Chapter 26

RECOMMENDATIONS FOR FURTHER ENVIRONMENTAL ASSESSMENT

26. RECOMMENDATIONS FOR FURTHER ENVIRONMENTAL ASSESSMENT AND RESEARCH

26.1 HYDROLOGY AND RIVER MORPHOLOGY

More detailed quantification of inflows from tributaries to allow for the following flood release strategies:

Strategy 1: Assessment of the range of floods resulting from fixed releases as inflows from tributaries downstream of Grand Falls vary, both during minimum normal flood periods, and during major floods (of say greater than once in 10 or 20 years).

Strategy 2: Identification of rainfall thresholds necessary for effective flood release.

26.2 LEVELS OF SEDIMENTS AND POLLUTANTS

1. Further studies and specific monitoring of pollutant levels will be required, leading to a catchment management strategy. In particular, it is necessary to conduct a comprehensive sediment and water analysis programme over an extended period, with daily or more frequent measurements in the Kiambere outflow, the Mutonga and Kathita tributaries and at points downstream including Garissa. Only with comprehensive data will it be possible to evaluate the available options for management of flood waters and the sediments carried by flood waters in an optimum manner, to maximise both power production and benefits to downstream users.

2. Studies of land use in the catchment are required. These should be aimed at the construction of a soil erosion / sediment transport model, using the universal soil loss equation (or one of a number of similar approaches), as input to both sediment and runoff studies.

3. More general management of sediment load may be possible through sediment release or diversion structures, although the critical factor still remains as control of land use in the upper catchment. Further sampling of dry season and rainy season sediment loads over a longer time period would give a better indication of total and seasonal variations.

4. For a complete seasonal picture and for indications of trends in sediment load, further studies and a full monitoring programme will be necessary.

5. Further studies will be required to establish the downstream flood dynamics, including hydraulic modelling of the floodplain. Monitoring of rainfall and flow levels will be needed to ensure optimum management of the system, balancing flood requirements with maximised power output.

26.3 RESERVOIR MODELLING

1. The predictions of the model are sensitive to the factors affecting the growth of the specific species of algae in the Tana River reservoirs. These data are not currently available but could be obtained through new research commissioned to examine environmental and physical parameters controlling growth and population dynamics of algae in the existing Tana River reservoirs. There is also a lack of knowledge of the rates of recycling of nitrogen from silted mud and detrital matter. The coefficients used should be treated and verified by simulating conditions in the existing reservoirs, especially Kiambere.

2. There is a need to construct rating curves for the flux of suspended mud, organic matter and particulate and dissolved nutrients for the Mutonga and Kathita Rivers.

3. There is also a need for a daily record of meteorological conditions and synthesised sediment and pollution loads so that the models can be run for a number of years, including solar heating and wind effects. These studies will need to be coupled to detailed measurements of discharge and sediment loads, concentrating especially on the fine sediments within the Mutonga and Kathita Rivers, and a land use based analysis within these catchments facilitating the application of the universal soil loss equation (or similar approach). Finally, there is a need to study the detailed behaviour of the passage of sediment laden floods from the Mutonga and Kathita Rivers through the reservoirs, using a fine gridded 3-D model.

26.4 FLOOD FORECASTING

1. Investigations and research into the use of near real-time remote sensing combined with improved real-time climate monitoring from ground stations for rainfall/runoff forecasting in this area, coupled with a network of near real-time rainfall monitoring stations and real-time river gauging stations.

2. Based on the above, design of a suitable network of instrumentation and telemetry to guide the effective management of flood releases, in combination with data from remote sensing.

3. Design of a suitable system of a participatory management advisory service to maximise the benefits of controlled flooding to downstream users, and to provide a feedback mechanism on the effectiveness of such flooding.

26.5 MANAGEMENT OF ARTIFICIAL FLOOD RELEASE

The one aspect of improved management of the Mutonga-Grand Falls system that has not been reflected in any previous phases of hydropower development in Kenya is the need to support the multi-purpose objective of flood release to benefit downstream community needs and hydropower generation in a participatory management structure that extends beyond a notional consultative process.

The management decision making process, supporting the release of floods to the downstream systems, must include representation from the downstream communities, extending beyond consultation to active participation planning and management.

Given the critical demands for management that are defined by the release of floods rather than the traditional maximisation of power output, the structure of the management institution must reflect the multi-purpose objectives of the project and include representatives from the traditional pastoralist and arable farming and fishing communities, as well as the more established formal structures of the irrigation schemes. The concerns of the "conservation" bodies will also only be met by their direct inclusion in the decision making process, there will therefore be a need to incorporate representation from KWS, NMK and national and possibly international NGOs.

Again it needs to be stressed that this broadening of the institutional scope is more than a consultation process and provide the capacity to negotiate acceptable management decisions between users with potentially conflicting demands for timing and extent of flood release. Only if the communities can be assured that their views are incorporated will there be a possibility of avoiding conflict, this assurance must be given by their own representatives involved in the decision and negotiation process.

Mechanisms for establishing participatory management of the reservoir, and in particular the release of floods, must to be reviewed. As yet in Kenya there are few examples of true community participation in environmentally sensitive programme, or in major engineering programmes that have major effects on rural economies; as such the review process will have to look at institutional arrangements that are being developed in other countries within the region and elsewhere.

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Annex A

SUPPORTING DOCUMENTATION

Annex to Chapter 1

CHAPTER 1 ANNEX

Table A1-1 Tana River Basin Population Projections by District

District	Rates used	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Embu	3.415	368194	380768	393771	407218	421125	435506	450379	465759	481665	498114	515124	532716	550908	569722	589178	609298	630106
Garissa	0.436	36925	37086	37248	37410	37573	37737	37902	38067	38233	38399	38567	38735	38904	39073	39244	39415	39587
Isiolo	4.624	6979	7302	7639	7993	8362	8749	9153	9577	10019	10483	10967	11475	12005	12560	13141	13749	14384
Kiambu	2.588	568	583	598	613	629	645	662	679	697	715	733	752	772	792	812	833	855
Kilifi	4.020	13608	14155	14724	15316	15931	16572	17238	17931	18652	19401	20181	20992	21836	22714	23627	24577	25565
Kirinyaga	3.152	397492	410022	422948	436281	450034	464221	478855	493950	509521	525584	542152	559243	576872	595057	613816	633166	653125
Kitui & Mwingi	2.971	599694	617512	635860	654753	674207	694239	714866	736106	757978	780499	803689	827568	852157	877477	903548	930395	958039
Laikipia	5.449	10777	11364	11984	12637	13325	14051	14817	15624	16476	17374	18320	19319	20371	21481	22652	23886	25188
Lamu	6.819	7020	7499	8010	8556	9140	9763	10428	11140	11899	12710	13577	14503	15492	16548	17677	18882	20169
Machakos	3.000	132351	136322	140411	144624	148962	153431	158034	162775	167658	172688	177869	183205	188701	194362	200193	206199	212385
Meru	2.901	667563	686929	706857	727363	748464	770177	792520	815511	839169	863513	888564	914341	940866	968161	996248	1025149	1054888
Muranga	2.849	833751	857506	881939	907067	932911	959492	986830	1014947	1043865	1073607	1104196	1135657	1168015	1201294	1235521	1270724	1306930
Nithi	2.901	250510	257777	265255	272950	280869	289017	297401	306029	314907	324042	333443	343116	353070	363312	373852	384697	395857
Nyandarua	4.213	32121	33474	34884	36354	37885	39481	41145	42878	44684	46567	48529	50573	52703	54924	57238	59649	62162
Nyeri	2.442	576669	590751	605177	619956	635095	650604	666492	682768	699441	716521	734019	751944	770306	789117	808387	828128	848351
Tana River	4.092	137696	143330	149195	155299	161654	168268	175153	182320	189780	197545	205628	214042	222800	231916	241406	251283	261565
Basin Total		4071918	4192381	4316500	4444389	4576167	4711954	4851875	4996061	5144644	5297762	5455559	5618180	5785779	5958511	6136538	6320029	6509155

Annex to Chapter 6

Table A6.1 Population and Household Density within the Study Area: 1989 census data summarised by individual village area.

(Forest Reserves have been separated and are listed separately since these areas are without no population.)

EMBU DISTRICT

CENSUS ID	DIVISION	LOCATION	SUBLOC	VILLAGE	POPU-LATION	HOUSE-HOLDS	POP. DENSITY	HOUSEHOLD DENSITY	AREA (KM^2)
41311011	SIAKAGO	MUMINJI	KIRIE	NGIIRI	1202	403	31.32	10.50	38.3831
41311021	SIAKAGO	MUMINJI	KIRIE	CIERIA	642	121	19.32	3.64	33.2368
41311031	SIAKAGO	MUMINJI	KIRIE	MBARUARI B	322	64	38.87	7.73	8.2830
41311041	SIAKAGO	MUMINJI	KIRIE	MBARUARI A	465	95	62.62	12.79	7.4254
41311051	SIAKAGO	MUMINJI	KIRIE	ITAMBARARIA	513	125	74.94	18.26	6.8457
41311061	SIAKAGO	MUMINJI	KIRIE	NGUTHI	771	144	38.44	7.18	20.0581
41311071	SIAKAGO	MUMINJI	KIRIE	MAREMBO	710	145	50.81	10.38	13.9735
41322011	SIAKAGO	KIANGOMBE	THAMBU	KIENIRE	1050	175	55.88	9.31	18.7917
41322021	SIAKAGO	KIANGOMBE	THAMBU	MANGOTE	910	184	30.09	6.08	30.2442
41322031	SIAKAGO	KIANGOMBE	THAMBU	KIGUAMBITI	377	82	66.46	14.45	5.6730
41322041	SIAKAGO	KIANGOMBE	THAMBU	KARAMBARI	574	103	115.94	20.81	4.9507
41322051	SIAKAGO	KIANGOMBE	THAMBU	KIAMBITI	747	143	104.77	20.06	7.1296
41323011	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KAMIGUA EAST	265	49	32.66	6.04	8.1127
41323021	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KAMWAA A	223	47	22.53	4.75	9.8976
41323031	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KAMWAA B	221	43	20.60	4.01	10.7291
41323041	SIAKAGO	KIANGOMBE	IRIA-ITUNE	NGARIWERERI	342	71	14.50	3.01	23.5811
41323051	SIAKAGO	KIANGOMBE	IRIA-ITUNE	NGOCE B	270	51	32.67	6.17	8.2636

41323061	SIAKAGO	KIANGOMBE	IRIA-ITUNE	NGOCE A	290	62	21.66	4.63	13.3858
41323071	SIAKAGO	KIANGOMBE	IRIA-ITUNE	MUTURIGURU	369	69	49.99	9.35	7.3817
41323081	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KIRIGO B	390	67	78.91	13.56	4.9421
41323091	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KIRIGO A	422	71	55.34	9.31	7.6252
41323101	SIAKAGO	KIANGOMBE	IRIA-ITUNE	KAMIGUA WEST	326	60	58.98	10.85	5.5276
41332011	SIAKAGO	EVURORE	KAMARANDI	KAMARINDO	338	61	48.00	8.66	7.0420
41332021	SIAKAGO	EVURORE	KAMARANDI	NTHIGIRANI	749	119	32.18	5.11	23.2772
41332031	SIAKAGO	EVURORE	KAMARANDI	MUTHANTHARA A	246	40	27.19	4.42	9.0487
41332041	SIAKAGO	EVURORE	KAMARANDI	MUTHANTHARA B	489	78	60.57	9.66	8.0740
41332051	SIAKAGO	EVURORE	KAMARANDI	KOGARI B	414	84	33.93	6.88	12.2013
41332061	SIAKAGO	EVURORE	KAMARANDI	KOGARI A	414	86	43.46	9.03	9.5254
41332071	SIAKAGO	EVURORE	KAMARANDI	KAMUTU	744	129	68.42	11.86	10.8739
41332081	SIAKAGO	EVURORE	KAMARANDI	KIANTHENGE	489	96	168.18	33.02	2.9076
41332091	SIAKAGO	EVURORE	KAMARANDI	KIBURU	381	69	71.42	12.94	5.3343

KITUI DISTRICT (NOW MWINGI DISTRICT)

CENSUS ID	DIVISION	LOCATION	SUBLOC	VILLAGE	POPU-LATION	HOUSE-HOLDS	POP. DENSITY	HOUSEHOLD DENSITY	AREA (KM^2)
43464011	KYUSO	KATSE	MUKONGA/IKONGA	MUGWUNI	FOREST RESERVE				16.3186
43464011	KYUSO	KATSE	MUKONGA/IKONGA	MUGWUNI	663	103	44.05	6.84	15.0498
43464021	KYUSO	KATSE	MUKONGA/IKONGA	MUKINDU	FOREST RESERVE				0.0725
43464021	KYUSO	KATSE	MUKONGA/IKONGA	MUKINDU	580	105	34.99	6.33	16.5748
43464031	KYUSO	KATSE	MUKONGA/IKONGA	MBONDO	FOREST RESERVE				22.9870

43464031	KYUSO	KATSE	MUKONGA/IKONGA	MBONDO	334	54	31.76	5.14	10.5148
43464041	KYUSO	KATSE	MUKONGA/IKONGA	KITHYOKO	FOREST RESERVE				0.2406
43464041	KYUSO	KATSE	MUKONGA/IKONGA	KITHYOKO	420	73	28.78	5.00	14.5937
43464051	KYUSO	KATSE	MUKONGA/IKONGA	IKONGO	FOREST RESERVE				0.0750
43464051	KYUSO	KATSE	MUKONGA/IKONGA	IKONGO	270	44	22.47	3.66	12.0165
43464061	KYUSO	KATSE	MUKONGA/IKONGA	KANGOMO	FOREST RESERVE				0.0795
43464061	KYUSO	KATSE	MUKONGA/IKONGA	KANGOMO	331	50	53.11	8.02	6.2321
43464071	KYUSO	KATSE	MUKONGA/IKONGA	NGAANI	FOREST RESERVE				41.3805
43464071	KYUSO	KATSE	MUKONGA/IKONGA	NGAANI	301	45	43.62	6.52	6.9012
43464081	KYUSO	KATSE	MUKONGA/IKONGA	KIKUMINI	229	36	26.62	4.19	8.6015
43464091	KYUSO	KATSE	MUKONGA/IKONGA	NGEUKYA	1830	303	75.71	12.53	24.1724
43471011	KYUSO	THARAKA	GACIGONGO/KANYENGYA	NTUMIRA	347	56	15.91	2.57	21.8159
43471021	KYUSO	THARAKA	GACIGONGO/KANYENGYA	KAMANGARA	225	35	15.68	2.44	14.3452
43471031	KYUSO	THARAKA	GACIGONGO/KANYENGYA	KAMAYAGI	316	55	29.52	5.14	10.7064
43471041	KYUSO	THARAKA	GACIGONGO/KANYENGYA	MIRAABA IKAMBA	332	63	12.79	2.43	25.9515
43471051	KYUSO	THARAKA	GACIGONGO/KANYENGYA	ITURA/MURA	333	63	20.90	3.95	15.9317
43471061	KYUSO	THARAKA	GACIGONGO/KANYENGYA	CIATUNGU	294	47	21.63	3.46	13.5898
43471071	KYUSO	THARAKA	GACIGONGO/KANYENGYA	GATORONI	172	33	14.54	2.79	11.8263
43471081	KYUSO	THARAKA	GACIGONGO/KANYENGYA	KANHOROKO	286	50	33.38	5.84	8.5682
43471091	KYUSO	THARAKA	GACIGONGO/KANYENGYA	KANYENGYA	361	65	25.92	4.67	13.9293
43471101	KYUSO	THARAKA	GACIGONGO/KANYENGYA	NKARAKU	284	43	14.93	2.26	19.0207
43472011	KYUSO	THARAKA	GAKOMBE	GAKOMBE	295	47	46.39	7.47	6.2908
43472021	KYUSO	THARAKA	GAKOMBE	NKORU	212	33	9.88	1.54	21.4479

43472031	KYUSO	THARAKA	GAKOMBE	MURICANI	322	52	18.90	3.05	17.0381
43472041	KYUSO	THARAKA	GAKOMBE	NDIANI/ITHUMBI	334	47	30.11	4.24	11.0922
43472051	KYUSO	THARAKA	GAKOMBE	CIAIKURU	339	59	25.91	4.51	13.0828
43472061	KYUSO	THARAKA	GAKOMBE	KURUNDU	270	43	31.63	5.04	8.5363
43473011	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	GACIONGO K	259	43	44.44	7.38	5.8285
43473021	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	MUKURUNI	191	30	30.08	4.72	6.3507
43473031	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	NTHANGANI	189	30	39.30	6.24	4.8087
43473041	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	MAIKUME	195	32	23.54	3.86	8.2820
43473051	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	KAMWERINI	448	80	19.17	3.42	23.3734
43473061	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	IKIME/KAMAGITI	FOREST RESERVE				0.6009
43473061	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	IKIME/KAMAGITI	579	93	29.53	4.74	19.6054
43473071	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	KONYO	FOREST RESERVE				0.9565
43473071	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	KONYO	630	99	25.99	4.08	24.2430
43473081	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	KAMATUMO K	207	37	25.60	4.58	8.0849
43473091	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	UVETA	88	14	16.27	2.59	5.4082
43473101	KYUSO	THARAKA	KANTHUNGU/KAMAINDI	KANTHUNGU	211	27	35.58	4.55	5.9305

MERU DISTRICT (NOW THARAKA-NITHI)

CENSUS ID	DIVISION	LOCATION	SUBLOC	VILLAGE	POPU-LATION	HOUSE-HOLDS	POP. DENSITY	HOUSEHOLD DENSITY	AREA (KM^2)
46311011	THARAKA	NORTH THARAKA	GATUNGA	GACIONGO G	105	22	18.10	3.79	5.8014
46311021	THARAKA	NORTH THARAKA	GATUNGA	KAGUCWANI	284	46	34.44	5.58	8.2473
46311031	THARAKA	NORTH THARAKA	GATUNGA	KAMATUMO G	330	57	47.25	8.16	6.9839

46311041	THARAKA	NORTH THARAKA	GATUNGA	KARII KA MBURI	478	83	44.41	7.71	10.7629
46311051	THARAKA	NORTH THARAKA	GATUNGA	GITUGU	FOREST RESERVE				0.0125
46311051	THARAKA	NORTH THARAKA	GATUNGA	GITUGU	387	64	50.06	8.28	7.7306
46311061	THARAKA	NORTH THARAKA	GATUNGA	KARUGWARU	425	66	40.73	6.33	10.4342
46311071	THARAKA	NORTH THARAKA	GATUNGA	NKUNJU	428	80	42.08	7.86	10.1720
46311081	THARAKA	NORTH THARAKA	GATUNGA	KINUNKU EAST	323	55	30.75	5.24	10.5034
46311091	THARAKA	NORTH THARAKA	GATUNGA	KINUNKU WEST	362	65	45.89	8.24	7.8883
46311101	THARAKA	NORTH THARAKA	GATUNGA	GATUNGA	257	44	49.29	8.44	5.2137
46312011	THARAKA	NORTH THARAKA	GATUE	KAYURIA/KITHUNGURU	227	33	15.73	2.29	14.4317
46312021	THARAKA	NORTH THARAKA	GATUE	KAYURIA	141	22	25.96	4.05	5.4319
46312031	THARAKA	NORTH THARAKA	GATUE	MANDURU	FOREST RESERVE				0.0083
46312031	THARAKA	NORTH THARAKA	GATUE	MANDURU	FOREST RESERVE				0.9828
46312031	THARAKA	NORTH THARAKA	GATUE	MANDURU	311	50	31.92	5.13	9.7426
46312041	THARAKA	NORTH THARAKA	GATUE	MARAGWA	FOREST RESERVE				4.4080
46312041	THARAKA	NORTH THARAKA	GATUE	MARAGWA	FOREST RESERVE				3.4778
46312041	THARAKA	NORTH THARAKA	GATUE	MARAGWA	216	31	26.66	3.83	8.1012
46312051	THARAKA	NORTH THARAKA	GATUE	RWARII	FOREST RESERVE				1.8606
46312051	THARAKA	NORTH THARAKA	GATUE	RWARII	182	31	20.07	3.42	9.0675
46312061	THARAKA	NORTH THARAKA	GATUE	KATHUURI	FOREST RESERVE				3.3510
46312061	THARAKA	NORTH THARAKA	GATUE	KATHUURI	364	64	24.97	4.39	14.5799
46312071	THARAKA	NORTH THARAKA	GATUE	KAMAGUNA	293	50	16.05	2.74	18.2555
46312081	THARAKA	NORTH THARAKA	GATUE	NTHIMA	341	56	41.24	6.77	8.2677
46312091	THARAKA	NORTH THARAKA	GATUE	KIRIMBU	338	62	15.02	2.76	22.5029

46312111	THARAKA	NORTH THARAKA	GATUE	KIIGAGAKA	FOREST RESERVE				4.2261
46312111	THARAKA	NORTH THARAKA	GATUE	KIIGAGAKA	337	58	16.12	2.77	20.9055
46312121	THARAKA	NORTH THARAKA	GATUE	KAMWATHU	FOREST RESERVE				1.0406
46312121	THARAKA	NORTH THARAKA	GATUE	KAMWATHU	284	51	15.72	2.82	18.0630
46312131	THARAKA	NORTH THARAKA	GATUE	MUKENGU	290	54	33.51	6.24	8.6541
46312141	THARAKA	NORTH THARAKA	GATUE	NDURUKU/NDIUNI	596	98	24.26	3.99	24.5692
46331011	THARAKA	SOUTH-THARAKA	CHIAKARIGA	GACERAKA B	532	99	74.17	13.80	7.1727
46331021	THARAKA	SOUTH-THARAKA	CHIAKARIGA	GACERAKA A	655	90	55.77	7.66	11.7437
46331031	THARAKA	SOUTH-THARAKA	CHIAKARIGA	NKARINI	732	127	80.43	13.95	9.1011
46331041	THARAKA	SOUTH-THARAKA	CHIAKARIGA	KAMATHURI	FOREST RESERVE				2.8211
46331041	THARAKA	SOUTH-THARAKA	CHIAKARIGA	KAMATHURI	813	128	103.87	16.35	7.8270
46331051	THARAKA	SOUTH-THARAKA	CHIAKARIGA	KARUGUJUNI/KOMBO	1942	336	189.85	32.85	10.2293
46331061	THARAKA	SOUTH-THARAKA	CHIAKARIGA	CHIAKARIGA	FOREST RESERVE				5.5655
46331061	THARAKA	SOUTH-THARAKA	CHIAKARIGA	CHIAKARIGA	636	166	148.67	38.80	4.2780
46331071	THARAKA	SOUTH-THARAKA	CHIAKARIGA	MITAANI/NTANGANI	FOREST RESERVE				5.9799
46331071	THARAKA	SOUTH-THARAKA	CHIAKARIGA	MITAANI/NTANGANI	897	170	65.45	12.40	13.7056
46331081	THARAKA	SOUTH-THARAKA	CHIAKARIGA	MATERI	602	98	57.43	9.35	10.4820
46331091	THARAKA	SOUTH-THARAKA	CHIAKARIGA	KITHAGA/MUTONGA	1096	204	202.13	37.62	5.4222
46332011	THARAKA	SOUTH-THARAKA	KAMANYAKI	KIRUKUMA	FOREST RESERVE				6.7352
46332011	THARAKA	SOUTH-THARAKA	KAMANYAKI	KIRUKUMA	751	109	57.11	8.29	13.1499
46332021	THARAKA	SOUTH-THARAKA	KAMANYAKI	KATHIRANI	FOREST RESERVE				2.0356
46332021	THARAKA	SOUTH-THARAKA	KAMANYAKI	KATHIRANI	313	52	108.31	17.99	2.8898
46332031	THARAKA	SOUTH-THARAKA	KAMANYAKI	KARIE/KANJERU	FOREST RESERVE				2.1010

46332031	THARAKA	SOUTH-THARAKA	KAMANYAKI	KARIE/KANJERU	234	46	55.37	10.88	4.2262
46332041	THARAKA	SOUTH-THARAKA	KAMANYAKI	KAMUTHANGA	376	63	32.44	10.85	9.4010
46332051	THARAKA	SOUTH-THARAKA	KAMANYAKI	KAMANYAKI/KARUNGARU	FOREST RESERVE				6.8914
46332051	THARAKA	SOUTH-THARAKA	KAMANYAKI	KAMANYAKI/KARUNGARU	391	73	37.34	6.97	10.4725
46332061	THARAKA	SOUTH-THARAKA	KAMANYAKI	KATHANDENI	464	83	91.08	16.29	5.0946
46332071	THARAKA	SOUTH-THARAKA	KAMANYAKI	KYUNGU	249	45	10.63	1.92	23.4184
46332081	THARAKA	SOUTH-THARAKA	KAMANYAKI	MPUNJA	421	70	40.91	6.80	10.2914
46332091	THARAKA	SOUTH-THARAKA	KAMANYAKI	NDURUKU	1040	180	118.49	20.51	8.7768
46332101	THARAKA	SOUTH-THARAKA	KAMANYAKI	KIAMAIRI	214	41	64.07	12.28	3.3399
46332111	THARAKA	SOUTH-THARAKA	KAMANYAKI	MBACACA/KITHURI	FOREST RESERVE				0.8026
46332111	THARAKA	SOUTH-THARAKA	KAMANYAKI	MBACACA/KITHURI	527	78	74.07	10.96	7.1151
46342011	THARAKA	MARIMANTI	MARIMANTI	KANGANTA/NKUNDI	471	78	51.70	8.56	9.1110
46342021	THARAKA	MARIMANTI	MARIMANTI	KARUMA	397	72	73.65	13.36	5.3905
46342031	THARAKA	MARIMANTI	MARIMANTI	MARORERIA	239	38	31.74	5.05	7.5295
46342041	THARAKA	MARIMANTI	MARIMANTI	GACHEE	379	67	59.93	10.59	6.3239
46342051	THARAKA	MARIMANTI	MARIMANTI	KARURUKUNI/IGUMO	618	109	98.26	17.33	6.2894
46342061	THARAKA	MARIMANTI	MARIMANTI	NTHANGATHINI/KAMATUNGU	661	119	66.98	12.06	9.8680
46342071	THARAKA	MARIMANTI	MARIMANTI	KAIGA KAMWE/NKOMARU	376	68	25.45	4.60	14.7761
46342081	THARAKA	MARIMANTI	MARIMANTI	KATHENGESA	298	50	31.00	5.20	9.6117
46342091	THARAKA	MARIMANTI	MARIMANTI	MAKOMANGO	264	43	37.98	6.19	6.9512
46342101	THARAKA	MARIMANTI	MARIMANTI	MURERE/RWAKINANGA	453	78	178.91	30.81	2.5320
46342111	THARAKA	MARIMANTI	MARIMANTI	NTHAARA	409	80	44.34	8.67	9.2240
46342121	THARAKA	MARIMANTI	MARIMANTI	MUYOYA	50	21	13.46	5.65	3.7160

46342131	THARAKA	MARIMANTI	MARIMANTI	MAGUNDU	419	71	64.41	10.92	6.5047
46342141	THARAKA	MARIMANTI	MARIMANTI	GAMPUA	283	54	47.85	9.13	5.9137
46342151	THARAKA	MARIMANTI	MARIMANTI	MARIMANTI	509	149	146.38	42.85	3.4771
46343011	THARAKA	MARIMANTI	KANYURU	GACIGONGOONI/KANGOMBE	512	88	80.07	13.76	6.3947
46343021	THARAKA	MARIMANTI	KANYURU	KANOA	446	75	157.85	26.54	2.8255
46343031	THARAKA	MARIMANTI	KANYURU	IRURUMA/GAMPARE	FOREST RESERVE				0.4598
46343031	THARAKA	MARIMANTI	KANYURU	IRURUMA/GAMPARE	439	77	68.67	12.04	6.3929
46343041	THARAKA	MARIMANTI	KANYURU	KITHIORI/MAGARINI	FOREST RESERVE				3.8109
46343041	THARAKA	MARIMANTI	KANYURU	KITHIORI/MAGARINI	251	44	30.26	5.30	8.2960
46343051	THARAKA	MARIMANTI	KANYURU	MUGUKO/KATHITHI	FOREST RESERVE				0.2002
46343051	THARAKA	MARIMANTI	KANYURU	MUGUKO/KATHITHI	FOREST RESERVE				3.7088
46343051	THARAKA	MARIMANTI	KANYURU	MUGUKO/KATHITHI	350	63	21.47	3.86	16.3001
46343061	THARAKA	MARIMANTI	KANYURU	MUTUGUNI	FOREST RESERVE				10.2540
46343061	THARAKA	MARIMANTI	KANYURU	MUTUGUNI	557	96	31.36	5.41	17.7595
46343071	THARAKA	MARIMANTI	KANYURU	RUKENYA	FOREST RESERVE				3.0016
46343071	THARAKA	MARIMANTI	KANYURU	RUKENYA	205	36	26.04	4.57	7.8715
46343081	THARAKA	MARIMANTI	KANYURU	NKURURUNI	FOREST RESERVE				1.3060
46343081	THARAKA	MARIMANTI	KANYURU	NKURURUNI	756	128	102.02	17.27	7.4104
46343091	THARAKA	MARIMANTI	KANYURU	MUKINYANGO/NCHUKUUNI	FOREST RESERVE				1.5016
46343091	THARAKA	MARIMANTI	KANYURU	MUKINYANGO/NCHUKUUNI	537	96	71.17	12.72	7.5456
92624202	THARAKA	NORTH THARAKA	GATUE	IRUMA	1160	210	53.19	9.63	21.8103

Annex to Chapter 8

ANNEX 8

A-8.1 RESPONSES FROM THE GENERAL QUESTIONS ABOUT THE PROJECT

(note: responses are given in percentage terms)

ITEM B1 - Have you ever heard of Mutonga/Grand Falls hydropower project ?

	Yes	No
MWINGI	100	
EMBU	96	4
THARAKA NITHI	91	9
TOTAL		

Total Responses to B2-B7, whether B1 = Yes or No

ITEM: B3 - Has the idea of the project been clearly explained to you ?

	1	2
MWINGI	27	74
EMBU	9	90
THARAKA NITHI	15	85
TOTAL	13	87

1 = Clear 2=Not Clear

ITEM: B4 - In your opinion, is the project acceptable ?

	Y	N
MWINGI	61.8	38.2
EMBU	70.5	29.5
THARAKA NITHI	56.9	43.1
TOTAL	64.7	35.3

Y = Yes
N = No

ITEM: B5 - What are the perceivable benefits of the project ?

	1	2	3	4
MWINGI	19.0	61.9	19.0	
EMBU	34.5	34.5	23.0	8.0
THARAKA NITHI	35.1	45.9	13.5	5.4
TOTAL	32.7	40.4	20.5	6.4

1 = Irrigated Agriculture
2= Infra-structure Development
3= Employment
4 = Others

ITEM: B7 - What are reasons for not accepting the project ?

	1	2	3	4	5	6
MWINGI						
EMBU	8	7	17	9	27	25
THARAKA NITHI						
TOTAL						

1 = Don't want to move
2= Don't see direct benefits
3= Project may be a danger to community around
4 = Reservoir may be breeding ground for water borne diseases
5 = Project may take land and cause problem of finding alternative land
6 = Other

Item C5 - Demographic Information- Sex

District **Response**

	1	2
Mwingi	46.6	53.4
Embu	52.1	47.9
Tharaka Nithi	54.9	45.1
All	52.4	47.6

Key:
1. Male
2. Female

Item C12 - Demographic Information- Religion

District	Response			
	1	2	3	4
Mwingi	13.0	87.0	-	-
Embu	23.6	74.5	2.0	-
Tharaka Nithi	23.6	70.6	0.2	5.6
All	22.0	74.8	0.1	3.1

Key:
1. Catholic
2. Protestant
3. Muslim
4. Other (Specify)

ITEM: C 18 - Type of sickness experienced in past 2 weeks

Percentage Responses

	1	2	3	4	5	6	7	8	9	10	11	12	13
MWINGI	28	20				1	1		1			6	44
EMBU	24	1		1	1	1	1			1		26	44
THARAKA NITHI	27	10	1	1	1	1	2		1	1		1	57
TOTAL	25	6		1	1	1	1			1		16	48

1 = Malaria
2 = Upper Respiratory Infection
3 = Skin Disease
4 = Intestinal Worm
5 = Accidents
6 = Eye Infection
7 = Diarrhoea
8 = Urinary Tract Infection
9 = Dental Disorder
10 = Ear Infection
11 = Schistomiasis
12 = Other
13 = Not Applicable
14 = Undefined

ITEM: D11 - How did you acquire this land ?

	Inherited	Bought	Rented	Gift
MWINGI	64.7	17.6	8.8	8.8
EMBU	85.4	10.7		3.9
THARAKA NITHI	92.3	6.2		1.5
TOTAL	84	10	2	4

Item D12B - What is your land tenure status

District	Response						
	1	2	3	4	5	6	7
Mwingi	5.0	2.5	55.0	20.0	5.0	12.5	-
Embu	27.7	12.1	28.4	5.7	2.8	23.4	-
Tharaka Nithi	3.9	4.9	75.5	3.9	8.8	2.0	-
All	15.9	8.1	49.1	7.1	5.3	14.1	0.4

Key:
1. Absolute ownership/Freehold
2. Leasehold
3. Individual Ownership
4. Share Cropping
5. Joint Ownership
6. Communal Ownership/Trust Land
7. Other (Specify)

Item D13 - Do You Rent Out any Land?

District	Response	
	1	2
Mwingi	17.5	82.5
Embu	3.7	96.3
Tharaka Nithi	4.0	96.0
All	5.8	94.2

Key:
1. Yes
2. No

Item D16 - In your opinion is the quality of the soils on this land good?

District	Response	
	1	2
Mwingi	100	-
Embu	74.8	25.2
Tharaka Nithi	97.1	2.9
All	86.3	13.7

Key:
1. Yes
2. No

ITEM: D111 - What is your most common mode of transport for marketing your farm products ?

	Road	Railway	Animal of Burden	Human Labor	Bicycle
MWINGI	32		50	18	
EMBU	39		15	39	
THARAKA NITHI			54	43	3
TOTAL	25	34	37	1	3

Item D112 - Do you produce enough for your substance needs on this farm?

District **Response**

	1	2
Mwingi	95.0	5.0
Embu	93.3	6.7
Tharaka Nithi	98.0	2.0
All	95.5	4.5

Key:
1. Yes
2. No

Item F3 - Access to Social Amenities
Distance to Primary School

District	Response				
	1	2	3	4	5
Mwingi	15	32	27	15	12
Embu		16	32	33	15
Tharaka Nithi	12	48	32	8	
All	15	37	32	13	3

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. Over 10 km

Item F4 - Access to Social Amenities - Main Road

District	Response				
	1	2	3	4	5
Mwingi	7.5	12.5	15.0	27.5	37.5
Embu	12.4	14.3	23.8	14.3	35.2
Tharaka Nithi	2.0	4.9	6.9	4.9	81.4
All	7.3	10.1	15.4	12.6	54.7

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. over 10 km

ITEM: C6 - Demographic Information -- Age Brackets of Households

	0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90 and over	Not Stated
MWINGI	31.9	18.8	15.2	14.1	4.7	2.1	2.6	1.0	3.7		5.8
EMBU	25.7	26.0	16.3	10.4	8.7	3.8	4.7	2.3	0.4	0.1	1.7
THARAKA NITHI	19.0	28.8	17.7	13.5	6.6	4.5	5.3	2.6	1.6	0.3	
TOTAL	24.6	25.7	16.6	11.9	7.5	3.8	4.6	2.2	1.3	0.2	1.8

ITEM: C11 - Demographic Information - Ethnic/Tribe

	1	2	3	4	5
MWINGI	93.7		5.8		0.5
EMBU	2.7	.8	25.4	68.4	2.7
THARAKA NITHI	3.7	.5	95.5		.3
TOTAL	16.5	0.6	43.2	38.0	1.6

1 = Kamba
2 = Meru
3 = Tharaka
4 = Embu/Mbere
5= Other

ITEM: C 18 - Type of sickness experienced in past 2 weeks

Percentage Responses

	1	2	3	4	5	6	7	8	9	10	11	12	13
MWINGI	28	20				1	1		1			6	44
EMBU	24	1		1	1	1	1			1		26	44
THARAKA NITHI	27	10	1	1	1	1	2		1	1		1	57
TOTAL	25	6		1	1	1	1			1		16	48

1 = Malaria
2 = Upper Respiratory Infection
3 = Skin Disease
4 = Intestinal Worm
5 = Accidents
6 = Eye Infection
7 = Diarrhoea
8 = Urinary Tract Infection
9 = Dental Disorder
10 = Ear Infection
11 = Schistomiasis
12 = Other
13 = Not Applicable
14 = Undefined

ITEM: D11 - How did you acquire this land ?

	Inherited	Bought	Rented	Gift
MWINGI	64.7	17.6	8.8	8.8
EMBU	85.4	10.7		3.9
THARAKA NITHI	92.3	6.2		1.5
TOTAL	84	10	2	4

Item D17 - Do Own any Other Piece of Land?

District	Response	
	1	2
Mwingi	37.5	62.5
Embu	33.3	66.7
Tharaka Nithi	22.5	77.5
All	30.1	69.9

Key:
1. Yes
2. No

Item D18A - If yes in D17, where?

District	Response	
	1	2
Mwingi	100.0	-
Embu	60.0	40.0
Tharaka Nithi	95.2	4.8
All	71.6	28.4

Key:
1. Within
2. Outside

Item D19A - What farm implement do you use to break ground?

District	Response			
	1	2	3	4
Mwingi	69.4	-	30.6	-
Embu	67.6	1.0	30.5	1.0
Tharaka Nithi	88.2	2.0	9.8	-
All	76.5	1.2	21.8	0.4

Key:
1. Ox-plough
2. Tractor
3. Hand implements
4. Other (Specify)

Item D19B - What farm implement do you use for sowing?

District	Response			
	1	2	3	4
Mwingi	-	-	100	-
Embu	41.0	1.0	57.1	1.0
Tharaka Nithi	1.0	2.9	95.1	1.0
All	18.1	1.6	79.4	0.8

Key:
1. Ox-plough
2. Tractor
3. Hand implements
4. Other (Specify)

Item D19C - What farm implement do you use for Weeding?

District	Response			
	1	2	3	4
Mwingi	5.0	-	80.0	15.0
Embu	1.0	1.9	96.2	1.0
Tharaka Nithi	4.9	-	91.2	3..9
All	3.2	0.8	91.5	4.5

Key:
1. Ox-plough
2. Tractor
3. Hand implements
4. Other (Specify)

Item D110 - Do you use any water and/or soil conservation techniques?

District	Response	
	1	2
Mwingi	70.0	30.0
Embu	95.2	4.8
Tharaka Nithi	65.7	34.3
All	78.9	21.1

Key:
1. Yes
2. No

Item D100 - On Farm Agricultural Income - Crop

Response	District			
	Mwingi	Embu	Tharaka Nithi	All
1	2.1	6.3	9.3	6.9
2	19.7	16.8	17.4	17.5
3	21.3	22	21.1	21.5
4	19.7	21.6	17.2	19.4
5	10.1	1.3	2.7	3.4
6	-	.2	-	.1
7	1.6	-	5.6	2.7
8	-	.6	-	.3
9	3.7	1.3	2.3	2.1
10	-	.4	2.7	1.3
11	1.1	-	1.4	.8
12	0.5	-	1.4	.7
13	13.8	17.2	16.1	16.2
14	6.4	6.5	1.9	4.5
15	-	-	-	-
16	-	3.9	.2	1.7
17	-	1.5	.6	.9
18	-	.2	-	.1

Key:

1. Cotton
2. Maize
3. Millet
4. Sorghum
5. Beans
6. Groundnuts
7. Vegetables
8. Sweet Potatoes
9. Cassava
10. Sugar cane
11. Fruits
12. Sunflower
13. Green Grams
14. Pigeon Peas
15. Sisal
16. Other
17. Cowpeas
18. Bananas

Item D200 - Livestock

District	Response								
	1	2	3	4	5	6	7	8	9
Mwingi	20.3	.6	15.8	20.9	24.7	7.6	-	9.5	.6
Embu	19.6	.9	14.4	21.5	21.7	5.2	-	16.7	-
Tharaka Nithi	20.9	.2	18.3	21.4	18.3	10.4	-	10.6	-
All	20.3	.6	16.3	21.3	20.7	7.8	-	12.9	.1

Key:
1. Indigenous Cattle
2. Grade Cattle
3. Sheep
4. Goats
5. Poultry
6. Donkey/Ass
7. Pigs
8. Beehive
9. Other

Item E6 - Distance to Water Source

District	Response				
	1	2	3	4	5
Mwingi	27	41	12	18	3
Embu	20	17	32	19	12
Tharaka Nithi	24	44	21	3	8
All	22	29	26	14	9

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. Over 10 km

Item E8 - Source of Cooking Fuel

District	Response				
	1	2	3	4	5
Mwingi	97		3		
Embu	90	2	3	2	4
Tharaka Nithi	96		3	2	
All	93	1	3	1	2

Key:
1. Firewood
2. Charcoal
3. Kerosene
4. Electric
5. Others

Item E9 - Source of Lighting

District	Response					
	1	2	3	4	5	6
Mwingi	82	12	3		3	
Embu	74	7	2	1	16	1
Tharaka Nithi	70	5	2	2	23	
All	74	7	2	1	16	1

Key:
1. Kerosene
2. Firewood
3. Solar
4. Electric
5. Candle
6. Other

Item E04 - Housing - Source of Water - Wet Season

District	Response							
	1	2	3	4	5	6	7	8
Mwingi	2.5	7.5	42.5	-	15.0	2.5	30.0	-
Embu	-	11.3	41.7	4.3	27.0	.9	14.8	-
Tharaka Nithi	-	5.8	22.3	-	51.5	-	18.4	1.9
All	.4	8.5	34.1	1.9	34.9	.8	18.6	.8

Key:
1. Piped
2. Spring
3. River
4. Dam
5. Well
6. Pond
7. Rain Water
8. Other

Item E05 - Housing - Source of Water - Dry Season

District	Response						
	1	2	3	4	5	6	7
Mwingi	2.5	2.5	60.0	-	35.0	-	-
Embu	-	12.2	75.7	2.6	9.6	-	-
Tharaka Nithi	-	-	92.2	-	2.9	-	1.9
All	.4	5.8	79.8	1.2	10.9	-	1.2

Key:
1. Piped
2. Spring
3. River
4. Dam
5. Well
6. Pond
7. Rain Water

Item E06 - Housing - Source of Water - Distance

District	Response				
	1	2	3	4	5
Mwingi	25.0	42.5	15.0	15.0	2.5
Embu	20.0	16.5	32.2	19.1	12.2
Tharaka Nithi	23.5	44.1	24.5	2.9	4.9
All	22.2	31.5	26.5	12.1	7.8

Key:
1. Less than 1 km
2. to 2.99 km
3. to 5.99 km
4. to 9.99 km
5. over 10 km

Item E07 - Housing - Excreta Disposal

District	Response				
	1	2	3	4	5
Mwingi	2.5	-	-	87.5	10.0
Embu	.9	.9	5.2	87.8	5.2
Tharaka Nithi	1.0	-	1.9	82.5	14.6
All	1.2	.4	3.1	85.7	9.7

Key:
1. Main Sewer
2. Cess Pool
3. Bucket Latrine
4. Pit Latrine
5. Bush

Item F1 - Access to Social Amenities - Health Facility

District	Response				
	1	2	3	4	5
Mwingi	-	5.0	12.5	25.0	57.5
Embu	1.0	1.0	10.5	15.2	72.4
Tharaka Nithi	-	12.7	32.4	28.4	26.5
All	.4	6.5	19.8	22.3	51.0

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. over 10 km

Item F2 - Access to Social Amenities - Market Place

District	Response				
	1	2	3	4	5
Mwingi	-	7.5	17.5	20.0	55.0
Embu	-	1.9	8.6	12.4	77.1
Tharaka Nithi	-	2.0	8.8	10.8	78.4
All	-	2.8	10.1	13.0	74.1

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. over 10 km

Item F5 - Access to Social Amenities
Distance to Electric Supply

District	Response				
	1	2	3	4	5
Mwingi			9	6	85
Embu		8	4	9	80
Tharaka Nithi					100
All		4	4	6	87

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. Over 10 km

Item F6 - Access to Social Amenities - Cattle Dip

District	Response				
	1	2	3	4	5
Mwingi	2.5	-	5.0	40.0	52.5
Embu	6.7	15.2	26.7	27.6	23.8
Tharaka Nithi	-	6.3	12.5	6.3	75.0
All	3.3	9.1	17.4	21.2	49.0

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. over 10 km

Item F7 - Access to Social Amenities - Administration Centre

District	Response				
	1	2	3	4	5
Mwingi	27.5	25.0	10.0	7.5	30.0
Embu	1.0	1.0	11.4	15.2	71.4
Tharaka Nithi	2.9	14.7	55.9	9.8	16.7
All	6.1	10.5	29.6	11.7	42.1

Key:
1. Less than 1 km
2. 1 to 2.99 km
3. 3 to 5.99 km
4. 6 to 9.99 km
5. over 10 km

Item H1 - In your opinion, how much should you be paid for all the buildings on this holding?

District	Response					
	1	2	3	4	5	6
Mwingi	15	7.5	12.5	20	10	35
Embu	12.4	22.0	14.3	7.7	9.6	29.5
Tharaka Nithi	7.9	4	10.8	9.8	5.9	62.7
All	7.6	12.1	12.5	10.5	8.1	44.1

Key:
1. 0 - 40,000
2. 40,001 - 80,000
3. 80,001 - 150,000
4. 150,001 - 300,000
5. 300,001 - 500,000
6. 500,001 Plus

Item H2 - How much would you require to replace all your buildings on another piece of land?

District	Response					
	1	2	3	4	5	6
Mwingi	27.5	7.5	7.5	5.0	17.5	35.0
Embu	13.4	13.4	7.7	10.5	4.8	43.8
Tharaka Nithi	5	1	6.8	9.8	10.8	66.7
All	8.4	7.2	7.2	9.4	9.3	51.8

Key:
1. 0 - 40,000
2. 40,001 - 80,000
3. 80,001 - 150,000
4. 150,001 - 300,000
5. 300,001 - 500,000
6. 500,001 Plus

Item H3 - How much would you ask for per acre (hectare) of your land?

District	Response				
	1	2	3	4	5
Mwingi	60	15	20	5	-
Embu	39	29.5	27.7	2.0	1.0
Tharaka Nithi	24.6	30.3	30.4	5.9	8.8
All	31.5	27.5	27.5	4.0	4.0

Key:
1. 0 - 30,000
2. 30,001 - 80,000
3. 80,001 - 200,000
4. 200,001 - 500,000
5. 500,001 Plus

Item H5 - What Type of Fencing ?

District	Response				
	1	2	3	4	5
Mwingi	3	52	6	40	
Embu	3	81		17	
Tharaka Nithi	2	34	2	49	14
All	2	59	2	33	5

Key:
1. Barbed wire
2. Live hedge
3. Timber / bamboo
4. Others

Item H7 - In case of being resettled in another area, you would prefer to ...

District	Response			
	1	2	3	4
Mwingi	15	85		
Embu	34	64	3	
Tharaka Nithi	8	90	2	2
All	22	75	2	1

Key:
1. Move with village people
2. Move with family/ relatives
3. Move alone
4. Other

Item H8 - Please choose one for resettlement area .

District	Response				
	1	2	3	4	5
Mwingi	27	53	3	15	3
Embu	39	49	6	6	1
Tharaka Nithi	14	79	2	6	
All	29	59	4	7	1

Key:
1. Near reservoir
2. Neighboring village
3. Neighboring town
4. Neighboring district
5. Other

Item H9 - For your answer in H8, which of the following would you prefer ?

District	Response					
	1	2	3	4	5	6
Mwingi		27	12	6	44	12
Embu	3	31	11	34	20	
Tharaka Nithi	2	69	2	12	15	
All	2	43	8	23	23	2

Key:
1. Hill area
2. Plain
3. Government area
4. Planned irrigation area
5. Where relatives are
6. Other (specify)

Item H10 - What would be your most preferred employment opportunity in the resettlement area?

District	Response										
	1	2	3	4	5	6	7	8	9	10	11
Mwingi	17.5	67.5	5.0	2.5	-	5.0	-	-	-	2.5	-
Embu	2.9	91.3	-	-	1.0	1.9	-	-	1.0	-	1.9
Tharaka Nithi	10.8	87.3	-	1.0	-	-	-	-	-	1.0	-
All	8.5	85.8	.8	.8	.4	1.6	-	-	.4	.8	.8

Key:
1. Farming only
2. Farming with animal husbandry
3. Animal husbandry alone
4. Hired labor
5. Operating a store
6. Manufacturing
7. Fishing
8. Farming with fishing
9. Bee keeping
10. Fishing and part time work
11. Other (define)

Item H11 - Is there any security problem in this area ?

District	Response	
	1	2
Mwingi	44	56
Embu	37	63
Tharaka Nithi	31	69
Total Sample	36	64

Key:
1. Yes
2. No

Item H12 - Do you think security will be a constraint for resettlement?

District	Response	
	1	2
Mwingi	62	38
Embu	56	44
Tharaka Nithi	83	17
All	66	34

Key:
1. Yes
2. No

Item H17 - Resettlement Options

District	Response			
	1	2	3	4
Mwingi	55	7.5	35.0	2.5
Embu	19.4	29.1	25.2	26.2
Tharaka Nithi	52.5	5.9	13.9	27.7
All	38.9	16.0	22.1	23.0

Key:
1. Prefer Cash Compensation
2. Prefer Alternative Land
3. Prefer not to move
4. Prefer Land and Cash Compensation

Item H001 - what is your total acreage of your piece of land in hectares?

District	Response											
	1	2	3	4	5	6	7	8	9	10	11	12
Mwingi	-	2.5	12.5	2.5	2.5	17.5	12.5	15.0	12.5	12.5	-	10.0
Embu	-	14.9	24.8	12.9	12.9	11.9	7.9	5.9	2.0	-	-	6.9
Tharaka Nithi	-	-	2.9	5.9	7.8	18.6	4.9	12.7	5.9	5.9	5.9	29.4
All	-	6.6	13.6	8.2	9.1	15.6	7.4	10.3	5.3	4.5	2.5	16.9

Key:
1. Less than 1
2. Between 1 & 5
3. Between 5 & 10
4. Between 10 & 15
5. Between 15& 20
6. Between 20 & 30
7. Between 30 & 40
8. Between 40 & 50
9. Between 50 & 60
10. Between 60 & 70
11. Between 70 & 80
12. Over 81

A-8.2 DATA DICTIONARY: HOUSEHOLD QUESTIONNAIRE

page 1 Data Dictionary: MUTONGA IMPS Version 3.1

Created: 08/02/96 10:44:18

Record Length: 70

The following records have been defined:

Record Name	Record Type Value (RECTYPE)	Required	Max. Records
HH-HHOLD-NUMBER	01	N	1
B-HEARD-PROJ	02	N	1
C-DEMOGRAPHY	03	N	30
D-LAND-INFORM	04	N	1
D1-FARM-INCOM	05	N	17
D2-LIVESTOCK	06	N	5
E-HOUSING	07	N	1
F-ASS-SOCIO-AMEN	08	N	1
G-HH-INCOM-EXPEN	09	N	30
G1-EXPENDITURE	10	N	30
H-RESTTLEMENT	11	N	1

.he following COMMON items have been defined. They occur on all records.

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Value Name	Values
(record type)	A	1-2	2		
A01-DISTRICT	N	3-4	2		41
A02-DIVISION	N	5-6	2		03
A03-LOCATION	N	7-8	2		01:10
A04-SUB-LOCATION	N	9-10	2		01:15
A05-VILLAGE	N	11-13	3		011:991
A06-ZONE	N	14	1		1:9

Record Name: HH-HHOLD-NUMBER Record Type: 01

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
HOUSEHOLD	N	15-17	3	0	HOUSEHOLD NUMBER	001:999

Record Name: B-HEARD-PROJ Record Type: 02

Item (occurs) Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
B01-HAERD-MUTONG	N	15	1	0	YES	1
					NO	2
B02-HOW-KNOW-IT	N	16	1	0	PUBLIC BARAZA	1

					NEIGHBOUR/FRIEND	2
					NEWSPAPERS	3
					TELEVISION	4
					RADIO	5
					OTHER	6
B03-IDEA-CLEAR	N	17	1	0	VERY CLEAR	1
					QUITE CLEAR	2
					CLEAR	3
					NOT QUITE CLEAR	4
					NOT CLEAR	5
					NEVER BEN EXPLAI	6
					OTHER	7
B04-OPION-ACCEPT	N	18	1	0	YES	1
					NO	2
B05-BENEFITS	N	19	1	0	IRRIGATE AGRICUL	1
					INFRASTRURE DEV.	2
					EMPLOYMENT	3
					OTHER	4
B06-EXPER-IRRIG	N	20	1	0	YES	1
					NO	2
B07-REAS-NOT-PRO	N	21	1	0	DONT WANT TO MOV	1
					DONT SEE DIR BEN	2
					PROJECT DANGER	3
					BREED WATER BORN	4
					LAND TAKE NO LAN	5
					OTHER	6
					NOT APPLICABLE	7
B08-ANY-MEM-FARM	N	22	1	0	YES	1
					NO	2
B09-ACT-OF-GROUP	N	23	1	0	SOIL CONSERVATIO	1
					COMMUNAL WORK	2
					CEREMONIES	3
					MARKETING	4
					OTHER	5
					NOT APPLICABLE	7
B10-MEMBE-WGROUP	N	24	1	0	YES	1
					NO	2

. Created: 08/02/96 10:44:18

.ecord Name: B-HEARD-PROJ Record Type: 02

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
B11-ACTIS-WGROUP	N	25	1	0	SELF-HELP	1
					DANCING	2
					FARMING	3
					TRADI/BUSINESS	4
					SAVING/CREDIT	5
					TREE NURSER	6
					OTHER	7
B12-ANY-DISPLACE	N	26	1	0	YES	1
					NO	2
B13-ANY-PERS-MOV	N	27	1	0	YES	1
					NO	2
B14-THEY-LIV-NEA	N	28	1	0	YES	1
					NO	2

Record Name: C-DEMOGRAPHY Record Type: 03

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
C01-SERIAL-NUMBE	N	15-16	2	0		
C03-RELATIONSHIP	N	17-18	2	0	HEAD	01

					SPOUSE	02
					SON	03
					DAUGHTER	04
					BROTHER	05
					SISTER	06
					FATHER	07
					MOTHER	08
					OTHER RELATIVE	09
					NON-RELATIVE	10
C05-SEX	N	19	1	0	MALE	1
					FEMALE	2
C06-AGE	N	20-21	2	0		
C08-OCCUPATION	N	22	1	0	FARMER/PASTORALI	1
					REGULAR-WAGE-EAR	2
					CASUAL EMPLOYEME	3
					HOMEMAKER/HOUSEW	4
					STUDENT	5
					OTHER	6
C09-EDUCA-STATUS	N	23	1	0	NONE	0
					AT SCHOOL	1
					LEFT SCHOOL	2
C10-EDUCAT-LEVEL	N	24-25	2	0	NONE	00
					STANDARD 1	01
					STANDARD 2	02
					STANDARD 3	03
					STANDARD 4	04
					STANDARD 5	05
					STANDARD 6	06
					STANDARD 7	07
					STANDARD 8	08
					FORM 1	11
					FORM 2	12
					FORM 3	13
					FORM 4	14
					FORM 5	15
					FORM 6	16
					UNDER GRADUATE	17
					POST GRADUATE	18
C11-ETHNIC-TRIBE	N	26	1	0	KAMBA	1

.ecord Name: C-DEMOGRAPHY Record Type: 03

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.tem (occurs) . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
MERU 2						
					THARAKA	3
					EMBU/MBERE	4
					OTHER	5
C12-RELIGION	N	27	1	0	CATHOLIC	1
					PROTESTANT	2
					MUSLIM	3
					OTHER	4
C13-BIRTH-PLACE	N	28	1	0	WITHIN PROJECT A	1
					WITHOUT PROJECT	2
					OTHER	3
C14-PREVIO-RESID	N	29	1	0	WITHIN PROJECT A	1
					WITHOUT PROJECT	2
					OTHER	3
C15-DURAT-STA-AR	N	30-31	2	0		
C16-REAS-MIGRATI	N	32	1	0	SEARCH PASTURE	1
					SEARCH LAND	2

					MOVED FRO PROJ A	3
					FOR EMPLOYMENT	4
					FISHING	5
					NO REASON	6
					OTHER	7
					NOT APPLICABLE	8
C17-SICK-2-WEEKS	N	33	1	0	YES	1
					NO	2
C18-IFY-SICK-TYP	N	34-35	2	0	MALARIA	01
					UPPER-RES-INFECT	02
					SKIN DISEASE	03
					INTENSTINAL WORM	04
					ACCIDENTS	05
					EYE INFECTION	06
					DIARRHOEA	07
					URINARY TRAC INF	08
					DENTAL DISODER	09
					EAR INFECTION	10
					SCHISTOSOMAISIS	11
					OTHER	12
					NOT APPLICABLE	13

Record Name: D-LAND-INFORM Record Type: 04

.tem (occurs) . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
D11-HOW-LAND-ACQ	N	15	1	0	INHERITED	1
					BOUGHT	2
					RENTED	3
					GIFT	4
					OTHER	5
D12A-AMOUNT-PAID	N	16-22	7	0		0000000:9999999
D12B-LAND-TENURE	N	23	1	0	ABSO. OWNER/FREE	1
					LEASEHOLD	2
					INDIVIDUAL OWNER	3
					SHARE CROPPING	4
					JOINT OWNERSHIP	5
					COMMUN OWN/TRUST	6
					OTHER	7
D13-RENT-OUT-LAN	N	24	1	0	YES	1
					NO	2
D14-LAND-RENT-OU	N	25-29	5	0		00000:99999
D15-REN-OPERERAT	N	30-34	5	0		00000:99999
D16-QUALITY-SOIL	N	35	1	0	YES	1
					NO	2
D17-OWN-ANY-LAND	N	36	1	0	YES	1
					NO	2
D18A-YES-OWNLAND	N	37	1	0	WITHIN	1
					OUTSIDE	2
D18B-ACREAGE-LAN	N	38-42	5	0		00000:99999
D19A-BREAK-GROUD	N	43	1	0	OX-POUGH	1
					TRACTOR	2
					HAND IMPLEMENTS	3
					OTHER	4
D19B-SOWING	N	44	1	0	OX-POUGH	1
					TRACTOR	2
					HAND IMPLEMENTS	3
					OTHER	4
D19C-WEEDING	N	45	1	0	OX-POUGH	1
					TRACTOR	2
					HAND IMPLEMENTS	3
					OTHER	4

.ecord Name: D-LAND-INFORM Record Type: 04

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
D110-USE-CONSERV	N	46	1	0	YES	1
					NO	2
D111-TRANSPORT	N	47	1	0	ROAD	1
					RAILWAY	2
					ANIMAL OF BURDEN	3
					HUMAN LABOUR	4
					BICYCLE	5
					OTHER	6
D112-ENOUGH-SUBS	N	48	1	0	YES	1
					NO	2

Record Name: D1-FARM-INCOM Record Type: 05

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
D100-CROP	N	15-16	2	0	COTTON	01
					MAIZE	02
					MILLET	03
					SORGHUM	04
					BEANS	05
					GROUNDNUTS	06
					VEGETABLES	07
					SWEET POTATOES	08
					CASSAVA	09
					SUGAR CANE	10
					FRUITS	11
					SUN FLOWER	12
					GREEN GRAMS	13
					PIGEON PEAS	14
					SISAL	15
					OTHER	16
					COW PEAS	17
					BANANAS	18
D101-ACREAGE	N	17-20	4	0		
D105-TOT-PRO-UNI	N	21	1	0	KILOGRAMMES	1
					BAGS	2
					DEBES	3
					OTHERS	4
D106-PROD-AMOUNT	N	22-24	3	0		
D109-VALUE-PUNIT	N	25-28	4	0		
D113-TOT-SOL-12M	N	29-31	3	0		
D116-HARV-PER-YR	N	32	1	0		
D117-TYPE-SEED	N	33	1	0	CERTIFIED SEED	1
					LOCAL SEEDS	2
					OTHER SEEDS	3
D118-USE-FERTILI	N	34	1	0	YES	1
					NO	2
D119-USE-PEST-HE	N	35	1	0	YES	1
					NO	2

Record Name: D2-LIVESTOCK Record Type: 06

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
D200-LIVESTOCK	N	15	1	0	INDIGEN CATTLE	1
					GRADE CATTLE	2
					SHEEP	3
					GOATS	4
					POUTRY	5

					DONKEY/ASS	6
					PIGS	7
					BEE HIVES	8
					OTHER	9
D201-BREAD-METHO	N	16	1	0	AI	1
					TRADITIONAL	2
					DON'T KNOW	3
					OTHER	4
D202-ACREAGE	N	17-20	4	0		
D206-NUMBER	N	21-23	3	0		
D209-VAL-PER-UNI	N	24-28	5	0		
D214-PRODU-UNIT	N	29	1	0	MILK-BOTTLES	1
					EGGS- NUMBER	2
					HONEY-KG	3
					PIGLETS NUMBER	4
					KIDS (NUMBER)	5
					LAMBS(NUMBER)	6
					MEAT (KG)	7
					OTHER	8
D215-PRICE-UNIT	N	30-32	3	0		
D0218-MARKET-PLA	N	33	1	0	LOCAL MARKET	1
					NEAREST URBAN	2
					NEAR MAJOR URBAN	3
					OTHER	4

Record Name: E-HOUSING Record Type: 07

.tem (occurs) . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
E01-FLOOR-TYPE	N	15	1	0	CEMENT	1
					WOODEN	2
					EARTH	3
					STONE	4
					TILES	5
					OTHER	6
E02-WALL-TYPE	N	16	1	0	CEMENT	1
					WOODEN	2
					MUD	3
					IRON SHEET	4
					STONE	5
					OTHER	6
E03-TYPE-OF-ROOF	N	17	1	0	TILES	1
					ASBESTOS	2
					IRON SHEETS	3
					GRASS	4
					OTHER	5
E04-WATER-WET-SE	N	18	1	0	PIPED	1
					SPRING	2
					RIVER	3
					DAM	4
					WELL	5
					POND	6
					RAIN WATER	7
					OTHER	8
E05-DRY-SEASON	N	19	1	0	PIPED	1
					SPRING	2
					RIVER	3
					DAM	4
					WELL	5
					POND	6
					RAIN WATER	7
					OTHER	8

E06-DIST-TO-WATE	N	20	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
E07-EXCRET-DISPO	N	21	1	0	MAIN SEWER	1
					CESS POOL	2
					BUCKET LATRINE	3
					PIT LATRINE	4

.ecord Name: E-HOUSING Record Type: 07

.tem (occurs) / . Subitem (occurs) / .-	Data Type	Position	Item Len.	Dec.	Value Name	Values
					BUSH	5
					OTHER	6
E08-SOU-COOK-FUE	N	22	1	0	FIREWOOD	1
					CHARCOAL	2
					KEROSINE	3
					ELECTRIC	4
					OTHERS	5
E09-SOURCE-LIGHT	N	23	1	0	KEROSINE	1
					FIREWOOD	2
					SOLAR	3
					ELECTRIC	4
					CANDLE	5
					OTHERS	6

Record Name: F-ASS-SOCIO-AMEN Record Type: 08

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
F01-HEALTH	N	15	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F02-MARKET-PLACE	N	16	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F03-PRIMA-SCHOOL	N	17	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F04-MAIN-ROAD	N	18	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F05-ELECTR-SUPPL	N	19	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F06-CATTLE-DIP	N	20	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5

F07-ADMINST-CENT	N	21	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5
F08-CHURCH-MOSQU	N	22	1	0	LESS THAN 1KM	1
					ONE TO 2.99 KM	2
					THREE TO 5.99 KM	3
					SIX TO 9.99 KM	4
					OVER 10 KM	5

Record Name: G-HH-INCOM-EXPEN Record Type: 09

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
G00-SOURCE-INCOM	N	15-16	2	0	SALARY	01
					WAGES	02
					CASH CROPS	03
					FOOD CROPS	04
					FISH	05
					BEE KEEPING	06
					GIFTS/HAND-OUTS	07
					BUSINESS	08
					LIVESTOCK SALES	09
					LIVESTOCK PRODUC	10
					OTHERS	11
G01-AMOUNT	N	17-24	8	0		

Record Name: G1-EXPENDITURE Record Type: 10

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
GH0-HH-EXPEDN	N	15-16	2	0	EDUCATION	01
					FOOD	02
					MEDICAL	03
					TRANSPORTATION	04
					FUEL	05
					CLOTHING	06
					AGRO-CHEMICAL	07
					MACHINERY	08
					DONATION	09
					WATER	10
					WAGES	11
					ANIMAL FEEDS	12
					OTHERS	13
GH1-AMOUNT	N	17-24	8	0		

Record Name: H-RESTTLEMENT Record Type: 11

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
H001-ACREAGE	N	15-18	4	0		
H005-LAND-CULTIV	N	19-22	4	0		
H009-LAND-GRAZE	N	23-26	4	0		
H013-WOOD-FALLOW	N	27-30	4	0		
H017-RESET-OPTIO	N	31	1	0	PREFER-CASH-COMP	1
					PREFER-ALTER-LAN	2
					PREF-NOT-TO-MOVE	3
					PREF-LAND & CASH	4
					OTHERS	5
H018-LUGGAGE-WGT	N	32-33	2	0		
H1-OPION-PAY-BLD	N	34-40	7	0	AMOUNT	
0000000:9999999						

H2REQU-REP-BLD	N	41-47	7	0	AMOUNT	
0000000:9999999						
H3-ASK-PER-ACRE	N	48-53	6	0	AMOUNT-PER-ACRE	
000000:999999						
H4-LAND-ENCL-FEN	N	54	1	0	YES	1
					NO	2
H5-TYPE-FENCING	N	55	1	0	BARBED WIRE	1
					LIVE WIRE	2
					TIMBER/BAMBOO	3
					ANY OTHER	4
					NOT STATED	5
H6-ESTIM-COST-FE	N	56-63	8	0	ESTI-COST-OF-FEN	
00000000:99999999						
H7-INCAS-RES-PRE	N	64	1	0	MOVE WIT VIL PEO	1
					MOVE FAMILY/RELA	2
					MOVE ALONE	3
					OTHER	4
H8-RESETTLE-AREA	N	65	1	0	NEAR RESERVOIR	1
					NEIGHBOR VILLAGE	2
					NEIGHBORING TOWN	3
					NEIGHBOR DISTRIC	4
					OTHER	5
H9-ANS-H8-PREFER	N	66	1	0	HILL AREA	1
					PLAIN	2
					GOVERNMENT AREA	3

.ecord Name: H-RESTTLEMENT Record Type: 11

.tem (occurs) / . Subitem (occurs)	Data Type	Position	Item Len.	Dec.	Value Name	Values
					PLAN IRRIGAT ARE	4
					WHERE RELATI ARE	5
					OTHER	6
H10-MOS-PRE-EMPL	N	67-68	2	0	FARMING ONLY	01
					FARM WITH ANIHUS	02
					ANIM HUSBAN ONLY	03
					HIRED LABOUR	04
					OPERATING STORE	05
					MANUFACTURING	06
					FISHING	07
					FARM WITH FISHIN	08
					BEE KEEPING	09
					FISH & PART-TIME	10
					OTHER	12
H11-SECUR-PROBLE	N	69	1	0	YES	1
					NO	2
H12-SEC-CONS-RES	N	70	1	0	YES	1
					NO	2

Annex to Chapter 12

Annex 12

A-12.1. FLORA OF THE STUDY AREA

(PROPOSED RESERVOIRS AND SURROUNDINGS)

PTERIDOPHYTA (Ferns)

ADIANTACEAE

Actiniopteris radiata (Sw.) Link

Pellaea longipilosa Bonap

GYMNOSPERMAE
(Cone-bearing plants)

ZAMIACEAE

Encephalartos powysiorum Beentje

CUPPRESACEAE

Juniperus procera Endl.

Cuppressus arizonica

C. lusitanica

SPERMATOPHYTA
(Seed-bearing plants)

8 ANNONACEAE

Antabotrys sp.

Uvaria lucida Benth. ssp. lucida

23 MENISPERMACEAE

Chasmanthera dependens Hochst.

Cissampelos pareira L.

Tiliacora funifera (Miers) Oliv.

36 CAPPARACEAE

Boscia coriacea Pax

Cadaba farinosa Forssk

Capparis tomentosa Lam.

Cleome allamanii chiov.

C. hirta (Klotzsch) Oliv.

Gynadropsis gynadra (L.) Briq.

Maerua crassifolia Forssk.

M. edulis (Gilg. & ened) De Wolf

M. triphylla A. Rich.

Thylachium africanum Lour.

39 CRUCIFERAE

Farsetia stenoptera Hochst.

Rorippa micrantha (Roth) Joasell

42 POLYGALACEAE

Polygala erioptera DC.

P. sphenopteri Fresen.

53 CARYOPHYLLACEAE

Polycarpaea eriantha A-Rich

54 AIZOACEAE

Gisekia pharnaceoides L.

Mollugo cerviana L.

Trianthema triquetra Wild.

Zaleya pentandra (L.) Jeffrey

56 PORTULACACEAE

Portulaca foliosa Ker-Gawl.

P. oleracea L.

Talinm potulacifolium Schweint

57 POLYGONACEAE

Oxygonum sinuatum (Meisn.) Dammer

Polygonum salicifolium Willd.

P. senegalensis Meisn

Securidaca longepedunculata Fres.

59 PHYTOLACACEAE

Phytolaca dodecandra L'Herit

61 CHENOPODIACEAE

Chenopodium procerum Moq.

63 AMARANTHACEAE

Achyranthes aspera L.

Aerva lanata (L.) Juss

Alternanthera pungens H.B. & K.

Amaranthus graecizans L.

A. spinosus L.

Cyathula coriacea Schinz

Digera muricata (Hochst.) Schinz.

Psilotrichum ellioti Baker

Puppalia lappacea (L.) Juss.

Sericocomopsis hildebrandtii Schinz

66 ZYGOPHYLACEAE

Tribulus cistoides L.

T. terrestris L.

72 LYTHRACEAE

Lawsonia inermis L.

77 ONAGRACEAE

Ludwigia abyssinica A. Rich

81 THYMELEACEAE

Gnidia latifolia (Oliv.) Gilg

Synaptolepis kirkii Oliv.

83 NYCTAGINACEAE

Boerhavia coccinia Mill.

Commicarpus plumbagineus (Car.) Standl.

84 PROTEACEAE

Grevillea robusta A. Cunn.

95 CANELLACEAE
Warburgia ugandensis Spraque

101 PASSIFLORACEAE
Adenia gummifera (Harv.) Harms

103 CUCURBITACEAE
Cucumis dipsaceus Spach
Kedrostis foetidissima (Jacq.) Cogn.
K. gijef (J.F. Gmel.) C .Jeffrey
Lagunaria sphaerica (Sond.) Nand.
Zehneria scabra (L.F.) Sond.

114 OCHNACEAE
Ochna inermis (Forssk.) Schweinf.
Ochna insculpta Sleumer

118 MYRTACEAE
Eugenia taxon B (probably a new species)
Syzygium guineense (Willd.) DC.

121 COMBRETACEAE
Combretum aculeatum Vent.
C. hereroense Schinz
C. molle G. Don
C. paniculatum Vent
Terminalia brownii Fresen
T. prunioides Laws
T. spinosa Engl.

126 GUTTIFERAE
Garcinia livingstonei T. Anders

128 TILIACEAE
Corchorus aestuans L.
Corchorus trilocularis L.
Grewia bicolor Juss
G. plagiophylla K. Schum
Grewia tembensis Fresen
G. tenax (Forssk.) Fiori
G. villosa Willd.
T. tomentosa Boj
Triumfetta flavescens A. Rich

130 STERCULIACEAE
Dombeya dawei Sprague
D. rotundifolia (Hochst) Planch
Hermania alhiensis K. Schum
Hermania exappendiculata (Mast) K. Schum
Melhania ovata (Car.) Spreng
Sterculia stenocarpa H. Winkler

131 BOMBACACEAE
Adansonia digitata L.

132 MALVACEAE
Abutlon fruticosum Guill. & Perr.
A mauritianum (Jacq.) Medic.
Azanza garckeana (F. Hoffm. Exel and Hillcoat
Gossypium somalense (Guerke) J.B. Hutch
Hibiscus aponeurus Sprague & Hutch
H. diversifolius Jacq.
H. fuscus Garcke
H. micranthus L.f.
H. palmatus Forssk.
Pavonia patens (Andr.) Chiov.
Sida ovata Forssk.
Thespesia danis Oliv.

136 EUPHORBIACEAE
Acalypha fruticosa Forssk.
Antidesma venosum Tul.
Bridelia cathartica Bertol f.
Bridelia taitensis Pax Vatke
Croton macrostachyus Del.
C. megalocarpus Hutch
Erythrococca bongensis Pax
Euphorbia candelabrum Kotschy
E. crotonoides Boiss
E. cuneata Vahl
E. hirta L.
E. nyikae Pax
E. pseudograntii Pax
E. scheffleri Pax
E. tirucalli
Jatropha spicata Pax
Phyllanthus guineensis Pax
Ricinus communis L.
Securinega virosa (Willd.) Pax & K. Hoffu
Spirostachys africana sond.
S. venenifera (Pax) Pax

141 PLUMBAGINACEAE
Plumbago zeyalanica L.

143 ROSACEAE
Rubus pinnatus Willd.
R. scheffleri Engl.

146 CAESALPINIACEAE
Bauhinia taitensis Taub.
B. tomentosa L.
Caesalpinia trothae Harms
Cassia longiracemosa (Eng.)

C. occidentalis L.
C. singueana Del.
Delonix elata (L.) Gamble
Piliostigma thonningii (Schumach) Milne-Redh.
Prosopis chilenis
Tamarindus indica L.
Tylosema humifusa (Pich. - Serm. and Rot Mich.) Brenan

147 MIMOSACEAE
Acacia ataxacantha DC.
A. brevispica Harms
A. bussei Sjostedt
A. elatior Brenan
A. mellifera (Vahl) Benth.
A. nilotica (L.) Del.
A. polyacantha Willd.
A. robusta Burch.
A. senegal (L) Wild.
A seyal Del.
A. thomasii Harms
A. tortilis (forssk.) Hayne
Albizia harveyi Fourn
Dichrostachys Cinerea (L.) Wight and Arn.
Entada leptostachya Harms
Mimosa pudica L.
Newtonia hildebrandtii (Vatke) Torre

148 PAPILIONACEAE
Abrus specatorius L.
Aeschynomeme abyssinica (A. Rich.) Vatke
Aeschynomeme schimperi A. Rich.
Calpurnia aurea (Ait) Benth.
Canavalia ensiforms Thouars
Clitoria ternatea L.
Colutea abyssinica Kunth and Bouche
Crotalaria cleomiifolia Bak.
Dalbegia melanoxylon Guill. and Perr.
Erythrina abyssinica DC.
E. burtii Bak.f.
Indigofera arrecta A. Rich
I. hochstetteri Bak.
I schimperi Junb. and Spach
I spinosa Forssk.
I trita L.
I volkensii Taub.
Milletia dura Dunn
M. tanaensis Gillett
Ormocarpum trachycarpum (Taub.) Harms
Platycelyphium voense (Engl) Wild
Rhynchosia elegana A. Rich
R. minima (L.) DC.
Sesbania sesban (L.) Merrill)
Tephrosia Villosa (L.) Pers.
Tephrosia pumilla (Lam.) Pers.

165 ULMACEAE
Chaetacme aristata Planch.

167 MORACEAE
Ficus exasperata Vahl
F. ingens (Miq.) Miq.
F. sur Forssk.
F. sycomorus L.
F. vallis - choudae Del.

169 URTICACEAE
Urtica massaica Mildbr.

171 AQUIFOLIACEAE
Ilex mitis (L.) Radlk.

173 CELASTRACEAE
Hippocratea africana (Wild.) Loes.
Maytenus senegalensis (Lam.) Excell
Mystroxylon aethiopicum (Thunb.) Loes.

179 ICACINACEAE
Apodytes dimidiata Arn.
Pyrenacantha sp.

180 SALVADORACEAE
Azima tetracantha Lam
Dobera glabra (Forssk.) Poir
Salvadora percica L.

182 OLACEAE
Ximenia americana L.
Opilia amentacea Roxb.

183 OPILIACEAE
Opilia copressa Engl.

185 LORANTHACEAE
Phragmanthera dschallensis (Engl.)Balle
Osyris lanceolata Hochst. & steudel
Tapinanthus aurantiacus (Engl) Danser

185/A.VISCACEAE
Viscum schimperi Engl.

190 RHAMNACEAE

Berchemia discolor (Klotzsch) Hemsl.

Helinus mystacinus (Ait.) Stend.

Scutia myrtina (Burm.f.) Kurz

Ziziphus mucronata Willd

Ziziphus pubescens Oliv.

Z. spina-christi (L.) Desf.

193 VITACEAE

Cissus rotundifolia (Forssk.) Vahl.

Cissus quadrangularis L.

Cyphostemma sp.

Rhoicissus tridentata (L.f.) Wild & Drummond

194 RUTACEAE

Clausena anisata (Willd.) Benth

Teclea simplicifolia (Engl.) Verdoorn

Toddalia asiatica (L.) Lam.

Zanthoxyllum usambarense Engl. Kokwaro

195 SIMAROUBACEAE

Harrisonia abyssinica Oliv

Kirkia tenuifolia Engl.

195A. BALANITACEAE

Balanites glabra Mildbr. and Schlecht.

B. pedicellaris Mildbr. and Schlecht.

196 BURSERACEAE

Boswellia neglecta S. Moore

Commiphora africana (A. Rich.) Engl.

C. boiviniana Engl.

C. campestris Engl.

C. holtziana Engl.

C. mildbraedii Engl.

197 MELIACEAE

Elkebergia capensis Sparrm.

Lepidotrichilia volkensii (Guerke) Leroy

Melia volkensii Gurke

198 SAPINDACEAE

Allophylus ferrugineus Taub

A. rubifolius (A. Rich.) Engl.

Deinbollia barbonica Scheff)

Haplocoelum foliolosum (Hiern) Bulloch

Lecaniodiscus flaxinifolius Bak.

Pappea capensis Eckl. and Zeyh.

202 MELIANTHACEAE

Bersama abyssinica Fres.

205 ANACARDIACEAE

Lannea alata (Engl.) Engl.

L. fulva (Engl.) Engl.

L. rivae (Chior) Sacl.

L. schimperi (A. Rich.) Engl.

L. triphylla (A. Rich.) Engl.

Ozoroa insignis Del.

Pistacia aethiopica Kokwaro

Rhus longipes Engl.

R. natalensis Krauss

R. vulgaris Meikle

Sclerocarya birrea (A. Rich.) Hochst.

206 CONNARACEAE

Agelaea pentagyna (Lam.) Baill

210 ALANGIACEAE

Alangium salviifolium (L.f) Wangerin

212 ALALIACEAE

Cussonia holstii Engl.

C. Spicata Thunb.

Schefflera abyssinica (A. Rich.) Harms

213 UMBELLIFERAE

Steganotaenia araliacea Hochst.

Trachyspermum aethiisifolium Chiov.

221 EBENACEAE

Diospyros abyssinica (Hiern) F. White

D. consolatae Chiov.

Euclea divinorum Hiern

222 SAPOTACEAE

Aningeria adolfi-friedericii (Engl.) Robyns and Yilb.

Chrysophyllum gorungosanom Engl.

223 MYRSINACEAE

Maesa lanceolata Forssk.

Myrsine africana L.

228 LOGANIACEAE

Nuxia congesta Fres.

Strychnos lenningsii Gilg

229 OLEACEAE

Jasminum fleminense Vell

Olea europaea L.

230 APOCYNACEAE

Acokanthera schimperi (A.DC.) *Schweinf.*
Adenium obesum (Forssk.) Roem and Schult
Carissa edulis (Forssk.)

231 ASCLEPIADACEAE

Calotropis procera (Ait) Ait. f.
Cerepegia sp.
Dregea abyssinica (Hochst.) K. Schum.
Kanahia laniflora (Forssk.) R.Br.
Secamone punctulata Decne.

232 RUBIACEAE

Breonadia microcephala (Del.) Ridsdale
Carphalea glaucescens (Hiern) verdc.
Conostomium quadrangulare (Rendle) Cufod
Galium aparinoids Forssk.
Gardenia volkensii K. Schum.
Kohautia caespitosa Schnizl.
Meyna tetraphylla (Hiern) Robyns
Oldenlandia corymbosa L.
Pauridiantha paucinervis (Hiern) Brem.
Psychotria kirkii Hiern
Pentas parvifolia Hiern.
Psydrax schimperiana (A. Rich.) Bridson
Rothmannia urcelliformis (Hiern) Robyns
Spermacoce filituba (K. Schum.) Verdc.
Tarenna graveolens (S. Moore) Brem.
Tennantia sennii (Choiv.) Verdc. and Bridson
Vangueria madagascariensis Gmel.

238 COMPOSITAE

Acanthospermum hispidum DC.
Bidens pilosa L.
Blepharispermum lanceolatum Chiov.
Conyza aegyptiaca (L.) L.
Eclipta prostrata (L.)
Gutenbergia cordifolia Oliv.
Helichrysum glumaceum DC.
Kleinia kleinioides Sch. Bip.) M.R.F. Taylor
Melanthera scandens (Schum. and Thonn.) Roberty
Pluchea dioscoridis DC.
Senecio discifolius Oliv.
Sphaeranthus ukambensis Vatke and O. Hoffm.
Tithonia divesifolia (Hemsl) A. Gray
Tridax procumbens L.
Vernonia amygdalina Del.
Xanthium pungens wallroth

249 BORAGINACEAE

Cordia monoica Roxb.
Cordia sinensis Lam.
Ehretia cymosa Thonn.
Heliotropium albohispindum Bak.
H. steudneri Vatke
H. subulatum (DC.) Martelli

250 SOLANACEAE

Datura stramonium L.
Lycium europaeum L.
Solanum arundo Mattei
S. aculeastrum Dunal
S. incanum L.
S. nigrum L.
S. renschii Vatke
Withania somnifera (L.) Dunal

251 CONVOLVULACEAE

Astraipomoea hyoseyamoides (Vatke) Verdc.
Convolvulus rhyniospermus Choisy
Cuscuta sp.
Evolvulus alsinoides L.
Ipomoea bullata Oliv.
I. cairica (L.) Sweet
I. cicatricosa Bak.
I. kituiensis Vatke

252 SCROPHULALIACEAE

Craterostigma sp.
Halleria lucida L.

257 BIGNONIACEAE

Kigelia africana (Lam.) Benth.
Markhamia lutea (Benth) K. Schum.
Spathodea campanulata P. Beauv

258 PEDALIACEAE

Sesamothamnus rivae Engl.
Sesamum calycinum Welw.

259 ACANTHACEAE

Anisotes parvifolius Oliv.
Barleria acanthoides Vahl.
B. submollis Lindan
B. taitensis S. Moore
Blepharis hildebrandtii Lindau
B. linariifolia Pers
B. maderaspatensis (L.)
Crabbea velutina S. Moore
Crossandra stenostachya (Lindau) C.B.Cl)
Duosperma eremophilum Milne-Redh
Dyschoriste thunbergiiflora (S. Moore) Lindau
Ecbolium revolutium (Lindau) C.B.Cl)
Hypoestes verticillaris (L.f.) Roem. and Schult
Justicia diclipteroides Lindau
J. flava Vahl.
J. odora (Forssk.) Vahl.
Ruellia prostrata (Nees) T. Anders
Thunbergia guerkeana Lindau

263 VERBENACEAE

Clerodendrum myricoides (Hochst.) Vatke
Lantana camara L.
Lantana trifolia L.
Premna holstii Gurke
P. resinosa (Hochst.) Schauer
Priva cordifolia (L.)
Vitex doniana Sweet

264 LABIATAE

Basilicum polytachion (L.) Moench
Becium obovatum (E. Mey) N.E. Br.
Erythrochlamys spectabilis Gurke
Hoslundia opposita Vahl
Leonotis sp.
Leucas glabrata (Vahl) R. Br.
L. tomentosa Gurke
Ocimium basilicum L.
Orthosiphon somalensis Vatke
Plectranthus barbatus Andr.
Pycnostachys umbrosa Vatke Perkins
Tetradenia riparia (Hochst) Codd.
Tinnea aethiopica Hook

293A ALOEACEAE

Aloe sp.

293B DRACAENACEAE

Dracaena laxissima Engl.

314 PALMAE

Hyphaene compressa H. Wendl.
Phoenix reclinata Jacq.
Raphia farinifera (Gaertn.) Hyland

319 VELLOZIACEAE

Xerophyta spekei Bak.

COMMELINACEAE

Commelina benghalensis L.
Commelina latifolia A. Rich.

LILIACEAE

Asparagus africanus Lam.
Gloriosa minor Lindl.
Gloriosa simplex L.
Anthericum whytei Bak.

AGAVACEAE

Sansevieria sp.

CYPERACEAE

Cyperus articulatus L.
Cyperus immensus C.B.Cl.
Cyperus alternifolius L.
Cyperus compessus L.
Fimbristylis hispindula (Vahl.)
Kyllinga alba Nees
Mariscus macropus C.B.Cl.
Pycreus pelophilus (Ridley) C.B.Cl.

332 GRAMINEAE

Aristida kenyensis Henr.
A. mutabilis Trin. and Rupr.
Brachiaria deflexa (Schumach) Robyns
B. leersioides (Hochst) Stapf
Cenchrus ciliaris L.
Chloris roxburghiana Schult
Chrysopogon plumulosus Hochst.
Dactyloclenium aegyptium (L.) Willd.
Dichanthium insculptum (A. Rich.) Clayton
Digitaria milanjiana (Rendle) Stapf
D. velutina (Forssk.) P. Beauv.
Diheteropogon amplectus (Nees) Clayton
Echinochloa colona (L.) Link
Eragrostis superba Peyr.
Heteropogon contortus (L.) Roem. and Schult
Leptochloa obtusiflora Hochst

Leptothrium senegalense (Kunth) Clayton
Microchloa kuuthii Desv.
Oropetium capense stapf
Panicum coloratum L.
P. denstum Thunb.
P. maximum Jacq.
Paspalidum geminatum (Forssk.) Stapf
Pennisetum sphacelatum Fresen
Paspalum desertorum (A. Rich.) Stapf
Perotis hildebrandtii Mez.
Phyragmites karka (Retz.) Steud.
P. mauritianus Kunth
Rhynchelytrum repens (Willd) CE. Hubb.
Sporobolus fibriatus (Trin) Nees
S. ioclados (Trin) Nees
Tetrapogon bidentatus Pilg.
Tragus berteronianus Schult

A-12.2. DISTRIBUTION OF SPECIES BY FAMILIES

Family	No. Species	(%)	Family	No. species	(%)
Adiantaceae	2	0.5	*Olacaceae*	2	0.5
Zamiaceae	1	0.2	*Opiliaceae*	1	0.2
Cuppressaceae	3	0.7	*Loranthaceae*	3	0.7
Annonaceae	2	0.5	*Viscaceae*	1	0.2
Menispermaceae	3	0.7	*Rhamnaceae*	6	1.3
Capparaceae	10	2.3	*Vitaceae*	4	0.9
Cruciferae	2	0.5	*Rutaceae*	4	0.9
Polygalaceae	2	0.5	*Simaroubaceae*	2	0.5
Caryophyllaceae	1	0.2	*Balanitaceae*	2	0.5
Aizoaceae	3	0.7	*Burseraceae*	6	1.4
Portulacaceae	3	0.7	*Meliaceae*	3	0.7
Polygonaceae	4	0.9	*Sapindaceae*	6	1.4
Phytolacaceae	1	0.2	*Melianthaceae*	1	0.2
Chenopodiacea	1	0.2	*Anacardiaceae*	12	2.8
Amaranthaceae	10	2.3	*Connaraceae*	1	0.2
Zygophylaceae	2	0.5	*Alangiaceae*	1	0.2
Lathraceae	1	0.2	*Alaliacea*	3	0.7
Onagraceae	1	0.2	*Umbelliferae*	2	0.5
Thymeleaceae	2	0.5	*Ebenaceae*	3	0.7
Nyctaginaceae	2	0.5	*Sapotaceae*	2	0.5
Proteaceae	1	0.2	*Myrsinaceae*	2	0.5
Canellaceae	1	0.2	*Loganiaceae*	2	0.5
Passifloraceae	1	0.2	*Apocynaceae*	2	0.7
Cucurbitaceae	5	1.2	*Oleaceae*	2	0.5
Ochnaceae	1	0.5	*Asclepiadaceae*	6	1.4
Myrtaceae	2	0.5	*Rubiaceae*	17	3.9
Combretaceae	7	1.6	*Compositae*	16	3.7
Guttiferae	1	0.2	*Boraginaceae*	6	1.4
Tiliaceae	10	2.3	*Solanaceae*	8	1.9
Sterculiaceae	6	1.4	*Convolvulaceae*	8	1.9
Bombacacea	1	0.2	*Scrophulaliaceae*	2	0.5
Malvaceae	12	2.8	*Bignoniaceae*	3	0.7
Euphorbiaceae	21	4.9	*Pedaliaceae*	2	0.5
Plumbaginacea	1	0.2	*Acanthaceae*	18	4.2
Rosaceae	2	0.5	*Verbenaceae*	7	1.6
Caesalpiniaceae	11	2.5	*Labiatae*	13	3.0
Mimosaceae	17	3.9	*Aloeacea*	1	0.2
Papilionaceae	26	6.0	*Dracaenaceae*	1	0.2
Ulmaceae	1	0.2	*Palmae*	3	0.7
Moraceae	5	1.2	*Velloziaceae*	1	0.2
Urticaceae	1	0.2	*Commelinaceae*	2	0.5
Aquifoliaceae	1	0.2	*Liliaceae*	4	0.9
Celastracea	3	0.7	*Agavaceae*	1	0.2
Icacinaceae	2	0.5	*Cyperaceae*	8	1.9
Salvadoraceae	3	0.7	*Gramineae*	33	7.7
TOTAL FAMILIES	**90**		**TOTAL SPECIES**	**431**	

A-12.3. SPECIES DISTRIBUTION IN THE STUDY AREA

Plant Growth Form:	Habitat
H - herb	R - Riverine
S - shrub	B - Bushland
C - climber	F - Forest
T - tree	
L - liana	
st - shrub or tree	

Plant Species	Form	R	B	F
Actiniopteris radiata	H			+
Pellaea longipilosa	H			+
Encephalartos powysiorum	S			+
Ntabotrys sp.	S	+		
Uvaria lucida	S	+		
Chasmanthera dependens	L			+
Cissampelos pareira	C			+
Tiliocora funifera	L	+		
Boscia coriacea	S		+	
Cadaba farinosa	S		+	
Capparis tomentosa	S		+	
Cleome allamanii	S		+	+
C. hirta	H		+	+
Gynadropsis gynadra	H		+	
Maerua crassifolia	S		+	
M. edulis	S		+	
M. triphylla	S		+	
Thylachium africanum	S	+		
Farsetia stenoptera	H		+	
Rorippa micrantha	H			+
Polygala erioptera	H		+	
P. sphenopteri	H		+	
Polycarpaea eriantha	H		+	
Gisekia pharnaceoides	H	+		
Mollugo cerviana	H	+		
Trianthema triquetra	H		+	
Zaleya pentandra	H		+	
Portulaca foliosa	H		+	
P. oleracea	H	+		
Talinum portulacifolium	H		+	
Oxygonum sinuatum	H		+	
Polygonum salicifolium	H	+		
P. senegalensis	H	+		
Securidaca longipedunculata	st		+	+
Phytolaca dodecandra	S		+	+
Chenopodium procerum	S		+	+
Alternanthera pungens	H		+	
Amaranthus graecizans	H		+	
A. spinosus	H		+	
Achyranthes aspera	H		+	
Aerva lanata	H		+	
Cyathula coriacea	H		+	
Digera muricata	H		+	+
Psilotrichum elliotii	H		+	
Puppalia lappacea	H		+	
Sericocomopsis hildebrandtii	H		+	
Tribulus cistoides	H		+	
T. terrestris	H		+	
Lawsonia inermis	st	+		
Ludwigia abyssinica	H	+		
Gnidia latifolia	S		+	+
Synaptolepis kirkii	T			+
Boerhavia coccinia	H		+	
Commicarpus plumbagineus	H		+	
Gravillea robusta	T		+	
Warburgia ugandensis	T			+
Adenia gummifera	L			+
Cucumis dipsaceus	H			+
Kedrostis foetidissima	C			+
K. gijef	C		+	
Lagunaria sphaerica	C	+		+
Zehneria scabra	L		+	
Ochna inermis	S			+
Ochna insculpta	S		+	
Eugenia sp.	S	+		
Syzygium guineense	T	+		
Combretum aculeatum	st		+	
C. hereroense	T		+	
C. molle	T		+	
C. paniculatum	T		+	
Terminalia brownii	T		+	
T. prunioides	T		+	
T. spinosa	T		+	
Garcinia livingstonei	T	+		

Corchorus aestuans	H	+			*B. tomentosa*	S		+	
Corchorus trilocularis	H	+			*Caesalpinia trothae*	H	+		
Grewia biclor	S		+		*Cassia longiracemosa*	S		+	
G. Plagiophylla	S		+		*C. occidentalis*	S		+	
Grewia tembensis	S		+		*C. singueana*	S		+	
G. tenax	S		+		*Delonix elata*	T		+	+
G. trichocarpa	S		+		*Piliostigma thonningii*	T		+	
G.villosa	S		+		*Prosopis chilenis*	S	+		
Triumfetta flavescens	S	+			*Tamarindus indica*	T	+		
T. tomentosa	S			+	*Tylosema humifusa*	S	+		
Dombeya dawei	T		+		*Acacia ataxacantha*	S	+		+
D. rotundifolia	T		+		*A. brevispica*	S		+	
Hermania alhiensis	H		+		*A. bussei*	S		+	
Hermania exappendiculata	H		+		*A. elatior*	T	+		
Melhania ovata	H		+		*A. mellifera*	S		+	
Sterculia stenocarpa	T		+		*A. nilotica*	st		+	
Adansonia digitata	T		+		*A. polyacantha*	T	+		
Abutilon fruticosum	H	+			*A. robusta*	T	+		
A. Mauritianum	S			+	*Acacia senegal*	st		+	
Azanza garckeana	T	+			*A. seyal*	T		+	
Gossypium somalense	S		+		*A. thomasii*	S		+	
Hibiscus aponeurus	S			+	*A. tortilis*	T	+	+	
H. diversifolius	S	+			*Albizia harvey*	T			+
H. fuscus	S			+	*Dichrostachys cinerea*	S		+	
H. micranthus	S			+	*Entada leptostachya*	L	+	+	
H. palmatus	S			+	*Mimosa pigra*	S	+		
Pavonia patens	S			+	*Newtonia hildebrandtii*	T	+		
Sida ovata	S			+	*Abrus specatorius*	C			+
Thespesia danis	S		+		*Aeschynomene abyssinica*	H			+
Acalypha fruticosa	S			+	*Aeschynomene schimperi*	H			+
Antidesma venosum	T			+	*Calpurnia aurea*	H			+
Bridelia cathartica	T			+	*Canavalia ensiformis*	H		+	
Bridelia taitensis	T			+	*Clitoria ternatea*	C			+
Croton macrostachyus	T			+	*Colutea abyssinica*	H			+
C. megalocarpus	T			+	*Crotalaria cleomiifolia*	S		+	
Erythrococca bongensis	st			+	*Dalbergia melanoxylon*	st		+	
Euphorbia candelabrum	T			+	*Erythrina abyssinica*	T		+	
E. crotonoides	H			+	*E. burtii*	S		+	
E. cuneata	S		+		*Indigofera arrecta*	S		+	
E. hirta	H		+		*I. hochstetteri*	S		+	
E. nyikae	T		+		*I. schimperi*	S		+	
E. pseudograntii	H		+		*I. spinosa*	S		+	
E. scheffreli	S		+		*I. trita*	st			+
E. tirucalli	S		+	+	*I. volkensii*	H		+	
Jatropha spicata	S		+		*Milletia dura*	st	+		+
Phyllanthus guineensis	S		+		*M. tanaensis*	st			+
Recinus communis	S	+			*Ormocarpum trachycarpum*	S		+	
Securinega virosa	S		+		*Platycelyphium voense*	T		+	
Spirostachys africana	T	+			*Rhynchosia elegans*	H		+	
S. venenifera	T	+			*R. minima*	H		+	
Plumbago zeyalanica	S	+			*Sesbania sesban*	S	+		
Rubus pinnatus	S	+			*Tephrosia villosa*	S			+
R. schefferi	S			+	*Tephrosia pumilla*	S			+
Bauhinia taitensis	S			+	*Chaetacme aristata*	S	+		

Ficus exasperata	T	+		+	*Lannea alata*	st		+		
F. ingens	st	+			*L. fulva*	st		+		
F. sur	T	+			*L rivae*	st		+		
F. sycomorus	T	+			*L. shimperi*	T			+	
F. vallis choudae	T	+			*L. schweinfurthii*	T		+	+	
Urtica masaica	H		+		*L. triphylla*	S		+		
Ilex mitis	S			+	*Ozoroa insignis*	T		+		
Hippocratea africana	S	+			*Pistacia aethiopica*	st			+	
Maytenus senegalensis	S			+	*Rhus longipes*	S			+	
Mystroxylon aethiopicum	S			+	*R. natalensis*	S		+		
Apodyles dimidiata	T			+	*R. vulgaris*	S		+		
Pyrenacantha sp.	L			+	*Sclerocarya birrea*	T		+		
Azima tetracantha	S		+		*Agelaea pentagyna*	S			+	
Dobera glabra	S		+		*Alangium salviifolium*	st	+			
Salvadora percica	st		+		*Cussonia holstii*	T		+		
Ximenia americana	st		+		*C. spicata*	T			+	
Opilia amentacea	L	+			*Schefflera abyssinica*	T			+	
Opilia copressa	S		+		*Steganotaenia araliacea*	st		+		
Phragmanthera dschallensis	S		+		*Trachyspermum aethiisifolium*	H		+		
Osyris lanceolata	st	+	+		*Dispyros abyssinica*	T	+			
Tapinanthus aurantiacus	H		+		*D. consolatae*	T	+			
Viscum schimperi	H		+		*Euclea divinorum*	S			+	
Berchemia discolor	T		+	+	*Aningeria adolfi-friedericii*	T			+	
Ziziphus pubescens	S			+	*Chrysophyllum gorungosanom*	T			+	
Scutia myrtina	S			+	*Maesa lanceolata*	st			+	
Ziziphus mucronata	S			+	*Myrsine africana*	S			+	
Z. spina-christi	S	+			*Nuxia congesta*	T			+	
Cissus rotundifolia	C			+	*Strychnos henningsii*	S	+		+	
Cissus quadransgularis	C			+	*Jasminum fluminense*	C			+	
Cyphostemma sp.	H		+		*Olea europaea*	st			+	
Rhoicissus tridentata	S			+	*Acokanthera schimperi*	S			+	
Clausena anisata	S			+	*Adenia obsesum*	S		+		
Teclea simplicifolia	S			+	*Carissa edulis*	S		+		
Toddalia asiatica	L			+	*Calotropis procera*	S	+			
Zanthoxyllum usambarense	T			+	*Ceropegia sp*	C		+		
Harrisonia abyssinica	S			+	*Dregea abyssinica*	C			+	
Kirkia temfolia	S		+		*Kanahia laniflora*	S	+			
Balnites glabra	T		+		*Pergularia daemia*	H			+	
Balanites pedicellaris	T		+		*Secamone punctulata*	C	+		+	
Boswella neglecta	T		+		*Breonadia microcephala*	S	+			
Commiphora africana	st		+		*Carphalea glaucescens*	S		+		
Commiphora boiviniana	T		+		*Conostomium guadrangulare*	H		+		
Commiphora campestris	S		+		*Galium aparinoides*	H			+	
Commiphora hottziana	T		+		*Gardenia volkensii*	T	+			
Commiphora mildbraedii	S		+		*Kohautia caespitosa*	H		+		
Ekebergia capensis	T			+	*Meyna tetraphylla*	L			+	
Lepidotrichilia volkensii	T			+	*Oldenlandia corymbosa*	H		+		
Melia volkensii	T		+		*Pauridiantha paucinervis*	S			+	
Allophylla ferrugineus	st			+	*Pentas parvifolia*	S		+		
Allophylla rabifolius	st			+	*Psychotria kirkii*	S			+	
Deinbollia barbonica	T	+			*Psydrax schimperiana*	S		+		
Haplocoelum foliolosum	T	+			*Rothmannia urcelliformis*	T			+	
Lecaniodiscus flaxinifolius	st	+			*Spermacoce filituba*	H	+			
Bersama abyssinica	S			+	*Tarenna graveolens*	T	+	+		

Temnantia senni	S	+		
Vangueria madagasscariensis	T		+	
Acanthospermum hispidum	H	+		
Bidens pilosa	H		+	
Blepharispermum lanceolatum	S		+	
Conyza aegyptiaca	H		+	
Eclipta prostrata	H		+	
Gutenbergia cordifolia	H		+	
Helichrysum glumaceum	H		+	
Kleinia kleinioides	S			+
Melanthera scandens	H	+		
Pluchea dioscoridis	H	+		
Senecio discifolius	H		+	
Sphaeranthus ukambensis	H	+		
Tithonia diversifolia	H		+	
Tridax procumbens	H		+	
Vernonia amygdalina	S	+		
Xanthium pungens	H	+		
Cordia monoica	S		+	
Cordia sinensis	S		+	
Ehretia cymosa	S			+
Heliotropium albohispidum	H		+	
H. steudneri	H		+	
H. Subulatum	H	+		
Datura stramonium	H	+		
Lycium europaeum	S		+	
Solanum arundo	S	+		
Solanum aculeastrum	S			+
S. incanum	S		+	
S. nigrum	H			+
S. renschii	S		+	
Withania somnifera	H		+	
Astraipomoea hyoseyamoides	S		+	
Convolvulus rhyniospermus	H		+	
Cuscuta sp.	H			
Evolvulus alsinoides	H		+	
Ipomoea bullata	H		+	
I. cairica	H		+	
I. cicatricosa	S			+
I. kituiensis	S		+	
Craterostigma sp	H		+	
Halleria lucida	S		+	
Kigelia africana	T	+		
Markhamia lutea	T	+		
Spathodea campanulata	T			+
Sesamothamnus rivae	st		+	
Sesamum calycinum	H		+	
Anisotes parvifolum	S		+	
Barleria acanthoides	H		+	
B. submollis	H		+	
B. taitensis	H		+	
Blepharis hildebrandtii	H		+	
B. linariifolia	H		+	

B. maderaspatensis	H		+	
Crabbea velutina	H		+	
Crossandra stenostachya	H		+	
Duosperma eremophilum	S		+	
Dyschoriste thunbergiifolia	H			+
Ecbolium revolutum	H			+
Hypoestes verticillaris	H		+	
Justicia diclipteroides	H		+	
J. flava	H			+
J. odora	H		+	
Ruellia prostrata	H		+	
Thunbergia guerkeana	C			+
Clerodendrum myricoides	S		+	
Lantana camara	S		+	
Lantana trifolia	S		+	
Premna holstii	S		+	
P. resinosa	S		+	
Priva cordifolia	H		+	
Vitex doniana	T			+
Basilicum polytachion	H	+		
Becium obovatum	H		+	
Erythrochlamys spectabilis	S		+	
Hoslundia opposita	S		+	
Leonotis sp	S		+	
Leucas glabrata	H		+	
L. tomentosa	H		+	
Ocimum basilicum	H		+	
Orthosiphon somalensi	H	+		
Plectranthus barbatus	S			+
Pycnostachys umbrosa	H	+		
Tetradenia riparia	S		+	
Tinnea aethiopica	S		+	
Aloe sp.	S		+	
Dracaena laxissima	S	+		
Hyphaene compressa	T	+	+	
Phoenix reclinata	T	+		
Raphia farinifera	T	+		
Xerophyta spekei	S			+
Commelina benghalensis	H			+
Commelina latifolia	H			+
Asparagus africanus	H		+	
Gloriosa minor	H		+	
Gloriosa simplex	H			+
Anthericum whytei	H			+
Sanserieria sp	S			+
Cyperus articulatus	H	+		
Cyperus immensus	H	+		
Cyperus alternifolius	H	+		
Cypeus compessus	H		+	
Fimbristylis hispidula	H	+		
Kyllinga alba	H		+	
Mariscus macropus	H		+	
Pycreus pelophilus	H	+		
Aristida kenyensis henr	H		+	

A. mutabilis	H		+	
Brachiaria deflexa	H		+	
B. leersioides	H		+	
Cenchrus ciliaris	H	+		
Chloris roxburghiana	H		+	
Chrysopogon plumulosus	H		+	
Dactyloclenium aegyptium	H		+	
Dichanthium insculptum	H		+	
Digitaria milanjiana	H		+	
D. velutina	H		+	
Diheteropogon amplectus	H		+	
Echinochloa colona	H	+		
Eragrostis superba	H	+		
Heteropogon contortus	H		+	
Leptochloa obtusiflora	H	+		
Microchloa kunthii	H		+	
Oropetium capense	H		+	
Panicum coloratum	H		+	
P. dentum	H			+
P. maximum	H	+		+
Paspalidium geminatum	H	+		
Pennisetum sphacelatum	H	+		
Paspalum dersertorum	H	+		
Perotis hildebrandtii	H			+
Phragmites karka	H	+		
P. mauritianus	H	+		
Rhynchelytrum repens	H		+	
Sporobolus fibriatus	H		+	
S. ioclados	H		+	
Tetrapogon bidentatus	H		+	
Tragus berteronianus	H		+	

Annex to Chapter 13

ANNEX TO CHAPTER 13

Table A13-1 Dry Season Flow Discharges at Sampling Time

	Kindaruma Plunge Pool	Kiambere Tailrace End	Mutonga 4EA7		Kazita 4F19		Grand Falls		Garissa 4G1	
	Q	Q	H	Q	H	Q	H	Q	H	Q
Date	m^3/sec	m^3/sec	m	m^3/sec	m	m^3/sec	m	m^3/sec	m	m^3/sec
7-9-95	117.00	73.1	0.56	14.18						
8-9-95					0.58	7.06	2.08	101.00		
9-9-95	70.50	77.5	0.32	16.39						
10-9-95					0.57	7.05	2.22	104.00		
11-9-95	99.00	75.0	0.28	15.70					1.64	94.20
12-9-95					0.57	6.91	2.26	103.00		
13-9-95	111.00	75.0	0.24	14.70					1.63	91.60
14-9-95					0.56	6.78	2.21	102.00		
15-9-95	114.00	75.0	0.23	14.36					1.64	93.40
16-9-95					0.56	6.01	2.05	100.00		
17-9-95	75.00	80.6	0.21	14.16					1.64	93.40
18-9-95					0.56	5.75	2.02	97.70		
19-9-95	72.00	74.4	0.19	13.70					1.58	88.90
20-9-95					0.54	5.83	2.04	98.60		
21-9-95	72.00	78.1	0.18	12.92					1.57	87.00
22-9-95					0.53	5.44	2.04	99.50		
23-9-95	84.00	83.8	0.19	12.69					1.53	84.70
24-9-95					0.52	5.40	2.00	97.70		
25-9-95	90.00	78.8	0.17	11.77					1.56	88.10
26-9-95					0.53	5.40	1.99	96.40		
27-9-95	111.00	83.8	0.16	11.93					1.56	86.40
28-9-95					0.52	4.76	2.04	100.00		
29-9-95	114.00	75.0	0.16	11.26					1.53	83.10
30-9-95					0.52	5.17	1.98	96.80		
1-10-95	99.00	83.1	0.21	11.44					1.56	87.90
2-10-95					0.52	5.21	1.54	91.30		
3-10-95	72.00	83.1	0.20	11.37					1.52	78.80
4-10-95					0.51	5.17	2.09	102.00		
5-10-95	108.00	75.0	0.64	22.50					1.46	72.70
6-10-95					0.53	5.30	2.09	102.00		
7-10-95									1.55	85.2
8-10-95										
9-10-95									1.6	87.1

Table A13-2 Wet Season Flow Discharges at Sampling Time

	Kindaruma Plunge Pool	Kiambere Tailrace End	Mutonga 4EA7		Kazita 4F19		Grand Falls 4F13		Garissa 4G1	
Date	Q m^3/sec.	Q m^3/sec.	H m	Q m^3/sec.	H m	Q m^3/sec.	H m	Q m^3/sec.	H m	Q m^3/sec.
27-10-95			2.55	184.00						
28-10-95					0.88	21.00	3.80	330.00		
29-10-95	120.00	84.40	1.18	51.00						
30-10-95					1.42	68.80	4.03	362.00	2.39	194.00
31-10-95	120.00	75.60	2.28	153.00						
1-11-95					0.91	21.60	3.68	269.00	2.67	245.00
2-11-95	114.00	75.60	1.25	52.00						
3-11-95					0.84	14.60	3.78	280.00	2.88	294.00
4-11-95	120.00	85.20	1.38	55.10						
5-11-95					0.76	11.80	3.36	236.00	2.57	232.00
6-11-95	105.00	76.20	1.24	52.00						
7-11-95					0.78	11.10	3.22	217.00	2.59	235.00
8-11-95	114.00	96.30	1.08	46.20						
9-11-95					0.78	9.90	3.17	212.00	2.49	210.00
10-11-95	120.00	102.00	1.08	38.80						
11-11-95					0.78	35.00	3.27	225.00	2.43	202.00
12-11-95	117.00	77.30	1.08	52.90						
13-11-95					1.26	59.50	3.39	242.00	2.34	187.00
14-11-95	117.00	111.00	2.29	165.00						
15-11-95					1.26	53.40	4.63	443.00	2.35	189.00
16-11-95	120.00	112.00	1.40	69.00						
17-11-95					1.03	29.70	3.90	303.00	3.33	425.00
18-11-95	120.00		1.47	81.30						
19-11-95		150.00			1.00	24.10	3.94	312.00	2.92	300.00
20-11-95	120.00		1.34	64.40						
21-11-95		158.00			0.90	22.10	3.80	280.00	2.83	280.00
22-11-95	123.00		1.41	74.20						
23-11-95		182.00			0.94	22.10	4.48	415.00	2.84	283.00
24-11-95	106.00		1.39	54.40						
25-11-95		190.00			0.90	21.20	4.32	391.00	3.15	360.00
26-11-95	114.00									
27-11-95		194.00							3.09	340.00

Table A13-3 Laboratory Suspended Sediment Analysis
Dry Season Sediment Concentration: Kindaruma Plunge Pool

Date	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
7-9-95	117.00	496.90	0.02	37	373
9-9-85	70.50	496.90	0.02	34	206
11-9-95	99.00	501.80	0.02	38	326
13-9-95	111.00	501.20	0.02	42	408
15-9-95	114.00	500.80	0.02	38	370
17-9-95	75.00	501.00	0.02	37	237
19-9-95	72.00	507.20	0.02	33	204
21-9-95	72.00	498.00	0.03	55	340
23-9-95	84.00	498.80	0.03	51	370
25-9-95	90.00	498.00	0.02	32	247
27-9-95	111.00	499.20	0.02	38	363
29-9-95	114.00	504.20	0.02	36	357
1-10-95	99.00	500.00	0.02	36	305
3-10-95	72.00	499.00	0.02	38	236
5-10-95	108.00	504.80	0.02	36	333

Wet Season Sediment Concentration: Kindaruma Plunge Pool

Date of Sampling	Discharge m^3/sec	Sediment Conc. ppm	Estimated Daily Load (mt)
29/10/95	120.00	62.00	643
31/10/95	120.00	66.00	684
2/11/95	114.00	40.00	394
4/11/95	120.00	38.00	394
6/11/95	105.00	28.00	254
8/11/95	114.00	24.00	236
10/11/95	120.00	28.00	290
12/11/95	117.00	48.00	485
14/11/95	117.00	34.00	344
16/11/95	120.00	60.00	622
18/11/95	120.00	28.00	290
20/11/95	120.00	32.00	332
22/11/95	123.00	46.00	489
24/11/95	106.00	28.00	256
26/11/95	114.00	32.00	315

Table A13-4 Laboratory Suspended Sediment Analysis

Dry Season Sediment Concentration: Kiambere Tail Race End

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
7-9-95	73.10	496.90	0.02	39	249
9-9-95	77.50	501.00	0.02	34	227
11-9-95	75.00	501.00	0.02	35	224
13-9-95	75.00	500.90	0.02	34	219
15-9-95	75.00	499.80	0.02	31	204
17-9-95	80.60	499.90	0.02	32	223
19-9-95	74.40	499.80	0.01	30	192
21-9-95	78.10	502.30	0.01	30	200
23-9-95	83.80	501.90	0.01	30	215
25-9-95	78.80	500.80	0.02	31	209
27-9-95	83.80	502.00	0.02	39	283
29-9-95	75.00	496.90	0.02	34	218
1-10-95	83.10	496.10	0.0147	30	212
3-10-95	83.10	502.20	0.0161	32	230
5-10-95	75.00	501.90	0.0161	32	208

Wet Season Sediment Concentration: Kiambere Tail Race End

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conce.ppm	Estimated Daily Load (mt)
29/10/95	84.400	497.100	0.009	18	132
31/10/95	75.600	497.000	0.011	22	145
2/11/95	75.600	499.000	0.015	30	196
4/11/95	85.200	496.000	0.013	26	193
6/11/95	76.200	495.100	0.011	22	146
8/11/95	96.300	498.600	0.015	30	250
10/11/95	102.000	499.000	0.021	42	371
12/11/95	77.300	496.000	0.019	38	256
16/11/95	112.000	496.000	0.019	38	371
19/11/95	150.000	498.000	0.019	38	494
21/11/95	156.000	498.600	0.016	32	438
23/11/95	182.000	496.000	0.017	34	539
25/11/95	180.000	499.000	0.022	44	724
27/11/95	194.000	499.000	0.016	32	537

Table A13-5 Laboratory Suspended Sediment Analysis
Dry Season Sediment Concentration: Mutonga 4EA7

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
9-9-95	14.80	498.00	0.02	31	40
11-9-95	16.39	498.20	0.02	37	52
13-9-95	15.70	498.30	0.02	31	42
15-9-95	14.70	499.60	0.02	33	42
17-9-95	14.36	497.60	0.02	33	41
19-9-95	14.16	497.40	0.01	30	36
21-9-95	13.70	499.00	0.02	32	38
23-9-95	12.92	498.30	0.02	31	35
25-9-95	12.69	499.20	0.02	35	38
27-9-95	11.77	497.20	0.03	52	53
29-9-95	11.93	497.70	0.02	34	35
1-10-95	11.26	499.60	0.02	35	34
3-10-95	11.44	499.60	0.02	35	35
5-10-95	11.37	498.30	0.02	31	30

Wet Season Sediment Concentration: Mutonga 4EA7

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
27/10/95	184.000	1071.100	44.686	41720	663,244
29/10/95	51.000	981.000	0.223	227	1,002
31/10/95	153.000	1039.000	4.564	4392	58,068
2/11/95	59.800	500.200	0.152	304	1,573
4/11/95	55.100	496.000	0.155	313	1,488
6/11/95	52.000	496.000	0.160	323	1,449
8/11/95	46.200	502.000	0.161	321	1,280
10/11/95	38.800	502.000	0.142	283	948
12/11/95	52.900	500.000	0.109	218	996
14/11/95	184.800	502.000	3.548	7067	100,635
16/11/95	69.000	501.000	0.546	1090	6,497
18/11/95	81.300	502.500	7.883	15687	110,194
20/11/95	64.400	496.000	9.173	349	102,903
22/11/95	74.200	498.000	0.185	371	2,382
24/11/95	54.500	497.300	0.233	469	2,206

Table A13-6 Laboratory Suspended Sediment Analysis
Dry Season Sediment Concentration: Kazita 4F19

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
8-9-95	7.06	498.10	0.01	27	16
10-9-95	7.05	497.20	0.01	29	18
12-9-95	6.91	497.20	0.01	26	16
14-9-95	6.76	498.00	0.01	29	17
16-9-95	6.01	497.10	0.02	39	20
18-9-95	5.75	496.90	0.02	30	15
20-9-95	5.83	498.90	0.01	24	12
22-9-95	5.44	497.60	0.02	37	18
24-9-95	5.40	498.20	0.01	28	13
26-9-95	5.40	500.00	0.01	21	10
28-9-95	4.76	496.30	0.01	22	9
30-9-95	5.17	500.20	0.01	21	9
2-10-95	5.21	498.20	0.01	30	13
4-10-95	5.17	497.60	0.02	47	21
6-10-95	5.30	498.90	0.01	21	10

Wet Season Sediment Concentration: Kazita 4F19

Date of Sampling	Discharge m3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
28/10/95	21.000	1002.400	20.256	20208	36,664
30/10/95	68.800	1002.100	4.914	4904	29,149
1/11/95	21.600	497.000	0.354	712	1,329
3/11/95	14.600	499.600	0.274	548	692
5/11/95	11.100	500.800	0.106	212	203
7/11/95	12.500	500.800	0.072	144	155
9/11/95	9.700	497.600	0.148	297	249
11/11/95	10.200	501.600	0.061	122	107
13/11/95	59.900	509.200	14.480	28437	147,170
15/11/95	47.700	501.000	1.754	3500	14,429
17/11/95	29.700	498.000	0.799	1604	4,117
19/11/95	26.900	499.400	0.350	701	1,629
21/11/95	21.200	498.000	0.572	1149	2,104
23/11/95	23.100	501.200	1.050	2095	4,181
25/11/95	21.200	496.000	0.126	254	465

Table A13-7 Laboratory Suspended Sediment Analysis
Dry Season Sediment Concentration: Tana Grand Falls 4F13

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conce.ppm	Estimated Daily Load (mt)
8-9-95	101.00	498.50	0.02	31	275
10-9-95	104.00	498.30	0.02	44	391
12-9-95	103.00	501.00	0.02	36	318
14-9-95	102.00	497.90	0.02	43	382
16-9-95	100.00	499.70	0.03	52	448
18-9-95	97.70	500.00	0.02	39	326
20-9-95	96.60	498.90	0.02	41	348
22-9-95	99.50	498.20	0.02	38	323
24-9-95	97.70	497.10	0.02	39	331
26-9-95	96.40	498.40	0.02	42	349
28-9-95	100.00	498.30	0.02	35	303
30-9-95	96.80	496.80	0.02	35	296
2-10-95	91.30	498.80	0.02	38	297
4-10-95	102.00	496.80	0.02	31	275
6-10-95	102.00	497.60	0.05	98	868

Wet Season Sediment Concentration: Tana Grand Falls 4F13

Date of Sampling	Discharge m3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
28/10/95	330.000	1003.600	1.506	1501	42,785
30/10/95	362.000	1002.600	1.988	1993	62,017
1/11/95	269.000	497.100	0.491	988	22,956
3/11/95	280.000	500.200	0.084	168	4,063
5/11/95	236.000	496.200	0.081	163	3,315
7/11/95	217.000	498.000	0.422	847	15,888
9/11/95	212.000	500.000	0.088	176	3,224
11/11/95	225.000	498.000	0.160	321	6,246
13/11/95	242.000	499.000	0.146	293	6,118
15/11/95	443.000	500.800	0.278	555	21,247
17/11/95	303.000	501.000	0.245	489	12,802
19/11/95	312.000	498.000	0.332	667	17,971
21/11/95	280.000	496.000	0.056	113	2,731
23/11/95	415.000	497.000	0.074	149	5,339
25/11/95	391.000	496.000	0.086	173	5,857

Table A13-8 Laboratory Suspended Sediment Analysis
Dry Season Sediment Concentration: Tana Garissa 4G1

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
11-9-95	94.20	498.00	0.18	355	2,893
13-9-95	91.60	498.00	0.06	112	890
15-9-95	93.40	499.00	0.13	263	2,119
17-9-95	93.40	501.20	0.10	208	1,674
19-9-95	88.90	498.00	0.07	143	1,095
21-9-95	87.00	498.80	0.06	110	829
23-9-95	84.70	499.00	0.05	499	733
25-9-95	88.10	499.80	0.11	220	1,675
27-9-95	86.40	497.10	0.08	159	1,186
29-9-95	83.10	498.30	0.07	136	980
1-10-95	87.90	498.00	0.07	133	1,007
3-10-95	78.80	497.30	0.07	131	890
5-10-95	72.70	500.00	0.06	110	691
7-10-95	85.20	498.00	0.09	175	1,286
9-10-95	87.10	499.10	0.19	383	2,880

Wet Season Sediment Concentration : Tana Garissa 4G1

Date of Sampling	Discharge m^3/sec	Wt. of Water & Sediment	Dry Sediment	Sediment Conc. ppm	Estimated Daily Load (mt)
30/10/95	194.000	498.600	1.299	2605	43,669
1/11/95	245.000	497.000	2.297	4622	97,833
3/11/95	294.000	500.600	1.428	2853	72,460
5/11/95	232.000	498.100	1.279	2568	51,470
7/11/95	235.000	498.600	1.661	3331	67,639
9/11/95	210.000	497.000	1.098	2209	40,085
11/11/95	202.000	498.000	1.295	2600	45,364
13/11/95	187.000	500.000	0.879	1758	28,404
15/11/95	189.000	498.000	1.461	2936	47,907
17/11/95	425.000	499.200	4.078	8169	299,968
19/11/95	300.000	499.000	1.326	4661	68,878
21/11/95	280.000	499.700	1.509	3020	73,055
23/11/95	282.000	497.000	1.673	3366	82,017
25/11/95	360.000	499.000	2.389	4788	148,913
27/11/95	340.000	499.600	1.487	2976	87,434

Table A13-9 Dry Season Suspended & Bed Load Particle Size distribution

Sampling Station	Load	Total Sample (gm)	Particle Sizes > 0.25mm	Particle Sizes > 0.025mm & < 0.25mm	Particle Sizes < 0.025mm
Mutonga River 4EA7	Bed Load gm	176.300	157.800	17.860	0.045
	Bed Load %		89.510	10.130	0.030
	Suspended gm	0.362	Undetected	Trace	0.362
	Load %			Unrecoverable	100.000
Kazita River 4F19	Bed Load gm	173.900	159.700	14.023	0.054
	Bed Load %		91.830	8.060	0.030
	Suspended gm	0.216	Undetected	Trace	0.215
	Load %			Unrecoverable	100.000
Tana Grand Falls 4F13	Bed Load gm	157.200	131.000	25.977	0.080
	Bed Load %		83.330	16.520	0.050
	Suspended gm	0.320	0.014	Trace	0.305
	Load %		4.400	Unrecoverable	95.300
Tana Garissa 4G1	Bed Load gm	151.800	95.600	54.785	1.312
	Bed Load %		62.960	36.090	0.860
	Suspended gm	1.365	0.033	0.208	1.122
	Load %		2.418	15.240	82.200
Kiambere Tail Race End	Suspended gm	0.246	Undetected	Undetected	0.239
	Load %				97.200
Kindaruma Plunge Pool	Suspended gm	0.290	Undetected	Undetected	0.286
	Load %				97.000

Table A13-10 Wet Season Suspended & Bed Load Particle Size distribution

Sampling Station	Load	Total Sample (gm)	Particle Sizes > 0.25mm	Particle Sizes > 0.025mm & < 0.25mm	Particle Sizes < 0.025mm
Mutonga River 4EA7	Bed Load gm	86.8	46.877	39.181	0.59
	Bed Load %		54.01	45.1	0.68
	Suspended gm	61.767	14.658	43.749	2.938
	Load %		24.05	70.83	4.76
Kazita River 4F19	Bed Load gm	134.8	121.111	13.337	0.102
	Bed Load %		89.84	9.89	0.08
	Suspended gm	41.117	33.702	7.147	0.05
	Load %		81.97	17.38	0.12
Tana Grand Falls 4F13	Bed Load gm	124.6	85.901	38.285	0.244
	Bed Load %		68.94	30.73	0.2
	Suspended gm	10.398	3.479	6.837	0.036
	Load %		33.46	65.75	0.35
Tana Garissa 4G1	Bed Load gm	111	10.365	92.681	7.399
	Bed Load %		9.34	83.68	6.67
	Suspended gm	24.254	4.99	18.734	0.283
	Load %		20.57	77.24	1.17
Kiambere Tailrace End	Suspended gm	0.223	Trace	Trace	0.201
	Load %				90
Kindaruma Plunge Pool	Suspended gm	0.297	Trace	Trace	0.288
	Load %				97

Table A13-11 Bacterial & Coliform Concentration No. Col/100ml in the River Stations during the Dry Season: A, 7/8 Sept. 1995; B, 27 Nov. 1995 and C, 6 Dec. 1995:

Station	A	B	C	
	No. Col/100ml	No. Col/100ml	No. Col/100ml	Remarks
Lower Catchment River Stations				
1 Irira	>2400	>2400	>2400	Remarkably Polluted
2 Thuci	>2400	>2400	1800	"
3 Ruguti	>1800	>2400	>2400	"
4 Mara	1800	>2400	>2400	"
5 Muton	>2400	>2400	>2400	"
6 Thing	1100	1800	>2400	"
7 Kazita	>2400	1800	1800	"
8 Tana	>2400	>2400	>2400	"
9 G. Falls	>2400	>2400	>2400	"
Upper Catchment River Stations				
10 Kazita	>2400	>2400	1800	"
11 Mara	>2400	>2400	1800	"
12 Thing	>2400	>2400	>2400	"
13 Irura	>2400	>2400	>2400	"
14 Muton	>2400	>2400	1800	"
15 Nithi	>2400	>2400	1800	"
16 Thuci	1100	>2400	1800	"
17 Ena	>2400	>2400	>2400	"
18 Mara	>2400	>2400	>2400	"
19 Ruguti	>2400	>2400	>2400	"
20 Naka	>2400	>2400	>2400	"

Table A13-12 Dry Season Physicochemical of Lower and Upper Catchment Stations on 7/8 Sept. 1995

Lower Catchment Stations		1	2	3	4	5	6	7	8	9
Temp	°C	25	21	20.5	20.5	21.5	20	20	20	25
pH		7	7.5	7.5	7	7	7	7	7	7
Turb	NTU	60	40	30	25	20	20	15	20	50
TDS	mg/l	70	60	40	50	57	55	56	60	70
DO	mg/l	9	8.5	9	9.5	10.2	8.6	9	9.5	9
BOD	mg/l	4.5	3.1	2.1	2.1	2.8	2	2.2	2.3	5
Cond	uS/cm	100	98	90	90	95	93	90	90	100
NO3	mg/l	0.1	0.11	0.01	0.02	0.01	0.01	0.01	0.01	0.01
NO2	mg/l	0	0	0	0	0	0	0	0	0
NH4	mg/l	0.3	0.2	0.1	0	0.1	0.1	0.1	0.1	0.01
PO4	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO4	mg/l	2.4	2.6	2.7	2.3	2.4	2.6	2.9	2.9	2
Mn	mg/l	0.01	0.01	0.02	0.05	0.05	0.08	0.09	0.04	0.04
Ca	mg/l	8.9	8	8	7	6.5	6	5.6	5.6	6
Mg	mg/l	2.1	0.9	0.8	0.9	1.1	1.2	1.2	2.4	2.4
Na	mg/l	7.1	7	6.9	6.9	6.8	5.2	5.9	3.6	8.9
K	mg/l	2	2.1	2.3	1.8	1.9	1.5	2.1	2.3	1.8
CaCO3	mg/l	60	52	60	60	59	46	34	60	46
Cl	mg/l	2	2.1	2.2	2.2	2.2	2.3	2.1	2	3
F	mg/l	0.8	0.3	0.1	0.1	0.2	0.2	0.1	0.1	0.2
SiO2	mg/l	19	18	18.5	18	19.2	19.7	16.1	18.9	20
Fe	mg/l	0.6	1.2	0.3	0.4	0.5	0.4	0.7	0.8	0.56
Hard	mg/l	30	24	21	19	18	19	20	21	26

Upper Catchment Stations		10	11	12	13	14	15	16	17	18	19	20
Temp	oC	18.5	18.5	19		19.5	19	20.5	19.5	19	18.5	19
pH		6.4	7.3	6.9	7	7.2	7.1	7.2	6.9	7.2	7.3	6.7
Turb	NTU	20	19	10	15	10	10	8	9	10	13	14
TDS	mg/l	67	64	58	60	50	55	22	22	43	30	20
DO	mg/l	9.9	9.2	9.3	9.5	9.6	9.1	9.3	8.8	9.4	9.7	9.4
BOD	mg/l	1	1.1	1.2	2.4	2.5	1	3	2.5	1.1	2	1.4
Cond	uS/cm	95	93	82	85	70	78	32	32	62	42	28
NO3	mg/l	0.55	1.33	3.3	1.34	0	0.67	0.55	0.89	1.111	0	0
NO2	mg/l	0	0	0	0	0	0	0	0	0	0.1	0
NH4	mg/l	0	0	0	0	0	0	0	0	0	0	0
PO4	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO4	mg/l	2	0	1.5	1.6	0.5	1	0.5	1.5	2	0	0
Mn	mg/l	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.05	0.02	0.01	0.01
Ca	mg/l	4	2.8	3.2	4	3.2	1.6	3.2	1.6	2.4	2.4	0.8
Mg	mg/l	2.4	1.2	1.9	1.8	1.6	1	0.01	1.9	1.9	0.01	0.01
Na	mg/l	14.7	17.5	13	14.5	16	16	6.6	5	12	7.2	8.5
K	mg/l	4	3.6	4.1	5	4.5	13.8	2.2	1	2.7	2	2.8
CaCO3	mg/l	50	50	42	40	48	46	24	16	36	24	16
Cl	mg/l	1	2	4	2.5	2	3	0.01	3	3	1	2
F	mg/l		0.4	2.2	0.3	0.4	0.2	0.2	0.3	0.1	0.2	0.2
SiO2	mg/l	40	40	30	35	30	25	10	20	20	20	10
Fe	mg/l	1.6	1.18	1.2	0.2	1.11	0.41	0.34	0.08	1.11	0.11	1.12
Hard	mg/l	26	28	20	23	30	35	30	20	21	22	40

Table A13-13 Wet Season Physicochemical of Lower and Upper Catchment stations on 27-28/10/1995

Lower Catchment Stations		1	2	3	4	5	6	7	8	9
Temp	oC	25	20.1	20.5	20	21	25	23	26.5	25
pH		7.1	6.5	7	6.8	6.9	6.8	6.8	6.8	7.1
Turb	NTU	40	35	30	30	35	34	32	33	45
TDS	mg/l	70	57	56	30	70	60	80	85	70
DO	mg/l	10.3	10.2	9	8.7	9.4	9.5	8.7	8	8.55
BOD	mg/l	4.5	3.2	2.5	3.4	4.3	3.6	4.5	4	3.8
Cond	uS/cm	100	50	80	42	100	86	115	120	110
NO3	mg/l	1.67	1.01	1.01	1.01	1.55	2.66	1.01	1.11	1.01
NO2	mg/l	0	0	0	0	0.03	0	0.03	0.03	0.03
NH4	mg/l	0	0.03	0.05	0	0	0	0	0	0
PO4	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO4	mg/l	6	5	3	0	0	2.5	5	5	4
Mn	mg/l	0.02	0.01	0.04	0.02	0.03	0.04	0.03	0.04	0.01
Ca	mg/l	6.4	3.2	4	1.6	6	4	5.6	8	11.2
Mg	mg/l	1.9	2.4	2.4	1	2.6	2	4.3	4.8	1.9
Na	mg/l	11	8.3	12	6.9	14	15.5	14	4	12
K	mg/l	2.7	4.3	4.6	2.4	3.8	5	4.5	6	4.5
CaCO3	mg/l	44	24	40	18	46	40	56	56	48
Cl	mg/l	6	5	3	3	3.5	5	2	4	6
F	mg/l	0.4	0.2	0.4	0.2	0.3	0.2	0.2	0.2	0.3
SiO2	mg/l	15	40	10	25	40	20	50	40	10
Fe	mg/l	1.01	0.5	5.83	1.41	2.21	0.28	2.76	3.55	0.03
Hard	mg/l	24	16	20	8	26	18	32	40	35

Upper Catchment Stations		10	11	12	13	14	15	16	17	18	19	20
Temp	oC	16.5	18	18.1	19	18	18.1	18	20	18	18.1	18
pH		7.5	7.5	7	7.5	7.5	7	7.5	7.5	7.5	7	7.5
Turb	NTU	10	12	14	15	18	15	20	16	18	19	18
TDS	mg/l	16	18	11	12	15	18	20	20	21	19	19
DO	mg/l	10.2	9.9	8.9	9.9	9	9.5	10.6	10.2	10	9.3	9.8
BOD	mg/l	2.2	1.1	1.4	1.6	1.8	1.8	1.9	1.4	1.3	2.1	2
Cond	uS/cm	10.5	98	85	93	96	100	110	98	95	96	90
NO3	mg/l	0.85	0.6	0.51	0.42	0.11	0.21	0.31	0.24	0.22	0.25	0.31
NO2	mg/l	0.8	0.01	0.1	0.1	0.1	0.1	0.08	0.05	0.1	0.1	0.1
NH4	mg/l	0.05	0	0	0	0	0	0.05	0	0	0	0
PO4	mg/l	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO4	mg/l	2	2.6	2.6	2.5	0.1	0.8	0.5	0.4	2.4	2.1	1.1
Mn	mg/l	0.01	0.03	0.01	0.01	0.02	0.03	0.02	0.01	0.01	0.01	0.01
Ca	mg/l	6.8	5.4	5.6	5.6	5.4	3.2	2	5.2	6	6	6.4
Mg	mg/l	2	1.9	1.5	1.6	0.9	0.9	0.8	1	1.2	2.1	2.3
Na	mg/l	12	10	11	9	14	12	10	12	13	14	16
K	mg/l	4.9	4	3.9	3.9	4.7	4.2	4.2	4.3	4.5	4.3	5
CaCO3	mg/l	50	43	34	38	50	51	35	38	33	30	29
Cl	mg/l	5	5.2	5.5	5.5	6	4.6	4.8	4.3	4.6	4.5	4.2
F	mg/l	0.4	0.5	0.5	0.4	0.3	0.6	0.7	0.4	0.4	0.3	0.4
SiO2	mg/l	18	30.1	40	20.1	14	18	21.2	19.2	21	23.6	25
Fe	mg/l	1.8	1.2	1.3	1.2	4.5	3.2	3.2	3.5	3.2	2.5	2.6
Hard	mg/l	25	26.8	20.1	22.1	26	27.5	28	22	25	26	40

Table A13-14 Mid Wet Season Physicochemical of Lower and Upper Catchment River Stations on 6/11/95

Lower Catchment Stations		1	2	3	4	5	6	7	8	9
Temp	oC	25	20.2	20.6	20.2	20.8	25	24	25.6	25.5
pH		7	7	7.2	6.8	7	70	7.2	7	7.2
Turb	NTU	40	30	35	30	38	30	33	35	45
TDS	mg/l	46	40	48	49	48	49	40	48	60
DO	mg/l	9.2	8.5	8.3	9.6	9.8	9.9	9.2	8.3	9.9
BOD	mg/l	2	2.2	2.3	3.4	3.6	3	2	2.6	3.9
Cond	uS/cm	105	95	98	96	90	96	98	99	110
NO3	mg/l	0.4	0.5	0.1	0.2	0.1	0.1	0.1	0.2	0.3
NO2	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NH4	mg/l	0	0	0	0	0	0	0	0	0
PO4	mg/l	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04
SO4	mg/l	2	1.5	1.5	1.9	1.8	1.8	1.9	2	2.6
Mn	mg/l	0.01	0.02	0.01	0.01	0.03	0.01	0.01	0.01	0.02
Ca	mg/l	4.6	4.8	2.1	2.2	2.2	2.3	2.2	2.4	4.7
Mg	mg/l	2.6	2	1.9	1.1	1.2	1.1	1.3	1.4	1.4
Na	mg/l	10.1	10.2	12.1	13.1	12.2	12.6	12.6	11.1	14.1
K	mg/l	5	6	7.2	7.5	5	5.2	5.5	4.5	0.6
CaCO3	mg/l	55	50	30	40	42	32	38	40	60
Cl	mg/l	1.2	1.3	1.4	1.2	2.4	4.2	2.2	2.3	2.2
F	mg/l	0.2	0.1	0.1	0.1	0.3	0.2	0.3	0.3	0.4
SiO2	mg/l	45	40	42	34	38	36	33	32	48
Fe	mg/l	2.3	1.2	1.3	1.1	1.1	1.3	1.4	1.6	3.4
Hard	mg/l	30	32	29	25	28	20	22	23	40

Upper Catchment Stations		10	11	12	13	14	15	16	17	18	19	20
Temp	oC	16.5	17.8	18	18	19	18.5	18.2	20.4	18.4	18.4	18
pH		7.5	7.5	7.5	7	7	75	7	7	7	7.5	7
Turb	NTU	25	10	15	16	18	16	17	18	18	19	20
TDS	mg/l	10	9	10	10	11	12	15	16	11	12	14
DO	mg/l	9.2	10.1	10	10.5	9.3	8.6	8.9	9.2	9.1	9.2	9.3
BOD	mg/l	2	2.1	1.6	2.3	1.4	1.6	2	2	2.3	1.3	1.4
Cond	uS/cm	9.5	80	86	89	85	80	82	80	83	84	86
NO3	mg/l	0.85	0.11	0.12	0.11	0.1	0.12	0.14	0.11	0.11	0.13	0.12
NO2	mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
NH4	mg/l	0	0	0	0	0	0	0	0	0	0	0
PO4	mg/l											
SO4	mg/l	2.6	2.2	2	1.6	1.8	1.8	1.1	2	2.1	0.9	1.2
Mn	mg/l	0.01	0.02	0.01	0.01	0.01	0.03	0.04	0.03	0.03	0.03	0.03
Ca	mg/l	5	4	3.2	4.2	3.4	3.5	6	4.2	4.3	4.2	4.3
Mg	mg/l	3.2	3.3	2.6	1.1	1.3	1.6	1.7	1.8	1.2	1.2	1.6
Na	mg/l	10.4	9	9.8	9.3	8.9	8.7	7.2	7.9	8.9	9.2	9.2
K	mg/l	4.2	4.3	4.2	4.3	4.3	4.4	3.2	4.1	4.2	4.3	4.6
CaCO3	mg/l	26	28	30	40	32	34	26	28	30	31	31
Cl	mg/l	1.3	1.3	1.3	1.5	1.6	1.1	1.1	1.2	1.3	1.2	1.1
F	mg/l	0.3	0.2	0.1	0.3	0.3	0.2	0.3	0.2	0.4	0.3	0.3
SiO2	mg/l	30	40	18	16	18	19	19	20	21	21	20
Fe	mg/l	1.1	1.6	1.4	1.1	0.9	0.8	0.9	1.1	1.6	1.2	1.6
Hard	mg/l	10	8	29	9	10	11	12	14	12	13	16