermeasures are proposed for environmental conservation of the lake:

(i) Total amount regulation of water utilization
(Non-structural measure)

- Regulation of regional development within Nakuru basin by a local act. At the same time, provision of regional plans in outlying areas of Nakuru basin for diversification of development activities
- Introduction of special water tariff in Nakuru basin primarily to encourage the saving of water use and secondarily to procure the funds for the structural countermeasures proposed below.

(ii) Structural measures

- To furnish urban sewerage system to prevent water pollution (Improvement of the existing sewage plant is an urgent work to be undertaken).
- To transfer water after treatment of sewerage water to outlying area of Nakuru basin by pumping, though this is a relatively costly attempt. The water so pumped may then be used for irrigation in outlying areas.
- To divert or retain the runoff during rainy season and transfer it to outside of Nakuru basin. For this purpose, it will be necessary to provide diversion drainage facilities and flood retention dams. The water will be used for irrigation in outlying areas.

To establish these programmes, a regional water use study should be carried out on an urgent basis. An important element in the proposed study is to formulate an integrated regional development plan aiming at diversification of development activities to outlying areas of Nakuru basin. The study area shall cover three lake basins; i.e. Nakuru, Elementaita and Naivasha.

Provision set forth in the Ramsar Rules (convention on wetlands of international importance especially as waterfowl habitats) is another aspect to be taken into account in the formulation of the Lake Nakuru conservation plan.

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TABLES

Table 2.2.1 Mean Annual Rainfall Depth for Successive 5-year Period

(Unit: mm)

Station	1911 - 1915	1916 - 1920	1921 - 1925	1926 - 1930	1931 - 1935	1936 - 1940	1941 - 1945	1946 - 1950	1951 - 1955	1956 - 1960	1961 - 1965	1966 - 1970	1971 - 1975	1976 - 1980	1981 - 1985
Kakamega	1,765	1,891	1,944	1,908	1,890	1,921	1,702	1,881	1,682	1,815	2,246	2,019	2,170	2,027	2,116
	(3)	(7)	(10)	(8)	(6)	(9)	(2)	(5)	(1)	(4)	(15)	(11)	(14)	(12)	(13)
Kapsabet	1,656	1,715	1,406	1,413	1,411	1,543	1,465	1,497	1,596	1,377	1,596	1,755	1,364	1,696	1,345
	(12)	(14)	(4)	(6)	(5)	(9)	(7)	(8)	(10)	(3)	(11)	(15)	(2)	(13)	(1)
Kisumu	1,125	1,135	1,148	1,059	1,111	1,184	1,076	1,021	1,130	908	1,267	1,102	1,151	1,274	1,058
	(8)	(10)	(11)	(4)	(7)	(13)	(5)	(2)	(9)	(1)	(14)	(6)	(12)	(15)	(3)
Londiani	999	962	1,055	1,114	1,069	1,187	1,162	1,130	1,167	1,187	1,323	1,197	1,209	1,074	1,054
	(2)	(1)	(4)	(7)	(5)	(12)	(9)	(8)	(10)	(11)	(15)	(13)	(14)	(6)	(3)
Kericho	1,811	1,803	1,778	1,838	1,744	1,875	1,751	1,940	1,864	1,820	2,129	2,006	1,773	1,827	1,995
	(6)	(5)	(4)	(9)	(2)	(11)	(1)	(12)	(10)	(7)	(15)	(14)	(3)	(8)	(13)
Naivasha	610	626	576	651	535	641	552	575	680	694	736	677	621	710	616
	(5)	(8)	(4)	(10)	(1)	(9)	(2)	(3)	(12)	(13)	(15)	(11)	(7)	(14)	(6)
Narok	733	801	683	707	550	723	651	639	646	893	953	803	744	824	641
	(9)	(11)	(6)	(7)	(1)	(8)	(5)	(2)	(4)	(14)	(15)	(12)	(10)	(13)	(3)
Kiambu	1,047	1,084	1,027	1,101	937	1,001	966	910	946	1,130	1,176	1,144	916	1,158	927
	(9)	(10)	(8)	(11)	(4)	(7)	(6)	(1)	(5)	(12)	(15)	(13)	(2)	(14)	(3)
Limuru	1,328	1,403	1,223	1,350	1,152	1,353	1,123	1,077	1,226	1,351	1,637	1,428	1,160	1,432	1,170
	(8)	(12)	(6)	(9)	(3)	(11)	(2)	(1)	(7)	(10)	(15)	(13)	(4)	(14)	(5)
Thika	834	887	807	902	784	956	897	704	805	738	977	877	776	920	683
	(8)	(10)	(7)	(12)	(5)	(14)	(11)	(2)	(6)	(3)	(15)	(9)	(4)	(13)	(1)
Machakos	1,074	1,002	862	960	924	871	775	827	999	815	1,044	994	815	1,011	977
	(15)	(12)	(5)	(8)	(7)	(6)	(1)	(4)	(11)	(2)	(14)	(10)	(3)	(13)	(9)
Makindu	535	914	1,034	588	397	540	507	522	521	498	734	700	433	640	611
	(7)	(14)	(15)	(9)	(1)	(8)	(4)	(6)	(5)	(3)	(13)	(12)	(2)	(11)	(10)
Voi	565	500	540	588	443	657	459	440	483	556	574	704	461	633	547
	(10)	(6)	(7)	(12)	(2)	(14)	(3)	(1)	(5)	(9)	(11)	(15)	(4)	(13)	(8)
Kwale	999	813	904	1,066	1,084	1,235	1,029	1,271	1,129	1,126	1,097	1,112	987	1,116	1,073
	(4)	(1)	(2)	(6)	(8)	(14)	(5)	(15)	(13)	(12)	(9)	(10)	(3)	(11)	(7)
Mombasa	1,087	1,083	1,201	1,105	1,311	1,403	1,168	1,201	1,096	1,142	1,032	1,376	1,060	1,138	1,316
	(4)	(3)	(11)	(6)	(12)	(15)	(9)	(10)	(5)	(8)	(1)	(14)	(2)	(7)	(13)
Total Point	110	124	104	124	69	160	72	80	113	112	193	178	86	177	98
Total Ranking	7	10	6	11	1	12	2	3	9	8	15	14	4	13	5

Note: Parenthesized figure indicates ranking in ascending order.

Table 2.3.1 Rating Equation of Suspended Load and Its Volume

No.	Code	River Name	Catchment Area (sq. km)	Annual Mean Discharge (cms)	Rating Equation		Suspended Load	
					a	b	Mean (ppm)	Annual (ton/year)
1	1DA02	Nzoia	8,417	56.6	18.531	0.446	112	212,298
2	1ED01	Lusumu	1,207	27.9	22.686	0.552	142	128,239
3	1GB05	Ainamotua	606	5.2	44.653	0.675	136	28,954
4	1GB07	Kapchure	129	1.1	68.831	0.328	71	2,555
5	1GD01	Nyando	2,598	17.6	136.508	0.623	815	566,362
6	1HA10	Luando	234	3.0	227.405	0.255	301	26,561
7	1JG01	Sondu	3,287	50.0	13.314	0.409	66	107,160
8	2ED02	Lelgel	108	0.5	79.223	1.115	37	799
9	2EE04	Perkerra	1,334	2.8	1197.201	1.010	3,387	390,033
10	2GB01	Malewa	1,430	3.3	19.302	0.736	46	5,637
11	3AA04	Mbagathi	272	1.6	139.713	0.685	193	4,456
12	3BA09	Karyra	44	0.8	368.177	0.737	312	9,124
13	3BA10	Ruaraka	65	1.1	31.142	0.225	32	989
14	3BA22	Nairobi	75	1.3	51.216	0.392	57	2,231
15	3BB10	Riara	41	0.4	144.554	0.219	118	1,474
16	3CB05	Ndarugu	312	4.4	95.369	0.505	202	29,356
17	3DA02	Athi	5,724	23.6	8.220	0.924	153	131,089
18	3F 02	Athi	10,272	33.6	39.338	0.750	549	753,627
19	3HA12	Athi (L. Falls)	25,203	33.2	48.079	0.823	859	2,057,487
20	3J 06	Lumi	451	1.2	210.044	1.663	284	9,020
21	4AA01	Sagana	96	1.1	40.572	0.739	44	1,659
22	4AA05	Sagana	505	5.6	31.183	0.676	100	18,845
23	4AC03	Sagana	282	4.1	21.177	0.763	62	8,405
24	4BC02	Tana-Sagana	2,365	21.0	2.084	1.924	729	999,721
25	4BD01	Mathioya	500	6.6	1.833	1.875	63	20,107
26	4BE01	Maragua	414	11.3	13.671	1.128	211	70,797
27	4CA02	Chania	518	8.2	8.591	0.967	66	22,132
28	4CB04	Thika	316	6.9	23.957	1.020	172	53,063
29	4DD01	Thiba	2,616	33.4	5.181	0.736	69	75,167
30	4F 01	Tana (G. Falls)	16,972	184.4	2.358	1.134	875	6,098,075
31	4F 19	Kazita	1,702	17.9	4.918	1.117	123	82,057
32	4G 01	Tana (Garissa)	32,892	166.0	134.316	0.447	1,320	6,907,451
33	5BC02	Naromoru	83	0.8	21.242	0.422	19	486
34	5BC06	Burgret	98	1.0	36.569	0.588	37	1,130
35	5BE20	Nanyuki	860	1.8	16.823	0.936	29	2,072
36	5E 03	Ewaso N'giro	15,300	21.6	230.284	0.618	1,538	1,045,035

Note: Annual suspended volume was calculated on daily basis by using dimensionless flow duration curve.

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (1/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C0955	11	Muthaiga	124	178.6	70.0	0.39
C1245	11	Karen	136	195.8	40.0	0.20
C2373	11	Dagoretti Corner	114	164.2	45.0	0.27
C2781	11	Dandora	227	326.9	70.0	0.21
C3001	11	Nairobi Natl. Park	181	260.6	50.0	0.19
C4190	11	Karen			20.0	
C4549	11	Kabete	100	144.0	115.0	0.80
C4663	11	Kitui Rd,Ind. Area	59.7	86.0	86.0	1.00
C4862	11	Embakasi				
C6228	11	Ruai	151	217.4	87.0	0.40
C6310	11	South C	100	144.0	13.0	0.09
C6689	11	Parliament Bldgs.				
C3710	21	Sigona	271	390.2	25.0	0.06
C4802	21	Kikuyu			192.0	
C5787	21	Limuru	122	175.7	264.0	1.50
C6259	21	Tigoni			120.0	
C6635	21	Ruiru	757	1090.1	21.0	0.02
C7295	21	Kiambaa	424	610.6	240.0	0.39
C9746	21	Kasarani			192.0	
C3584	22	Sagana				
C4318	22	Inoi	151	217.4	60.0	0.28
C4960	22	Kithage				
C5998	22	Murinduko				
C6900	22	Kagio				
C7458	22	Mutira			40.5	
C0724	23	Mitubiri	164	236.2	60.0	0.25
C3876	23	Murang'a T.				
C4571	23	Maragua Mrkt.				
C5326	23	Mitubiri-Makuyu			11.0	
C6264	23	Gaichanjiru	38	54.7	40.0	0.73
C9172	23	Makuyu School			21.0	
C1299	24	Ndaragwa	18	25.9	19.2	0.74
C1830	24	Kinangop				
C2264	24	Magumu	68	97.9	2.9	0.03
C3779	24	Ol Kalou	228	328.3	220.0	0.67
C6810	24	Gathimu				
C7842	24	Nyakambi Sec. Sch.				
C4629	25	kingongo				
C6800	25	Nanyuki			4.8	
C9170	25	Munyu				
Giat.	25	Giathogu				
Kabaru	25	Kabaru			12.0	
Karem	25	Karemeno			15.0	
Baric	31	Bungale			29.0	
C0575	31	Mazeras				
C0848	31	Ganda				
C0996	31	Mangea I				
C0997	31	Mangea II	9	13.0	12.0	0.93
C1010	31	Jila Ndigiria				
C1024	31	Gede	2	2.9	2.0	0.69
C1035	31	Kaloleni	178	256.3		
C1041	31	Marafa	45	64.8	82.0	1.27
C1047	31	Kaloleni				
C1048	31	Kaloleni				
C1866	31	Bararini				
C2501	31	Jariburi				
C3174	31	Vipingo				
C3186	31	Tezo				
C3264	31	Tezo				
C3303	31	Mnarani				
C3332	31	Tezo				
C4300	31	Vitengeni				
C4358	31	Mnarani				
C4422	31	Ganze				
C4596	31	Jilore			3.3	
C4813	31	Magarini				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (2/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C4908	31	Handu-(Magarini)				
C4937	31	Marikabuni-(Magarini)	200	288.0	80.0	0.28
C5231	31	Marafa-(Magarini)			96.0	
C6072	31	Kikambala				
C6315	31	Ganda				
C6337	31	Ganda				
C6646	31	Tezoroka				
C9400	31	Malindi Prison				
P0091	31	Bamba				
C4166	32	LungaLunga				
C4240	32	Diani	800	1152.0	310.0	0.27
C4570	32	Tiwi			744.0	
C4977	32	Milewa				
C5770	32	Kinondo			19.0	
C6042	32	kinondo	60	86.4	21.6	0.25
C6498	32	Mwereni				
C6505	32	Mwakijembe			18.0	
C6507	32	Kasagani			17.3	
C6530	32	Mwangoni Sch.			17.3	
C6597	32	Bomani			17.3	
C6604	32	Mwereni "B"			15.8	
C6671	32	Kikoneni			17.3	
C6716	32	Pongwe			15.8	
C6723	32	Urima Mrkt.			17.3	
C7264	32	Pongwe	96	138.2	29.0	0.21
C7354	32	Kikoneni			21.6	
C7356	32	Kikoneni			15.0	
C7362	32	Msambweni			17.3	
C7371	32	Kikoneni			14.4	
C7587	32	Lunga Lunga			17.3	
C7602	32	Msambweni			19.4	
C7615	32	Diani			9.6	
C8187	32	Diani	48	69.1	17.3	0.25
C8193	32	Lukore	57	82.1	17.3	0.21
C8206	32	Diani	30	43.2	19.4	0.45
C8646	32	Tiwi	38	54.7	17.3	0.32
C8669	32	Tiwi 3 No4			500.0	
C8670	32	Tiwi 3 No5	46	66.2	480.0	7.25
C8684	32	Lukore			17.3	
C9034	32	Ngombeni				
C9041	32	Manganani				
C3463A	33	Witu				
C3463B	33	Witu				
C3593	33	Munimbi				
C3594	33	Bargoni				
C7345	33	Mpeketoni	368	529.9	9.0	0.02
C7346	33	Mpeketoni				
Mombasa	34					
C0535	35	Taveta	315	453.6	150.0	0.33
C0561	35	Taveta	226	325.4	230.0	0.71
C0568	35	Taveta	315	453.6	150.0	0.33
C0936	35	Bura Maktao				
C0938	35	Ghazi				
C3146	35	Tsavo West P				
C3151	35	Tsavo North Park				
C3168	35	Tsavo West P	38	54.7	18.7	0.34
C3197	35	Taveta				
C3220	35	Voi Sisal				
C3357	35	Lualenyi Ranch				
C3360	35	Lualenyi Ranch	182	262.1	49.0	0.19
C3381	35	Tsavo Rhino	205	295.2	12.0	0.04
C3783	35	Bura-Maktau				
C4103	35	Lualenyi Ranch				
C4130	35	Taveta	397	571.7		
C4203	35	Mwatate	113	162.7	30.2	0.19
C4218	35	Mwatate	303	436.3		

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (3/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C4219	35	Mwatate	453	652.3		
C4602	35	Mwatate				
C4649	35	Salt Lick				
C4651	35	Mwatate				
C4654	35	Mbololo				
C6630	35	Chawia				
C6631	35	Chawia				
C6633	35	Chawia				
C7182B	35	Kasigau				
Aruba	35	Tsavo East P				
Eldoro	35	Eldoro			43.0	
Mkanj	35	Mkanjoni				
Ndara	35	Ndara				
P0032	35	Voi Roadway Station				
P0154	35	Taveta				
Riata	35	Taveta				
C6768	36	Madogo			96.0	
Gorfi	36	Gorfisa				
Sawal	36	Sawale				
Titila1	36	Titila 1			1.8	
Titila2	36	Titila 2				
Wema	36	Wema 2				
C4606	41	Kyeni				
C5336	41	Rianjeu				
C8079	41	Gwakariguo			4.5	
C9450	41	Siakago Catholic Miss				
Igum.	41	Igumory				
C2324	42	Kulamawe	91	131.0	48.0	0.37
C3665	42	Garba Tula	186	267.8	112.0	0.42
C4402	42	Merti	36	51.8	83.0	1.60
C4423	42	Garba Tula	118	169.9	15.0	0.09
C4543	42	Merti	43	61.9	10.0	0.16
C6656	42	Kinna	100	144.0	2.9	0.02
C6951	42	Bulessa				
C7329	42	Sericho			96.0	
C7631	42	Isiolo Township	136	195.8	250.0	1.28
C7712	42	Sericho			7.2	
C7734	42	Central				
C8976	42	Ngare Mara				
C9380	42	Merti				
Is.As	42	Isiolo				
C0135	43	Mutonguni				
C0538	43	Mutha				
C0696	43	Kanziku				
C0919	43	Ngomeni				
C1452	43	*Kangondi*				
C1452	43	Mui				
C1508	43	Yatta				
C1595	43	Yatta	182	262.1	8.0	0.03
C3198	43	Mutomo	98	141.1	162.0	1.15
C3712	43	Mwingi				
C3760	43	Yatta				
C3795	43	Ithokwe	76	109.4	616.0	5.63
C3883	43	Ikanga				
C4136	43	Changwithya	342	492.5	488.0	0.99
C4729	43	Ikanga	209	301.0	45.0	0.15
C4887	43	Migwani				
C4930	43	Migwani				
C4936	43	Migwani				
C5243	43	Mutomo				
C5527	43	Nguni	44	63.4	28.0	0.44
C5673	43	Mutuangombe				
C6628	43	Mutonguni Sec. Sch.	75	108.0	20.9	0.19
C7313	43	Mutha Mission	97	139.7	30.9	0.22
C7762	43	Matinyani			9.6	
C7764	43	Kalundu				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (4/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C7950	43	Changwithya				
C8027	43	Matinyani				
C8307	43	Nzambani			29.0	
C9375	43	Mathima				
C9470	43	Changwithya				
C9471	43	Mwingi				
Malik	43	Mulango			158.0	
Ngila	43	Changwithya				
C0078	44	Konza-Machakos				
C0224	44	Konza	61.0	87.8	70.0	0.80
C0461	44	Makueni	273	393.1	210.0	0.53
C0740	44	Athi River	110	158.4	60.0	0.38
C1693	44	Athi River	87	125.3	30.0	0.24
C1769	44	Kyanzavi	19	27.4	9.0	0.33
C2004	44	Kiu	75	108.0	40.0	0.37
C2232	44	Mbitine	121	174.2	58.0	0.33
C2976	44	Konza	36	51.8	13.0	0.25
C3121	44	Mtito Andei	19	27.4	27.0	0.99
C3977	44	Kathozweni				
C4742	44	Muthetheni	164	236.2	35.0	0.15
C4885	44	Masii	218	313.9	65.0	0.21
C4973	44	Kithimani	97	139.7	47.0	0.34
C5043	44	Katangi	23	33.1	30.0	0.91
C5054	44	Msongolani				
C5272	44	Madakos Township	38	54.7	15.0	0.27
C6328	44	Athi River				
C6349	44	Koma Rock				
C6536	44	Sengani				
C6588	44	Nzani				
C8028	44	Kithyoko				
Kambo	44	Mtito Andei				
C1758	45	Logologo	134	193.0	64.0	0.33
C3039	45	Jaldessa				
C3133	45	Gurgabo				
C3602	45	Laisamis				
C3681	45	Logologo				
C3723	45	Bubisa				
C3819	45	Gudas	135	194.4	64.0	0.33
C3890	45	Uran	76	109.4	68.0	0.62
C3896	45	Walda	455	655.2	273.0	0.42
C3966	45	Galole	167	240.5	70.0	0.29
C3983	45	Godoma				
C3984	45	Godoma				
C4084	45	Korr	240	345.6	24.0	0.07
C4181	45	Bori	75	108.0	22.0	0.20
C4825	45	Kalacha				
C5001	45	Sabarei				
C5047	45	Ileret				
C5901	45	Godoma			29.0	
C6063	45	Sololo				
C6357	45	Dukana				
C7201	45	Godoma			10.0	
C7202	45	Godoma			300.0	
C7207	45	Sololo			8.0	
C7618	45	Sololo			11.0	
C4233	46	Kariokomo			5.4	
C4272	46	Marima			21.8	
C4348	46	Kinyakine			3.6	
C5543	46	Mutunyi				
C6967	46	Maua			5.0	
C7136	46	Marimanti			10.8	
C7142	46	Nkondi Pr. School			160.0	
C7750	46	Ndoleni				
C9085	46	Meru Show Ground				
C9436	46	Marimanti			4.5	
C9512	46	Chiakariga				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (5/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C2485	51	Daadab	76	109.4	76.5	0.70
C3085	51	Welmarer				
C3240	51	Danken				
C3635	51	Madogashi				
C3667	51	Liboi	169	243.4	38.0	0.16
C3684	51	Kulan	159	229.0	229.0	1.00
C3695	51	Ifo	150	216.0	25.5	0.12
C3697	51	Goriale				
C3751	51	Shaniabak				
C3753	51	Bila				
C3781	51	Gurufa				
C3831	51	Alinjugul	72	103.7	72.0	0.69
C3852	51	Hagadera				
C3877	51	Kumahumato			200.0	
C3902	51	Liboi				
C4313	51	Yumbis				
C4341	51	Rhowa				
C4342	51	Sedefi Goshe				
C4447	51	Mbanani				
C4453	51	Damajale			270.0	
C6330	51	Garissa				
C6763	51	Garissa				
C2570	52	Mandera Town				
C3297	52	Mandera Town				
C3567	52	Babasiti				
C3568	52	BH 11				
C3696	52	Asahaba				
C3861	52	Wargadud				
C3865	52	Golobia				
C4388	52	Wargadud	83	119.5	54.0	0.45
C4389	52	Danissa				
C4394	52	Walderi				
C4730B	52	El Kotulo				
C6084	52	Elwak				
C7184	52	Shimbir Fatuma				
C8094	52	Fincharo				
C8769	52	Kotulo				
C3218	53	Adamasajida				
C3515	53	Gurar				
C3539	53	Tarbaj				
C3541	53	Eldas	49	70.6	23.0	0.33
C3658	53	Bute	21	30.2		
C3685	53	Dilmanyale			68.0	
C3715	53	Meri				
C3726	53	Khot Khot				
C3727	53	Abakorey			22.0	
C3736	53	Giriftu				
C3769	53	Hara Khot Khot				
C3788	53	Meri				
C3792	53	Kalalut				
C3820A	53	Sebule	135	194.4	38.0	0.20
C3891	53	Bute				
C3899	53	Dambas	152	218.9	180.0	0.82
C4124	53	Wajir Township				
C4176	53	Arbajahan			50.0	
C4234	53	Daryole				
C4257	53	Shimbirbul				
C4261	53	Selif	120	172.8	21.0	0.12
C4524	53	Biyamadhow	20	28.8	14.0	0.49
C4730	53	Kotulo	70	100.8	84.0	0.83
C4872	53	Huthiwal	128	184.3	23.0	0.12
C5267	53	Wajir Bor	21	30.2	25.0	0.83
C5795	53	Habaswein	140	201.6	50.0	0.25
C5796	53	Khorof Harar	100	144.0	120.0	0.83
C6712	53	Wajir Town				
C6902	53	Lefale				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (6/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C6903	53	Sabunley				
C8692	53	Adams Hadija				
C8693	53	Adams Hadija				
No 1	53	Wajir Town				
C4490	61	Nyaribari				
C5011	61	Ogembo				
C7845	61	Gesima				
C8038	61	Kitutu Chach	8	11.5	9.6	0.83
C8091	61	Nyamira	8	11.5	5.3	
C8123	61	Nyaribari				
C8049	62	N. Nyakach	24	34.6	7.2	0.21
C8055	62	Muhoroni	200	288.0		
C8057	62	W. Kabotto	12	17.3	26.4	1.53
C8117B	62	Awasi	200	288.0	3.6	0.01
C8118	62	East Kolwa	240	345.6	10.8	0.03
C8121	62	N. Kano	300	432.0	5.4	0.01
C3379	63	W. Alego				
C5456	63	N. Ugenya			5.8	
C5708	63	E. Ugenya			10.9	
C5741	63	Sigomore			13.0	
Masa.	63	Centra Uyoma			7.2	
C3395	64	W.Karachwony				
C5215	64	Angenga			11.3	
C6008	64	South Sakwa	50	72.0	10.8	0.15
C6029	64	S. Kabwoch			13.2	
C6263	64	Kanyamwa			12.2	
C6876	64	Magunga	300	432.0	3.6	0.01
C6942	64	Rusinga Isl.			11.0	
C6943	64	Rusinga				
C6950	64	Gem East			9.6	
C7152	64	Kanyanda			14.4	
C7778	64	N.Karachwony	80	115.2	8.6	
C8970	64	C. Suna				
Rakw.	64	W.Kamagambo			12.0	
C3437	71	Tangulbei	151	217.4	36.3	0.17
C3868	71	Nginyang	164	236.2	40.5	0.17
C4722	71	Kabarnet	286	411.8	370.0	0.90
C4777	71	Kisanana	197	283.7	42.0	0.15
C5072	71	Chemeron			21.0	
C5170	71	Kiboino				
C5883	71	Mogotio				
C6362	71	Salabani				
C6363	71	kositei				
C6364	71	Cheserimion	42	60.5	30.0	0.50
C6365	71	Ngambo				
C6652	71	Loboi			24.0	
C6970	71	Kabarnet				
C722B	71	Eldama Ravin				
C7456	71	Kabluk			50.4	
P0094	71	Olkokwe				
C1074	72	Bukar			72.0	
C1127	72	Kibtoro			3.6	
C5112	72	Chebloch				
C5159	72	Chepsirei				
C5346	72	Tot				
C6323	72	Iten town			100.0	
C0607	73	Konza			2.4	
C1183	73	Kinyewa	60	86.4	9.9	0.11
C1231	73	Endonet				
C1391	73	Elangataus				
C1534	73	Matapato				
C1539	73	Dalalakotok				
C2500	73	Ngong				
C2647	73	Matapato				
C2975	73	Sultan Hamud	152	218.9	10.0	0.05
C3392	73	Bissel				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (7/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C3436	73	Lodokilani				
C3481	73	Kaputei	227	326.9	14.0	0.04
C3519	73	Imaroro				
C3649	73	Odomogi				
C3746	73	Engorika				
C3836	73	Loitokitok				
C4182	73	Elangataus				
C4199	73	Kiserian	545	784.8	198.0	0.25
C4258	73	Emarti	155	223.2	24.0	0.11
C4498	73	Oloyiangalani				
C4532	73	Tursei				
C4612	73	Mashuru				
C4641	73	Olkiloriti				
C4934	73	Lorngoswa				
C6269	73	Ongatarongai	215	309.6	20.0	0.06
C6739	73	Isenya	150	216.0	72.0	0.33
C7447	73	Namanga				
Doiny	73	Matapato				
Iltil	73	Odomogi			19.8	
P0016	73	Kekonyoke			9.0	
P0059	73	Kinyewa			36.0	
C1134	74	Chepsir				
C3341	74	Sotik				
C4655	74	Kimulot				
C4868	74	Soin				
C0037	75	Aiyam				
C0150	75	Oldonyo Farm				
C0372	75	Twala			4.0	
C0523	75	Nturkana				
C0884	75	Muhonia				
C1646	75	Tinga Mara	288	414.7	96.0	0.23
C1767	75	Mutara	167	240.5	42.0	0.17
C1785	75	Luoniek				
C1813	75	Dol Dol	55	79.2	24.0	0.30
C1977	75	Tandare				
C2349	75	Ngobit				
C2561	75	Ol Pajeja	151	217.4	19.2	0.09
C3420	75	Mukogodo	72	103.7	28.8	0.28
C3670	75	Narumoru	11	15.8	2.4	0.15
C4180	75	Ngumo				
C5019	75	Nanyuki				
C5069	75	Kinamba			12.3	
C5139	75	Anandaguru				
C5140	75	Aljijo				
C5197	75	Ol Kinyei				
C6366	75	Sweet Waters				
Oldon	75	Oldonyo Farm				
BHNo1	76	Naivasha			700.0	
C0422	76	molo Town				
C0736	76	Kabazi				
C2704	76	Elmenteita	155	223.2	14.4	0.06
C5819	76	Mbaruk				
C6056	76	mau Narok				
C7381	76	Lomolo				
C7729	76	Nakuru town			2.0	
C8297	76	Njoro			249.0	
NdibF	76	Dabibi				
Barat	77	Chemundu				
C6306	77	Mosoroit	158	227.5	24.0	0.11
C6331	77	Chemundu	45	64.8	59.0	0.91
C3525	78	Masiro				
C4695	78	Talex				
C4831	78	Mulot				
C6017	78	Olololunga				
C6082	78	Kilgoris			3.6	
C6806	78	Naikara			1.02	

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (8/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C8315	78	Siria North				
C1639	79	Marti				
C1776	79	Barsalinga				
C2750	79	Kirimun				
C3505	79	Lerata				
C3566	79	Lerata				
C3599	79	Sorolepi	364	524.2	10.1	0.02
C3651	79	Lesirkan				
C3808	79	Wamba Hosp.			0.6	
C3832	79	Londungokwe	68	97.9	30.0	0.31
C3833	79	Sirata Oirobi	44	63.4	9.6	0.15
C3855	79	Baragoi				
C3869	79	Baragoi				
C4315	79	Wamba	80	115.2	37.0	0.32
C4316	79	Bawa				
C4417	79	Baragoi				
C4513	79	Wamba Town				
C7190	79	Sorelepi				
C7191	79	Lodo Kejek			6.0	
C7908	79	Lodero			9.0	
C7911	79	Wamba				
C7914	79	Lengusaka				
C7915	79	Lengei				
C7917	79	Kawop			29.0	
C7918	79	Basarloi				
C7919	79	Masekita				
C7921	79	Losuk				
C7922	79	Maralal				
C8989	79	Kirimunu	33	47.5	15.0	0.32
C9068	79	Maralal				
C9119	79	Opiroi				
Lorok	79	Naibo Keju			16.2	
Wamba	79	Wamba			0.9	
C7312	81	Kiminini			2.0	
C7827	81	Kiminini				
C8140	81	Chepsiro				
C8509	81	Gidea				
C8826	81	Chepchoina				
C9299	81	Sitatunga				
C3789	82	Lokichar	76	109.4	68.0	0.62
C5076	82	Kalobeyei				
C5079	82	Naweton				
C5080	82	Natira				
C5082	82	Kangakiporo				
C5088	82	Ngisiger				
C5100	82	Lokichogio				
C5621	82	Nakwzuro				
C5625	82	Yapakuno				
C5636	82	Kwatela				
C5644	82	Kaikor				
C5653	82	Ngisiger				
C5773	82	Kawalathe				
C5840	82	Kanamkemer				
C5843	82	Loperot				
C5859	82	Lotongot				
C5861	82	Kalemonyorok				
C5867	82	Lorengipi				
C5872	82	Lokori	200	288.0	36.0	0.13
C6087	82	Kalokol				
C6521	82	Lopur				
C6538	82	Lorgum				
C6540	82	Lorgum				
C6541	82	Lorgum				
C6548	82	Lomelo				
C6553	82	Napeitom				
C6554	82	Lokwamosing				

Table 2.4.1 Present Abstraction Rate and Utilization Ratio (9/9)

B/H no.	District	Location	Initial yield (l/min)	(m3/day)	Observed (m3/day)	Utilization ratio
C6563	82	Kerio				
C6564	82	Kerio				
C6568	82	Lorengipi				
C6568	82	Kinabur				
C6569	82	Lorengipi				
C6570	82	Lokore				
C6583	82	Kibish				
C6585	82	Kwatela				
C7634	82	Ngisiger				
C7637	82	Kwatela				
C7654	82	Lokitaung				
C7659	82	Aterika				
C7663	82	Nariokotome				
C7668	82	Montl				
C7674	82	Lopur				
C7678	82	Kakuma				
C7810	82	Lokichogio				
C8443	82	Lodwar				
TW274	82	Yapakuno				
C0617	83	Sergoit Ranch Farm				
C2689	83	Kabitm	27	38.88	6.0	0.15
C2762	83	Matunda	121	174.2	27.5	0.16
C3153	83	Laiguse				
C3712	83	Sergoit Ranch Farm				
C4333	83	Soy				
C6098	83	Lessos	67	96.48	59.0	0.61
C7763	83	Sergoit			12.0	
C9415	83	E Anabkoi				
Ngeri	83	Ngeria				
C4557	84	Marich Pass			54.0	
C5414	84	Morobus			5.8	
C5430	84	Chesera			3.6	
C5431	84	Serewa				
D0914	84	Nakitimer				
D1503	84	Kunyao			6.0	
C5284	91	S. Namwera			10.2	
C5288	91	Cheptais				
C7506	91	E. Bukusu			8.0	
C7999	91	Naitiri				
C8389	91	Bokoli				
C8771	91	Bumula				
C5123	92	S. Teso				
C5189	92	W.Bukhaya			17.8	
C5944	92	East Bukhayo			12.6	
C5975	92	Samia South				
C6129	92	N. Teso			7.2	
C7891	92	Samia North			12.6	
C5246	93	Municipality				
C7024	93	E. Wanga				
C7068	93	C. Kabras				
C7559	93	N. Wanga			13.0	
C8534	93	C. Marama				
C8556	93	Lumakanda	67	96.5	16.0	0.17
Count			139	139	174	131
Ave			144.6	208.2	77.0	0.48
Min			2.0	2.9	0.9	0.01
Max			800.0	1152.0	744.0	7.25
St. dev.			129.93	187.10	122.29	0.826

Table 2.4.2 Estimated Groundwater Abstraction Rates (1/5)

Basin code	Agricultural (m3/day)	Domestic (m3/day)	Exploratory (m3/day)	Irrigation (m3/day)	Livestock (m3/day)	Observation (m3/day)	Other (m3/day)	Public w/s (m3/day)	Unknown (m3/day)	Total (m3/day)
1AA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	107.9	27.0	134.9
1AB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.8	77.8
1AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	816.1	136.0	952.1
1AD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.0	41.0	82.0
1AE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	269.2	38.5	307.7
1AF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1AG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1AH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	882.0	348.7	1230.7
1BA	25.8	0.0	0.0	51.6	0.0	0.0	0.0	51.6	206.3	335.2
1BB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	264.0	264.0
1BC	38.1	38.1	0.0	0.0	0.0	0.0	0.0	0.0	152.3	228.4
1BD	24.2	0.0	0.0	24.2	0.0	0.0	48.4	24.2	96.9	218.0
1BE	29.5	44.3	0.0	29.5	0.0	0.0	14.8	0.0	59.1	177.2
1BG	42.4	0.0	0.0	0.0	0.0	0.0	21.2	0.0	63.6	127.3
1BH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1CA	45.0	0.0	0.0	22.5	0.0	0.0	45.0	22.5	404.9	539.9
1CB	138.7	0.0	0.0	0.0	27.7	0.0	27.7	27.7	277.4	499.4
1CC	35.7	0.0	0.0	0.0	0.0	0.0	0.0	17.9	142.9	196.5
1CD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	226.3	226.3
1CE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.4	92.4
1DA	0.0	0.0	0.0	19.1	0.0	0.0	19.1	325.5	153.2	517.0
1DB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	244.3	244.3
1DC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.9	44.7	72.6
1DD	49.4	0.0	0.0	0.0	0.0	0.0	0.0	716.1	148.1	913.6
1EA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	224.2	124.6	348.8
1EB	0.0	35.3	0.0	0.0	0.0	0.0	0.0	424.1	565.5	1025.0
1EC	0.0	0.0	0.0	0.0	0.0	0.0	21.1	400.1	252.7	673.9
1ED	20.6	0.0	0.0	0.0	0.0	0.0	0.0	205.6	370.0	596.2
1EE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	276.1	717.9	994.0
1EF	0.0	0.0	0.0	0.0	0.0	0.0	76.4	687.7	38.2	802.3
1EG	0.0	0.0	0.0	0.0	0.0	0.0	56.3	562.8	112.6	731.6
1FA	0.0	0.0	0.0	0.0	0.0	0.0	74.6	74.6	0.0	149.3
1FB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1FC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.6	106.6
1FD	84.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.9
1FE	0.0	0.0	0.0	0.0	0.0	0.0	67.6	67.6	67.6	202.8
1FF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1FG	0.0	0.0	0.0	0.0	0.0	0.0	42.6	42.6	0.0	85.2
1GA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1GB	230.1	0.0	0.0	76.7	0.0	0.0	230.1	0.0	76.7	613.7

Table 2.4.2 Estimated Groundwater Abstraction Rates (2/5)

Basin code	Agricultural (m3/day)	Domestic (m3/day)	Exploratory (m3/day)	Irrigation (m3/day)	Livestock (m3/day)	Observation (m3/day)	Other (m3/day)	Public w/s (m3/day)	Unknown (m3/day)	Total (m3/day)
1GC	207.4	0.0	0.0	0.0	0.0	0.0	207.4	0.0	345.6	760.4
1GD	324.4	108.1	0.0	0.0	0.0	0.0	540.7	162.2	162.2	1297.7
1GE	0.0	91.6	0.0	0.0	0.0	0.0	274.7	122.1	122.1	610.5
1GF	0.0	0.0	0.0	0.0	0.0	0.0	162.7	20.3	0.0	183.0
1GG	54.0	54.0	0.0	0.0	0.0	0.0	0.0	0.0	54.0	162.0
1HA	1253.1	0.0	0.0	167.1	0.0	0.0	1169.5	0.0	417.7	3007.4
1HB	0.0	0.0	0.0	0.0	0.0	0.0	39.4	0.0	39.4	78.8
1HC	0.0	135.5	0.0	0.0	0.0	0.0	45.2	45.2	0.0	225.8
1HD	0.0	280.7	0.0	0.0	0.0	0.0	28.1	84.2	0.0	393.0
1HE	0.0	214.0	0.0	0.0	0.0	0.0	53.5	0.0	0.0	267.5
1HF	0.0	730.8	0.0	0.0	0.0	0.0	203.0	162.4	0.0	1096.2
1HG	0.0	81.6	0.0	0.0	0.0	0.0	81.6	0.0	0.0	163.3
1JA	208.9	208.9	0.0	0.0	0.0	0.0	0.0	0.0	278.5	696.3
1JB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1JC	124.4	0.0	0.0	0.0	0.0	0.0	62.2	0.0	62.2	248.8
1JD	0.0	0.0	0.0	0.0	0.0	0.0	101.7	0.0	0.0	101.7
1JE	0.0	131.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.2
1JF	32.9	0.0	0.0	32.9	0.0	0.0	0.0	98.6	65.7	230.1
1JG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	89.8	89.8
1KA	57.9	57.9	0.0	0.0	0.0	0.0	57.9	115.7	57.9	347.2
1KB	0.0	0.0	0.0	0.0	0.0	0.0	151.6	50.5	50.5	252.6
1KC	0.0	25.5	0.0	0.0	0.0	0.0	50.9	127.4	0.0	203.8
1LA	126.2	0.0	0.0	42.1	0.0	0.0	84.1	84.1	0.0	336.5
1LB	202.1	161.7	0.0	0.0	40.4	0.0	80.8	40.4	323.3	848.8
2AA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2AB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	402.0	0.0	402.0
2BA	0.0	0.0	0.0	0.0	40.9	0.0	0.0	122.7	163.6	327.1
2BB	0.0	0.0	0.0	0.0	191.6	0.0	0.0	82.1	0.0	273.7
2BC	0.0	116.6	0.0	0.0	116.6	0.0	16.7	816.5	100.0	1166.4
2BD	0.0	480.0	0.0	0.0	36.9	0.0	0.0	886.2	73.8	1476.9
2CA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	201.6	201.6
2CB	0.0	0.0	0.0	78.4	0.0	0.0	78.4	78.4	78.4	313.6
2CC	0.0	0.0	0.0	0.0	0.0	0.0	30.8	276.9	61.5	369.2
2D	0.0	0.0	0.0	0.0	0.0	0.0	0.0	572.6	0.0	572.6
2EA	599.2	59.9	0.0	0.0	0.0	0.0	119.8	299.6	659.1	1737.6
2EB	371.6	0.0	0.0	0.0	0.0	0.0	92.9	0.0	0.0	464.4
2EC	680.2	0.0	0.0	42.5	0.0	0.0	127.5	170.0	850.2	1870.5
2ED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180.8	180.8
2EE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2EF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	117.1	117.1	234.2

Table 2.4.2 Estimated Groundwater Abstraction Rates (3/5)

Basin code	Agricultural (m3/day)	Domestic (m3/day)	Exploratory (m3/day)	Irrigation (m3/day)	Livestock (m3/day)	Observation (m3/day)	Other (m3/day)	Public w/s (m3/day)	Unknown (m3/day)	Total (m3/day)
2EG	499.0	0.0	41.6	83.2	0.0	0.0	457.4	124.8	1081.2	2287.2
2EH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2EJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.3	112.3	224.5
2EK	58.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	234.6	293.2
2FA	506.1	56.2	0.0	0.0	56.2	0.0	168.7	56.2	224.9	1068.3
2FB	73.6	0.0	0.0	73.6	0.0	0.0	220.9	0.0	368.2	736.4
2FC	1413.0	97.4	0.0	292.3	146.2	0.0	730.8	438.5	1754.0	4872.2
2GA	0.0	0.0	0.0	0.0	110.8	0.0	166.1	0.0	498.4	775.3
2GB	459.1	57.4	57.4	114.8	0.0	0.0	172.2	229.5	1090.3	2180.6
2GC	124.6	62.3	0.0	0.0	0.0	0.0	0.0	0.0	124.6	311.4
2GD	1899.0	263.7	0.0	105.5	52.7	52.7	527.5	105.5	2743.0	5749.7
2H	341.2	255.9	42.7	85.3	128.0	0.0	170.6	298.6	810.4	2132.6
2J	0.0	26.7	0.0	0.0	0.0	0.0	0.0	935.1	26.7	988.5
2K	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2KA	147.5	0.0	0.0	0.0	0.0	0.0	49.2	0.0	196.7	393.3
2KB	128.6	0.0	0.0	0.0	0.0	0.0	0.0	64.3	192.9	385.8
2KC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3AA	1672.8	897.6	0.0	489.6	122.4	0.0	1387.2	693.6	4691.9	9954.9
3AB	382.5	0.0	0.0	31.9	63.7	0.0	63.7	127.5	924.4	1593.7
3AC	344.5	98.4	0.0	49.2	0.0	0.0	492.2	147.7	885.9	2017.9
3BA	4435.4	0.0	82.1	1067.8	82.1	0.0	3244.4	1314.2	9404.7	19630.7
3BB	2184.7	115.0	0.0	345.0	57.5	0.0	747.4	977.4	3679.6	8106.5
3BC	1087.1	483.2	0.0	181.2	0.0	0.0	483.2	60.4	422.8	2717.7
3BD	572.2	0.0	0.0	286.1	0.0	57.2	114.4	171.7	743.8	1945.4
3CA	1061.0	1185.8	0.0	748.9	62.4	0.0	374.5	624.1	436.9	4493.4
3CB	776.6	0.0	0.0	0.0	59.7	0.0	477.9	59.7	597.4	1971.4
3DA	173.5	0.0	0.0	0.0	0.0	0.0	86.7	86.7	303.6	650.5
3DB	97.2	0.0	0.0	0.0	0.0	0.0	97.2	0.0	97.2	291.7
3EA	419.3	125.8	0.0	41.9	0.0	0.0	209.6	377.4	838.6	2012.5
3EB	0.0	0.0	0.0	0.0	0.0	0.0	88.0	132.0	220.1	440.1
3EC	116.3	0.0	0.0	0.0	0.0	0.0	58.2	290.8	116.3	581.6
3ED	0.0	0.0	0.0	0.0	0.0	0.0	62.1	186.4	124.2	372.7
3FA	333.3	999.8	0.0	0.0	333.3	0.0	999.8	333.3	0.0	2999.3
3FB	2734.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2734.7
3G	0.0	0.0	0.0	0.0	0.0	0.0	410.1	58.6	0.0	468.6
3HA	0.0	0.0	0.0	0.0	107.9	0.0	0.0	107.9	107.9	323.6
3HB	0.0	0.0	0.0	0.0	107.9	0.0	0.0	107.9	107.9	323.6
3HC	86.2	86.2	0.0	0.0	86.2	0.0	86.2	86.2	0.0	431.1
3HD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	323.6	0.0	323.6

Table 2.4.2 Estimated Groundwater Abstraction Rates (4/5)

Basin code	Agricultural (m3/day)	Domestic (m3/day)	Exploratory (m3/day)	Irrigation (m3/day)	Livestock (m3/day)	Observation (m3/day)	Other (m3/day)	Public w/s (m3/day)	Unknown (m3/day)	Total (m3/day)
3J	0.0	0.0	0.0	0.0	0.0	0.0	0.0	140.0	559.9	699.8
3K	76.3	0.0	0.0	25.4	0.0	0.0	0.0	1678.4	152.6	1932.7
3L	99.1	49.6	0.0	0.0	24.8	0.0	223.0	1412.3	396.4	2205.2
3M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3MA	175.0	0.0	0.0	58.3	58.3	58.3	175.0	408.3	408.3	1341.4
3MB	191.4	0.0	0.0	63.8	0.0	63.8	191.4	382.8	446.6	1339.8
3MC	191.4	0.0	0.0	63.8	0.0	0.0	191.4	382.8	510.4	1339.8
3MD	128.8	322.0	0.0	64.4	64.4	0.0	193.2	386.4	515.2	1674.4
3N	197.9	0.0	0.0	0.0	0.0	0.0	346.3	346.3	247.4	1137.9
4AA	127.8	127.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	255.6
4AB	234.9	0.0	0.0	93.9	0.0	0.0	93.9	0.0	140.9	563.6
4AC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4AD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.7	201.4	302.0
4BA	159.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.7	239.1
4BB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4BC	0.0	162.9	0.0	0.0	0.0	0.0	0.0	0.0	81.4	244.3
4BD	127.3	169.8	0.0	0.0	0.0	0.0	0.0	0.0	42.4	339.5
4BE	0.0	0.0	0.0	0.0	0.0	0.0	81.0	162.0	162.0	404.9
4BF	69.7	0.0	0.0	0.0	0.0	0.0	104.5	104.5	348.4	627.1
4BG	0.0	0.0	45.1	45.1	45.1	0.0	135.2	45.1	225.4	540.8
4CA	314.7	0.0	0.0	0.0	0.0	0.0	157.4	0.0	681.9	1154.0
4CB	284.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.1	426.2
4CC	684.3	45.6	0.0	136.9	0.0	0.0	547.5	136.9	547.5	2098.6
4DA	153.9	153.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	307.8
4DB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4DC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4DD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4DE	64.6	129.2	0.0	0.0	0.0	0.0	64.6	0.0	64.6	323.0
4EA	0.0	0.0	0.0	0.0	0.0	0.0	173.7	0.0	0.0	173.7
4EB	0.0	0.0	0.0	0.0	0.0	0.0	221.6	55.4	0.0	277.0
4EC	82.8	0.0	0.0	82.8	0.0	0.0	82.8	0.0	82.8	331.1
4ED	0.0	0.0	0.0	0.0	0.0	0.0	119.8	0.0	179.7	299.4
4FA	0.0	0.0	0.0	0.0	0.0	0.0	175.7	0.0	0.0	175.7
4FB	38.3	0.0	0.0	0.0	38.3	0.0	0.0	574.4	38.3	689.2
4GA	0.0	0.0	0.0	0.0	29.5	0.0	29.5	206.5	59.0	324.5
4GB	0.0	0.0	0.0	0.0	38.1	0.0	38.1	76.2	38.1	190.4
4GC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	190.4	0.0	190.4
4GD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4GE	0.0	229.0	0.0	0.0	0.0	0.0	0.0	343.5	0.0	572.5
4GF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 2.4.2 Estimated Groundwater Abstraction Rates (5/5)

Basin code	Agricultural (m3/day)	Domestic (m3/day)	Exploratory (m3/day)	Irrigation (m3/day)	Livestock (m3/day)	Observation (m3/day)	Other (m3/day)	Public w/s (m3/day)	Unknown (m3/day)	Total (m3/day)
4GG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4HA	0.0	0.0	0.0	0.0	45.4	0.0	45.4	227.1	90.9	408.8
4HB	0.0	0.0	0.0	0.0	40.9	0.0	81.8	204.4	81.8	408.8
4JA	0.0	0.0	0.0	105.3	0.0	0.0	0.0	52.6	105.3	263.2
4JB	0.0	0.0	0.0	105.3	0.0	0.0	0.0	52.6	105.3	263.2
4KA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4KB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	485.4	242.7	728.1
5AA	167.3	0.0	0.0	0.0	0.0	0.0	55.8	27.9	529.8	780.7
5AB	68.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	238.3	306.3
5AC	259.9	0.0	0.0	0.0	37.1	0.0	148.5	0.0	222.8	668.3
5AD	111.5	0.0	0.0	0.0	55.8	0.0	55.8	0.0	0.0	223.0
5BA	114.2	0.0	0.0	0.0	0.0	0.0	57.1	0.0	171.3	342.5
5BB	47.1	0.0	0.0	0.0	0.0	0.0	47.1	0.0	188.2	282.3
5BC	158.3	0.0	0.0	22.6	0.0	0.0	45.2	22.6	384.5	633.3
5BD	246.0	0.0	0.0	0.0	0.0	0.0	82.0	0.0	287.0	614.9
5BE	46.8	0.0	0.0	0.0	0.0	0.0	46.8	0.0	327.9	421.5
5CA	86.5	0.0	0.0	28.8	57.7	0.0	28.8	115.3	115.3	432.4
5CB	35.7	0.0	0.0	0.0	0.0	0.0	35.7	142.8	142.8	356.9
5CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5DA	181.5	18.2	0.0	0.0	18.2	0.0	54.5	127.1	308.6	707.9
5DB	134.0	0.0	0.0	0.0	26.8	0.0	53.6	107.2	267.9	589.4
5DC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5DD	0.0	213.4	0.0	213.4	0.0	0.0	213.4	0.0	0.0	640.3
5EA	0.0	0.0	0.0	0.0	41.6	0.0	41.6	145.6	83.2	312.0
5EB	0.0	0.0	0.0	0.0	30.2	0.0	150.9	271.6	120.7	573.4
5EC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	125.2	0.0	125.2
5FA	0.0	0.0	0.0	0.0	130.7	0.0	32.7	555.3	32.7	751.3
5FB	0.0	0.0	0.0	0.0	128.0	0.0	42.7	469.3	42.7	682.6
5G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5J	0.0	0.0	0.0	0.0	0.0	0.0	202.5	354.3	0.0	556.7
(m3/day)	32192.9	9488.5	268.8	5692.8	2942.0	232.1	21619.9	30483.7	53836.1	156756.9
(m3/year)	11750415	3463319	98123.5	2077863	1073829	84714	7891275	11126550	19650189	57216279

Table 2.4.3 Availability of Safe-yielding Boreholes by Distrit

Code	Distrit	Boreholes Analysed (no.)	Safe-yielding Boreholes (no.)
110	Nairobi	-	-
210	Kiambu	61	3
220	Kirinyaga	3	
230	Murang'a	11	2
240	Nyandarua	6	
250	Nyeri	13	1
310	Kilifi	1	
320	Kwale	11	2
330	Lamu	3	1
340	Mombasa		
350	Taita Taveta	2	
360	Tana River	17	2
410	Embu	9	1
420	Isiolo	5	1
430	Kitui	16	
440	Machakos/Makueni	31	1
450	Marsabit	8	1
460	Meru	7	
510	Garissa	17	
520	Mandera	2	1
530	Wajir	11	1
610	Kisii/Nyamira	7	2
620	Kisumu	5	
630	Siaya	13	3
640	South Nyanza	28	6
710	Kajiado	9	
720	Kericho	21	1
730	Laikipia	12	
740	Nakuru	18	
750	Narok	9	
760	Trans Nzoia	8	2
770	Uasin Gishu	2	1
810	Baringo	14	2
820	Elgeyo Marakwet	8	2
830	Nandi	5	1
840	Samburu	3	
850	Turkana	79	6
860	West Pokot	14	2
910	Bungoma	10	
920	Busia	17	2
930	Kakamega/Vihiga	40	2
	Unknown	371	22
Total		927	71

Note : Boreholes Analyzed : Boreholes for which the aquifer test data are avilable and the drawdown analysis was made.

Safe-yielding Boreholes : Boreholes which were assumed by drawdown analysis to provid the water at the rate of their initial yields for 20 years with drawdown depth of less than 10 m.

Ratio of availability of safe-yielding boreholes : 0.076 (71/927)

Table 2.4.4 Potential and Safe Groundwater Abstraction by District

(Unit:MCM/year)

Code	Distrit	Boreholes Potential Yield (1)	Borehole Safe Abstraction (2)	Shallow Well Safe Abstraction (3)	Total (4)
110	Nairobi	-	-	0.02	0.02
210	Kiambu	12.10	0.91	0.04	0.95
220	Kirinyaga	6.90	0.53	0.03	0.56
230	Murang'a	8.04	1.03	0.34	1.37
240	Nyandarua	12.04	0.92	0.09	1.01
250	Nyeri	11.82	1.09	0.07	1.16
310	Kilifi	69.88	5.35	11.79	17.14
320	Kwale	42.10	5.36	7.48	12.84
330	Lamu	62.85	3.61	5.72	9.33
340	Mombasa	1.84	0.14	0.06	0.20
350	Taita Taveta	105.65	8.09	15.23	23.32
360	Tana River	258.03	19.82	40.29	60.11
410	Embu	10.61	0.83	1.74	2.57
420	Isiolo	114.36	11.50	23.59	35.09
430	Kitui	126.09	9.66	27.89	37.55
440	Machakos/Makueni	71.96	5.51	10.78	16.29
450	Marsabit	263.98	20.22	27.05	47.27
460	Meru	44.23	3.39	2.24	5.63
510	Garissa	185.28	14.19	42.80	56.99
520	Mandera	60.07	5.26	23.30	28.56
530	Wajir	163.85	13.62	56.76	70.38
610	Kisii/Nyamira	9.32	0.77	1.99	2.76
620	Kisumu	11.06	0.85	2.63	3.48
630	Siaya	8.10	0.64	2.23	2.87
640	South Nyanza	21.36	2.10	4.43	6.53
710	Kajiado	86.78	6.65	12.27	18.92
720	Kericho	17.54	1.46	1.01	2.47
730	Laikipia	44.56	3.41	2.76	6.17
740	Nakuru	26.01	1.99	1.35	3.34
750	Narok	23.89	4.13	8.55	12.68
760	Trans Nzoia	4.83	0.60	1.72	2.32
770	Uasin Gishu	13.65	1.10	0.54	1.64
810	Baringo	51.54	3.97	3.48	7.45
820	Elgeyo Marakwet	5.94	0.46	2.46	2.92
830	Nandi	5.82	0.47	1.66	2.13
840	Samburu	68.97	5.28	15.00	20.28
850	Turkana	216.23	23.33	51.65	74.98
860	West Pokot	22.12	1.99	8.46	10.45
910	Bungoma	15.05	1.15	1.86	3.01
920	Busia	4.74	0.50	1.66	2.16
930	Kakamega/Vihiga	11.57	1.15	3.12	4.27
Total		2300.76	193.03	426.12	619.15

Note : (1) Based on groundwater yield shown in Figure 2.4.1.

(2) (1) x Ratio of safe-yielding boreholes to all boreholes by location.
An average of the rations is 0.076.

Table 2.5.1 Intercensal Comparison of 1979 Census with 1989 Census Provisional Results

Code	District	1979 Census ('000)			1989 Census ('000)			Intercensal Growth Rate(%)			Pop. Density in 1989*2
		Total	Urban	Rural	Total	Urban*1	Rural	Total	Urban	Rural	
110	Nairobi	828	828	0	1,346	1,346	0	4.98	4.98	-	2,285
210	Kiambu	686	51	635	914	99	815	2.91	6.79	2.53	454
220	Kirinyaga	291	8	284	388	18	370	2.90	8.74	2.69	372
230	Murang'a	648	17	631	846	59	787	2.70	12.94	2.24	405
240	Nyandarua	222	0	222	349	11	339	4.63	-	4.31	148
250	Nyeri	486	41	446	613	98	515	2.34	9.16	1.45	409
310	Kilifi	431	34	397	611	59	552	3.55	5.62	3.36	63
320	Kwale	288	8	280	384	14	370	2.91	5.50	2.82	53
330	Lamu	42	11	32	57	12	45	3.03	1.25	3.57	16
340	Mombasa	341	341	0	467	465	2	3.19	3.15	-	2,359
350	Taita Taveta	148	7	140	202	24	178	3.19	12.58	2.40	38
360	Tana River	92	5	87	129	11	118	3.39	7.47	3.09	5
410	Embu	263	16	247	358	20	338	3.13	2.37	3.17	153
420	Isiolo	43	14	29	70	22	48	4.88	4.69	4.96	3
430	Kitui	464	7	458	640	15	625	3.26	8.60	3.16	33
440	Machakos/Makueni	1,023	102	921	1,393	157	1,236	3.14	4.41	2.99	115
450	Marsabit	96	22	74	125	33	92	2.65	4.15	2.17	2
460	Meru	830	73	757	1,138	90	1,048	3.20	2.13	3.30	170
510	Garissa	129	20	109	124	31	94	-0.38	4.26	-1.50	3
520	Mandera	106	25	81	123	7	116	1.54	-11.91	3.65	5
530	Wajir	139	19	120	125	22	103	-1.08	1.41	-1.52	2
610	Kisii/Nyamira	870	30	840	1,146	57	1,089	2.80	6.81	2.63	522
620	Kisumu	482	158	324	674	205	470	3.40	2.61	3.77	357
630	Siaya	475	4	470	643	23	620	3.09	19.26	2.79	270
640	South Nyanza	818	16	802	1,095	47	1,048	2.96	11.32	2.72	210
710	Kajiado	149	14	135	262	32	230	5.81	8.48	5.49	15
720	Kericho	633	38	596	859	51	808	3.09	3.02	3.10	227
730	Laikipia	146	30	116	213	41	172	3.86	3.01	4.08	26
740	Nakuru	523	133	389	862	242	620	5.13	6.15	4.76	195
750	Narok	210	16	195	402	16	386	6.69	0.44	7.08	29
760	Trans Nzoia	260	28	231	394	53	341	4.26	6.47	3.96	209
770	Uasin Gishu	301	51	250	440	115	325	3.88	8.58	2.65	149
810	Baringo	204	14	190	286	25	261	3.45	6.07	3.23	33
820	Elgeyo Marakwet	149	0	149	212	5	207	3.60	-	3.34	168
830	Nandi	299	3	296	440	13	427	3.93	15.83	3.72	200
840	Samburu	77	15	62	114	24	91	4.01	4.54	3.88	7
850	Turkana	143	6	136	179	0	179	2.29	-	2.77	3
860	West Pokot	159	5	154	231	12	219	3.83	9.52	3.59	28
910	Bungoma	504	45	459	731	68	664	3.79	4.08	3.76	293
920	Busia	298	25	273	423	14	409	3.57	-5.45	4.12	295
930	Kakamega/Vihiga	1,031	36	995	1,389	81	1,308	3.03	8.58	2.77	445
100	Nairobi	828	828	0	1,346	1,346	0	4.98	4.98	-	2,285
200	Central	2,335	118	2,217	3,110	285	2,825	2.91	9.25	2.45	346
300	Coast	1,343	407	936	1,850	585	1,265	3.26	3.70	3.06	34
400	Eastern	2,720	233	2,487	3,724	337	3,387	3.19	3.75	3.14	30
500	North-Eastern	374	63	310	372	59	313	-0.05	-0.71	0.08	3
600	Nyanza	2,644	208	2,436	3,558	332	3,226	3.01	4.80	2.85	305
700	Rift Valley	3,252	353	2,899	4,894	628	4,266	4.17	5.94	3.94	32
900	Western	1,833	106	1,727	2,543	163	2,380	3.33	4.41	3.26	361
	Kenya	15,327	2,316	13,011	21,397	3,736	17,661	3.39	4.90	3.10	45
	Kenya(Revised)	16,141			(--->	22,000	)	3.15			46

Source : A.04, A.08, A.13, A.14 and A.26

Remark : *1 Estimated by District based on Table A9.2. *2 Unit:Persons/sq.km.

Table 2.5.2 Urban Population of Major Urban Centres : 1979 and 1989

No	Major Urban Centre*1	Location Code	Census Population		Change of Urban Population between Two Censuses		Percentage of Urban Population (%)		
			1979	1989	Increment	Ann.Growth(%)	1979	1989	Increment
1	Nairobi	110	827,775	1,346,000	518,225	5.0	35.7	36.0	36.5
2	Mombasa	340	341,148	465,000	123,852	3.1	14.7	12.4	8.7
3	Kisumu	622.1	152,643	185,100	32,457	1.9	6.6	5.0	2.3
4	Nakuru	749.0	92,851	162,800	69,949	5.8	4.0	4.4	4.9
5	Machakos	441.1	84,320	116,100	31,780	3.3	3.6	3.1	2.2
6	Eldoret	772.5	50,503	104,900	54,397	7.6	2.2	2.8	3.8
7	Nyeri	257.0	35,753	88,600	52,847	9.5	1.5	2.4	3.7
8	Meru	461.4	70,439	78,100	7,661	1.0	3.0	2.1	0.5
9	Thika	214.4	41,324	57,100	15,776	3.3	1.8	1.5	1.1
10	Kitale	762.3	28,327	53,000	24,673	6.5	1.2	1.4	1.7
11	Kakamega	935.4	32,025	47,300	15,275	4.0	1.4	1.3	1.1
12	Kisii	615.0	29,661	44,000	14,339	4.0	1.3	1.2	1.0
13	Kericho	725.5	29,603	40,000	10,397	3.1	1.3	1.1	0.7
14	Malindi	314.4	23,275	35,200	11,925	4.2	1.0	0.9	0.8
15	Naivasha	744.1	11,491	34,500	23,009	11.6	0.5	0.9	1.6
16	Maragwa	232.7	6,980	30,600	23,620	15.9	0.3	0.8	1.7
17	Bungoma	912.4	25,161	29,100	3,939	1.5	1.1	0.8	0.3
18	Garissa	519.1	14,076	27,200	13,124	6.8	0.6	0.7	0.9
19	Webuye	914.2	17,963	25,700	7,737	3.6	0.8	0.7	0.5
20	Nanyuki	731.5	18,986	24,500	5,514	2.6	0.8	0.7	0.4
21	Mumias	93A.4	-	23,900	-	-	-	0.6	-
22	Athi River	442.3	9,760	23,000	13,240	9.0	0.4	0.6	0.9
23	Muranga	234.3	15,290	21,000	5,710	3.2	0.7	0.6	0.4
24	Homa Bay	641.1	7,489	20,800	13,311	10.8	0.3	0.6	0.9
25	Wajir	532.4	6,384	19,200	12,816	11.6	0.3	0.5	0.9
26	Embu	413.7	15,986	18,200	2,214	1.3	0.7	0.5	0.2
27	Maralal	841.4	10,230	16,900	6,670	5.1	0.4	0.5	0.5
28	Siaya	634.1	4,022	16,800	12,778	15.4	0.2	0.4	0.9
29	Isiolo	421.1	11,331	15,400	4,069	3.1	0.5	0.4	0.3
30	Karuri	211.1	-	14,800	-	-	-	0.4	-
31	Gilgil	743.2	9,103	14,000	4,897	4.4	0.4	0.4	0.3
32	Nyahururu	733.9	11,277	13,900	2,623	2.1	0.5	0.4	0.2
33	Elburgon	747.3	8,701	12,000	3,299	3.3	0.4	0.3	0.2
34	Ruiru	214.1	1,718	11,800	10,082	21.3	0.1	0.3	0.7
35	Kilifi	313.2	5,866	11,700	5,834	7.1	0.3	0.3	0.4
36	Narok	753.7	5,690	11,200	5,510	7.0	0.2	0.3	0.4
37	Marsabit	454.1	8,739	10,900	2,161	2.2	0.4	0.3	0.2
38	Kangundo	445.1	5,709	10,500	4,791	6.3	0.2	0.3	0.3
39	Molo	747.5	5,350	10,200	4,850	6.7	0.2	0.3	0.3
40	Taveta	351.1	1,812	10,200	8,388	18.9	0.1	0.3	0.6
41	Nyamira	612.2	8,003	10,100	2,097	2.4	0.3	0.3	0.1
42	Mandera	521.1	13,126	6,900	-6,226	-6.2	0.6	0.2	-0.4
43	Nairangi Enkare	752.5	10,000	-	-	-	0.4	-	-
	Total of 43 Centres		2,109,890	3,318,200	1,208,310	4.6	91.1	88.8	85.1
	Total of Urban Population		2,315,696	3,735,900	1,420,204	4.9	100.0	100.0	100.0

Source : A.08 and A.14

Remark : Service centres which have an urban population of more than 10,000 at both two censuses.

Table 2.5.3 GDP by Industrial Origin at Current Prices : 1979 - 1989

(Unit : K.Pound Million)

Item	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
I. GDP at Current Prices											
A. Non-Monetary Economy											
Forestry	15.21	16.66	19.22	21.71	25.14	28.39	33.58	37.26	43.68	52.60	59.27
Fishing	0.46	0.55	0.82	1.03	1.11	1.25	1.46	1.80	1.85	2.11	2.85
Building & Construction	37.19	41.57	46.20	48.96	60.02	62.06	76.34	71.77	77.07	84.17	90.42
Water Collection	14.04	15.10	17.12	19.29	22.07	24.79	28.09	31.57	35.78	40.73	47.06
Ownership of Dwelling	52.06	57.79	67.41	73.59	91.21	98.64	107.46	121.41	139.00	162.29	189.43
Sub-Total	118.96	131.67	150.77	164.58	199.55	215.13	246.93	263.81	297.38	341.90	389.03
B. Monetary Economy											
1. Enterprises & Non-profit Institutions :											
Agriculture	648.78	688.13	791.74	964.06	1,126.53	1,244.34	1,357.17	1,598.05	1,669.26	1,902.69	2,088.39
Forestry	12.88	15.66	18.59	32.81	26.75	29.18	32.93	37.91	34.65	61.60	93.42
Fishing	3.70	4.37	6.56	8.33	9.02	10.34	12.09	15.09	17.50	20.09	27.39
Mining & Quarring	5.04	5.73	5.91	6.61	7.37	8.15	9.97	11.45	13.27	13.69	18.62
Manufacturing	249.84	295.14	328.16	372.32	408.26	460.96	518.40	608.23	652.47	752.96	855.36
Building & Construction	82.26	105.17	121.00	135.82	137.58	132.55	161.49	175.12	210.81	284.13	386.93
Electricity & Water	30.23	32.63	41.18	23.72	24.65	43.22	49.54	52.14	55.24	57.63	64.03
Trade, Restaurants & Hotels	214.07	244.66	274.03	306.67	371.04	439.67	520.64	561.01	628.25	712.03	829.07
Transport, Strage & Communication	114.65	127.81	143.39	195.87	215.89	250.32	296.40	341.08	393.35	433.74	485.79
Finance, Real Estate & Business Services	117.63	135.68	168.82	209.74	248.65	269.00	314.85	365.22	418.65	501.83	576.89
Ownership of Dwellings	87.20	103.41	127.42	187.78	196.73	214.53	214.53	262.96	303.89	355.93	393.87
Other Services	39.59	49.41	56.15	82.45	92.21	107.27	129.58	153.72	181.66	197.92	228.00
Less: Imputed Bank Services	-56.10	-62.86	-71.21	-87.29	-114.51	-120.18	-130.64	-150.24	-172.98	-195.79	-281.62
Total	1,549.77	1,744.94	2,011.74	2,438.89	2,750.17	3,089.35	3,486.95	4,031.74	4,406.02	5,098.45	5,766.14
2. Private Households (Domestic Services)	19.16	23.34	28.62	32.75	35.63	44.87	51.78	62.96	71.78	83.94	97.49
3. Producers of Government Services :											
Public Administration	61.44	71.30	87.22	90.87	95.34	103.01	117.96	143.79	165.78	169.20	172.67
Defence	14.19	14.90	14.35	17.75	18.28	17.42	16.35	18.17	26.11	15.64	37.59
Education	129.57	154.18	178.19	200.04	212.55	240.12	292.78	373.26	399.17	478.48	588.25
Health	31.24	36.16	41.64	48.22	52.31	56.56	65.85	77.51	86.45	101.67	114.77
Agricultural Services	20.69	22.24	27.67	31.72	34.62	37.29	42.03	43.21	40.68	40.68	60.20
Other Services	32.13	33.68	41.85	52.75	62.15	67.82	81.37	100.51	104.53	104.63	104.36
Total	289.26	332.46	390.92	441.35	475.25	522.22	616.34	756.45	822.72	910.30	1,077.84
Total Monetary Economy	1,858.19	2,100.74	2,431.28	2,912.99	3,261.05	3,656.44	4,155.07	4,851.15	5,300.52	6,092.69	6,941.47
Total GDP at Factor Cost	1,977.15	2,232.41	2,582.05	3,077.57	3,460.60	3,871.57	4,402.00	5,114.96	5,597.90	6,434.59	7,330.50
GDP per Capita (KPounds)	122.49	133.94	149.13	171.10	185.21	199.46	218.30	244.18	257.24	284.64	312.15
GDP per Capita (US$)	334.31	353.97	289.97	268.93	268.49	252.78	268.12	304.42	311.53	306.08	289.01
II. Percentage Distribution (%)											
A. Non-Monetary Economy											
Forestry	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.7	0.8	0.8	0.8
Fishing	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Building & Construction	1.9	1.9	1.8	1.6	1.7	1.6	1.7	1.4	1.4	1.3	1.2
Water Collection	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Ownership of Dwelling	2.6	2.6	2.6	2.4	2.6	2.5	2.4	2.4	2.5	2.5	2.6
Sub-Total	6.0	5.9	5.8	5.3	5.8	5.6	5.6	5.2	5.3	5.3	5.3
B. Monetary Economy											
1. Enterprises & Non-profit Institutions											
Agriculture	32.8	30.8	30.7	31.3	32.6	32.1	30.8	31.2	29.8	29.6	28.5
Forestry	0.7	0.7	0.7	1.1	0.8	0.8	0.7	0.7	0.6	1.0	1.3
Fishing	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Mining & Quarring	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Manufacturing	12.6	13.2	12.7	12.1	11.8	11.9	11.8	11.9	11.7	11.7	11.7
Building & Construction	4.2	4.7	4.7	4.4	4.0	3.4	3.7	3.4	3.8	4.4	5.3
Electricity & Water	1.5	1.5	1.6	0.8	0.7	1.1	1.1	1.0	1.0	0.9	0.9
Trade, Restaurants & Hotels	10.8	11.0	10.6	10.0	10.7	11.4	11.8	11.0	11.2	11.1	11.3
Transport, Strage & Communication	5.8	5.7	5.6	6.4	6.2	6.5	6.7	6.7	7.0	6.7	6.6
Finance, Real Estate & Business Services	5.9	6.1	6.5	6.8	7.2	6.9	7.2	7.1	7.5	7.8	7.9
Ownership of Dwellings	4.4	4.6	4.9	6.1	5.7	5.5	4.9	5.1	5.4	5.5	5.4
Other Services	2.0	2.2	2.2	2.7	2.7	2.8	2.9	3.0	3.2	3.1	3.1
Less: Imputed Bank Services	-2.8	-2.8	-2.8	-2.8	-3.3	-3.1	-3.0	-2.9	-3.1	-3.0	-3.8
Total	78.4	78.2	77.9	79.2	79.5	79.8	79.2	78.8	78.7	79.2	78.7
2. Private Households (Domestic Services)	1.0	1.0	1.1	1.1	1.0	1.2	1.2	1.2	1.3	1.3	1.3
3. Producers of Government Services:											
Public Administration	3.1	3.2	3.4	3.0	2.8	2.7	2.7	2.8	3.0	2.6	2.4
Defence	0.7	0.7	0.6	0.6	0.5	0.4	0.4	0.4	0.5	0.2	0.5
Education	6.6	6.9	6.9	6.5	6.1	6.2	6.7	7.3	7.1	7.4	8.0
Health	1.6	1.6	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.6	1.6
Agricultural Services	1.0	1.0	1.1	1.0	1.0	1.0	1.0	0.8	0.7	0.6	0.8
Other Services	1.6	1.5	1.6	1.7	1.8	1.8	1.8	2.0	1.9	1.6	1.4
Total	14.6	14.9	15.1	14.3	13.7	13.5	14.0	14.8	14.7	14.1	14.7
Total Monetary Economy	94.0	94.1	94.2	94.7	94.2	94.4	94.4	94.8	94.7	94.7	94.7
Total GDP at Factor Cost	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source : A.07, A.19-24 and A.38 (Sectoral Report A)

Table 2.5.4 Estimated Value Added and GRDP by District : 1989

(Unit : K.P.Million)

Code	District	Agricul. and Forestry	Mining and Quarry	Manu-fac-turing	Electri-city and Water	Const-ruction	Wholesale Retail & Catering	Trans-port & Commun	Finance, Insuran. R.Estate	Social & Personal Services	Total	Non-Monetary Sector	Total
110	Nairobi	52.0	3.0	405.4	24.0	237.2	457.1	248.0	219.7	548.4	2,194.9	29.4	2,224.3
210	Kiambu	233.4	0.0	37.6	1.2	5.2	18.1	5.9	5.2	82.3	388.9	45.0	433.9
220	Kirinyaga	23.1	0.1	3.9	0.4	1.6	3.1	0.8	0.5	22.5	56.1	6.2	62.2
230	Murang'a	208.3	0.0	4.1	1.1	4.1	5.9	0.8	0.9	54.2	279.4	25.5	304.9
240	Nyandarua	116.4	0.0	3.7	0.5	1.2	4.8	0.7	0.4	22.7	150.5	3.5	153.9
250	Nyeri	31.7	0.0	19.4	2.8	12.3	17.5	2.2	3.2	59.4	148.5	7.6	156.1
310	Kilifi	49.5	0.0	9.9	0.6	2.2	19.9	2.0	1.3	22.0	107.5	4.9	112.5
320	Kwale	4.8	0.4	1.6	0.1	0.6	21.1	0.3	0.1	14.9	44.0	3.2	47.2
330	Lamu	5.7	0.0	3.0	0.2	0.6	1.1	0.2	0.1	6.4	17.4	1.1	18.5
340	Mombasa	71.1	1.7	92.0	6.3	22.6	121.1	164.4	27.3	103.5	610.0	3.3	613.3
350	Taita Taveta	13.2	0.3	6.3	0.6	1.8	4.8	1.9	0.8	15.1	44.9	6.0	50.9
360	Tana River	0.3	0.0	0.7	0.3	0.7	0.2	0.1	0.0	8.1	10.5	0.8	11.2
410	Embu	0.7	0.0	4.1	1.8	7.6	0.6	4.5	1.1	29.4	49.7	3.7	53.4
420	Isiolo	5.4	0.0	1.6	0.6	2.1	0.6	0.2	0.0	9.1	19.5	1.4	20.9
430	Kitui	2.7	1.0	1.5	0.8	5.5	1.6	0.6	0.2	24.7	38.5	1.5	40.0
440	Machakos/Makueni	69.0	0.1	21.1	1.3	7.2	10.8	6.8	1.1	69.6	187.0	14.2	201.3
450	Marsabit	1.9	0.0	4.6	0.3	1.5	1.1	0.0	0.0	9.3	18.8	1.0	19.7
460	Meru	4.0	0.0	13.6	0.7	4.9	7.3	1.4	1.8	50.1	83.8	7.7	91.5
510	Garissa	0.3	0.0	0.9	0.8	3.2	0.3	0.5	0.2	14.0	20.1	1.3	21.5
520	Mandera	0.0	0.0	1.5	0.2	0.6	0.1	0.0	0.0	8.7	11.1	0.5	11.5
530	Wajir	6.3	0.0	0.0	0.7	0.3	0.1	0.0	0.0	6.0	13.4	0.6	14.0
610	Kisii/Nyamira	24.8	0.0	12.6	1.2	3.3	5.5	0.9	1.3	57.4	106.8	9.8	116.6
620	Kisumu	12.3	0.5	34.6	4.5	13.8	21.1	10.6	6.5	72.2	176.1	10.5	186.6
630	Siaya	228.5	0.0	9.9	0.0	0.5	1.5	1.0	1.1	18.5	261.0	0.0	261.0
640	South Nyanza	564.6	0.0	17.9	0.8	3.5	4.2	0.6	1.7	50.7	644.1	5.4	649.5
710	Kajiado	0.8	9.9	0.4	0.5	0.5	6.4	0.5	0.3	10.5	29.6	1.9	31.5
720	Kericho	51.0	0.1	21.5	0.6	2.1	4.8	1.4	1.4	38.7	121.5	51.7	173.2
730	Laikipia	3.4	0.4	10.4	0.4	1.3	7.1	0.9	0.9	16.6	41.3	8.2	49.5
740	Nakuru	90.4	0.7	41.1	5.1	9.7	35.3	12.9	5.9	79.6	280.7	41.2	321.9
750	Narok	9.7	0.0	2.0	0.3	0.8	3.9	0.1	0.2	10.3	27.4	2.0	29.4
760	Trans Nzoia	48.9	0.2	9.0	0.2	1.3	7.8	4.0	0.9	23.7	95.9	15.0	110.9
770	Uasin Gishu	46.4	0.1	18.5	0.8	5.4	12.8	4.4	5.0	33.4	126.7	10.6	137.3
810	Baringo	7.0	0.0	1.7	0.4	0.9	2.2	0.7	0.0	17.6	30.5	4.1	34.6
820	Elgeyo Marakwet	0.1	0.0	0.8	0.1	0.2	0.2	0.0	0.2	11.9	13.6	1.5	15.1
830	Nandi	21.3	0.0	7.7	0.3	0.5	3.3	0.6	0.4	16.3	50.2	29.5	79.7
840	Samburu	25.0	0.0	2.0	0.5	1.1	1.4	0.2	0.0	5.4	35.6	1.0	36.6
850	Turkana	0.9	0.0	3.1	0.2	0.5	0.8	0.3	0.0	7.0	12.7	0.6	13.4
860	West Pokot	17.5	0.0	0.5	0.2	2.7	0.2	0.2	0.0	8.8	30.2	2.0	32.2
910	Bungoma	23.2	0.0	8.5	0.4	4.8	6.8	1.6	1.7	43.7	90.7	8.9	99.6
920	Busia	22.9	0.0	2.1	0.4	1.1	1.1	0.6	0.2	19.3	47.7	1.6	49.3
930	Kakamega/Vihiga	110.7	0.0	14.3	1.8	10.2	5.7	2.8	3.6	75.4	224.6	15.1	239.7
100	Nairobi	52.0	3.0	405.4	24.0	237.2	457.1	248.0	219.7	548.4	2,194.9	29.4	2,224.3
200	Central	612.9	0.1	68.8	6.0	24.3	49.4	10.4	10.2	241.2	1,023.3	87.8	1,111.1
300	Coast	144.6	2.4	113.7	8.0	28.6	168.3	169.0	29.6	170.0	834.4	19.3	853.6
400	Eastern	83.7	1.1	46.4	5.4	28.8	22.0	13.5	4.2	192.2	397.3	29.5	426.8
500	North-Eastern	6.6	0.0	2.5	1.7	4.0	0.5	0.5	0.2	28.6	44.6	2.4	47.0
600	Nyanza	830.2	0.5	75.0	6.5	21.1	32.2	13.1	10.7	198.8	1,187.9	25.7	1,213.7
700	Rift Valley	322.4	11.5	118.6	9.7	26.8	86.1	26.2	15.1	279.6	896.0	169.4	1,065.4
900	Western	156.8	0.0	24.9	2.7	16.1	13.5	5.1	5.6	138.4	363.0	25.6	388.7
	Kenya	2,209.2	18.6	855.4	64.0	386.9	829.1	485.8	295.3	1,797.2	6,941.5	389.0	7,330.5

Table 2.5.5 Leontief Inverse Matrix of Domestic Intermediate Sectors : 1986

No.	Delivering Sector	Receiving Sector														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Traditional Economy	1.1200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	Agriculture	0.0249	1.0425	0.0117	0.2790	0.0673	0.0226	0.0259	0.0153	0.0103	0.0082	0.0112	0.0519	0.0109	0.0270	0.0037
3	Mining & Quarrying	0.0005	0.0006	1.0067	0.0026	0.0023	0.0031	0.0254	0.0104	0.0030	0.0052	0.0063	0.0020	0.0055	0.0020	0.0011
4	M. of Food, Beverages & Tobacco	0.0075	0.0286	0.0369	1.4787	0.0836	0.0387	0.0736	0.0508	0.0400	0.0288	0.0401	0.2593	0.0413	0.1296	0.0156
5	M. of Textile, Apparel & Leather	0.0013	0.0131	0.0352	0.0124	1.2938	0.0231	0.0065	0.0064	0.0093	0.0027	0.0050	0.0084	0.0063	0.0053	0.0011
6	M. of Wood, Paper Products & Printing	0.0343	0.0028	0.0350	0.0565	0.0343	1.3562	0.0236	0.0442	0.0261	0.0202	0.0400	0.0247	0.0208	0.0282	0.0164
7	M. of Chemicals & Petroleum Products	0.0241	0.0308	0.3134	0.1253	0.1135	0.1481	1.2300	0.4964	0.1444	0.2523	0.3008	0.0975	0.2685	0.0988	0.0545
8	*M. of Non-metalic Mineral Products*	0.0346	0.0006	0.0465	0.0069	0.0034	0.0047	0.0126	1.0891	0.0172	0.0078	0.0895	0.0035	0.0060	0.0042	0.0038
9	M. of Metal, Machinery & Others	0.0480	0.0177	0.1905	0.1253	0.0980	0.1598	0.1532	0.2422	1.6534	0.1441	0.2952	0.0720	0.2549	0.0774	0.0526
10	Electricity & Water Supply	0.0029	0.0055	0.0314	0.0220	0.0244	0.0163	0.0482	0.0597	0.0178	1.0858	0.0221	0.0131	0.0222	0.0147	0.0074
11	Building & Construction	0.0019	0.0020	0.0282	0.0113	0.0115	0.0148	0.0608	0.0338	0.0129	0.0161	1.0521	0.0111	0.0176	0.0276	0.0361
12	Wholesale, Retail Trade & Catering	0.0236	0.0420	0.0778	0.1373	0.1054	0.1212	0.0741	0.1080	0.1053	0.0658	0.1015	1.0543	0.0694	0.0474	0.0229
13	Transport & Communication	0.0059	0.0082	0.1243	0.0460	0.0272	0.0449	0.0336	0.0906	0.0324	0.0420	0.0473	0.0851	1.2336	0.0700	0.0378
14	Government Services	0.0004	0.0011	0.0053	0.0033	0.0020	0.0025	0.0207	0.0084	0.0025	0.0043	0.0051	0.0019	0.0047	1.0023	0.0010
15	Other Services	0.0190	0.0205	0.2638	0.1328	0.1929	0.1941	0.1996	0.2314	0.1677	0.1815	0.1640	0.2325	0.2001	0.1216	1.3722
	Total	1.3489	1.2160	2.2068	2.4395	2.0598	2.1501	1.9876	2.4867	2.2423	1.8647	2.1802	1.9173	2.1620	1.6561	1.6262

Table 2.5.6 Inventory of Service Centres by District

Code	District Name	Growth Centre No.	Growth Centre Source	Urban Centre No.	Urban Centre Source	Rural Centre No.	Rural Centre Source	Market Centre No.	Market Centre Source	Local Centre No.	Local Centre Source	Total
110	Nairobi	1	B	0	-	0	-	0	-	0	-	1
210	Kiambu	1	B	7	C	11	C	21	C	38	C	78
220	Kirinyaga	0	-	3	A	3	A	9	A	28	C	43
230	Murang'a	0	-	5	A	6	A	22	A	50	C	83
240	Nyandarua	0	-	1	A	4	B	9	A	22	C	36
250	Nyeri	1	B	2	A	4	A	19	C	40	B	66
310	Kilifi	1	B	2	A	4	A	20	A	19	A & B	46
320	Kwale	0	-	2	A	2	A	8	C	22	B	34
330	Lamu	0	-	1	B	1	B	6	C	9	C	17
340	Mombasa	1	B	0	-	0	-	0	-	0	-	1
350	Taita Taveta	0	-	2	A & B	1	B	9	C	19	C	31
360	Tana River	0	-	4	A	2	A	4	A	7	C	17
410	Embu	1	B	2	A & B	3	A	9	B	19	C	34
420	Isiolo	0	-	1	A	2	A	3	A	2	C	8
430	Kitui	0	-	3	A	7	A	18	C	28	B	56
440	Machakos/Makueni	1	B	5	A	10	A	37	C	68	B	121
450	Marsabit	0	-	1	B	1	B	3	B	7	B	12
460	Meru	1	B	4	A	8	A	25	A	40	C	78
510	Garissa	0	-	1	A	12	A	16	A	9	A	38
520	Mandera	0	-	1	A	3	A	4	A	14	C	22
530	Wajir	0	-	1	B	2	B	4	C	13	C	20
610	Kisii/Nyamira	1	B	3	B	6	B	26	C	59	C	95
620	Kisumu	1	B	2	A	6	B	14	A & B	38	C	61
630	Siaya	0	-	4	A	4	B	12	B	34	C	54
640	South Nyanza	0	-	4	A	11	A & B	37	C	68	C	120
710	Kajiado	0	-	2	B	3	B	3	C	17	C	25
720	Kericho	1	B	2	A	7	B	14	B	31	C	55
730	Laikipia	0	-	2	B	1	B	5	A & B	8	B	16
740	Nakuru	1	B	3	A	3	A	8	A	26	A	41
750	Narok	0	-	1	B	1	B	4	B	22	B	28
760	Trans Nzoia	1	B	0	A	2	A	4	A	13	A	20
770	Uasin Gishu	1	B	0	A	4	A	13	C	20	C	38
810	Baringo	0	-	2	A	5	A	14	A	25	A	46
820	Elgeyo Marakwet	0	-	1	A	3	A	10	A & B	23	C	37
830	Nandi	0	-	2	A	6	A	10	A	15	A	33
840	Samburu	0	-	1	B	2	A	2	C	11	B	16
850	Turkana	0	-	1	B	3	B	3	B	15	B	22
860	West Pokot	0	-	1	B	2	B	6	B	23	B	32
910	Bungoma	0	-	3	A	5	A	17	A	37	A	62
920	Busia	0	-	1	A	7	D	10	D	23	D	41
930	Kakamega/Vihiga	1	B	6	B	9	B	17	C	41	B	74
	Total	15		89		176		475		1,003		1,758

Source : A03, A04 and A26

Remark : *1 Sources are the following references :

A: "District Development Plans 1989-1993"

B: "National Development Plan 1974-1978" & "Human Settlement in Kenya"

C: Socio-economic Survey, January-March 1991, JICA Study Team

D: Comments by Technical Sub-Committee (held on 26 Sept., 1991)

*2 Including Growth Centres (Principal Towns)

Table 2.5.7 Urban Household Income and Expenditure in Major Towns : 1983

Item	Nairobi	Mombasa	Thika	Nakuru	Eldoret	Kisumu	Other Towns	All Towns
I. Average Income by Income Class								
A) Average Income (KShs./Month)								
Below 2,000	908	928	838	836	845	915	941	912
2,000 - 7,999	3,504	3,983	3,920	3,627	3,296	3,500	3,297	3,604
More than 8,000	14,020	16,395	9,067	12,965	12,625	14,078	13,311	13,822
Average of all Classes	1,822	2,232	1,320	1,754	1,381	2,182	1,953	1,931
B) Distribution of Sample Frequency								
Below 2,000	9,480	4,756	817	1,472	1,012	1,355	7,214	26,106
2,000 - 7,999	2,883	2,694	95	371	154	310	2,240	8,747
More than 8,000	313	105	19	59	22	110	378	1,006
Average of all Classes	12,676	7,555	931	1,902	1,188	1,775	9,832	35,859
II. Average Expenditure by Major Expenditure Item *1								
A) Income Class : Below Kshs.2,000/Month								
Food & Beverages	429	440	415	316	378	437	377	408
Household Good *2	211	209	184	168	221	230	206	207
Major Goods *3	245	194	254	254	251	361	293	249
Regular Expenditure *4	184	150	125	219	113	150	174	170
Total	1,069	993	978	957	963	1,178	1,050	1,034
B) Income Class : KShs.2,000 - 7,999/Month								
Food & Beverages	857	1,228	817	651	756	907	12	922
Household Good *2	969	1,002	2,206	870	847	894	791	938
Major Goods *3	1,076	1,170	2,558	1,684	1,441	1,497	851	1,098
Regular Expenditure *4	776	705	130	885	381	479	755	729
Total	3,678	4,105	5,711	4,090	3,425	3,777	2,409	3,687
C) Income Class : More Than KShs.8,000/Month								
Food & Beverages	1,183	2,956	230	1,830	1,222	3,062	1,060	1,548
Household Good *2	2,722	6,040	156	2,849	5,318	4,920	4,220	3,887
Major Goods *3	342	2,447	-	2,181	750	-	946	1,185
Regular Expenditure *4	2,371	2,569	38	3,593	795	5,950	1,220	2,344
Total	6,618	14,012	424	10,453	8,085	13,932	7,446	8,964
D) All Income Classes								
Food & Beverages	545	756	452	428	444	682	478	566
Household Good *2	446	573	391	388	396	637	493	489
Major Goods *3	574	697	510	946	560	898	582	645
Regular Expenditure *4	372	381	124	453	160	367	346	368
Total	1,937	2,407	1,477	2,215	1,560	2,584	1,899	2,068
III. Relation between Income and Water Expenditure (using efficient sample only)								
No. of Efficient Samples	243	225	31	26	9	78	345	957
Average Income	1,806	2,058	1,170	3,692	1,787	1,999	2,007	1,984
Average Expenditure for Potable Water	25	36	21	54	41	15	21	26
% of Water Exp. to Income	1.4%	1.7%	1.8%	1.5%	2.3%	0.8%	1.0%	1.3%

Source : Urban Household Budget Survey, 1983, CBS (Unpublished)

Remark : *1 Some unjustifiable figures are perceived in the table, because some probles occured in the survey.

*2 Clothing, Footwear, Fuel, Furnishing, Utensils, Transport, Communication & Recreation

*3 Furniture, Electric Appliances and Transport Equipment

*4 Education, Insurance, Water, Electricity, Telephone, House Rent and Taxes

Table 2.5.8 Price Indices : 1979 - 1990

Item	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1. Consumer Price Indices in December for Nairobi (Base: Jan.-June 1975)												
Upper Income Index *1	163.8	185.0	220.3	259.0	285.7	307.0	333.3	346.6	382.4	428.7	475.0	537.7
Middle Income Index*2	155.7	173.3	216.3	155.9	281.7	312.6	348.4	368.6	405.5	452.7	505.8	571.0
Lower Income Index *3	177.1	200.3	239.0	270.8	297.9	330.4	364.6	379.2	400.5	440.5	483.1	540.1
2. Consumer Price Indices in Annual Average for Major Towns (Base: 1976 Average)												
Mombasa	151.3	167.7	208.8	236.1	256.4	268.6	283.8	291.9	316.5	352.2	393.2	454.6
Kisumu	131.7	156.4	192.2	212.8	242.3	261.2	286.3	295.5	327.2	356.1	378.2	429.2
Nakuru	146.2	158.1	187.2	210.6	242.8	257.0	276.0	282.9	301.6	331.6	361.9	411.9
3. Cost Indices in December (Base: 1972)												
Residential Building	-	303.2	346.8	395.6	423.0	452.1	514.4	546.1	610.2	687.0	760.6	-
Non-residential Bldg	-	320.1	352.0	400.1	416.4	453.0	502.0	540.6	614.4	683.9	753.9	-
Building	-	311.1	349.2	397.7	419.9	452.5	508.6	543.5	612.2	686.0	759.1	-
Civil Engineering	-	282.7	305.6	362.6	379.5	460.0	500.1	533.8	591.9	636.0	690.3	-
Overall Construction	-	332.1	384.0	404.1	404.1	455.5	505.3	539.7	604.3	666.4	732.2	-
- Materials	-	400.8	459.3	490.5	490.5	511.3	567.6	600.6	659.0	742.4	811.1	-
Sand	-	250.0	326.9	384.6	384.6	384.6	384.6	576.9	576.9	653.8	653.8	-
Cement	-	361.0	481.8	481.8	481.8	481.8	616.3	616.3	616.3	678.0	745.8	-
Steel product	-	393.6	440.1	512.1	550.4	605.0	603.7	620.1	667.9	708.6	766.7	-
Fuel & lubricants	-	620.5	665.8	677.9	677.9	733.2	733.2	699.2	767.2	775.6	937.2	-
- Labour	-	201.4	246.4	246.4	246.4	353.5	391.5	428.7	504.3	527.7	588.2	-
Unskilled	-	236.4	300.0	300.0	300.0	458.2	520.0	555.5	630.0	660.0	747.3	-
Semi-skilled	-	215.8	270.5	270.5	270.5	408.9	434.9	495.2	598.6	628.1	697.3	-
Skilled	-	170.0	196.7	196.7	196.7	250.3	283.0	304.0	359.7	374.7	412.7	-

Source : A.07-10, A.23 and A.24

Remark : *1 The upper income gourp comprises households with monthly earnings of Kshs.2,500 and above.

*2 The middle income group comprises households with monthly earnings, between Kshs.700- 2,499.

*3 The lower income group compirses households with montyly earnings below Kshs.699.

Table 2.5.9 Foreign Exchange Mean Rates (End of Period) : 1979 - 1991

Item	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991 Jan.	1991 Feb.
1. National Currency Units per SDR (Special Drawing Rights : IMF)														
U.S. Dollar	1.31733	1.27541	1.16396	1.10311	1.04695	0.98021	1.09842	1.22319	1.41866	1.34570	1.31416	1.42266	1.43476	1.42053
Kenya Shilling	-	-	-	14.060	14.417	15.187	17.738	19.135	23.429	25.029	28.387	34.263	35.468	35.805
Japanese Yen	-	-	-	-	-	246.13	220.23	194.61	175.20	169.36	188.52	191.21	188.24	187.51
2. National Currency Units per U.S. Dollar														
Kenya Shilling	7.328	7.568	10.286	12.725	13.796	15.781	16.284	16.042	16.515	18.599	21.601	24.084	24.721	25.205
Japanese Yen	240.58	202.52	219.55	233.92	231.55	251.10	200.50	159.10	123.50	125.85	143.45	134.40	131.20	132.00
3. National Currency Unit per 100 Japanese Yen														
U.S. Dollar	0.416	0.494	0.455	0.428	0.432	0.398	0.499	0.629	0.810	0.795	0.697	0.744	0.762	0.758
Kenya Shilling	3.046	3.737	4.685	5.440	5.958	6.306	8.120	10.030	13.394	14.800	15.032	17.920	18.842	19.095
4. National Currency Units per Kenya Shilling														
U.S. Dollar	0.136	0.132	0.097	0.079	0.072	0.063	0.061	0.062	0.061	0.054	0.046	0.042	0.040	0.040
Japanese Yen	32.830	26.759	21.345	18.382	16.784	15.858	12.315	9.970	7.466	6.757	6.652	5.580	5.307	5.237
4. National Currency Unit per Kenya Pound														
U.S. Dollar	2.729	2.643	1.944	1.572	1.450	1.267	1.228	1.247	1.211	1.075	0.926	0.830	0.809	0.793
Japanese Yen	656.6	535.2	426.9	367.6	335.7	317.2	246.3	199.4	149.3	135.1	133.0	111.6	106.1	104.7

Source : A.10 and A.38

Table 2.5.10 GDP and Approved Public Expenditure of Central Government

(Unit : K.Pound million)

Item	1980 1980/81	1981 1981/82	1982 1982/83	1983 1983/84	1984 1984/85	1985 1985/86	1986 1986/87	1987 1987/88	1988 1988/89	1989 1989/90
1. GDP	2,232.4	2,582.5	2,913.0	3,473.6	3,873.0	4,418.7	5,115.0	5,612.5	6,391.1	7,330.5
2. Public Expenditure										
1) Budgetary Itemization										
A) Recurrent Expenditure	649.0	798.1	955.1	1,030.1	1,125.6	1,221.4	1,581.6	1,882.6	2,347.1	2,516.2
a) Appropriations-in-Aid	32.6	77.9	86.9	76.3	58.7	49.7	72.0	156.4	108.7	163.6
b) Net Expenditure	616.4	720.2	868.2	953.9	1,067.0	1,171.7	1,509.6	1,726.3	2,238.5	2,352.7
B) Development Expenditure	303.7	324.5	356.7	300.3	436.5	409.8	537.5	623.8	806.1	1,006.5
a) Appropriations-in-Aid	60.0	38.4	86.6	97.8	235.2	114.5	202.0	288.6	413.8	548.9
b) Net Expenditure	243.8	286.1	270.1	202.5	201.3	295.3	335.4	335.2	392.4	457.7
C) Total Expenditure	952.7	1,122.6	1,311.8	1,330.5	1,562.1	1,631.2	2,119.1	2,506.4	3,153.3	3,522.7
2) Analytical Itemization										
A) Total Current Expend.	661.6	834.9	861.4	972.3	1,092.5	1,242.0	1,491.8	1,702.4	2,104.4	2,338.9
B) Capital Expenditure	188.8	143.2	142.0	133.2	204.6	165.1	324.6	281.9	372.0	665.9
a) Gross Fixed Cap. Form.	166.9	123.5	134.9	118.9	194.7	150.0	283.7	242.0	327.8	603.4
b) Capital Transfers	21.8	19.6	7.0	14.4	9.9	15.2	40.9	39.9	44.2	62.5
C) Net Lending	67.5	74.0	30.9	25.4	36.0	43.9	48.0	29.3	62.7	74.8
D) Public Debt Redemption	50.8	66.3	150.2	105.7	184.6	169.9	192.4	180.2	502.8	416.4
E) Total Expenditure	968.7	1,118.3	1,184.4	1,236.7	1,517.8	1,621.0	2,056.7	2,193.8	3,041.9	3,496.1
3. Expenditure for Projects Related to Water Development										
A) Expenditure by MOWD	-	32.9	32.1	28.4	29.6	35.6	41.1	38.1	57.7	75.2
B) E. by Agencies Concerned	-	27.3	13.9	17.0	52.2	36.7	98.6	74.4	88.3	150.1
C) Total Expenditure	-	60.3	46.0	45.4	81.9	72.3	139.8	112.5	146.1	225.4
4. Percentage (%)										
A) (2.1.C)/(1)	42.7	43.5	45.0	38.3	40.3	36.9	41.4	44.7	49.3	48.1
B) (2.1.B)/(2.1.C)	31.9	28.9	27.2	22.6	27.9	25.1	25.4	24.9	25.6	28.6
C) (2.1.B.a)/(2.1.B)	19.7	11.8	24.3	32.6	53.9	27.9	37.6	46.3	51.3	54.5
D) (2.1.B.b)/(2.1.B)	80.3	88.2	75.7	67.4	46.1	72.1	62.4	53.7	48.7	45.5
E) (2.2.B)/(2.1.B)	62.2	44.1	39.8	44.4	46.9	40.3	60.4	45.2	46.1	66.2
F) (2.2.B.a)/(2.1.B)	55.0	38.1	37.8	39.6	44.6	36.6	52.8	38.8	40.7	59.9
G) (3.C)/(2.1.C)	-	5.4	3.5	3.4	5.2	4.4	6.6	4.5	4.6	6.4
H) (3.C)/(2.1.B)	-	18.6	12.9	15.1	18.8	17.6	26.0	18.0	18.1	22.4
I) (3.A)/(2.1.B)	-	10.1	9.0	9.4	6.8	8.7	7.6	6.1	7.2	7.5
K) (3.A)/(3.C)	-	54.6	69.7	62.5	36.2	49.2	29.4	33.9	39.5	33.4

Source : A.19, A.20, A.23 and A.24
Estimates of Recurrent & Development Expenditures

Table 3.1.1 Percent Distribution of All Women to Access to Water Source, 1989

Residence/ province	Source of water: Piped into house	Public Tap	Well with pump	Well without pump	Lake	River	Pond	Rain-Water	Other	Total	No. of women
	<------- Protected water sources --------><---------- Unprotected water sources ---------->										
Residence											
Urban	56.1	34.7	2.1	2.3	0.2	3.0	1.0	0.2	0.4	100.0	1236
Rural	11.6	6.6	5.9	12.5	1.9	43.9	7.4	1.6	8.6	100.0	5914
Province											
Nairobi	57.7	38.1	0.8	1.3	0.0	1.7	0.0	0.2	0.1	100.0	554
Central	34.0	3.9	6.3	7.6	0.0	38.8	2.7	4.9	1.8	100.0	1120
Coast	24.4	32,7	4.0	6.1	0.1	15.7	15.7	0.0	1.2	100.0	498
Eastern	15.6	8.8	3.9	22.5	0.1	38.0	3.6	1.0	6.5	100.0	1269
Nyanza	7.6	9.2	6.5	12.1	8.8	27.1	3.4	0.4	25.0	100.0	1218
Rift Valley	9.0	5.9	7.0	10.2	0.2	51.9	9.2	1.1	5.6	100.0	1519
Western	13.7	8.8	4.9	5.8	0.2	52.5	11.5	1.0	1.5	100.0	971
Total	19.3	11.4	5.3	10.7	1.6	36.8	6.3	1.4	7.2	100.0	7150

Source : Demographic and Health Survey, 1989

Table 3.1.2 Existing Water Supply Works

Dis. No.	District	E & F Analysis 1985/86			Operational Water Schemes 1989/90				Change
		Urban	Rural	Total	G.U.	G.R.	N.G.	Total	
100	NAIROBI PROVINCE				5		4	9	
210	Kiambu	6	5	11	6	6		12	1
220	Kirinyaga	4	4	8	4	4		8	0
230	Murang'a	6	8	14	6	8	1	15	1
240	Nyandarua	1	1	2	1	2	11	14	12
250	Nyeri	3	6	9	3	6		9	0
	CENTRAL PROVINCE	20	24	44	20	26	12	58	14
310	Kilifi	6	3	9	8	1		9	0
320	Kwale	4	1	5	4	1		5	0
330	Lamu	2		2	2			2	0
340	Mombasa	4		4	6			6	2
350	Taita Taveta	3	3	6	3	4		7	1
360	Tana River	1	2	3	1	2		3	0
	COAST PROVINCE	20	9	29	24	8	0	32	3
410	Embu	1	6	7	1	6		7	0
420	Isiolo	1	3	4	1	4	3	8	4
430	Kitui	2	4	6	2	10	1	13	7
440	Machakos	1	7	8	2	8	2	12	4
450	Marsabit	2	2	4	2	2	17	21	17
460	Meru	4	6	11	4	6	1	11	0
	EASTERN PROVINCE	11	28	40	12	36	24	72	32
510	Carissa	1	12	13	1	8	2	11	-2
520	Mandera	1	8	9	1	2	7	10	1
530	Wajir	1	16	17		1	8	9	-8
	NORTH-EASTERN PROVINCE	3	36	39	2	11	17	30	-9
610	Kisii	3	1	4	2	5	4	11	7
620	Kisumu	2	6	8	2	5	3	10	2
630	Siaya	3	5	8	4	5	7	16	8
640	South Nyanza	3	10	13	3	9	2	14	1
	NYAZA PROVINCE	11	22	33	11	24	16	51	18
710	Kajiado	4	4	8	4	3	9	16	8
720	Kericho	5	2	7	6	4	2	12	5
730	Laikipia		1	1		2		2	1
740	Nakuru	2	6	8	7	9	2	18	10
750	Narok	2	3	5	1	5	2	8	3
760	Trans Nzoia		2	2		2		2	0
770	Uasin Gishu	1	4	5	1	6	4	11	6
810	Baringo	2	14	16	2	10	9	21	5
820	Elgeyo-Marakwet	2	5	7	2	5		7	0
830	Nandi	2	4	6	2	5	1	8	2
840	Samburu			0	1	3	3	7	7
850	Turukana	2	9	11	1	10	4	15	4
860	West Pokot	2	4	6	3	3	4	10	4
	RIFT VALLEY PROVINCE	24	58	82	30	67	40	137	55
910	Bungoma	3	5	8	3	6		9	1
920	Busia	1	8	9	2	8		10	1
930	Kakamega	3	11	14	7	8		15	1
	WESTERN PROVINCE	7	24	31	12	22	0	34	3
	TOTAL excluding Nairobi	96	201	298	111	194	109	414	116

Remarks; E& F Analysis represents Ref D.03
G.U. is Gazetted Urban W/S
G.R. is Gazetted Rural W/S
N.G. is Non-Gazetted W/S

Table 3.1.3 Inventory of Water Supply Systems in Service Centres : 1990

Code	District	Urban Centre				Urban Centre				Market Centre				Local Centre			
		PS	CWP	OS	NA	PS	CWP	OS	NA	PS	CWP	OS	NA	PS	CWP	OS	NA
110	Nairobi	1															
210	Kiambu	8				11		2		17		4		36		2	
220	Kirinyaga	3				3				9				23		5	
230	Murang'a	5				7				21			1	50			
240	Nyandarua	1				4				3	1	5		5	4	13	
250	Nyeri	3				4				19				36	2	2	
310	Kilifi	3				4				18		2		16		3	
320	Kwale	2				1	1			1	5	2		8		14	
330	Lamu	1				1				1	1	3	1			7	2
340	Mombasa	3				1				9				10			1
350	Taita Taveta	2				1				9				18		1	
360	Tana River	3		1		2				3		1				7	
410	Embu	2				3				9				10	6		3
420	Isiolo	1				1		1		1	1	1		1	1		
430	Kitui	3				6		1		10		8		8		20	
440	Machakos	6				10				37				68			
450	Marsabit	1				1				2		1		1	2	4	
460	Meru	4				2		4	2	6	3	8	8	6	1	7	26
510	Garissa	1					3	9			4	12			3	6	
520	Mandera	1				1		2				4		3		11	
530	Wajir	1				1		1				4			6	7	
610	Kisii	2		1	1	3		2	1	9		12	5	4		47	8
620	Kisumu	3				3	2			7		7		24		9	5
630	Siaya	4				4				12				34			
640	South Nyanza	4				7			3	5	3		29	8	1		59
710	Kajiado	2				3				3				11	6		
720	Kericho	3				4		2		12		2		16		15	
730	Laikipia	3				1				2		3		2		6	
740	Nakuru	4				2		1		4	2	2		3	5	16	2
750	Narok	1				2				2		2		3	10	9	
760	Trans Nzoia	1				2				2		2		1		12	
770	Uasin Gishu	1				3		1		5		8		3		17	
810	Baringo	2				5				9		5		11	2	7	5
820	Elgeyo Marakwet	1				4				4	4	2		7	3	13	
830	Nandi	2				5		1		3		5	2	3		12	
840	Samburu	1				3				1		1		3		8	
850	Turkana	1				3				2		1		5	1	9	
860	West Pokot	2				2				5		1		9		14	
910	Bungoma	3				5				10		7		21		16	
920	Busia	1				9		6				1		4	1	17	
930	Kakamega	7				6	1	3		8	1	8		7	1	33	
100	Nairobi	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
200	Central	20	0	0	0	29	0	2	0	69	1	9	1	150	6	22	0
300	Coast	14	0	1	0	10	1	0	0	41	6	8	1	52	0	32	3
400	Eastern	17	0	0	0	23	0	6	2	65	4	18	8	94	10	31	29
500	North-Eastern	3	0	0	0	2	3	12	0	0	4	20	0	3	9	24	0
600	Nyanza	13	0	1	1	17	2	2	4	33	3	19	34	70	1	56	72
700	Rift Valley	24	0	0	0	39	0	5	0	54	6	34	2	77	27	138	7
900	Western	11	0	0	0	20	1	9	0	18	1	16	0	32	2	66	0
	Kenya	103	0	2	1	140	7	36	6	280	25	124	46	478	55	369	111
	System Total in Kenya :					1,001	87	531	164	===(Grand Total)===>				1,783			

Source : Socio-Economic Survey, Janaury-March 1991, JICA Study Team

Remark : PS:Piped System, CWP:Communal Water Points, OS:OtherSources, NA:No Answer

Table 3.2.1 Area and Number of Exisiting Irrigation Schemes by District

Code	District	Small Holder/GOK Managed Schemes		Individual Farms	Private
		Number (nos.)	Area (ha)	(ha)	(ha)
110	Nairobi				1,564
210	Kiambu			330	10,688
220	Kirinyaga	9	6,149	88	61
230	Murang'a	2	38	99	6,107
240	Nyandarua	6	32	50	64
250	Nyeri	20	988	95	520
310	Kilifi	1	80	35	245
320	Kwale	6	64	71	48
330	Lamu	1	0		
340	Mombasa				
350	Taita Taveta	7	1,228	12	
360	Tana River	18	3,921		
410	Embu	3	412	43	194
420	Isiolo	17	1,106	2	
430	Kitui				
440	Machakos	32	3,261	36	1,382
450	Marsabit				
460	Meru	10	2,312	35	46
510	Garissa	36	631	4	
520	Mandera	7	640		
530	Wajir				
610	Kisii				
620	Kisumu	51	6,147		
630	Siaya	57	177		
640	South Nyanza	11	415		
710	Kajiado	19	2,136		16
720	Kericho				
730	Laikipia	6	472	126	
740	Nakuru	1	32	117	3,460
750	Narok	7	165	4	8
760	Trans Nzoia			117	124
770	Uasin Gishu				8
810	Baringo	33	1,336	3	
820	Elg. Marakwet	80	4,446		
830	Nandi			2	
840	Samburu	1	20		
850	Turkana	11	912		
860	West Pokot	38	1,469	2	
910	Bungoma	3	324		
920	Busia	7	350	4	
930	Kakamega	2	5		
	Total	502	39,267	1,275	24,535

Source : Ref.E.23, E.37

Table 3.2.2 Present Irrigation Water Demand (1/5)
Drainage Area 1

Unit : m3/sec

Basin	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1AA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1AB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1AC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1AD	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1AE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1AF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1AG	0.000	0.009	0.043	0.048	0.000	0.000	0.000	0.000	0.000	0.006	0.038	0.051
1AH	0.000	0.001	0.005	0.007	0.002	0.002	0.002	0.002	0.002	0.003	0.006	0.006
1BA	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
1BB	0.000	0.000	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
1BC	0.001	0.001	0.001	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.001
1BD	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
1BE	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501	0.501
1BG	0.002	0.002	0.002	0.002	0.071	0.071	0.071	0.071	0.071	0.071	0.002	0.002
1BH	0.088	0.288	0.330	0.285	0.023	0.001	0.001	0.001	0.001	0.079	0.044	0.001
1CA	0.220	0.194	1.185	0.450	0.684	0.293	0.011	0.011	0.011	0.017	1.133	0.982
1CB	0.011	0.011	0.011	0.011	0.011	0.011	0.245	0.245	0.245	0.011	0.011	0.011
1CC	0.081	0.129	0.244	0.050	0.066	0.030	0.003	0.003	0.003	0.032	0.109	0.094
1CD	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091	0.091
1CE	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
1DA	0.000	0.000	0.000	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
1DB	0.001	0.001	0.001	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
1DC	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1DD	0.003	0.004	0.005	0.005	0.004	0.003	0.003	0.003	0.005	0.007	0.006	0.005
1EA	0.000	0.000	0.000	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.000
1EB	0.001	0.001	0.001	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.078	0.001
1EC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1ED	0.000	0.000	0.000	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143	0.143
1EE	0.000	0.000	0.000	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
1EF	0.230	0.015	0.044	0.029	0.250	0.463	0.650	0.650	0.691	0.717	0.711	0.496
1EG	0.000	0.000	0.000	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
1FA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1FB	0.000	0.000	0.000	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
1FC	0.000	0.000	0.000	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060	0.060
1FD	0.001	0.001	1.389	1.389	1.389	1.389	1.389	1.389	1.389	1.389	1.389	1.389
1FE	0.000	0.000	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
1FF	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1FG	0.000	0.004	2.856	2.852	2.849	2.845	2.844	2.844	2.855	2.863	2.861	2.854
1GA	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1GB	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378	0.378
1GC	0.000	0.000	0.000	0.128	0.128	0.128	0.128	0.128	0.128	0.128	0.000	0.000
1GD	0.000	0.000	0.000	1.628	1.628	1.628	1.628	1.628	1.628	1.628	1.628	1.628
1GD1	0.064	0.030	0.046	0.014	0.044	0.083	0.124	0.170	0.227	0.235	0.125	0.083
1GD2	0.485	0.227	0.348	0.102	0.328	0.626	0.941	1.285	1.719	1.774	0.950	0.626
1GD3	0.451	0.211	0.323	0.095	0.305	0.582	0.875	1.195	1.599	1.650	0.884	0.582
1GE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1GF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1GG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1HA	0.000	0.110	0.172	0.197	0.163	0.145	0.143	0.149	0.348	0.391	0.180	0.162
1HB	0.000	0.004	0.006	0.036	0.034	0.034	0.034	0.035	0.043	0.044	0.034	0.034
1HC	0.003	0.010	0.034	0.023	0.017	0.005	0.003	0.003	0.032	0.050	0.046	0.028
1HD	0.000	0.007	0.011	0.171	0.168	0.168	0.168	0.169	0.183	0.185	0.168	0.000
1HE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1HF	0.000	0.023	0.091	0.059	0.062	0.021	0.000	0.001	0.108	0.158	0.135	0.086
1HG	0.000	0.001	0.006	0.004	0.004	0.001	0.000	0.000	0.007	0.010	0.008	0.005
1JA	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.000
1JB	0.005	0.005	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1JC	0.002	0.002	0.002	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.002	0.002
1JD	0.000	0.000	0.000	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
1JE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1JF	0.001	0.001	0.001	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
1JG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KA	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.000	0.000
1KB	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
1KB1	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KB2	0.000	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KB3	0.000	0.004	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KB4	0.000	0.001	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KB5	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1KC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1LA1	0.000	0.000	0.000	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.000
1LA2	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
1LA3	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059
1LB1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1LB2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sub Total	2.825	2.474	8.439	9.384	10.030	10.328	11.063	11.782	13.094	13.248	12.253	10.771

Table 3.2.2 Present Irrigation Water Demand (2/5)
Drainage Area 2

Unit : m3/sec

Basin	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2AA	0.000	0.052	0.030	0.086	0.113	0.081	0.020	0.000	0.085	0.114	0.106	0.039
2AB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2BA	0.008	0.100	0.173	0.093	0.116	0.032	0.008	0.008	0.050	0.081	0.165	0.135
2BB	0.000	0.345	0.616	0.320	0.405	0.089	0.000	0.000	0.158	0.273	0.588	0.476
2BC	0.000	0.111	0.198	0.127	0.154	0.053	0.024	0.024	0.075	0.088	0.213	0.153
2BD	0.000	0.169	0.162	0.346	0.464	0.356	0.109	0.000	0.293	0.513	0.525	0.214
2CA	0.000	0.017	0.010	0.028	0.037	0.027	0.007	0.000	0.028	0.037	0.035	0.013
2CB	0.000	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.000
2CB1	0.000	0.003	0.004	0.004	0.003	0.001	0.001	0.000	0.003	0.004	0.004	0.003
2CB2	0.000	0.008	0.011	0.010	0.009	0.002	0.002	0.000	0.006	0.011	0.011	0.008
2CB3	0.000	0.114	0.153	0.143	0.115	0.025	0.025	0.000	0.092	0.154	0.155	0.105
2CC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2CC1	0.000	0.047	0.080	0.048	0.061	0.019	0.002	0.000	0.027	0.045	0.085	0.064
2CC2	0.000	0.004	0.007	0.005	0.006	0.002	0.000	0.000	0.003	0.004	0.008	0.006
2CC3	0.000	0.020	0.034	0.021	0.026	0.009	0.001	0.000	0.011	0.020	0.036	0.028
2CC4	0.000	0.415	0.706	0.422	0.540	0.171	0.022	0.000	0.236	0.404	0.750	0.564
2CC5	0.000	1.043	1.776	1.059	1.356	0.428	0.054	0.000	0.593	1.014	1.884	1.415
2D	0.008	0.012	0.020	0.006	0.015	0.017	0.007	0.004	0.019	0.017	0.018	0.019
2EA	0.000	0.000	0.000	0.113	0.113	0.113	0.113	0.113	0.113	0.000	0.000	0.000
2EB	0.000	0.000	0.000	0.075	0.075	0.075	0.075	0.075	0.075	0.000	0.000	0.000
2EB1	0.080	0.027	0.050	0.005	0.037	0.059	0.052	0.028	0.000	0.034	0.053	0.080
2EB2	0.030	0.010	0.019	0.002	0.014	0.022	0.020	0.010	0.000	0.013	0.021	0.030
2EB3	0.023	0.008	0.015	0.002	0.011	0.017	0.015	0.008	0.000	0.010	0.015	0.024
2EC	0.001	0.001	0.001	0.001	0.044	0.001	0.044	0.044	0.001	0.001	0.001	0.001
2ED	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000
2EE	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000
2EE1	0.693	0.335	0.336	0.254	0.340	0.455	0.515	0.432	0.338	0.453	0.517	0.562
2EE3	0.944	0.457	0.457	0.346	0.463	0.620	0.703	0.589	0.461	0.618	0.705	0.765
2EF	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
2EG1	0.000	0.000	0.000	0.000	0.039	0.000	0.039	0.039	0.000	0.000	0.000	0.000
2EG2	0.000	0.000	0.000	0.124	0.124	0.124	0.124	0.124	0.124	0.000	0.000	0.000
2EG21	0.135	0.041	0.062	0.000	0.064	0.100	0.088	0.047	0.000	0.057	0.089	0.132
2EG22	0.249	0.075	0.114	0.000	0.118	0.185	0.163	0.087	0.000	0.106	0.165	0.245
2EH	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2EH1	0.014	0.004	0.006	0.000	0.006	0.010	0.009	0.005	0.000	0.006	0.009	0.013
2EH2	0.268	0.081	0.123	0.000	0.127	0.199	0.176	0.093	0.000	0.114	0.177	0.263
2EJ	0.065	0.020	0.030	0.000	0.031	0.049	0.043	0.023	0.000	0.028	0.043	0.064
2EK	0.061	0.018	0.028	0.005	0.034	0.050	0.045	0.026	0.005	0.026	0.040	0.060
2FA	0.000	0.000	0.000	0.000	0.057	0.000	0.057	0.057	0.000	0.000	0.000	0.000
2FB	0.000	0.000	0.000	0.007	0.007	0.000	0.007	0.007	0.000	0.000	0.000	0.000
2FC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2GA	0.000	0.000	0.000	0.000	0.056	0.000	0.056	0.056	0.000	0.000	0.000	0.000
2GB	0.000	0.000	0.000	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
2GC	0.000	0.000	0.000	0.000	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.000
2GD	0.000	0.000	0.000	0.000	0.687	0.687	0.687	0.687	0.687	0.000	0.000	0.000
2H	0.005	0.002	0.219	0.219	0.219	0.005	0.002	0.002	0.003	0.007	0.221	0.222
2J	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2K	0.000	0.013	0.046	0.022	0.067	0.053	0.049	0.009	0.038	0.132	0.141	0.050
2KA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2KB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2KC	0.030	0.000	0.092	0.103	0.109	0.039	0.000	0.056	0.039	0.131	0.137	0.108
Sub Total	2.615	3.553	5.581	4.222	6.530	4.440	3.631	2.920	3.829	4.779	7.182	6.085

Table 3.2.2 Present Irrigation Water Demand (3/5)
Drainage Area 3

Unit : m3/sec

Basin	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
3AA	0.201	0.201	0.201	0.201	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.201
3AA11	0.000	0.004	0.005	0.001	0.004	0.003	0.003	0.000	0.003	0.009	0.007	0.004
3AA12	0.000	0.027	0.037	0.011	0.027	0.020	0.019	0.002	0.023	0.063	0.055	0.027
3AA13	0.000	0.008	0.011	0.003	0.008	0.006	0.006	0.001	0.007	0.018	0.016	0.008
3AA2	0.000	0.015	0.021	0.006	0.015	0.011	0.011	0.001	0.013	0.035	0.031	0.015
3AB	0.011	0.011	0.011	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011
3AC	0.060	0.060	0.060	0.060	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.060
3BA	0.008	0.008	0.008	3.756	3.756	3.756	3.756	0.008	0.008	0.008	3.756	3.756
3BA1	0.001	0.058	0.079	0.023	0.058	0.043	0.041	0.004	0.050	0.135	0.118	0.059
3BA2	0.011	0.535	0.727	0.211	0.535	0.401	0.380	0.039	0.458	1.245	1.089	0.544
3BB	0.000	0.001	0.001	0.000	2.409	2.409	0.001	0.000	0.001	0.003	0.002	0.000
3BC	0.000	0.001	0.002	0.873	0.873	0.873	0.874	0.000	0.001	0.004	0.876	0.873
3BD	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540
3CB	0.070	0.160	0.135	0.593	0.605	0.573	0.570	0.064	0.119	0.158	0.645	0.012
3DA	0.000	0.000	0.000	0.325	0.325	0.325	0.000	0.000	0.000	0.000	0.325	0.000
3DB	0.000	0.000	0.000	0.048	0.048	0.048	0.000	0.000	0.000	0.000	0.048	0.000
3EA	0.000	0.000	0.000	0.359	0.359	0.359	0.000	0.000	0.000	0.000	0.359	0.359
3EB	0.000	0.000	0.000	0.342	0.342	0.342	0.000	0.000	0.000	0.000	0.342	0.342
3EC	0.129	0.209	0.349	0.305	0.372	0.307	0.070	0.053	0.433	0.489	0.317	0.581
3ED	0.000	0.000	0.000	0.007	0.007	0.007	0.000	0.000	0.000	0.000	0.007	0.007
3FA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3FA1	0.024	0.046	0.000	0.030	0.055	0.061	0.036	0.000	0.042	0.074	0.051	0.043
3FA2	0.010	0.019	0.000	0.012	0.022	0.025	0.015	0.000	0.017	0.030	0.021	0.017
3FA3	0.003	0.005	0.000	0.003	0.006	0.006	0.004	0.000	0.004	0.008	0.005	0.005
3FB	0.179	0.345	0.000	0.228	0.414	0.459	0.271	0.000	0.316	0.562	0.384	0.323
3G	0.736	0.736	0.736	0.736	0.736	0.736	0.736	0.736	0.736	0.736	0.736	0.736
3G1	0.531	0.207	0.000	0.000	0.000	0.629	0.213	0.078	0.324	0.874	0.315	0.487
3G2	0.043	0.017	0.000	0.000	0.000	0.051	0.017	0.006	0.026	0.071	0.026	0.040
3G3	0.278	0.108	0.000	0.000	0.000	0.329	0.112	0.041	0.169	0.458	0.165	0.255
3G4	0.027	0.011	0.000	0.000	0.000	0.032	0.011	0.004	0.017	0.045	0.016	0.025
3HA	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
3HB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3HC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3HD	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3HD2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3J	0.000	0.000	1.264	1.264	1.264	0.000	0.000	0.000	0.000	0.000	1.264	1.264
3K	0.001	0.015	0.011	0.162	0.159	0.013	0.005	0.001	0.154	0.174	0.180	0.157
3LA	0.000	0.000	1.507	1.507	1.507	0.000	0.000	0.000	0.000	0.000	1.507	1.507
3LB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3MA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3MB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3MC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3MD1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3MD2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3N	0.009	0.004	0.000	0.000	0.000	0.011	0.004	0.001	0.006	0.015	0.005	0.008
Sub Total	2.927	3.406	5.760	11.671	14.499	12.429	7.750	1.634	3.522	5.809	13.261	12.320

Table 3.2.2 Present Irrigation Water Demand (4/5)
Drainage Area 4

Unit : m3/sec

Basin	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
4AA	0.649	0.062	0.109	0.689	0.699	0.770	0.675	0.651	0.682	0.762	0.726	0.683
4AB	0.010	0.010	0.010	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207
4AC	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095
4AD	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.000	0.019	0.019	0.019	0.019
4BA	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099	0.099
4BB	0.872	0.918	0.954	0.901	0.895	0.906	0.880	0.876	0.904	0.970	0.932	0.891
4BC	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724	0.724
4BD	0.580	0.771	0.811	0.727	0.701	0.596	0.580	0.616	0.818	0.838	0.717	0.696
4BE	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
4BF	0.175	0.334	0.367	0.297	0.276	0.189	0.175	0.205	0.373	0.389	0.289	0.271
4BG	1.215	1.215	1.215	1.215	1.215	1.215	1.215	1.215	1.215	1.215	1.215	1.215
4CA	0.866	0.866	0.003	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866	0.866
4CB	0.888	0.888	0.000	0.888	0.888	0.888	0.888	0.888	0.888	0.888	0.888	0.888
4CC	2.644	2.644	0.002	2.644	2.644	2.644	2.644	2.644	2.644	2.644	2.644	2.644
4DA	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163	0.163
4DA1	0.242	0.600	1.748	1.345	0.625	0.720	0.559	1.389	2.316	1.545	0.633	1.108
4DA2	0.758	1.879	5.472	4.213	1.957	2.254	1.751	4.350	7.256	4.841	1.983	3.472
4DB	0.062	0.062	0.000	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
4DC	0.082	0.061	0.074	0.129	0.121	0.087	0.082	0.094	0.158	0.164	0.126	0.119
4DD	1.790	1.790	1.790	1.790	1.790	1.790	1.790	1.790	1.790	1.790	1.790	1.790
4DE	0.009	0.009	0.000	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
4EA	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294	0.294
4EA1	0.000	0.093	0.428	0.000	0.209	0.329	0.071	0.077	0.772	0.463	0.000	0.026
4EA2	0.000	0.015	0.070	0.000	0.034	0.053	0.011	0.013	0.125	0.075	0.000	0.004
4EB	0.231	0.246	0.254	0.245	0.254	0.237	0.239	0.234	0.260	0.259	0.243	0.243
4EC	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
4ED	0.001	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.001	0.001
4FA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4FA1	0.000	0.093	0.186	0.094	0.176	0.120	0.051	0.073	0.295	0.221	0.069	0.066
4FA2	0.000	0.184	0.369	0.186	0.349	0.238	0.100	0.144	0.586	0.437	0.136	0.129
4FB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4GA	0.031	0.419	0.672	0.481	0.744	0.411	0.230	0.331	0.986	0.809	0.361	0.331
4GB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4GC	0.112	0.001	0.427	0.520	0.562	0.146	0.001	0.278	0.148	0.550	0.468	0.357
4GD	0.197	0.000	3.555	3.092	3.142	0.504	0.000	2.185	1.405	3.170	2.975	2.542
4GE	0.068	0.000	1.235	1.074	1.092	0.175	0.000	0.759	0.488	1.102	1.034	0.883
4GF	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4GG	0.225	0.000	0.912	0.923	0.811	0.111	0.000	0.530	0.285	0.982	0.834	0.904
4HA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4HB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4HC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4JA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4JB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4KA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4KB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sub Total	13.351	14.804	22.307	24.242	21.973	17.172	14.731	22.112	27.182	26.902	20.852	22.051

Table 3.2.2 Present Irrigation Water Demand (5/5)
Drainage Area 5

Unit : m3/sec

Basin	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
5AA	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.074	0.006	0.006	0.006
5AB	0.003	0.060	0.102	0.080	0.114	0.071	0.047	0.000	0.029	0.103	0.104	0.067
5AC	0.009	0.223	0.381	0.299	0.424	0.266	0.174	0.000	0.110	0.385	0.390	0.250
5AD	0.000	0.001	0.002	0.002	0.003	0.002	0.001	0.000	0.001	0.002	0.002	0.002
5BA	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.627	0.627
5BB	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161	0.161
5BC	1.126	1.286	1.425	1.268	1.387	1.906	1.296	1.123	1.192	1.366	1.337	1.279
5BD	0.000	0.000	0.000	0.016	0.016	0.000	0.000	0.000	0.000	0.000	0.016	0.016
5BE	0.010	0.053	0.089	0.591	0.625	0.224	0.055	0.006	0.023	0.071	0.611	0.595
5CA	0.000	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.000	0.001	0.000
5CB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5CC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5DA	0.015	0.015	0.015	0.000	0.000	0.015	0.015	0.015	0.015	0.000	0.000	0.000
5DB	0.009	0.009	0.009	0.000	0.000	0.009	0.009	0.009	0.009	0.000	0.000	0.009
5DC	0.009	0.009	0.009	0.000	0.000	0.009	0.009	0.009	0.009	0.009	0.000	0.000
5DD	0.013	0.013	0.013	0.000	0.000	0.013	0.013	0.013	0.013	0.013	0.000	0.000
5EA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5EB	0.000	0.000	0.003	0.003	0.003	0.000	0.000	0.000	0.000	0.003	0.003	0.000
5EC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5ED	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5FA	0.000	0.230	0.296	0.510	0.762	0.536	0.143	0.012	0.550	0.651	0.501	0.207
5FB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5GA	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5GB	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5H	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5J	0.000	0.007	0.014	0.012	0.017	0.007	0.003	0.000	0.000	0.013	0.017	0.007
Sub Total	1.988	2.700	3.152	3.576	4.146	3.852	2.560	1.982	2.813	3.410	3.776	3.226
Total	23.705	26.937	45.239	53.096	57.178	48.220	39.735	40.430	50.440	54.148	57.324	54.453

Table 3.3.1 Present Livestock Population

unit : 1,000

Code	District	Cattle				Sheep/Goats				Camels				Donkeys			
		DDP*1	DRSRS*2	MOLD*3	Estimated	DDP	DRSRS	MOLD	Estimated	DDP	DRSRS	MOLD	Estimated	DDP	DRSRS	MOLD	Estimated
110	Nairobi			6.6	6.6			7.7	7.7								
210	Kiambu	181.9		166.5	174.2	111.2		161.7	136.5								
220	Kirinyaga	110.0		88.9	99.4	63.7		109.5	86.6								
230	Murang'a	167.6		196.0	181.8	87.6		77.6	82.6								
240	Nyandarua	212.5		215.0	213.7	241.9		237.1	239.5							8.8	8.8
250	Nyeri	135.4		149.7	142.5	74.8		161.7	118.3								
310	Kilifi	10.6	77.2	219.9	102.6		45.4	211.5	128.4						0.1		0.1
320	Kwale	274.2		205.1	239.7	245.8		199.1	222.4								
330	Lamu	53.8	8.6	49.0	37.1	26.0	0.8	21.0	15.9								
340	Mombasa	3.0		5.0	4.0	10.5		8.6	9.5								
350	Taita Taveta	148.5		149.4	149.0	205.0		400.0	302.5							0.3	0.3
360	Tana River		305.2	521.1	413.1		402.8	654.8	528.8		52.4	13.9	33.1		2.3	10.5	6.4
410	Embu	98.1		101.2	99.7	130.3		136.9	133.6			0.2	0.2				
420	Isiolo	149.2	122.5	246.2	172.6	306.0	423.8	351.8	360.5	25.5	52.9	2.7	27.1	89.2	2.3	87.3	59.6
430	Kitui	271.6		334.5	303.0	513.2		688.1	600.7					6.7		49.4	28.0
440	Machakos	370.5		445.9	408.2	318.7		548.8	433.7								
450	Marsabit	314.5	125.4	346.0	261.9	835.8	923.9	961.2	907.0	227.3	92.2	238.7	186.1	23.4	8.0	23.5	18.3
460	Meru	295.1		685.8	490.4	583.3		575.0	579.2			2.7	2.7				
510	Garissa	477.7	257.9	600.4	445.3	424.4	273.1	550.0	415.8	61.0	42.5	70.0	57.8	4.0	2.7	4.5	3.7
520	Mandera	105.8	61.3	151.0	106.0	418.3	308.9	400.0	375.7	118.2	76.0	120.0	104.7	3.6	1.8	5.0	3.5
530	Wajir	250.0	130.4	264.3	214.9	400.0	497.1	684.8	527.3	120.0	153.4	206.0	159.8		3.4	6.9	5.1
610	Kisii	583.0		583.0	583.0			197.9	197.9								
620	Kisumu	251.9		259.5	255.7			287.2	287.2								
630	Siaya	387.6		421.3	404.4	261.1		390.5	325.8								
640	South Nyanza			550.7	550.7			408.5	408.5								
710	Kajiado	662.3	475.8	670.1	602.7	1000.0	639.0	1245.2	961.4						12.2		12.2
720	Kericho	700.0		534.3	617.2	150.4		297.7	224.1								
730	Laikipia	242.4	162.4	254.5	219.8	563.2	244.2	609.6	472.3		0.8		0.8	0.9	0.7		0.8
740	Nakuru	153.3		425.5	289.4	322.5		316.1	319.3								
750	Narok	813.4	565.9	1180.1	853.1	2274.9	437.2	2315.3	1675.8					128.6	13.3	159.0	100.3
760	Trans Nzoia			189.3	189.3			59.0	59.0								
770	Uasin Gishu	272.0		272.9	272.5	125.0		129.5	127.2								
810	Baringo	205.0	141.8	192.9	179.9	776.0	311.7	897.2	661.6		0.5	5.5	3.0		2.9	4.5	3.7
820	Elg. Marakwet	146.3		158.6	152.4	328.9		299.6	314.2			3.7	3.7	5.9			5.9
830	Nandi	341.3		386.2	363.8	61.5		66.5	64.0								
840	Samburu	154.7	146.4	165.4	155.5	415.3	460.0	478.0	451.1	13.6	13.2	15.3	14.0	10.4	5.8		8.1
850	Turkana	210.0	197.3	298.6	235.3	1800.0	1446.3	2169.8	1805.4		102.1		102.1		54.1		54.1
860	West Pokot	180.0	124.2	205.0	169.7	296.5	133.5	370.0	266.7		0.5		0.5		1.2		1.2
910	Bungoma	287.0		302.0	294.5	108.4		97.4	102.9								
920	Busia	156.0		157.3	156.6	81.8		67.1	74.4					0.1			0.1
930	Kakamega	441.7		445.6	443.6	97.8		13.4	55.6								
	Total	9817.9	2902.1	12800.0	11255.0	13659.7	6547.4	17862.4	15066.7	565.6	586.5	678.8	695.7	272.7	110.9	359.6	320.2

Source: *1=Ref.F.3,*2=Ref.F.11,*3=Ref.F.19

Table 3.3.2. Average Live-weight

Herd Composition	Grade Cattle Proportion (%)	Grade Cattle Live-weight (kg)	Local Cattle Proportion (%)	Local Cattle Live-weight (kg)	Sheep Goat Live-weight (kg)	Camel Live weight (kg)
Bull	2	400	2	280		
Cow	45	320	28	220		
Heifer	17	240	25	160		
Heifer Calves	14	140	10	100		
Bull Calves	11	140	10	100		
Steer	11	240	25	160		
Average Live-weight		254		167	30	300
LU/head		0.56		0.37	0.07	0.67

Source: Ref.F.19

Table 3.3.3. Present Livestock Water Demand

Subbasin	Demand	Subbasin	Demand	Subbasin	Demand	Subbasin	Demand	Subbasin	Demand	Subbasin	Demand
1AA	7.40	1FD	17.34	2AA	28.64	3AA	5.14	4AA	8.05	5AA	21.24
1AB	5.69	1FE	22.22	2AB	25.33	3AB	15.11	4AB	10.47	5AB	9.32
1AC	3.05	1FF	8.47	2BA	9.40	3AC	7.31	4AC	6.94	5AC	9.02
1AD	7.80	1FG	35.84	2BB	11.29	3BA	11.22	4AD	7.53	5AD	4.73
1AE	1.76	1GA	15.60	2BC	26.75	3BB	5.74	4BA	5.68	5BA	2.97
1AF	10.14	1GB	19.70	2BD	40.33	3BC	11.54	4BB	4.57	5BB	6.67
1AG	9.03	1GC	32.86	2CA	9.59	3BD	7.49	4BC	5.44	5BC	18.89
1AH	12.45	1GD	26.59	2CB	32.40	3CB	9.74	4BD	13.31	5BD	7.72
1BA	13.65	1GE	13.84	2CC	53.29	3DA	7.80	4BE	13.05	5BE	14.40
1BB	16.74	1GF	8.56	2D	49.84	3DB	5.74	4BF	9.20	5CA	12.96
1BC	14.26	1GG	14.80	2EA	6.40	3EA	7.01	4BG	6.64	5CB	6.90
1BD	18.56	1HA	28.12	2EB	9.15	3EB	6.34	4CA	12.66	5CC	6.64
1BE	26.89	1HB	25.08	2EC	13.86	3EC	5.46	4CB	7.67	5DA	29.66
1BG	22.32	1HC	22.10	2ED	5.62	3ED	4.49	4CC	17.09	5DB	9.70
1BH	14.66	1HD	23.80	2EE	4.60	3FA	81.87	4DA	14.94	5DC	9.94
1CA	17.62	1HE	23.15	2EF	2.94	3FB	28.17	4DB	9.72	5DD	5.38
1CB	17.83	1HF	10.92	2EG	6.66	3G	33.54	4DC	4.19	5EA	67.17
1CC	17.90	1HG	3.77	2EG	11.84	3HA	2.52	4DD	5.21	5EB	84.86
1CD	18.34	1JA	23.31	2EH	4.77	3HB	6.78	4DE	6.29	5EC	84.26
1CE	7.02	1JB	10.00	2EJ	11.45	3HC	7.78	4EA	11.39	5FA	83.64
1DA	14.80	1JC	12.37	2EK	4.45	3HD1	1.65	4EB	17.47	5FB	37.08
1DB	18.28	1JD	8.46	2FA	10.30	3HD2	1.04	4EC	7.07	5G	63.98
1DC	10.96	1JE	28.94	2FB	2.56	3HD3	1.11	4ED	19.19	5H	33.48
1DD	9.60	1JF	39.76	2FC	26.91	3J	7.83	4FA	30.32	5J	77.63
1EA	13.15	1JG	13.00	2GA	6.67	3K	34.22	4FB	40.78		
1EB	11.27	1KA	20.59	2GB	22.42	3L	20.71	4GA	13.93		
1EC	6.82	1KB	105.80	2GC	18.16	3MA	21.55	4GB	16.78		
1ED	4.38	1KC	50.18	2GD	20.61	3MB	10.62	4GC	5.13		
1EE	15.77	1LA	25.22	2H	88.29	3MC	7.89	4GD	33.66		
1EF	12.08	1LA	17.32	2J	72.92	3MD	8.04	4GE	42.62		
1EG	21.64	1LA	43.97	2KA	83.78	3N	27.04	4GF	17.04		
1FA	6.17	1LB	28.85	2KB	24.70			4GG	38.02		
1FB	14.58	1LB	43.75	2KC	24.05			4HA	18.47		
1FC	10.60							4HB	20.45		
								4JA	41.44		
								4JB	12.04		
								4KA	28.04		
								4KB	33.02		
Total			1257.47		769.95		412.46		615.51		708.25

Table 3.6.1 Chronology of Flood Events

Year	Lake Victoria Basin						Rift Valley Basin			Athi River Basin			Tana River	Ewaso Ngiro North River	Remarks
	Nzoia River	Yala River	Nyando River	Sondu River	Kuja River	Mara River	Turkwel River	Kerio River	Ewaso South Ngiro River	Athi River	Lumi River	Nairobi River			
1961	●	●	●	●	●	-	-	-	-	◎	○	◎	●	○	Uhuru Rains
1962	-	-	-	○	-	-	-	-	-	-	○	-	-	-	
1963	◎	○	○	○	○	-	-	-	-	-	-	-	◎	-	
1964	○	○	◎	◎	○	-	-	-	-	-	-	-	◎	-	
1965	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1966	-	-	-	-	-	-	-	-	-	-	-	-	○	-	
1967	-	-	-	-	-	-	-	-	-	-	○	-	○	-	
1968	○	◎	○	◎	○	-	-	-	-	-	○	-	◎	○	
1969	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1970	○	-	○	-	-	-	-	-	-	-	○	-	-	-	
1971	-	○	-	-	-	-	-	-	-	-	○	-	○	-	
1972	○	-	○	-	-	-	-	-	-	-	-	-	-	-	
1973	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1974	-	-	○	-	○	-	-	-	-	-	-	-	-	-	
1975	◎	-	-	-	-	-	-	-	-	-	-	-	-	-	
1976	-	-	-	-	-	-	-	-	-	-	○	-	-	-	
1977	◎	○	○	○	○	-	-	-	-	◎	-	◎	○	-	
1978	○	◎	○	-	◎	-	-	-	-	○	○	-	○	-	
1979	-	◎	○	-	-	-	-	-	-	-	-	-	○	-	
1980	-	-	-	-	-	-	-	-	-	-	○	-	-	-	
1981	○	○	-	○	-	-	-	-	-	-	○	-	-	-	
1982	○	○	○	○	○	-	-	-	-	-	○	-	-	○	
1983	○	○	-	-	-	-	-	-	-	-	-	-	-	-	
1984	-	-	-	-	-	-	-	-	-	-	-	-	○	-	
1985	-	○	◎	-	○	-	-	-	-	-	○	-	-	-	
1986	-	-	-	-	-	-	-	-	-	○	-	◎	-	-	
1987	-	-	-	○	-	-	-	-	-	-	○	○	-	-	
1988	○	○	◎	○	○	-	○	-	-	-	-	○	○	○	
1989	-	-	-	-	-	-	-	-	-	-	○	-	○	○	
1990	-	○	○	◎	◎	-	-	-	-	-	-	-	○	-	

Notes :

● : Most serious flood between 1961 and 1990
◎ : Serious floods
○ : Floods causing a certain damage

Table 3.6.2 Flood Condition and Damage by District (1/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
WESTERN PROVINCE									
1. Bungoma District:	Upper Reaches of Nzoia, Sio and Malakisi								
a. Mountain Area of Mt. Elgon	Less	Less; rocky	Less	None	None	None	Less	None	N N
b. Foot Area of Mt. Elgon	- Riverine areas of small rivers, e.g., Bokoli & Mayanga - Almost every year (e.g., 1986) - Some 100m wide (some km2) - Less than 0.5m deep - Lasts a few hours	Slight	Slight	None; no human settlements existing in the riverine areas	Less; less cultivation and only seasonal grazing practiced in the riverine areas	Less; some intakes existing, but barely damaged	Less; A minor bridge washed away in 1986	None	N S
2. Kakamega District:	Middle Reaches of Nzoia and Yala								
a. Whole District; Hilly Land	- Valley bottoms of Nzoia, Yala & thier tributaries (e.g., Edzawa) - Some years (e.g., 1988) - Less than 100m wide (some km2) - Less than 0.5m deep - Lasts a few hours	Slight	Less	None; no human settlements existing in the valley bottoms	Less; less cultivation and only seasonal grazing practiced in the valley bottoms	Less; many intakes existing, but barely damaged	Less; A minor bridge washed away in 1988	None	N S
3. Busia District:	Lower Reaches of Malakisi and Sio, plus Downmost Reaches of Nzoia and Yala								
a. Lower Reaches of Malakisi River	- Riverine areas of Malaba & its tributaries (e.g., Malakisi) - Almost every year (e.g., 1987 & 89) - Some 100m wide (some km2) - Less than 0.5m deep - Lasts a day or more	Slight	Slight	Less; few human settlements existing in the riverine areas	Slight; limited farmlands damaged and gazing affected by floods in the riverine areas	Less; some intakes existing, but barely damaged	Less; A minor bridge washed away in 1987	None	L S
b. Lower Reaches of Sio River	- Riverine areas of Sio & its tributaries - Almost every year - Max. 3km wide (some km2) - Less than 0.5m deep - Lasts a day or more	Slight	Sometimes heavy causing Busia water supply intake	Less; few human settlements existing in the riverine areas	Slight; limited farmlands damaged and gazing affected by floods in the riverine areas	Less; some intakes existing, e.g., pump station for Busia Water Supply, but barely damaged	Less; minor bridges sometimes submerged during high flood	None	L S
c. Downmost Reaches of Nzoia & Yala rivers	- Yala swamp area affected by combination of floods from Nzoia & Yala rivers - Almost every year (e.g., 1982) - About 110km2 (incl. 4.a) - 0.5m to 1m deep - Lasts about a month	Slight; esp., along Nzoia	Slight; esp., at rivermouth of Nzoia & Yala Swamp	Serious; villages along both banks of Nzoia inundated/damaged by floods, causing human transfer to higher places, and sometimes life lost	Slight; farmlands along both banks of Nzoia damaged by floods (main crops damaged are rice and maize), and some livestocks lost	None; no intakes existing	Serious; many roads & bridges submerged and sometimes damaged, causing isolation of human settlements	16km dikes on both banks of Nzoia R. downstream of Luambwa Br.	M L

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (2/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
NYANZA PROVINCE									
4. Siaya District:	Lower Reaches of Nzoia and Yala, plus Small rivers in the South								
a. Lower Reaches of Nzoia & Yala rivers	- Yala swamp area affected by combination of floods from Nzoia & Yala rivers - Almost every year (e.g., 1982) - About 110km2 (incl. 3.c) - 0.5m to 1m deep - Lasts about a month	Slight; esp., along Nzoia	Slight; esp., at Yala Swamp	Slight; villages on left bank of Nzoia sometimes inundated by floods	Serious; farmlands in/ around Yala Swamp, esp., Yala Swamp Farm-Area 1, damaged by floods, and livestocks lost	Less; there are intakes of Bunyala Irr. Scheme on Nzoia and of Yala Swamp Farm on Yala, but barely damaged	Slight; farm roads submerged and sometimes damaged	A 9km dike on right bank of Yala River, a part of which was breached in 1988	M L
b. Hilly Land	- Valley bottoms of Nzoia, Yala & thier tributaries - Almost every year - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts a few hours	Slight; esp., along Nzoia	Less	None; no human settlements existing in the valley bottoms	Less; limited farmlands in the valley bottoms sometimes damaged by floods	Less; intakes sometimes submerged	Less; minor bridges submerged and sometimes damaged	None	N S
5. Kisumu District:	Middle / Lower Reaches of Nyando and Sondu, plus small rivers in the Northeast								
a. Lower Reaches of Nyando River	- Kano Plain affected by the floods from Nyando as well as other small rivers: Kibos, Luanda, Ombeyi, Miriu, Nyaidho and Awach Kano - Almost every year (e.g., 1961, 82 & 88) - About 200km2 - 0.5m to 1m deep - Lasts about a week	Slight	Slight	Serious; towns/villages in Kano Plain, esp., Ahero Town, inundated/ damaged by floods, causing human transfer to higher places, and sometimes life lost	Serious; farmlands damaged and grazing affected by floods in Kano Plain (main crops damaged are rice, sugar-cane, maize & cotton)	Slight; intakes on Nyando submerged, but barely damaged (there are intakes of Ahero Pilot Sch. & S.W. Kano Irr. Project)	Serious; minor roads/bridges submerged and sometimes damaged (however truck roads are rarely affected)	2km dikes on both banks along Nyando downstream of Ahero Bridge	H L
b. Lower Reaches of Sondu River	- Rivermouth of Sondu on right bank (Lower Kadianga area) - Almost every year (esp.,1990) - About 10km2 (incl. 6.a) - 0.5m to 1m deep - Lasts about a week	Slight	Slight	Serious; villages/human settlements in Lower Kadianga area inundated/ damaged by floods, causing human transfer to higher places	Slight; limited farmlands in Lower Kadianga area damaged by floods, and livestocks lost	None; no intakes existing	Slight; community roads/bridges submerged and sometimes damaged (however the truck road to Kundu Bay is not affected)	None	M M
c. Mountain Slope Zone	Less	Serious	Slight	None	Less	Less	Less	None	N N
6. South Nyanza District:	Middle / Lower Reaches of Sondu, Awach Tende and Kuja, plus Lambwe River								
a. Lower Reaches of Sondu River	- Rivermouth of Sondu on left bank (Kobala area) - Almost every year (esp., 1990) - About 10km2 (incl. 5.b) - 0.5m to 1m deep - Lasts about a week	Slight	Slight	Serious; villages/human settlements in Kabola area inundated/damaged by floods, causing human transfer to higher places	Slight; limited farmlands in Kabola area damaged by floods, and livestocks lost	None; no intakes existing	Slight; community roads/bridges submerged and sometimes damaged (however the truck road to Kundu Bay is not affected)	None	M M

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (3/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
b. Lower Reaches of Awach Tende	- Rivermouth of Awach Tender - Almost every year (e.g., 1987 & 88) - Less than km2 - Less than 0.5m deep - Lasts about a week	Slight	Slight	Less; few human settlements existing in the rivermouth	Less; limited farmlands in the rivermouth sometimes damaged by floods	None; no intakes existing	Slight; the truck road to Homa Bay submerged/damaged	None	L S
c. Lower Reaches of Lambwe River	- Riverine area of Lambwe River - Almost every year - About some km2 - Less than 0.5m deep - Lasts about a week	Slight	Slight	None; no human settlements existing in the riverine area	Less; less cultivation and only seasonal grazing practiced in the riverine area	Less; few intakes existing	Slight; the truck road to Mbita submerged/damaged	None	L S
d. Lower Reaches of Kuja	- Rivermouth of Kuja (Central & South Kaden area) - Almost every year (esp., 1990) - About 25km2 - Less than 0.5m deep - Lasts about a month	Slight	Slight	Serious; human settlements in Central Kaden area inundated/ damaged by floods, *causing human transfer* to higher places and sometimes life lost	Slight; farmlands damaged and grazing affected by floods in Central Kaden area	Less; few intakes existing	Slight; main roads submerged and sometimes damaged	None	M M
e. Hilly Land	Less	Slight	Less	None	Less	Less	Less	None	N N
7. Kisii District:	Upper Reaches of Kuja and Awach Tende, plus small tributaries of Sondu								
a. Whole District; Hilly Land	- Valley bottoms of small rivers - Almost every year - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts a few hours	Slight	Less	None; no human settlements existing in the valley bottoms	Less; limited farmlands in the valley bottoms sometimes damaged by floods	Less; intakes sometimes submerged, but barely damaged	Less; minor bridges submerged and sometimes damaged	None	N S
RIFT VALLEY PROVINCE									
8. Trans Nzoia District:	Upper Reaches of Nzoia								
a. Mountain Areas of Mt. Elgon & Cherangan Hill	Less	Less	Less	None	Less	None	Less	None	N N
b. Highland Area in between	- Riverine areas of small rivers, e.g., *Nzoia & Koitobos rivers* - Almost every year - Max. 1km wide (some km2) - Less than 0.5m deep - Lasts a few days	Slight	Slight	Less; few human *settlements existing* in the riverine areas	Less; limited farmlands in the riverine areas damaged by floods	Less; many intakes existing and Kitale Town Water Supply sometimes stopped by floods	Less; minor bridges submerged and sometimes damaged	None	N S

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (4/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
9. Uasin Gishu District:	Upper Reaches of Nzoia, and Upmost Reaches of Yala and Nyando								
a. Mountain Area of Mt. Londiani	Less	Less	Less	None	Less	None	Less	None	N N
b. Highland Area	- Riverine areas of small rivers, e.g., Sosiani River - Almost every year - Some 100m wide (some km2) - Less than 0.5m deep - Lasts a few days	Less	Less	None; no human settlements existing in the riverine areas	Less; less cultivation and only seasonal grazing practiced in the riverine areas	Less; many intakes existing, but barely damaged	Less; minor bridges sometimes submerged, but barely damaged	None	N S
10. Nandi District:	Upper Reaches of Nzoia, Yala and Nyando								
a. Whole District; Highland Area	- Riverine areas of small rivers, e.g., Kimondi River - Some years - Some 100m wide (some km2) - Less than 0.5m deep - Lasts a few days	Slight	Slight	None; no human settlements existing in the riverine areas	Less; less cultivation and only seasonal grazing practiced in the riverine areas	Less; many intakes existing and Nandi Hills & Lelemoko water supplies affected by floods	Less; minor bridges sometimes submerged, but barely damaged	None	N S
11. Kericho District:	Upper Reaches of Nyando, Sondu and Mara								
a. Whole District; Mountain Area	- Valley bottoms of small rivers, e.g., Nyando & Kipsonoi - Some years (e.g., 1988 & 90) - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts a few hours	Less	Less; basin well covered with vegitation	None; no human settlements existing in the valley bottoms	Less; limited farmlands in the valley bottoms sometimes damaged by floods	Less; many intakes existing, but barely damaged	Less; minor bridges submerged and sometimes damaged (A minor bridge washed away in either 1988 or 90)	None	N S
12. Nakuru District:	Upper Reaches of Molo, and Lake Basins of Nakuru, Elmentaita and Naivasha, plus Upmost Reaches of Sondu								
a. Escarpment Zones on Both Sides of Rift Valley	Less	Slight	Less	None	Less	None	Less	None	N N
b. Bottom Plains of Rift Valley	- Rivermouth of Malewa flowing into Lake Naivasha - Some years (e.g., 1961) - About 5km2 - Less than 0.5m deep - Lasts a few days	Slight	Slight	None; no human settlements existing in the rivermouth	Slight; limited farmlands damaged and grazing affected by floods in the rivermouth	Less; some intakes existing, but barely damaged	Less; minor bridges sometimes submerged and drifts unpassable	None	L S

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (5/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
13. Baringo District:	Lower Reaches of Molo and Small Tributaries of Kerio, plus Lagas								
a. Whole District; Bottom Plains of Rift Valley	- Rivermouth of Molo flowing into Lake Baringo - Almost every year - Some km2 - Less than 0.5m deep - Lasts a few days	Slight	Slight; making tarbid the Baringo lake water	None; no human settlements existing in the rivermouth	Slight; limited farmlands in the rivermouth damaged by floods	Less; many intakes existing and Seretimini W.S. intake on Ndau R. swept away in 1988	Less; drifts unpassable	None	L S
14. Elgeyo-Marakwet District:	Small Tributaries of Kerio								
a. Whole District; Elgeyo Escarp. zone	Less	Slight	Serious	None	Less	Less	Less; drifts unpassable	None	N N
15. West Pokot District:	Upper Reaches of Turkwel and Small Tributaries of Kerio								
a. Whole District; Mountain Area	- Parts of riverine areas of Suam & Weiwei - Some years (e.g., 1984, 85 & 87) - Some 10m wide (Less than km2) - Less than 0.5m deep - Lasts a few hours	Slight	Less	Less; few human settlements existing in the riverine areas	Less; limited farmlands in the riverine areas sometimes damaged by floods	Less; few intakes existing	Less; drifts unpassable and a bridge washed away in 1985	None	N S
16. Turkana District:	Lower Reaches of Turkwel and Kerio, plus Some Lagas								
a. Midle/Lower Reaches of Turkwel River	- Riverine areas of Turkwel, esp. upstream of Katilo - Some years (e.g., 1988) - Some 100m wide on either bank (about 15km2) - Less than 0.5m deep - Lasts a few days	Slight	Slight	None; no human settlements existing in the riverine areas	Slight; limited farmlands in the riverine areas sometimes damaged by floods (there are irr. schemes at Katilo, Juluk & Nakwamoru)	Less; some intakes existing, but barely damaged	Less; drifts unpassable	None	L M
b. Lower Reaches of Kerio River	- Riverine areas of Kerio - Some years - Some 10m wide on either bank (some 10km2) - Less than 0.5m deep - Lasts about a week	Slight	Slight	None; no human settlements existing in the riverine areas	Less; less cultivation and only nomadic grazing practiced in the riverine areas	Less; few intakes existing	Less; drifts unpassable	None	N M
c. Other ASAL Area	Less	Less	Less	None	Less	None	Less; drifts unpassable	None	N N

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (6/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
17. Laikipia District:	Upper Reaches of Ewaso Ngiro North								
a. Whole District; Highland Area	Less	Slight	Slight	None	Less	Less	Less; drifts unpassable	None	N N
18. Samburu District:	Middle Reaches of Ewaso Ngiro North, and Lagas								
a. Whole District; Hilly Land	Less	Slight	Slight	None	Less	Less; some intakes damaged	Less; drifts unpassable	None	N N
19. Narok District:	Ewaso Ngiro South, Middle / Lower Reaches of Mara, and Upper Reaches of Kuja (Migori)								
a. Whole District; ASAL Area	Less	Slight	Slight	None	Less	Less	Less; drifts unpassable	None	N N
20. Kajiado District:	Lower Reaches of Ewaso Ngiro South, Lake Basins of Magadi and Amboseli, plus Upper Reached of Athi, Kiboko and Tsavo								
a. Whole District; ASAL Area	Less	Slight	Slight	None	Less	Less	Less; drifts unpassable	None	N N
CENTRAL PROVINCE									
21. Kiambu District:	Upper Reaches of Athi								
a. Mountain Area of Nyandarua Mountains	Less	Less; rocky	Less	None	Less	Less	Less	None	N N
b. Foot Area of Nyandarua Mountains	- Valley Bottoms of small rivers, e.g., Ruiru - Almost every year - Some 10m wide (Less than km2) - Less than 0.5m deep - Lasts a few hours	Slight	Slight	None; no human settlements existing in the valley bottoms	Less; limited farmlands in the valley bottoms sometimes damaged by floods	Less; many intakes existing, but barely damaged	Less; minor bridges sometimes submerged, but barely dameged	None	N S
22. Muranga District:	Upper Reaches of Tana								
a. Mountain Area of Nyandarua Mountains	Less	Less; rocky	Less	None	Less	Less	Less	None	N N
b. Foot Area of Nyandarua Mountains	- Valley Bottoms of small rivers, e.g., Saba Saba & Muragua - Almost every year (e.g., 1987 & 88) - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts about a day	Slight	Slight	None; no human settlements existing in the valley bottoms	Less; limited farmlands in the valley bottoms damaged by floods	Slight; intake weirs damaged in 1988 & 90	Slight; minor bridges damaged in 1987 & 88	None	L S

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (7/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
23. Kirinyaga District:	Upper Reaches of Tana								
a. Mountain Area of Mt. Kenya	Less	Less; rocky	Less	None	Less	Less	Less	None	N N
b. Foot Area of Mt. Kenya	- Riverine areas of small rivers, e.g., Thiba & Ragati - Almost every year (e.g., 1987 & 88) - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts about a day	Slight	Slight	None; no human settlements existing in the riverine areas	Less; limited farmlands in the riverine areas damaged by floods (there are Mwea Irr. Scheme)	Less; some intakes existing, but barely damaged (Sedimentation takes place)	Less; minor bridges sometimes submerged, but barely dameged	None	N S
24. Nyeri District:	Upper Reaches of Tana								
a. Whole District; Mountain Area	Less	Slight	Less	None	Less	Less; many intakes existing, but barely damaged	Less	None	N N
25. Nyandarua District:	Upper Reaches of Malewa and Upmost Reaches of Ewaso Ngiro North								
a. Whole District; Highland Area	- Swampy area of Lake Ol Bolossat - Some years (e.g., 1961 & 85) - Less than 10km2 - 0.5m to 1m deep - Lasts a few weeks	Less; rocky	Less	Slight; some human settlements forced to be relocated	Less; less cultivation and only seasonal grazing practiced in the swampy area	less; few intakes existing	Less; minor bridges sometimes submerged, but barely dameged	None	L S
26. NAIROBI:	Upper Reaches of Athi								
a. Whole Province; Highland Area	- Valley bottoms of small rivers: Nairobi & Ngong, due to narrow sections of bridges/culverts - Some years (esp., 1977, 86 & 88) - Some 10m wide (less than km2) - 0.5m to 1m deep - Lasts a few hours	Less	Less	Serious; some houses in the valley bottoms inundated/damaged, and sometimes life lost	Less; less cultivation practiced in the valley bottoms	less; few intakes existing	Serious; floodwaters restricted by bridges/culverts overflowing main roads, causing traffic interruption	Revetment in Nairobi & Ngong rivers, damaged in places by 1988-flood	M S
EASTERN PROVINCE									
27. Embu District:	Upper Reaches of Tana								
a. Mountain Area of Mt. Kenya	Less	Less; rocky	Less	None	Less	Less	Less	None	N N
b. Highland Area	- Riverine areas of small rivers, e.g., Thiba & Ena - Some years (e.g., 1988) - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts a few hours	Slight	Slight	None; no human settlement existing in the riverine areas	Less; less cultivation and only seasonal grazing practiced in the riverine areas	Less; A part of intake weir for Ena Water Supply washed away	Slight; minor bridges washed away, and many submerged in 1988	None	L S

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (8/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
28. Meru District:	Upper Reaches of Tana and Ewaso Ngiro North								
a. Mountain Area of Mt. Kenya	Less	Less; rocky	Less	None	Less	Less	Less	None	N N
b. Highland Area	- Riverine areas of small rivers, e.g., Kazita & Mutonga, flowing into Tana - Almost every year (e.g., 1984, 88 & 89) - Some 10m wide (less than km2) - Less than 0.5m deep - Lasts a few hours	Slight	Less; Mt. Kenya well covered with forest	None; residents in Igarie sometimes forced to transfer to higher places	Less; limited farmlands, e.g., Kajuwa Irr. Scheme, sometimes damaged by floods	Less; an intake (under construction) damaged in 1989	Less; A minor bridge washed away in 1984	None	N S
29. Isiolo District:	Middle Reaches of Ewaso Ngiro North, and Upper Reaches of Tana								
a. Whole District; ASAL Area	- Riverine area of Ewaso Ngiro N. - Almost every year (e.g., 1983, 88 & 89) - About 10km wide - Less than 0.5m deep - Lasts about a month	Less	Slight	Less; few human settlement existing in the riverine area	Less; limited farmlands, e.g., Makadaka Irr. Scheme, sometimes damaged by floods	Less; few intakes existing	Less; bridges & culverts sometimes damaged	None	N L
30. Marsabit District:	Some Lagas								
a. Whole District; ASAL Area	Less	Less	Less	None	Less	Less	Less; Marsabit road unpassable at Sololo, Laisamis & Logo Logo	None	N N
31. Machakos District:	Middle Reaches of Athi								
a. Whole District; ASAL Area	Less	Slight	serious; at Thwake R.	None	Less	Less	Less; drifts unpassable	None	N N
32. Kitui District:	Middle Reaches of Tana								
a. Whole District; ASAL Area	Less	Slight	Slight; esp., in lagas	None	Less	Less	Less; drifts unpassable	None	N N
NORTH EASTERN PROVINCE									
33. Mandera District:	River Daua and Some Lagas								
a. Whole District; ASAL Area	- Parts of riverine area of Daua on right bank - Some years - Less than km2 - Less than 0.5m deep - Lasts about a week	Slight	Slight	Less; few human settlements existing in the riverine areas	Slight; limited farmlands in the riverine areas damaged by floods	Less; some intakes existing, but barely damaged	Less; drifts unpassable	Small/short dikes around three irr. schemes	L S

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (9/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
34. Wajir District:	Lower Reaches of Ewaso Ngiro North, and Some Lagas								
a. Whole District; ASAL Area	- Riverine area of Ewaso Ngiro North on left bank - Almost every year - About 5km wide on left bank - Less than 0.5m deep - Lasts about a month	Less	Slight	None; no human settlement existing in the riverine area	Less; less cultivation and only nomadic grazing practiced in the riverine area	Less; few intakes existing	Less; drifts unpassable	None	N L
35. Garissa District:	Lower Reaches of Ewaso Ngiro North and Tana, plus Lagas flowing into Indian Ocean								
a. Lower Reaches of Ewaso N'giro North and Small River Basins	- Riverine area of Ewaso Ngiro North on right bank - Almost every year - About 5km wide on right bank - Less than 0.5m deep - Lasts about a month	Less	Slight	None; no human settlement existing in the riverine area	Less; less cultivation and only nomadic grazing practiced in the riverine area	Less; few intakes existing	Less; drifts unpassable	None	N L
b. Middle Reaches of Tana River	- Riverine area of Tana River on left bank - Some years - About 100m wide on left bank (About 2,000km2 incl. 36.a) - Less than 0.5m deep - Lasts about a month	Serious; banks at concaved portions eroded annually 5m on average, leaving oxbow lakes	Serious; local deposition	Less; human settlements, generally located on natural dikes, barely inundated by floods	Slight; farmlands, e.g., in ADC Farm, eroded by floods	Slight; high cost maintenance due to bank erosion and sedimentation (turbidity of river water is also problem)	Slight; drifts un-passable, sometimes damaged, in lagas joining to Tana	Riprap works at Garissa	L L
COAST PROVINCE									
36. Tana River District:	Lower Reaches of Tana								
a. Whole District; ASAL Area	- Riverine areas of Tana - Some years (e.g., 1961, 88, 89 & 90) - About 5km wide on either bank (About 2,000km2 incl. 35.b) - Less than 0.5m deep - Lasts about a month	Serious; banks at concaved portions eroded annually 5m on average, leaving oxbow lakes	Serious; local deposition	Less; human settlements, generally located on natural dikes, barely inundated by floods (Garsen Village and other human settlements inundated only by 1961-flood)	Slight; limited farmlands inundated and eroded by floods	Slight; costly maintenance due to bank erosion, sedimentation and change of river course as observed at Hola and Bura irr. schemes	Slight; traffic interruption due to overflowing of lagas, and Bura new bridge threatened by change of river course	Dike around Lower Tana Irr. Scheme, and ripraps at Hola & Garissa	L L
37. Lamu District:	Lagas flowing into Indian Ocean								
a. Whole District; ASAL Area	Less; brackish water intrusion, however, observed in rivers	Less	Less	None	Less	Less	Less; difts unpassable	None	N N

* Refer to Table 3.5.3

Table 3.6.2 Flood Condition and Damage by District (10/10)

Area	Flood Condition			Flood Damage				Existing Counter-measures	Category *
	Flooding	Bank Erosion	Sedimentation	Housing	Farmland / Grazing	Intake Facilities	Road / Bridge		
38. Taita-Taveta Dist.:	Middle Reaches of Athi, Upper Reaches of Voi, and Lower Reaches of Lumi								
a. Whole District; ASAL Area	- Rivermouth of Lumi near L. Jipe - Almost every year (e.g., 1987 & 89) - About 30km2 - 0.5m to 1m deep - Lasts about a week	Slight	Slight	Slight; some human settlements in the rivermouth damaged by floods	Serious; farmlands in the rivermouth, esp., at Kimorigo Irr. Scheme, damaged by floods	Slight; some intakes damaged by floods	Slight; minor roads/bridges damaged	Dikes on right bank of Lumi with short distances, damaged in places	M M
39. Kilifi District:	Lower Reaches of Athi, Voi (Rare) and Tana, plus Small Rivers, all flowing into Indian Ocean								
a. ASAL Area	Less	Less	Less	None	Less	Less	Less	None	N N
b. Coastal Area	- Riverine areas of Athi - Some years (e.g., 1961) - Some 100m wide (About 15km2) - Less than 0.5m deep - Lasts about a month	Slight	Serious; Athi riverbed gradually rising	Less; few human settlements existing in the riverine areas	Less; less cultivation and only seasonal grazing practiced in the riverine area	Slight; Baricho intake silted (turbidity of river water also problem)	Less; B-8 road br., however, washed away by 1961-flood	None	L M
40. Kwale District:	Small Rivers flowing into Indian Ocean								
a. ASAL Area	Less	Less	Less	None	Less	Less	Less	None	N N
b. Coastal Area	Less	Less	Slight; many dams filled with sand	None	Less	Less; intakes sometimes damaged	Less	None	N N
41. Mombasa Municipality:	No Particular Rivers								
a. Whole Municipality; Coastal Area	Less; Inundation, however, takes place due to poor drainage systems	Less	Less	None	Less	Less	Less	None	N N

* Refer to Table 3.5.3

Table 3.6.3 Categorization of Flood Areas

Damage	Flood Area per Place	Large (more than 50km2)	Medium (10km2 to 50km2)	Small (less than 10km2)	Nil
High		HL : 1 place - Kano Plain in Kisumu District	HM : None	HS : None	HN : None
Mid		ML : 1 place - Yala Swamp in Busia & Siaya districts	MM : 3 places - Sondu Rivermouth in Kisumu & South Nyanza districts - Kuja Rivermouth in South Nyanza District - Lumi Rivermouth in Taita-Taveta District	MS : 1 place - Nairobi City in Nairobi Province	MN : None
Low		LL : 1 place - Lower Tana in Tana River & Garissa districts	LM : 2 places - Middle/Lower Turkwel in Turukana District * - Downmost Athi in Kilifi District	LS : 10 places - Lower reaches of Malakisi, Sio, Awach Tende, Lambwe, Malewa, Molo & Daua rivers - Parts of Muranga, Nyandarua & Embu districts	LN : None
Negligible		NL : 1 place - Middle/Lower Ewaso Ngiro North in Garissa, Wajir & Isiolo districts	NM : 1 place - Lower Kerio in Turukana District	NS : 12 places - Riverine areas/valley bottoms in upper reaches	NN : 26 places - Small streams in mountain areas - Lagas in the ASAL area

* Damage only recorded at the katilo, Juluk and Nakwamoru irrigation schemes in the Middle Turkwel.

Note: HL, etc. are the abbreviations for categorizing flooded areas, which are also filled in the column "Category" of Table 3.5.2

Table 3.6.4 Features of Taget Areas, Basic Methods and Protection Levels (1/2)

Target Area	Relevant Districts	Human Activities/Land Use in Flooded Area (Agricultural Potential)	Problem Identified	Target River/Stretch			Basic Method of Structural Measure	Protection Level	Design Discharge	Catchment Area	Specific Discharge
				River Name	Stretch(km) /Gradient	Length (km)		(year)	(m3/s)	(km2)	(m3/s/km2)
Yala Swamp	- Busia - Siaya	Rather intensive agriculture with livestock farming & fishery. There are Bunyala Pilot Irr. Scheme & Yala Swamp Farm - Area I. Considerable number of human settlements along Nzoia River. (High)	Flooding from Nzoia & Yala rivers	Nzoia	0 - 18 (1/3,400)	18	- Rihabilitation of existing dikes with construction of a drainage sluice (16km) - Construction of new dikes (2km)	25	1,070 (Control point : 1EE1)	11,849	0.090
				Yala	2 - 16 (1/2,700)	14	- Heightening of existing dike (9km) - Construction of a new dike on the right bank with a drainage sluice (14km) - Construction of a bridge	25	370 (Control point : 1FG2)	2,864	0.129
Kano Plain	- Kisumu	Intensive agriculture with livestock farming. There are Ahero Pilot and West Kano irrigation schemes. A lot of human settlements. (High)	Flooding from Nyando River together with Kibos, Luando, Ombeyi, Miriu, Nyaidho & Awach Kano rivers	Nyando	10 - 30 (1/700)	20	- Rihabilitation/heightening of existing dikes (2km) - Construction of new dikes (18km) - Re-construction of Ahero Bridge	25	590 (Control point : 1GD3)	2,625	0.225
				Kibos	0 - 10 (1/450)	10	- Construction of new dikes (10km) - Re-construction of two bridges	25	55 (Control point : Rivermouth)	274	0.201
				Luando	0 - 24 (1/700)	24	- Construction of new dikes with two closing sluices (24km) - Re-construction of four bridges	25	65 (Control point : Rivermouth)	440	0.148
				Ombeyi	-	-	- No measure. Only for usual drainage.	-	-	-	-
				Miriu	-	-	- No measure. Only for usual drainage.	-	-	-	-
				Nyaidho	0 - 12 (1/600)	12	- Construction of new dikes (12km) - Re-construction of a bridge	25	55 (Control point : Immediately upstream of confluence with Awach Kano River)	255	0.216
				Awach Kano	0 - 5 (1/400)	5	- Construction of new dikes (5km) - Re-construction of a bridge	25	60 (Control point : Immediately upstream of confluence with	364	0.165

Table 3.6.4 Features of Taget Areas, Basic Methods and Protection Levels (2/2)

Target Area	Relevant Districts	Human Activities/Land Use in Flooded Area (Agricultural Potential)	Problem Identified	Target River/Stretch			Basic Method of Structural Measure	Protection Level	Design Discharge	Catchment Area	Specific Discharge
				River Name	Stretch(km) /Gradient	Length (km)		(year)	(m3/s)	(km2)	(m3/s/km2)
Sondu Rivermouth	- Kisumu - South Nyanza	Subsistence agriculture, grazing & fishery. Some human settlements. (Mid)	Flooding from Sondu River	Sondu	1 - 8 (1/500)	7	- Construction of new dikes (7km)	25	500 (Control point : 1JG1)	3,287	0.152
Kuja Rivermouth	- South Nyanza	Subsistence agriculture, grazing & fishery. Considerable number of human settlements. (Mid)	Flooding from Kuja River	Kuja	1 - 11 (1/900)	10	- Construction of new dikes (10km)	25	850 (Control point : 1KB5)	6,600	0.129
Middle Tukwel	- Turkana	Grazing and limited farming at Katilo, Juluk & Nakwamoru irr. schemes. Few human settlements. (Low)	Flooding from Turkwel River in parts	Turkwel	177 - 209 (1/570)	32	- Construction of three polders each with a intake sluice (11km for Katilo, 5km for Juluk and 7km for Nakwamoru irrigation schemes)	10	32 (Control point : Immediately downstream of confluence with Malmalte River)	7,014	0.046
Downmost Athi	- Kilifi	Grazing and limited farming. Few human settlememts. (Mid)	Flooding from Athi River	Athi	9 - 29 (1/1,400)	20	- Construction of new dikes (20km)	10	1,590 (Control point : Rivermouth)	36,903	0.043
Lumi Rivermouth	- Taita-Taveta	Rather intensive agriculture with livestock farming. There is Kimorigo Irr. Scheme. Considerable number of human settlements. (High)	Flooding from Lumi River	Lumi	10 - 21 (1/400)	11	- Construction of new dikes with two intake sluices (11km) - Re-construction of a bridge	25	160 (Control point : 3J15C)	448	0.357
Nairobi City *	- Nairobi Province	A lot of housings with roads, bridges, culverts & service pipes. Less agriculture (urban area).	Flooding due to narrow sections of bridges/ culverts	)bi River, Ngong River nd their tributaries)			- Enlargement of existing bridges/culverts (13 sites) - Channel works immediately up/down-strean of bridges/culverts (11 sites)	50 (without dike, for bridge)	(Variable by location.)		
Lower Tana	- Tana River - Garissa	Grazing and limited farming. There are Tana Delta Irr. Scheme, Hola/Bura irr. projects & ADC Farm. A few human settlements located on natural dikes barely inundated. (Mid to Low)	Bank erosion at concave portions near villages, intakes & bridges	Tana	0 - 650 (1/6,000 to 1/1,500)	650	- Bank protection with groynes/riprap at Ngao, Garsen, Mnazini, Wenje, Hola, Hola Intake, Bura Bridge, Bura Intake, Garissa, ADC Farm Intake, Saka & Mbalambala (35km in total)	10	(Variable by location.)		

* See Ref.2.

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Table 3.7.1 (a) Water Quality of the Nyando River

Parameter	Units	Upper zone Maximum	Upper zone Minimum	Middle zone Maximum	Middle zone Minimum	Lower zone Maximum	Lower zone Minimum
pH	–	8.7	7.1	8.3	6.6	8.6	7.1
Turbidity	NTU	900	5	320	53	2700	10
Colour	mg Pt/l	1000	5	660	15	1000	5
Conductivity	uS/cm	3900	100	1180	140	315	140
Iron	mg/l	6.0	0.1	16.0	0.1	8.0	0.1
Manganese	mg/l	11.0	0.0	5.0	0.2	1.1	0.1
Calcium	mg/l	32.0	6.8	35.0	7.6	36.8	12.6
Magnesium	mg/l	18.0	3.0	50.0	4.0	49.0	3.0
Sodium	mg/l	25.0	16.0	30.0	15.0	27.0	11.8
Total Hardness	mg/l	436	38	242	20	234	4
Tot. alkalinity	mg/l	202	26	164	30	136	66
Chloride	mg/l	60.0	2.0	12.0	1.0	25.0	3.0
Fluoride	mg/l	0.0	4.0	1.5	0.3	0.0	1.0
Nitrate	mg/l	2.7	0.1	2.8	0.1	1.7	0.0
Sulphate	mg/l	119.0	0.3	18.7	0.2	24.0	1.3
Phosphate	mg/l	0.7	0.2	2.0	0.1	0.4	0.1
TDS	mg/l	280	145	270	19	320	84

Source: MOWD data; various dates from 1974-1988.

Table 3.7.1 (b) Water Quality of the Nyando River

Parameter	Unit	Upper zone	Middle zone	Lower zone
pH	---	7.8	7.8	7.7
Colour	mg Pt/l	360	45	25
Turbidity	NTU	46	25	15
Oxygen absorbed	mg/l	40	27	18
Conductivity	uS/cm	297	215	255
Iron	mg/l	0.87	2.10	2.10
Manganese	mg/l	0.02	0.10	0.02
Total hardness	mg/l CaCO3	103	178	88
Total alkalinity	mg/l CaCO3	132	93	114
Chloride	mg/l	6.4	5.3	7.9
Fluoride	mg/l	0.46	0.32	0.52
Sulphate	mg/l	3.0	2.3	0.9
Orthophosphate	mg/l	0.56	0.13	0.14
TDS	mg/l	172	129	120

Source: Ministry of Water Development, NES 1987.
Values given are mean values (1983 - 1984)

Table 3.7.2 Water Quality of the Nzoia River

Parameter	Unit	Upper zone (Kipkareen)	Middle zone (Siranga))	Lower zone (L.Victoria)
pH	---	7.4	7.0	7.7
Colour	mg Pt/l	50	150	30
Turbidity	NTU	12	65	10
Oxygen absorbed	mg/l	28.0	30.0	23.0
Conductivity	uS/cm	125	83	162
Iron	mg/l	---	---	2.5
Manganese	mg/l	0.20	0.10	0.03
Calcium	mg/l	9.4	3.7	12.0
Magnesium	mg/l	4.4	1.8	4.2
Sodium	mg/l	---	---	---
Potassium	mg/l	---	---	---
Total hardness	mg/l CaCO3	37	27	48
Total alkalinity	mg/l CaCO3	56	36	77
Chloride	mg/l	4.0	3.0	12.0
Fluoride	mg/l	0.20	0.17	0.15
Sulphate	mg/l	---	---	2.2
Orthophosphate	mg/l	0.02	0.03	0.03
TDS	mg/l	73	48	97

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.3 Water Quality of the Sondu-Miriu River

Parameter	Unit	Upper zone	Middle zone
pH	---	7.0	7.1
Colour	mg Pt/l	20	10
Turbidity	NTU	8	7
Oxygen absorbed	mg/l	15	12
Conductivity	uS/cm	58	69
Iron	mg/l	0.9	1.2
Manganese	mg/l	0.01	0.01
Calcium	mg/l	3.2	4.0
Magnesium	mg/l	1.0	1.3
Sodium	mg/l	---	---
Potassium	mg/l	---	---
Total hardness	mg/l CaCO3	12	15
Total alkalinity	mg/l CaCO3	21	32
Chloride	mg/l	6.3	7.0
Fluoride	mg/l	0.58	0.45
Sulphate	mg/l	0.8	6.0
Orthophosphate	mg/l	0.03	0.02
TDS	mg/l	35	42

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.4 Water Quality of the Yala River

Parameter	Unit	DAMSITE			KIMONDI			MOKONG		
		MEAN	MAX	MIN	MEAN	MAX	MIN	MEAN	MAX	MIN
Temperature	oC	18.7	20.1	17.2	18.0	20.0	17.5	18.4	20.1	16.5
Conductivity	uS/cm	107	130	90	79	99	55	144	160	130
pH	--	7.8	8.8	7.0	7.4	8.3	6.8	7.4	8.5	6.7
Colour	mg Pt/l	79	110	40	40	78	10	59	112	10
Turbidity	NTU	49	88	22	17	24	12	54	90	28
Dissolved oxygen	mg/l	8.9	10.8	7.3	8.3	9.9	7.1	7.6	8.9	7.1
DO % saturation	%	119	140	100	113	130	96	102	115	96
Carbon dioxide	mg/l	2.8	2.9	ND	3.5	4.0	ND	6.9	9.0	4.5
Alkalinity-total	mg/l	47.3	52.0	35.0	38.1	52.0	21.0	72.3	89.0	66.0
Harness-total	mg/l	41.4	58.0	34.0	24.2	34.0	14.3	57.5	103.6	36.0
Chloride	mg/l	3.4	7.2	<1.0	3.3	8.3	ND	3.4	7.7	1.0
Fluoride	mg/l	0.34	0.62	ND	0.27	0.53	ND	0.43	0.67	0.15
Manganese	mg/l	0.047	0.090	0.020	0.055	0.120	0.020	0.064	0.135	0.030
Iron	mg/l	1.430	2.500	0.700	1.320	2.200	0.680	1.020	2.360	0.560
Ammonia-N	mg/l	0.096	0.280	0.001	0.099	0.220	ND	0.108	0.230	0.022
T.S.S.	mg/l	41.0	76.0	11.0	13.3	31.2	6.1	62.8	149.0	14.2

Source: Ministry of Water Development.
Data : 1985-1986

Table 3.7.5 Water Quality Data for the Arror River (RGS 2C5)

Parameter	Units	Mean	Max	Min
pH	--	7.4	7.9	6.9
Colour	mg Pt/l	17.5	70.0	5.0
Turbidity	NTU	14.2	29.0	1.5
Conductivity	uS/cm	238	420	132
Iron	mg/l	2.1	8.5	0.2
Manganese	mg/l	0.2	0.4	0.1
Calcium	mg/l	17.6	38.0	6.6
Magnesium	mg/l	6.6	11.0	0.4
Sodium	mg/l	8.7	17.0	4.0
Total Hardness	mg/l	79.5	158.0	2.4
Tot. alkalinity	mg/l	88.3	150.0	52.0
Chloride	mg/l	10.8	80.0	2.0
Fluoride	mg/l	0.4	4.0	0.1
Sulphate	mg/l	1.9	6.5	0.1
Phosphate	mg/l	0.02	0.10	0.01
TDS	mg/l	142	252	79

Source: Feasibility Study on the Integrated Development of the Arror River Basin (1990)

Table 3.7.6 Water Quality of the Kerio River

Parameter	Unit	Upper zone	Middle zone
pH	---	7.6	8.0
Colour	mg Pt/l	---	---
Turbidity	NTU	104	76
Oxygen absorbed	mg/l	27	28
Conductivity	uS/cm	145	230
Iron	mg/l	---	---
Manganese	mg/l	---	0.06
Calcium	mg/l	13.0	23.0
Magnesium	mg/l	15.0	5.9
Sodium	mg/l	---	---
Potassium	mg/l	---	---
Total hardness	mg/l CaCO3	81	86
Total alkalinity	mg/l CaCO3	114	102
Chloride	mg/l	3.0	6.0
Fluoride	mg/l	0.50	0.50
Sulphate	mg/l	2.5	---
Orthophosphate	mg/l	0.13	0.23
TDS	mg/l	100	120

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.7 (a) Water Quality Data: Malewa River Basin

Parameter	Units	R.Malewa tributaries above dam		River Malewa			
		River Kimuru	River Olkalou	15 km above damsite	Malewa damsite	13 km below damsite	28 km below damsite
Temperature	oC	14.3	18.0	16.5	15.7	17.0	18.5
pH	--	8.01	7.78	7.95	8.24	8.09	8.08
Colour	mg Pt/l	16	16	16	17	18	18
Turbidity	NTU	14	40	24	25	70	28
Suspended solids	mg/l	13	39	35	25	27	35
Conductivity	uS/cm	110	160	130	130	240	200
Dissolved oxygen	mg/l	8.4	6.8	6.8	7.4	7.2	7.2
COD	mg/l	8	15	4	8	7	10
Total nitrogen	mg/l	2.260	3.391	3.166	2.700	–	3.577
Kjeldhal-N	mg/l	1.05	2.25	2.25	2.70	–	2.55
Ammonia-N	mg/l	–	–	–	–	–	–
Nitrate-N	mg/l	1.20	1.10	0.90	<0.01	0.90	1.00
Nitrite-N	mg/l	0.010	0.041	0.016	<0.001	0.018	0.027
Phosphate-P	mg/l	0.13	0.09	0.04	0.12	0.09	0.10

ND = not detectable
Source: JICA 1990.

Table 3.7.7 (b) Water Quality Data: Malawa Damsite

Parameter	Units	June 15	July 5	July 11	July 17	July 25	MEAN
Temperature	oC	15.7	--	–	–	–	15.7
pH	--	8.24	–	8.27	7.88	8.08	8.08
Colour	mg Pt/l	17	16	--	19	19	18
Turbidity	NTU	25	--	–	–	–	25
Conductivity	uS/cm	130	104	65	71	74	89
Dissolved oxygen	mg/l	7.4	--	–	–	–	7.4
COD	mg/l	8	16	18	65	13	24
Total nitrogen	mg/l	2.700	–	--	–	–	2.7
Kjeldhal-N	mg/l	2.70	–	--	–	–	2.7
Ammonia-N	mg/l	–	0.04	0.05	0.26	0.06	0.10
Nitrate-N	mg/l	<0.01	1.00	0.60	2.00	0.50	0.84
Nitrite-N	mg/l	<0.001	0.017	0.026	0.154	0.005	0.041
Total phosphorus	mg/l	–	0.49	ND	1.54	0.63	0.89
Phosphate-P	mg/l	0.12	0.12	0.21	0.16	0.17	0.16
Suspended solids	mg/l	25	23	36	323	62	94

ND = not detectable
Source: JICA 1990.

Table 3.7.8 Water Quality of the Turkwel River

		Upper zone	Middle zone	Lower zone
pH	---	7.4	7.7	7.7
Colour	mg Pt/l	13	250	500
Turbidity	NTU	4	22	600
Oxygen absorbed	mg/l	4.0	5.5	0.4
Conductivity	uS/cm	78	100	208
Iron	mg/l	0.4	0.9	0.0
Manganese	mg/l	0.10	0.06	0.01
Calcium	mg/l	9.4	14.5	23.0
Magnesium	mg/l	4.4	4.3	0.5
Sodium	mg/l	4.8	5.4	7.5
Potassium	mg/l	2.4	2.7	3.5
Total hardness	mg/l CaCO3	42	53	60
Total alkalinity	mg/l CaCO3	53	76	96
Chloride	mg/l	1.0	1.0	2.0
Fluoride	mg/l	0.21	0.19	2.00
Sulphate	mg/l	4.1	1.0	2.5
Orthophosphate	mg/l	0.53	0.63	0.05
Nitrate	mg/l	0.67	0.75	0.44
TDS	mg/l	40	68	120

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.9 Water Quality of the Athi River

Parameter	Unit	Upper zone (14 Falls)	Middle zone (Kibwezi)	Lower zone (Coast)
pH	---	6.8	7.8	8.0
Colour	mg Pt/l	70	---	90
Turbidity	NTU	20	90	65
Oxygen absorbed	mg/l	35	47	42
Conductivity	uS/cm	245	305	594
Iron	mg/l	2.0	---	---
Manganese	mg/l	0.60	---	---
Calcium	mg/l	8.2	16.0	26.0
Magnesium	mg/l	3.5	8.5	19.0
Sodium	mg/l	58.0	---	---
Potassium	mg/l	9.0	---	---
Total hardness	mg/l CaCO3	45	76	161
Total alkalinity	mg/l CaCO3	64	123	193
Chloride	mg/l	22.0	14.0	63.0
Fluoride	mg/l	0.72	0.53	1.10
Sulphate	mg/l	7.3	6.8	42.0
Orthophosphate	mg/l	0.36	0.23	0.06
TDS	mg/l	147	183	371

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.10 Water Quality of the Tsavo River and Mzima Springs

Parameter	Unit	Tsavo River Upper	Tsavo River Middle	Tsavo River Lower	Mzima Springs Upper	Mzima Springs Lower
pH	--	8.7	8.8	8.2	8.6	8.4
Turbidity	NTU	250	64	2000	0.5	1.6
PV (*)	mg/l	235	391	94	Nil	Nil
Conductivity	uS/cm	820	610	600	600	550
Manganese	mg/l	0.6	0.6	1.6	0.1	0.1
Total hardness	mg/l	174	162	360	105	100
Total alkalinity	mg/l	281	238	259	202	216
Chloride	mg/l	95.9	32.0	22.5	8.5	12.9

(*) = permanganate value
Source: Ref:C36.
Data : April 1980

Table 3.7.11 (a) Water Quality of the Tana River

Parameter	Unit	Upper zone (Masinga dam)	Middle zone (Garsen)	Lower zone (Coast)
pH	---	7.1	8.0	7.7
Colour	mg Pt/l	55	---	---
Turbidity	NTU	28	---	80
Oxygen absorbed	mg/l	25	0	42
Conductivity	uS/cm	77	170	151
Iron	mg/l	2.2	---	---
Manganese	mg/l	0.13	---	0.07
Calcium	mg/l	5.0	20.0	18.0
Magnesium	mg/l	2.5	9.6	10.0
Sodium	mg/l	7.0	---	---
Potassium	mg/l	---	15.0	---
Total hardness	mg/l CaCO3	33.0	90.0	87.0
Total alkalinity	mg/l CaCO3	20.0	216.0	90
Chloride	mg/l	6.6	14.0	6.9
Fluoride	mg/l	0.25	0.25	0.50
Sulphate	mg/l	5.8	5.0	---
Orthophosphate	mg/l	0.04	---	0.07
TDS	mg/l	44	285	91

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.11 (b) Water Quality of Tana Tributary Rivers; 1990.

Parameter	Unit	River Mutonga (4EA6)	Mutonga River (4EA7)	Thanantu River (4F20)	Kazita River (4F18)	Kithenu River	Thingithu River at Mitungu	Thanantu River at Mukothima
pH	---	6.9	6.7	7.8	7.5	8.2	7.7	7.9
Colour	mg Pt/l	brown	brown	brownish	brownish	<5	10	<5
Turbidity	NTU	25	140	50	45	0	10	<5
Conductivity	uS/cm	95	82	180	150	100	100	240
Iron	mg/l	2.6	2.0	1.6	2.0	0.8	0.3	trace
Manganese	mg/l	0.10	0.10	0.20	0.3	0.0	0.0	0.0
Calcium	mg/l	2.2	2.2	11.0	14.0	10.0	6.4	2.4
Ammonia-N	mg/l	0.01	0.00	0.80	0.00	0.00	0.04	0.00
Nitrate-N	mg/l	<0.01	trace	0.0	<0.01	0.0	0.0	0.0
Nitrite-N	mg/l	<0.01	trace	0.0	<0.01	0.0	---	0.0
Total hardness	mg/l CaCO3	40	19	35	46	28	20	112
Total alkalinity	mg/l CaCO3	34	28	80	65	50	44	156
Chloride	mg/l	5.0	6.0	7.0	6.0	30.0	15.0	2.0
Fluoride	mg/l	0.25	0.25	0.50	0.35	0.00	0.20	0.40
Sulphate	mg/l	<0.3	<0.3	51.0	4.0	0.0	4.0	0.0
Total phosphorus	mg/l	0.01	<0.03	0.05	0.05	---	---	---
TDS	mg/l	57	49	108	90	70	80	170
Suspended solids	mg/l	20	512	30	510	---	---	---

Source: MOWD/SIDA; Greater Tharaka Water & Sanitation Project, June 1990.
Data : 1990

Table 3.7.12 Water Quality of the Ewaso Ngiro (North)

Parameter	Unit	Upper zone	Middle zone
pH	---	7.5	8.0
Colour	mg Pt/l	245	40
Turbidity	NTU	30	28
Oxygen absorbed	mg/l	24	53
Conductivity	uS/cm	198	313
Iron	mg/l	---	2.2
Manganese	mg/l	---	0.20
Calcium	mg/l	13.0	21.0
Magnesium	mg/l	8.8	13.0
Sodium	mg/l	---	---
Potassium	mg/l	---	---
Total hardness	mg/l CaCO3	67	96
Total alkalinity	mg/l CaCO3	79	57
Chloride	mg/l	9.0	14.0
Fluoride	mg/l	0.30	0.40
Sulphate	mg/l	1.7	1.2
Orthophosphate	mg/l	0.08	0.27
TDS	mg/l	119	188

Source: Ministry of Water Development
Values given are mean values (1983 - 1984)

Table 3.7.13 Water Quality of Kenyan Saline Lakes

Parameter	Unit	Lake Elmenteita	Lake Nakuru	Lake Magadi	Lake Bogoria
pH	---	10.2	9.5	9.7	9.7
Turbidity	NTU	6	21	--	253
Oxygen absorbed	mg/l	172	197	200	115
Conductivity	uS/cm	21,000	9,158	58,500	41,380
Iron	mg/l	--	1.2	--	0.6
Manganese	mg/l	--	0.7	--	0.2
Calcium	mg/l	1.5	5.7	13.0	1.1
Magnesium	mg/l	2.0	2.4	16.0	0.3
Sodium	mg/l	--	--	--	15,400
Total hardness	mg/l CaCO3	4	16	88	130
Total alkalinity	mg/l CaCO3	7,384	5,747	23,500	38,920
Chloride	mg/l	2,432	1,049	6,325	2,818
Fluoride	mg/l	598	167	112	899
Sulphate	mg/l	369	55	140	142
Orthophosphate	mg/l	--	0.30	--	--
TDS	mg/l	12,900	5,494	32,100	24,830

Note: closed basin saline lakes fluctuate substantially in water level and chemical concentration; the data shown here are mean values.
Source: Ministry of Water Development; NES 1987.
Data : 1983-1984

Table 3.7.14 Water Quality of Kenyan Freshwater Lakes

Parameter	Unit	Lake Naivasha	Lake Victoria	Lake Baringo	Lake Turkana
pH	---	8.3	8.0	8.6	9.3
Turbidity	NTU	25	4	70	21
Oxygen absorbed	mg/l	38	20	21	35
Conductivity	uS/cm	429	140	838	2730
Iron	mg/l	16.0	--	10.0	--
Manganese	mg/l	0.60	--	0.15	--
Calcium	mg/l	16.0	5.7	8.1	4.3
Magnesium	mg/l	8.4	5.5	4.5	2.6
Sodium	mg/l	32.7	--	--	189.3
Total hardness	mg/l CaCO3	96	37	50	22
Total alkalinity	mg/l CaCO3	125	53	360	914
Chloride	mg/l	20.0	9.3	48.0	400.0
Fluoride	mg/l	1.80	0.35	55.00	8.80
Sulphate	mg/l	1.3	2.6	7.1	28.0
Orthophosphate	mg/l	0.88	0.01	0.35	1.30
TDS	mg/l	259	86	510	2138

Source: Ministry of Water Development
Values given are mean values.
* Lake Turkana is virtually semi-saline;brackish and undrinkable.
Herein included in this table in view of low salinity compared with the lakes listed in Table 3.7.13.

Table 3.7.15 Summary of Water Quality in Kisumu Bay: 1985-1986.

Parameter	Unit	Study mean	SD as % of mean	WHO guide-line value
Temperature	oC	26.2	3.1	ngs
Conductivity	uS/cm	160	21	ngs
pH	---	7.9	2.5	6.5-8.5
Secchi depth	cm	50	20	ngs
Turbidity	NTU	15	40	5
Dissolved oxygen	mg/l	6	14	ngs
DO % saturation	%	89.5	14.7	ngs
Total hardness	mg/l CaCO3	24	26	500
Total alkalinity	mg/l CaCO3	71	16	ngs
Chloride	mg/l	7.5	42.7	250
Chlorophyll a	um/l	16.7	33.5	ngs
Phytoplankton	no/ml	1238	36	ngs
Zoolplankton	no/l	822	84	ngs

ngs = no guideline set
Source: Ministry of Water Development.
Data : 1985-1986

Table 3.7.16 Groundwater Quality in Kenya

Paramater	Unit	PROVINCE							
		Nairobi	Central	Coast	Estern	North-Eastern	Nyanza	Rift Valley	Western
pH	---	7.9	7.5	7.5	7.4	7.9	7.8	7.9	6.7
Turbidity	NTU	28.9	42.9	36.2	26.2	32.8	39.3	25.6	27.6
Oxygen absorbed	mg/l	3.05	2.66	1.12	1.86	0164	4.83	11.3	0.16
Conductivity	uS/cm	859	494	3291	1109	2315	719	1074	354
Iron	mg/l	1.48	2.00	1.26	2.3	0.99	1.25	1.57	0.89
Manganese	mg/l	0.70	0.42	27.9	2.9	29.2	2.90	0.79	1.52
Calcium	mg/l	43.3	17.3	135.1	63.4	151.9	57.6	52.2	18.6
Magnesium	mg/l	8.16	7.13	117.3	41.3	123.7	34.6	31.9	13.5
Sodium	mg/l	164.0	77.2	746.7	143.3	375.6	106.0	209.0	13.7
Potassium	mg/l	19.3	12.3	16.5	23.8	17	15.1	15.4	4.0
Hardness	mg/l CaCO3	48.4	68.4	369.8	348.7	239.8	238.7	161.9	78.4
Chloride	mg/l	72.4	35.4	1063	142.5	793.6	117.8	153.8	15.6
Fluoride	mg/l	6.59	1.78	1.16	1.9	5.69	2.38	3.33	2.04
Sulphate	mg/l	32.3	11.1	160.2	151.0	259.9	107.2	102.0	20.6
TDS	mg/l	521	314	2122	750	2101	585	916	181

Source : MOWD groundwater database newly established by this Study
Data coverage : covering since 1940's but mostly 1980's

Table 4.1.1 Population Projceted by District : 1990 - 2010

(Unit : Thousand)

Code	District	1990			1995			2000			2005			2010		
		Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural
110	Nairobi	1,413	1,413	0	1,780	1,780	0	2,260	2,260	0	2,785	2,785	0	3,465	3,465	0
210	Kiambu	972	106	866	1,093	156	937	1,249	242	1,007	1,405	302	1,103	1,583	376	1,207
220	Kirinyaga	413	19	393	464	30	434	519	45	474	574	58	516	633	74	559
230	Murang'a	899	65	834	983	90	893	1,087	129	959	1,195	156	1,039	1,316	189	1,126
240	Nyandarua	378	12	366	449	19	431	518	32	486	576	39	536	632	48	585
250	Nyeri	647	107	540	706	162	544	804	243	561	929	318	611	1,084	412	673
310	Kilifi	654	62	592	773	103	670	897	159	738	1,025	209	816	1,166	270	897
320	Kwale	409	15	394	461	22	439	523	43	480	576	53	523	632	65	567
330	Lamu	61	12	48	73	19	54	86	28	59	102	36	66	120	46	74
340	Mombasa	480	480	0	570	570	0	673	673	0	784	784	0	904	904	0
350	Taita Taveta	215	27	188	238	37	202	266	49	216	296	60	237	331	73	259
360	Tana River	138	12	126	158	18	140	186	33	153	210	41	168	235	51	184
410	Embu	382	20	361	440	32	408	501	51	450	558	65	494	619	82	537
420	Isiolo	75	28	47	100	50	50	129	79	50	167	106	61	211	136	74
430	Kitui	684	17	667	784	27	757	885	46	838	976	60	916	1,069	77	993
440	Machakos	1,486	166	1,320	1,721	260	1,461	1,985	395	1,591	2,264	510	1,754	2,577	652	1,925
450	Marsabit	138	34	104	168	57	111	196	79	117	230	99	131	270	123	147
460	Meru	1,213	92	1,122	1,416	145	1,271	1,633	229	1,403	1,841	295	1,546	2,067	376	1,691
510	Garissa	127	33	95	144	47	97	194	96	99	229	118	112	272	145	127
520	Mandera	127	22	106	138	27	111	155	37	117	173	44	129	196	54	142
530	Wajir	126	30	96	142	44	98	165	63	102	194	80	114	229	101	128
610	Kisii	1,202	60	1,142	1,279	80	1,199	1,401	126	1,275	1,522	154	1,369	1,662	189	1,473
620	Kisumu	708	210	498	817	301	516	971	434	537	1,156	547	609	1,382	689	692
630	Siaya	677	27	650	726	36	690	789	50	738	855	62	794	930	76	854
640	South Nyanza	1,155	50	1,105	1,242	72	1,170	1,357	106	1,251	1,473	128	1,345	1,604	156	1,448
710	Kajiado	286	34	252	373	58	315	461	98	363	554	138	416	652	183	469
720	Kericho	916	53	863	1,043	72	971	1,188	118	1,069	1,323	151	1,172	1,467	190	1,277
730	Laikipia	228	42	186	289	65	224	358	105	253	434	143	291	518	188	330
740	Nakuru	933	258	675	1,197	421	776	1,544	705	840	1,970	981	989	2,464	1,305	1,159
750	Narok	425	18	407	574	33	541	702	58	644	830	84	746	953	113	841
760	Trans Nzoia	424	56	368	507	85	422	616	150	466	723	200	523	842	260	582
770	Uasin Gishu	470	124	347	544	185	360	666	297	369	822	401	421	1,010	525	484
810	Baringo	306	26	280	353	37	316	405	57	348	458	74	384	516	95	421
820	Elg. Marakwet	227	6	221	265	8	256	301	14	287	332	17	315	363	20	343
830	Nandi	473	15	459	556	21	534	638	38	599	711	50	661	784	64	720
840	Samburu	122	25	98	148	37	111	180	59	122	218	79	138	260	104	157
850	Turkana	189	9	180	209	12	197	239	25	214	263	31	232	290	39	251
860	West Pokot	248	13	235	288	19	269	330	31	299	370	41	329	412	53	359
910	Bungoma	789	70	719	959	123	836	1,130	197	933	1,297	259	1,038	1,476	334	1,142
920	Busia	454	15	438	546	27	519	639	52	587	718	68	650	797	86	710
930	Kakamega	1,479	85	1,394	1,672	128	1,544	1,886	200	1,687	2,091	249	1,841	2,310	309	2,001
100	Nairobi	1,413	1,413	0	1,780	1,780	0	2,260	2,260	0	2,785	2,785	0	3,465	3,465	0
200	Central	3,309	309	3,000	3,695	457	3,238	4,176	690	3,486	4,680	874	3,806	5,248	1,098	4,150
300	Coast	1,956	607	1,349	2,273	769	1,504	2,631	985	1,646	2,993	1,183	1,810	3,390	1,410	1,980
400	Eastern	3,978	356	3,622	4,628	571	4,058	5,329	879	4,450	6,035	1,134	4,902	6,813	1,446	5,368
500	North Eastern	381	85	296	425	119	306	514	196	318	596	242	355	696	299	397
600	Nyanza	3,742	347	3,395	4,064	489	3,575	4,518	717	3,801	5,006	890	4,116	5,577	1,111	4,466
700	Rift Valley	5,248	677	4,571	6,348	1,054	5,294	7,627	1,755	5,872	9,008	2,390	6,617	10,532	3,139	7,392
900	Western	2,722	171	2,551	3,177	278	2,899	3,656	449	3,207	4,106	577	3,530	4,583	729	3,854
	Kenya	22,749	3,965	18,784	26,389	5,515	20,874	30,712	7,933	22,779	35,209	10,074	25,135	40,305	12,698	27,607

Source : A.04, A.08, A.13 and A.14