Agricultural Credit System in the Selected Countries

As the sample for financing support services by government or NGOS, Cambodia, Japan, Thailand and Philippines were selected. In case of Cambodia, NGOs have supported farmers in providing micro-credit because of inadequate institutional services by the government.

1. Cambodia

The need for rural credit in Cambodia is demonstrated by the existence of a widespread informal credit market and by the high rates of interest charged, in the order of 20 to 30 percent per month. Within agriculture, loan in kind in the form of fertilizer generally demand repayment of double the value at end of a 3 to 4 month period, equivalent to a 20 to 25 percent monthly rate.

Credit needs are therefore to substitute for exploitative consumption loans to cover household rice deficit as well as to facilitate and improve rice production and yields by providing for fertilizer and seeds, which will help to provide food security among poverty groups and to provide more productive, sustainable farm households. Loans are further needed for income diversification through small-scale non-farm activities.

While 31 commercial banks existed in Cambodia in 1995, these were largely concentrated in Phnom Penh, capital of Cambodia, and provided credit for import-export activities, and none of them offered rural credit for smallholders or other rural households. As a result, apart from high-interest informal sector lending by moneylenders, rural credit has been left largely to NGOs using bilateral assistance funding, and concerned primarily with poverty relief.

The earliest pioneering NGO was the GRET (Group de Reserche et d'Echanges Technologiques). In 1991, GRET established a number of village banks. The GRET scheme has expanded rapidly and by October 1995, there were 70,000 loans in total amount of 2.2 million US$, with client of 45,000. The average loans size is over 35 US$ confirms the focus on loans. The length of the loans varies between six (6) to ten (10) months. The guarantee system relies on the constitution of a collective liability of group of five (5) people. The interest is paid monthly-the rate is currently four (4) percent a month- and the capital is repaid at the end of the cycle. The repayment rate is 94 percent upon the deadline, and 98 percent six (6) month later. However GRET scheme doesn't cover small-scale irrigation project at present, because of focusing mainly on production loan for poor people.

2. Thailand

BAAC (Bank of Agriculture and Agricultural Cooperative) provides, under the present scope of activities stipulated in BAAC Act, loans only for agricultural purposes, excluding agribusiness sector. Farmers who are members of cooperatives are not entitled to borrow directly from BAAC. An individual farmer should fulfill the following 10 criteria to be eligible to register as a BAAC client:

1) have Thai nationality
2) be at least 20 years of age
3) be a farmer with at least one year of farming experience
4) have a sufficient farming experience, or professional training in the field of agriculture
5) normally produce a reasonable annual marketable surplus of agricultural products, or have the potential to produce a surplus one he has access to BAAC credit. The surplus should be sufficient to repay their loans
6) not have been expelled by any BAAC branch in the past
7) have a reputation for honesty, industriousness and thrift
8) not be mentally unsound or infirm
9) not be bankrupt
10) not be a borrower from another financial institution, including agricultural cooperatives, farmer associations and commercial banks.

These are the usual requirements. They can be relaxed in exceptional cases, normally within the framework of a BAAC special investment project.

Short term loans fall under two main categories;

a) Short term loans for agricultural purpose, viz.

1) for main crop production to offset the seasonal production expenses incurred in producing the primary agricultural commodity usually paddy, cassava or maize,
2) for other agricultural purposes to defray expenses incurred in producing commodities such as pig and vegetables cultivation which are supplementary sources of income.

b) Short term loans for postponement of sale, which are provided with the loan repayments and post-harvest household expenses in the event that the farmers are willing to sell their products soon after harvest due to severely depressed market prices.

Short term production loans are based upon credit needs per rai (0.16 ha), fixed by crop, but adjusted to reflect the loan conditions in Changwat(district). Individual borrowers who are unable to provide collateral are required to join a small informal guarantee group (5 members in minimum), which enable BAAC to take advantage of the socio-economic sanctions arising from the joint liability characteristics of these groups particularly in the case of repayment. Each member is liable for his/her own loan and for loans guaranteed by the group. The maximum loan amount per group member is Bahts 30,000 (8,750 US$, or 525,000 Ksh), but not exceeding 60 percent of the value of the expected marketable surplus produced. For loan between Bahts 30,000 and Bahts1,000,000 the farmer is required to mortgage his assets with BAAC. Interest on these loans is 14percent per year with repayment of one to 1/2 year.

The medium term loans are mainly provided for procurement of farm machinery and equipment, draught animas and land and refinancing of old debt. The security requirements and

interest rate charged are the same as for short-term loans (14 percent/year), and the loan repayment period is three (3) to five (5) years.

The long term loans are offered to individual borrowers for investments in agriculture and refinancing old debt. For investment in agriculture, viz. Purchase or develop agricultural resources or invest in agricultural assets which require a lengthy period before the borrower starts to receive a return on his investment, repayment is by installment within its period of up to 15 years or 20 years, in special cases and borrowers should submit their applications (for loan amount in excess of Bahts 160,000) in the form of detailed long term agricultural investment projects for BAAC's consideration. Borrowers are also required to furnish an equity contribution of at least 20 percent of the project's total investment costs and to secure the loan either by the use of two personal guarantors or by mortgaging their fixed assets with BAAC.

SSIRP (Small Scale Improvement and Rehabilitation Project) under the Social Improvement Project (SIP) Funded by OECF

Objectives of SIP are to assist the government of Kingdom of Thailand to respond effectively and rapidly to her financial and economic crisis through the rapid mobilization of resources to help increase her existing social safety net programs by a) improving basic infrastructure and services in places which attract tourism such as national parks, cultural archaeological sites, wildlife sanctuaries, nature preserves, public beaches, marine reserves and local museums and thereby creating employment opportunities; and b) rehabilitation and improving existing small scale irrigation projects involving extending distribution system in existing projects and thereby creating employment opportunities.

Executing agency for SSIP is RID and Tourism Authority for the improvement of basic infrastructure to promote tourism. In the SSIRP 585 sub-projects will be constructed or rehabilitated under the loan condition agreed between the two government, that is, one (1) percent of annual interest, 25 year repayment and 7 year grace period. However, any cost sharing is not laid on the beneficial farmers under the SSIP funded by OECF. Organizing Water Users Association (WUA) is depending on irrigation method. When applying canal irrigation, WUA is required to set up.

3. Communal Irrigation System in the Philippines

The communal irrigation system is one of small scale irrigation project. When applying this project, beneficial farmers are required to organize Irrigators Association (IA) to manage irrigation facilities and IA organization by farmers themselves. And they also required to deposit equity fund amounting to 30 percent of the direct construction cost, and remainder 70 percent is subsidized by the government. No other cost sharing is not laid on farmers. However, it is necessary to collect water charge from members to maintain irrigation facilities and to manage IA.

If beneficial farmers cannot to deposit 30 percent of the direct construction cost as the equity fund, they must deposit 10 percent of the estimated direct construction cost and repay remaining 90 percent during 50 years at free of interest.

4. Irrigation and Drainage Projects in Japan

This is one of the land improvement project and its purposes are to construct newly or to rehabilitate irrigation facilities. Executing body will be varied depending on the scale of beneficial area and command area on farm level, that is, government-constructed, prefecture-constructed and group-based ones. Roughly irrigation and drainage projects are composed of following eight (8) types:

1) irrigation and drainage project to construct dam, headworks, pump station and irrigation and drainage canals
2) integrated irrigation and drainage project
3) integrated upland field improvement pilot project
4) water resources development project for upland field
5) rehabilitation works of government-constructed land improvement facilities
6) government-operated drainage canal improvement project
7) special drainage improvement project
8) agricultural water use rationalization project.

For those irrigation and drainage project, government of Japan has supported by applying subsidiary system. For example, cost sharing of prefecture-constructed irrigation and drainage project is 50 percent for government, 25 percent for prefecture and 25 percent for beneficiaries. For group-based irrigation and drainage project which is required to cover above 20 ha, 45 percent for government, 25 percent for prefecture, 20 percent for local government and 10 percent for beneficial farmers, are applied. It can be said that small-scale irrigation in Kenya corresponds to the scale of the group-based irrigation and drainage project of Japan.

Beneficial farmers must repay their share with 5.5 percent of annual interest and 15 years repayment period in case of group-based irrigation and drainage project.

To support remote areas such as Hokkaido, Okinawa island, Amami island and other solitary islands, government of Japan applies higher subsidy than other areas.

ANNEX T

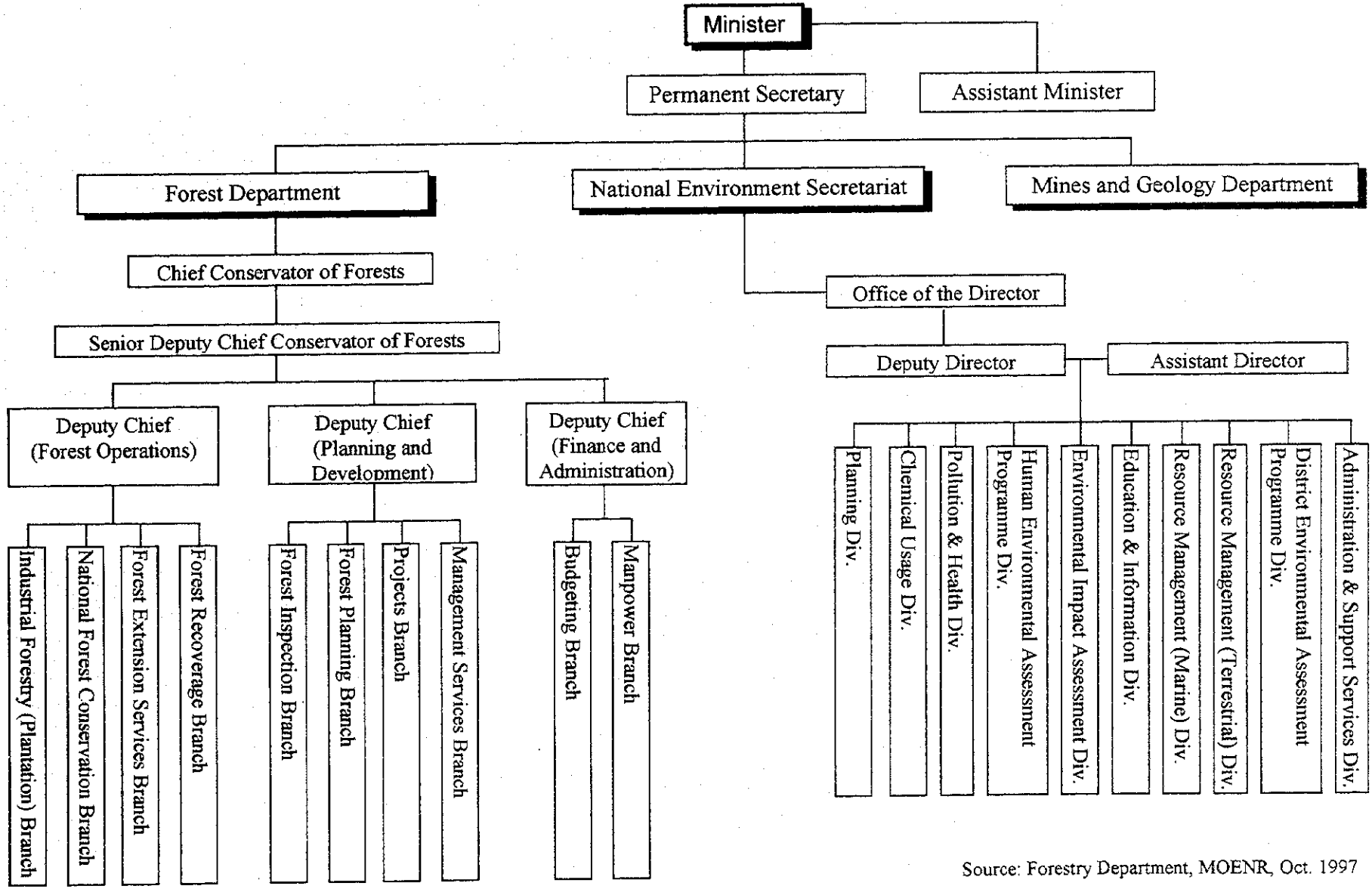
ENVIRONMENT

List of Tables and Figures

T.1 Master Plan Study

T.2 Feasibility Study

Figure T.1-1 Organizational Chart of the Ministry of Environment and Natural Resources



Source: Forestry Department, MOENR, Oct. 1997

Table T.1-1 District Training for Soil and Water Conservation 1995/96

District	T.A. Retrain*[1]		Teachers		Chiefs		W.G. & I.F. *[2]		Catch.Com.*[3]		Nursery Manage.		Others *[4]		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
Nyeri	27	6	15	3	0	0	0	0	110	51	0	0	1,540	2,030	1,692	2,090	3,782
Kirinyaga	10	5	50	30	0	0	0	0	100	50	0	0	1,360	1,270	1,520	1,355	2,875
Embu & Mbeere	12	8	11	0	0	0	105	25	76	74	9	13	3,168	1,717	3,381	1,837	5,218
Tharaka Nithi	15	5	20	0	0	0	0	100	94	62	0	0	1,878	3,065	2,007	3,232	5,239
Meru	9	6	14	6	0	0	24	120	170	46	0	0	1,723	3,181	1,940	3,359	5,299
Nyambene	0	0	0	0	0	0	0	0	160	60	0	0	1,385	2,097	1,545	2,157	3,702
Total	73	30	110	39	0	0	129	245	710	343	9	13	11,054	13,360	12,085	14,030	26,115
Other Districts	415	92	988	221	295	0	796	1,147	4,859	1,902	458	191	52,210	44,619	60,021	48,172	108,193
Grand Total	488	122	1,098	260	295	0	925	1,392	5,569	2,245	467	204	63,264	57,979	84,191	76,232	160,423

Source: Annual Report 1995/96, Soil & Water Conservation Branch, MOALD

Table T.1-2 Target of District Training for Soil and Water Conservation 1997/98

District	T.A. Retrain*[1]		Teachers		Chiefs		W.G. & I.F.*[2]		Catch.Com.*[3]		Nursery Manage.		Others *[4]		Total		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
Nyeri	20	0	0	0	0	0	50	110	98	70	15	10	1,610	1,640	1,793	1,830	3,623
Kirinyaga	10	10	50	50	0	0	10	40	50	24	15	5	1,675	670	1,810	799	2,609
Embu	20	0	0	0	0	0	30	20	100	0	20	0	2,105	80	2,275	100	2,375
Mbeere	12	8	0	0	0	0	16	8	120	80	0	0	780	840	928	936	1,864
Tharaka Nithi	15	5	10	10	0	0	20	20	192	0	0	0	2,665	75	2,902	110	3,012
Meru	15	0	0	0	0	0	32	0	170	48	16	0	3,160	140	3,393	188	3,581
Nyambene	15	5	0	0	0	0	30	30	170	0	0	0	1,110	1,150	1,325	1,185	2,510
Total	107	28	60	60	0	0	188	228	900	222	66	15	13,105	4,595	14,426	5,148	19,574
Other Districts	388	123	241	174	314	0	1,283	3,191	5,417	2,319	202	84	54,444	37,997	62,289	43,888	125,751
Grand Total	495	151	301	234	314	0	1,471	3,419	6,317	2,541	268	99	67,549	42,592	91,141	54,184	145,325

Source: Workplan 1997/98, Soil & Water Conservation Branch, MOALD

*1: Technical Assistant Retraining Course for 1 week

*2: 3-day course for Women Group members and Innovative farmers including one day tour

*3: Course for the catchment committee members

*4: 4K Club members (young farmers club), Young Farmers, Farmers Field Day and Collaboration Workshop

Table T.1-3 High Priority Forest Groups Ranked by Biodiversity, Environmental and Local Use Values and Threat

Forest Group (★: in the Study Area)	Biodiversity Value			Environmental Protection			Local Forest Use			Threats			
	Habitat Rarity	Species Richness	Threatened Species	Soil Erosion Protection	Water Catchment Potection	Water Source Spring Line	Fuelwood, Polewood, Charcoal	Honey, Medicine	Grazing, Thatching	Over Exploita-tion	Excision, Develop-ment	Population Pressure/ Forest Size	Habitat Damage by Wildlife/Fire
Aberdare ★	**	**	*	***	***	***	**	**	*	**	**	**	***
Embobut	*	*	*	***	***	**	***	***	***	**	***	***	*
Kakamega	***	***	**	*	*	*	***	***	***	***	***	***	*
Kitui	*	*	**	***	*	***	**	***	***	***	*	***	*
Meru ★	**	*	*	***	*	***	***	**	***	***	*	**	**
Mt. Kenya ★	***	***	***	***	***	***	***	***	*	***	***	**	***
Mt. Londiani	*	**	*	**	***	*	***	**	***	**	**	**	**
Nyambene ★	**	**	**	***	**	**	***	**	**	**	***	**	**
Nyeri ★	**	**	*	**	*	**	***	**	***	***	**	***	*
Taita	**	**	***	***	*	***	***	**	*	***	**	***	***

***: High value or threat, **: Medium value or threat, *: Low value or threat

Note: Significance should not be placed upon precise order of individual forests in this table.
As a general guide to planning and resource allocation however, the most important 10 forests among 50 are shown in the table.

Source: Kenya's Indigenous Forests, IUCN - The World Conservation Union, 1995

Table T.1-4 Endemic Trees and Shrubs in the Study Area

Family	Species	Sample Localities
VERBENACEAE	Premna maxima T.C.E. Fries	Marsabit, Meru
MIMOSACEAE	Albizia tanganyicensis Bak.f.ssp adamsoniorum Brenan	Meru Park
MYRSINACEAE	Embelia keniensis R.E. Fries	Tigoni, Mt. Kenya
MYRTACEAE	Eugenia sp Taxon A of KTSL	Nzaui, ?Mt. Kenya
RUBIACEAE	Ixora scheffleri K. Schum. ssp keniensii Bridson	Mt. Kenya, Embu
SIMAROUBACEAE	Brucea macrocarpa Stannard	Thika Falls, Kiambu, Meru Park

Source: Kenya's Indigenous Forests, IUCN - The World Conservation Union, 1995

Table T.1-5 Definition and Characteristics of the Government Forest

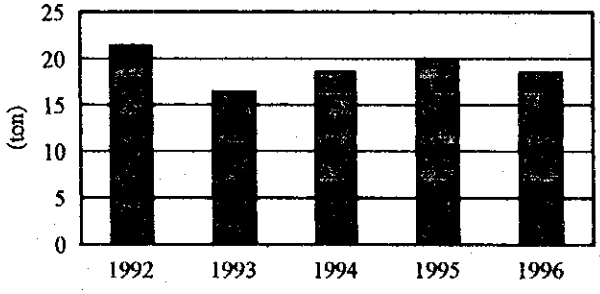
Item		Government Forest	
		Gazetted Forest	Trust Land Forest
Definition		Surveyed forest owned by the Government	Surveyed forest owned by the trust of local county councils
Kind of Forest	Plantation	○	×
	Indigenous Forest	○	○
	Bushland	○	○
	Grassland	○	○
	Bamboo Forest	○	○
Permission	Animal Grazing	○	○
	Fuelwood Collection	○	○
	Non Wood Product Collection	○	○
	Cutting	Only in the plantation forest	×
	Hunting	×	×

Table T.1-6 Endangered Wildlife in Kenya

Name		Number	Category
1. Black Rhinoceros	Diceros bicornis	500	A
2. Elephant	Loxodonta africana	16,000	A
3. Wild Dog	Lycaon pictus	400	A
4. Cheetah	Acinonyx jubatus	N.A.	A
5. Tana River Mangabey	Cercocebus galeritus galeritus	100	B
6. Red Colobus	Colobus badius rufomitratus	N.A.	B
7. Aders' Duiker	Cephalophus adersi	N.A.	B
8. Hunter's Hartebeest	Damaliscus hunteri	300	B
9. Grevy Zebra	Equus grevyi	N.A..	A
10. Dugong	Dugong dugon	N.A.	A
11. Small mammals		N.A.	B

Note: Category A; Inhabitant in Africa, Category B; Inhabitant only in Kenya and neighboring area
Source: Wildlife Protection Report, 1990

Figure T.1-2 Pesticides Usage in Coffee Production in Meru



Pesticides:
Copper Oxychloride,
Copper Mordox, DACO NIL,
Dyrene, Byleton, Fenitrothion,
Folimat, Ethion, Dursban,
Lebaycide, DECIS, DELAN,
Somition

Table T.1-7 Pesticide Maximum Residue Levels (MRL) for Some Crops and Specific MRL Authorized in France

(Unit: mg/kg)

Compound	Green beans		Mangoes		Pineapples	
	EU	France	EU	France	EU	France
Acéphate		0.02		0.02		0.02
Aldrine		0.01		0.01		0.01
Amétryne						0.2
* Aminotriazole	0.05	0.05	0.05	0.05	0.05	0.05
* Atrazine	0.1	0.1	0.1	0.1	0.1	0.1
Azinphos-éthyl		0.05		0.05		0.05
Azinphos-méthyl	0.5	0.05		0.05		0.05
Barbane		0.05		0.05		0.05
Bénalaxyl	0.05		0.05		0.05	
Bénomyl	0.1	0.1		0.1		0.1
Benfuracarbe	0.05	0.2	0.05		0.05	
Bentazone	0.2	0.05				
* Binapacryl	0.05	0.05	0.05		0.05	
Bromophos		1.0		1.0		1.0
* Bromophos éthyl	0.05	0.05	0.05	0.05	0.05	0.05
Bromopropylate		1.0		0.05		0.05
* Bromure de méthyle	0.05	0.05	0.05	0.05	0.05	0.05
* Camphéchlore	0.1	0.1	0.1	0.1	0.1	0.1
* Captafol	0.02	0.02	0.02	0.02	0.02	0.02
Captane		2.0		0.1		0.1
Carbaryl	5	1.0		1.0		1.0
Carbendazime	2	0.1		0.1		0.1
Carbofuran	0.1	0.5	0.1		0.1	
Carbosulfan	0.05		0.05		0.05	
Chinométhionate		0.3		0.3		0.3
Chlordane		0.05		0.05		0.05
Chlorvenphos		0.1		0.05		0.05
Chlorméquat				0.05		0.05
Chlorobenzilate		0.2		0.2		0.2
Chlorothalonil	5	0.02		0.01		0.01
Chloroxuron		0.2		0.2		0.2
Chlorpyriphos éthyl		0.05		0.05		0.05
Chlorpyriphos méhyl		0.05		0.05		0.05
Cycloxidime	1	0.5				
Cyfluthrine	0.05	0.01	0.02	0.01	0.02	0.01
Cyhexatin	0.2	0.05		0.05		0.05
Cyperméthrine	0.5	0.5		0.05		0.05
* DDT	0.05	0.05	0.05	0.05	0.05	0.05
Daminoside	0.02		0.02		0.02	
Deltaméthrine	0.2	0.2		0.2		0.2
Déméton S méthyl et S méthyle sulfone		0.4		0.4		0.4
Diallate		0.1		0.1		0.1
Diazinon	0.2	0.5		0.5		0.5
* Dibromure d'éthylène	0.01	0.01	0.01	0.01	0.01	0.01

Compound	Green beans		Mangoes		Pineapples	
	EU	France	EU	France	EU	France
Diclofluanide	2	5.0		5.0		5.0
* Dichlorprop	0.05	0.05	0.05	0.05	0.05	0.05
Dichlorvos	0.5	0.1		0.1		0.1
Diclofop méhyl		0.05		0.05		0.05
Dicofol	2	0.5		2.0		2.0
Dieldrine		0.01		0.01		0.01
Diéthon		0.1		0.1		0.1
Diéthofencarbe		0.1				
Diméthoate	2	1.0		1.0		1.0
Dinocap				0.1		0.1
* Dinosèbe	0.05	0.05	0.05	0.05	0.05	0.05
* Dioxathion	0.05	0.05	0.05	0.05	0.05	0.05
Diquat		0.1		0.05		0.05
Disulfoton	0.2					0.1
Dithiocarbamates	0.05	0.05		0.05		0.05
Dithiométon		0.5		0.5		0.5
Doguadin		0.2		0.2		0.2
Endosulfan	0.5	1.0		1.0		1.0
* Endrine	0.01	0.01	0.01	0.01	0.01	0.01
Ethéphon	0.05					1.0
Ethoprophos		0.01				
Fénarimol	0.02		0.02		0.02	
Fenbutine oxyde		1.0				
* Fenchlorphos	0.01	0.01	0.01	0.01	0.01	0.01
Fénitrothion		0.5		0.5		0.5
Fentin acétate et hydroxyde		0.05				
Fenvalérate	1	0.05		0.05		0.05
Fluazifop P butyl		0.1				
Fomésafène		0.05				
Formothion		0.1		0.1		0.1
Furathicarbe	0.05	0.5	0.05		0.05	
Lindane (γ HCH)		1.0		1.0		1.0
Glufosinate		0.5				
Glyphosate		0.1		0.1		0.1
* Heptachlore	0.01	0.01	0.01	0.01	0.01	0.01
Heptenophos		0.1		0.1		0.1
Hexachlorobenzène		0.05		0.05		0.05
Héxythiazox	0.5	0.2				
* Hydrazide maléique	1.0	1.0	1.0	1.0	1.0	1.0
Imazalil		0.02		0.02		0.02
Iprodione	2	0.02		0.02		0.02
Isophenphos		0.05				
Lambda cyhalothrine	0.2	0.2	0.02		0.02	
Malathion	2	3.0		0.5		0.5
Mercaptodiméthur		0.1				
Métalaxyl	0.05					
Métaldéhyde		5.0				
Méthamidophos		0.01		0.01		0.01

Compound	Green beans		Mangoes		Pineapples	
	EU	France	EU	France	EU	France
Méthidathion	0.1	0.2		0.2		0.2
Méthomyl		0.5				
Méthoxychlore		10.0		10.0		10.0
Mévinphos		0.1		0.1		0.1
Naled		0.2		0.2		0.2
Néburon		0.05		0.05		0.05
Nitrofène		0.1				
Ométhoate	0.2	0.2		0.2		0.2
Oxadiazinon				0.05		0.05
Paclobutrazol				0.5		0.5
* Paraquat	0.05	0.05	0.05	0.05	0.05	0.05
Parathion (éthyl)		0.5		0.5		0.5
Parathion méthyl	0.05	0.2		0.2		0.2
Perméthrine	0.5	0.5		0.05		0.05
Phosalone		1.0		1.0		1.0
Phosétyl Al						1.0
Phosphamidon	0.2	0.15		0.15		0.15
Procymidone	2.0	2.0		0.02		0.02
Prométhryne		0.2				
Propiconazole	0.05					
Propyzamide				0.1		0.1
Pyrèthres		1.0		1.0		1.0
Pyrimicarbe		0.5		0.5		0.5
Pyrimiphos éthyl		0.01		0.01		0.01
Pyrimiphos méthyl		2.0		2.0		2.0
Roténone		0.05		0.05		0.05
Séthoxydime		0.5		0.5		0.5
Soufre		50.0		50.0		50.0
Sulfotep		0.2		0.2		0.2
* 2.4.5 T	0.05	0.05	0.05	0.05	0.05	0.05
* TEPP	0.01	0.01	0.01	0.01	0.01	0.01
Tétrachlorvinphos		0.5		2.0		2.0
Thiodicarbe		0.5				
Triadiméfon				1.0		2.0
Triadiménol						2.0
Triforine	1.0	1.0		1.0		1.0
Vamidothion		0.05		0.05		0.05
Vinclozoline	2.0	0.05		0.05		0.05

Note : * : MRLs for pesticides not permitted for agricultural use in the EU.
MRLs for pesticides not mentioned in this list are fixed to 0.01 mg/kg.

Source: MCP, France
Manual for Horticultural Export Quality Assurance, 1994, Natural Resources Institute, UK

Table T.1-8 Health Facilities

District	Division	Population (1997)*	Hospital	Mater-nity	Health Centre	Dispen-sary	Outreach Clinics	Nursing Homes	Total
Nyeri	Municipality	109,974	3		1	6		3	13
	Tetu	97,782	0		3	9		0	12
	Othaya	102,288	0		2	8		1	11
	Mathira	175,165	2		1	8		1	12
	Kieni West	69,243	1		1	9		0	11
	Kieni East	66,778	0		1	7		0	8
	Mukurweini	106,729	0		1	9		2	12
	Forests	1,636							
	Total	729,595	6		10	56	0	7	79
Kirinyaga	Ndia	220,066	1		3	13	2	2	21
	Gichugu	137,064	0		2	13	1	1	17
	Mwea	135,812	1		1	21	3	2	28
	Total	492,942	2		6	47	6	5	66
Embu	Manyatta	66,036	0		1	6			7
	Runyenjes	72,162	1		0	2			3
	Nembure	60,319	0		1	6			7
	Kyeni	52,585	1		1	4			6
	Central	47,240	3		0	5			8
	Total	298,342	5		3	23			31
Mbeere	Evurori	40,050	1		0	2			3
	Gachoka	58,957	0		2	12			14
	Mwea	42,588	0		1	5			6
	Siakago	33,622	0		4	5			9
	Total	175,217	1		7	24		0	32
Tharaka Nithi	Chuka	57,130	2		1	9			12
	Magumoni	45,099	0		0	5			5
	Muthambi	36,040	0		1	10			11
	Mwimbi	75,733	1		3	11			15
	Igambangombe	17,119	0		1	2			3
	Tharaka South	23,541	0		2	3			5
	Tharaka Central	38,118	0		1	4			5
	Tharaka North	32,997	0		0	4			4
	Total	325,777	3		9	48		0	60
Meru	Nkuene	59,422	1		1	3		1	6
	Igoji	51,432	1		0	1		0	2
	Abothuguchi East	45,228	0		0	2		0	2
	Abothuguchi Central	36,185	0		0	0		0	0
	Abothuguchi West	63,481	0		2	0		1	3
	Mirigamieru West	70,464	3		1	5		2	11
	Mirigamieru East	66,407	0		0	3		0	3
	Timau	43,320	0		1	2		0	3
	Abogeta	61,723	0		1	2		0	3
	Buuri	42,706	0		0	0		0	0
	Mt. Kenya Forest	68							
	Total	540,436	5		6	18		4	33
Nyambene	Igembe South	15,927	0	0	0	1	1		2
	Igembe Centre	43,578	1	1	0	1	0		3
	Igembe North	56,509	0	0	0	1	1		2
	Igembe South East	18,495	0	0	0	0	0		0
	Igembe South West	20,899	0	0	0	0	0		0
	Igembe East	15,774	0	0	0	0	0		0
	Ndoleli	46,926	0	0	0	0	0		0
	Mutuati	50,411	0	0	0	1	1		2
	Laare	61,312	0	1	0	1	1		3
	Tigania North	83,443	1	0	0	4	0		5
	Tigania West	37,867	1	0	0	1	0		2
	Tigania Centre	60,788	0	1	0	2	0		3
	Tigania East	34,859	0	0	0	0	0		0
	Uringu	44,974	0	0	1	1	0		2
	Total	591,762	3	3	1	13	4	0	24

Source: MOH Nyeri 1997, District Medical Office of Health Kirugoya 1996
MOH Embu and Maua 1996, MOH Meru 1995,

* Population Projections: District Planning Unit, Nyeri, Kirugoya and Chuka, 1996,
District Statistics Office, Embu, Meru and Maua, 1996

Table T.1-9 Chemical Analysis of Water in Nyeri

Parameter	Unit	Stan-dard	Water Source				
			Burgured River (Bantu Rock Hotel)	Mureru River (Mureru Shopping Centre)	Nairobi River (Kaboru Chaka Rd)	Ihwagi W/Supply (Treated)	Furrow below Kimahui Shopping Centre
			17/4/97	7/4/97	10/4/97	22/5/97	28/5/97
Temperature	℃		21	21	21	22	18
pH		6.5-8.5	6.9	7.1	7.2	7.2	7.3
Turbidity	N.T.U.	<15	16.5	2.7	6	4.3	18.0
Conductivity	μ mhos/cm	2,000	83.6	576.9	110.7	56.5	73.6
Iron	mg/l	0.3	0.01	0.02	0.02	0.02	0.02
Manganese	mgMn/l	0.1	-	-	-	-	-
Calcium	mgCa/l		39.2	4.8	2.9	4.8	4.0
Magnesium	mgMg/l		<0.5	2.6	1.6	2.2	0.1
Total Hardness	mg/$CaCO_3$/l	500	74	146	16	22	18
Total Alkalinity	mg/$CaCO_3$/l	500	6	226	22	38	38
Chloride	mgCl/l	250	1.0	NIL	1.0	3.9	2.0
Sulphate	mgSO_4/l	400	4.4	28	0.3	4.2	0.8
TDS	mg/l	1,000	54.4	375	71.9	36.7	47.8
Free carbon dioxide	mgCO_2/l		3.99	10	44.24	4.0	22.1
20 min PV*	mgO_2/l	20	31.6	31.6	2.0	53.7	6.0

* 20 min PV: Permanganate Value (20 min. boiling)

Source: Provincial Water Office, MOWD, Nyeri

Table T.1-10 Bacteriological Examination of Water in Nyeri

Sampling Date	Water Source and Sampling Site	Protection	Coliform/100 ml
26/5/97	Ihwagi Water Supply		
	Water Supply Chamber	Completely coverd.	20
	Tap at Karatina Municipal Market	Piped.	95
28/5/97	Furrow below Shopping Centre	No protection.	550
28/5/97	Furrow (middle line)	No protection.	130
9/6/97	Naru Moru Tourist Lodge Treatment Works from the filter	Piped.	550

Source: Provincial Water Office, MOWD, Nyeri

Table T.1-11 Chemical Analysis of Water in Meru

Parameter	Unit	Stan-dard	Water Source				
			Kabuki Spring	Araigua Spring	Koonyo Spring	Rwarera Spring	Gikui Well
			18/5/94	18/5/94	18/5/94	18/5/94	27/6/94
pH		6.5-8.5	6.3	6.4	7.1	6.3	5.0
Colour	mg/t/l	<15	<5	Nil	<5	<5	<5
Turbidity	N.T.U.	<15	Nil	Nil	Nil	Nil	Fairly
Conductivity	μ mhos/cm	2,000	1,600	530	3,650	1,200	35
Total Alkalinity	mg$CaCO_3$/l	500	1,100	286	1,940	730	10.0
Phenolphtalein	mgCO_3/l		Nil	Nil	Nil	Nil	Nil
Methyl Orange	mgHCO_3/l		1,100	286	1,940	730	10.0
Chloride	mgCl/l	250	5.0	8.0	140.0	6.0	Nil
Sulphate	mgSO_4/l	400	2.0	5.0	75.0	1.0	7.0
Nitrate	mgNO_3/l	10	Nil	1.1	Nil	Nil	Nil
Nitrate	mgNO_2/l	10	Nil	Nil	0.02	Nil	Nil
Fluoride	mgF/l	1.5	0.1	0.2	Nil	0.1	Nil
Sodium	mgNa/l	200	63.0	29.5	676	54.0	3.0
Potassium	mgK/l		12.0	6.0	68.7	11.5	1.8
Calcium	mgCa/l		80.0	36.0	72.0	80.0	1.6
Magnesium	mgMg/l		168.0	37.0	149.0	86.5	1.0
Iron	mgFe/l	0.3	0.04	0.01	Nil	0.01	0.01
Manganese	mgMn/l	0.1	0.91	0.03	0.03	0.86	0.06
Ammonia -Free & Saline	mgNH_4/l		Nil	Nil	0.11	Nil	-
Ammonia -Albuminoid	mgNH_4/l		Nil	Nil	0.02	Nil	-
Total Hardness	mg/$CaCO_3$/l	500	90.0	244.0	800.0	560	8.0
Free Carbon Dioxide	mgCO_2/l		8.0	28.0	12.0	8.0	25.0
Silica	mgSiO_2/l		60.0	65.2	10.0	85.0	35.0
4 hr. PV*	mgO_2/l	20	0.15	Nil	0.5	0.1	1.8
TDS	mg/l	1,000	1,100	370	2,550	800	25.0

Source: MOH, Meru

* 4 hr. PV: Permanganate Value (4 hours boiling)

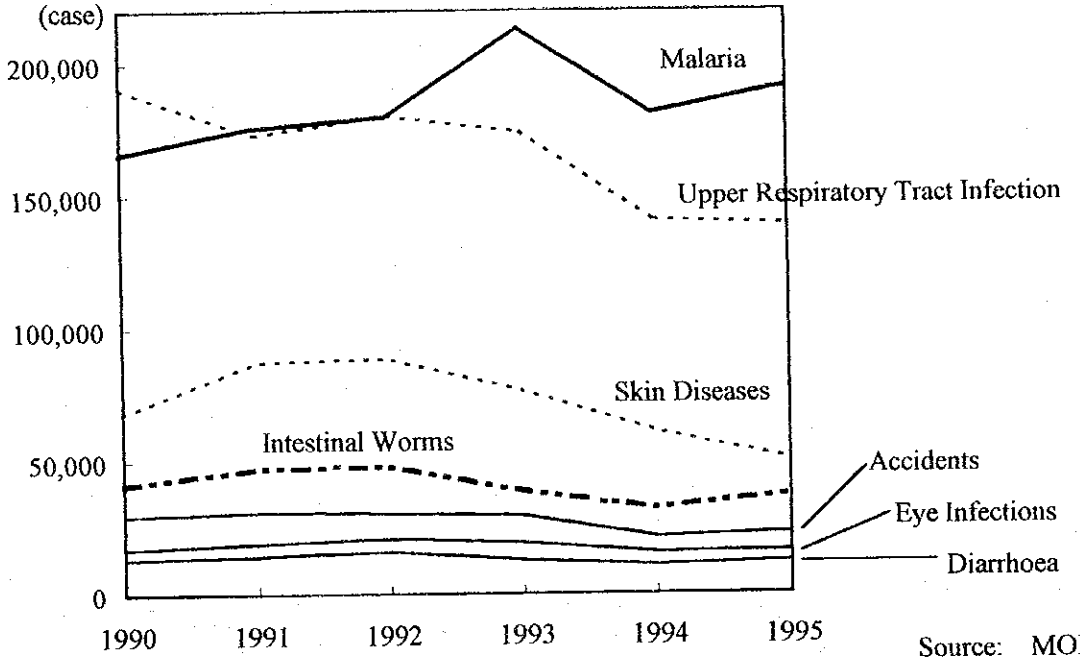
Table T.1-12 Bacteriological Examination of Water in Meru

	Protected Springs (Sampling date: No. 1-7 on 6/11/96, No. 8-13 on 11/5/96)												
	1	2	3	4	5	6	7	8	9	10	11	12	13
EC (μ s/cm)	151	181	163	251	144	218	80	199	195	254	1,633	269	523
Coliform/100 ml	160	200	560	580	40	400	100	0	0	120	200	0	60

	Unprotected Springs (Sampling year: 1995 - 1996)								
	1	2	3	4	5	6	7	8	9
EC (μ s/cm)	190	30	50	60	70	120	30	70	220
Coliform/100 ml	7	2	0	0	20	29	0	3	20

Source: MOH, Meru

Figure T.1-3 Mobilization of Main Diseases in Embu and Mbeere



Source: MOH, Embu

Table T.1-13 Bacteriological Examination of Water in Embu and Mbeere

Date	Division	Location	Source	Coliform/ 100ml
	Embu			
15/5/96	Runyenjes	Ena Water Treatment Plant	River before treatment	>1,000
31/7/96	Nembure	Gaturi South	Protected spring	50
31/7/96	Nembure	Gaturi South	Unprotected spring	2,000
31/7/96	Nembure	Gaturi South	Kangiri stream	1,100
31/7/96	Nembure	Gaturi South	Kirurumo River	2,000
	Mbeere			
15/5/96	Siakago	Health Centre	Treated water of storage tank	>1,000
15/5/96	Siakago		Protected spring	40

Source: MOH, Embu

Table T.1-14 Water Analysis by the Study Team

Date	District	Area	pH	EC	General Bacteria	Coli-form
	(River water for irrigation and drinking)			(μ s/cm)	(/ml)	(/ml)
16/9/97	Meru	Mitunguu Irrigation Scheme	8.2	192	30	3
17/9/97	Nyambene	Niorimba Irrigation Scheme	8.2	0	100	45
19/9/97	Embu	Gakui	8.1	59	5	30
22/9/97	Nyeri	Kimahuri	8.4	40	7	4
22/9/97	Nyeri	Island Farm Irrigation Scheme	8.2	46	4	4
23/9/97	Kirinyaga	Kibirigwi Irrigation Scheme	7.8	71	40	7
6/10/97	Mbeere	Mweiwa *(Handpump of bore hole)*	7.2	167	0	0
7/10/97	Mbeere	Umau Market Centre *(Protected spring)*	7.7	79	80	>100

Measurement: pH : TRNS Pal pH Meter
EC : HORIBA Conductivity Meter B-173
Bacteria count : KYORITSU TPA-BG
Coliform count : KYORITSU TPA-CG

Table T.1-15 Main Diseases Reported in the Hospitals

(Unit: Case)

Diseases	Nyeri			Meru		
	1994	1995	1996	1993	1995	1996
Microscopically Malaria	3	N.A.	N.A.	9,182	24,051	23,367
Clinical Malaria	18,072	3,400	4,621	16,235	705	402
Amoebiasis	353	222	475	1,004	4,509	4,609
Gastroenteritis	949	446	531	1,597	821	880
U.R.T.I.*	56,913	10,538	16,731	28,932	2,224	7
Pneumonia	4,717	1,463	1,508	1,543	1,715	1,634
Gonorrhoea	3,036	115	413	971	433	402
Chicken Pox	1,025	135	283	495	40	36
Mumps	816	252	223	40	66	65
Measles	371	35	118	147	50	44
Thphoid				N.A.	522	3
Other Dysentery				N.A.	299	265
AIDS	242	N.A.	N.A.	N.A.	290	262
Ankylostomiasis				N.A.	118	116
Tuberculosis				154	331	12
Salmonellosis				N.A.	412	2

Source: MOH, Nyeri and Meru
District Development Plan 1997 - 2001

*U.R.T.I.: Upper Respiratory Tract Infection

Table T.1-16 AIDS Related Deaths and HIV Positive Population

(Unit: thousand)

	1990	1993	1994	1995	1996
HIV Related Deaths					
Rural	7	15	19	25	30
Urban	13	29	37	46	56
Male	11	24	30	38	56
Female	9	20	26	33	40
Total	20	44	56	71	96
HIV Positive Population					
Rural	151	284	334	383	428
Urban	298	558	655	752	842
Male	244	457	537	617	689
Female	205	384	452	518	581
Total	449	841	989	1,135	1,270
Population (Projection)	23,900	26,002	26,424	27,519	28,267
Rate in Population	1.9 %	3.2 %	3.7 %	4.1 %	4.5 %

Source: National Development Plan, For the Period 1994 to 1996
Population Projections, April 1996

Table T.1-17 Initial Environmental Examination

××× : Serious negative impact expected
×× : Some negative impact expected
× : Extent of negative impact not known
□ : No impact

●●● : Important positive impact expected
●● : Some positive impact expected
● : Extent of positive impact not known

Environmental Item	In case of no problem in the project		In case of problem in the project	
	Evaluation	Hypothetical items for the evaluation basis	Evaluation	Hypothetical items for the evaluation basis
1. Settlement	□	No settlement.	□	
2. Involuntary resettlement	□	No settlement.	□	
3. Substantial changes in the way of life	●●	Increase of farm income by improved farming.	××	Increase of women's work in agriculture.
4. Conflict among people	●●	Good relation by well-organized community.	××	Difficulty of fair water distribution.
5. Impact on native people	□	No ethnic minorities.	□	
6. Population increase	××	Increase of job opportunities will bring it.	××	Increase of job opportunities will bring it.
7. Drastic change in population composition	□		□	
8. Changes in bases of economic activities	□		□	
9. Occupational change and loss of job opportunities	●●	Job opportunities will increase by irrigation farming.	□	
10. Increase in income disparities	×		××	By the partial water distribution.
11. Adjustment of water or fishing rights	×	Adjustment of water right of downstream area may be needed.	×	Adjustment of water right of downstream area may be needed.
12. Changes in social and institutional structures	●●●	Strengthening of rural organization is included in the project.	□	Training of farmers and community leaders will be insufficient.
13. Changes in existing institutions and customs	●●●	Decision making by women will be easier by training.	□	Training of women will be insufficient.
14. Increased use of agrochemicals	××	Agricultural development bring the increase of agrochemical use.	××	Use of agrochemicals is increasing gradually.
15. Outbreak of endemic diseases	××	Water related diseases such as Malaria and Amoebiasis may increase.	××	Water related diseases such as Malaria and Amoebiasis may increase.
16. Spreading of endemic diseases	××	Malaria may increase.	××	Malaria may increase.
17. Residual toxicity of agrochemicals	□	MOALD will support farmers for the appropriate use of agrochemicals.	××	Use of high toxic agrochemicals may increase.
18. Increase in domestic and other human wastes	××	Increase of population will bring it.	××	Increase of population will bring it.
19. Impairment of cultural assets	□	No cultural assets.	□	No cultural assets.
20. Damage to aesthetic sites	●●	Water source in N.P. of downstream area will protected by watershed management in the project area.	××	Water source in N.P. of downstream area will be damaged by over irrigation in the project area.
21. Impairment of buried assets	□	No buried assets.	□	No buried assets.
22. Changes in vegetation	●●	Watershed management will improve the vegetation.	□	

Environmental Item	In case of no problem in the project		In case of problem in the project	
	Evaluation	Hypothetical items for the evaluation basis	Evaluation	Hypothetical items for the evaluation basis
23. Negative impact on important or indigenous fauna and flora	×		× × ×	Conflict between farmers and elephants will increase by farming in the dry season.
24. Degradation of ecosystems with biological diversity	□	Project area is only in the farm land including road rehabilitation and construction of irrigation facilities.	□	
25. Proliferation of exotic and/or hazardous species	×		× ×	Malaria mosquito will increase through irrigation canals.
26. Destruction of wetlands and peat lands	□		□	
27. Decrease of tropical rain forests and wild lands	□	No tropical rain forest. Wild land is conserved in the high ground N.P.	□	
28. Destruction of mangrove forests	□	No mangrove forest.	□	
29. Degradation of coral reefs	□	No coral reefs	□	
30. Soil erosion	●●	Soil conservation plan is included in this project.	× ×	Negative participation of farmers for the soil conservation activities.
31. Soil salinization	□	Salinity of irrigation water is very low and it seems that the salinity of soil is also low.	□	
32. Deterioration of soil fertility	●●	Soil conservation plan is included.	× ×	Negative participation of farmers for the soil conservation activities.
33. Soil contamination by agrochemicals and others	□	Enforcement of extension service with the promotion of proper agrochemical use is planned.	× ×	Extension service will be insufficient.
34. Devastation or desertification of land	●●	Soil conservation plan is included.	× ×	Negative participation of farmers for the soil conservation activities.
35. Devastation of hinterland	□		□	
36. Ground subsidence	□	No exploitation of groundwater.	□	No exploitation of groundwater.
37. Change in surface water hydrology	□	Proper water allocation is promoted. Watershed management is promoted for water conservation.	× × ×	Proper water allocation in the project will be failed and water will decease in the downstream by the irrigation in the upstream area.
38. Change in ground water hydrology	□	Infiltration of irrigated water is a little and no exploitation of ground water.	□	Infiltration of irrigated water is a little and no exploitation of ground water.
39. Inundation	□	No inundation.	□	No inundation.
40. Sedimentation	●●	Soil conservation activity will reduce the sedimentation.	× ×	Failure of soil conservation activities will bring it in the downstream.
41. Riverbed degradation	□		□	
42. Impediment of inland navigation	□	No inland navigation.	□	No inland navigation.
43. Deterioration of water quality	× ×	Agricultural development will deteriorate water quality.	× × ×	Insufficient support of farmers for the use of agrochemicals will accelerate it.
44. Water eutrophication	×	It may increase by the increase of chemical fertilizer.	× ×	It will increase by the increase of chemical fertilizer.
45. Sea water intrusion	□		□	
46. Change in temperature of water	□		□	
47. Air pollution	□		□	

Table T.1-18 Mitigation for the Hypothetical Problem

Environmental Item	In case of problem		Mitigation
	Evaluation	Evaluation basis	
3. Substantial changes in the way of life	××	Increase of women's work in agriculture.	
4. Conflict among people	××	Difficulty of fair water distribution.	Establishment of water distribution monitoring system.
6. Population increase	××	Increase of job opportunities will bring it.	Promotion of health education including family planning.
14. Increased use of agrochemicals	××	Use of agrochemicals is increasing gradually.	Promotion of use of organic fertilizer and rotation cropping.
15. Outbreak of endemic diseases	××	Water related diseases such as Malaria and Amoebiasis may increase.	Promotion of health education including hygiene and protection of water source.
16. Spreading of endemic diseases	××	Malaria may increase.	
17. Residual toxicity of agrochemicals	××	Use of high toxic agrochemicals may increase.	Establishment of support system by MOALD.
20. Damage to aesthetic sites	××	Water source in N.P. of down-stream area will be damaged by over irrigation in the project area.	Establishment of water distribution monitoring system.
23. Negative impact on important or indigenous fauna and flora	×××	Conflict between farmers and elephants will increase by farming in the dry season.	
25. Proliferation of exotic and/or hazardous species	××	Malaria mosquito will increase through irrigation canals.	
30. Soil erosion	××	Negative participation of farmers for the soil conservation activities.	Enforcement of soil conservation programme including farmers' training.
32. Deterioration of soil fertility	××	Negative participation of farmers for the soil conservation activities.	Enforcement of soil conservation programme including farmers' training.
33. Soil contamination by agrochemicals and others	××	Extension service will be insufficient.	Establishment of extension service programme.
34. Devastation or desertification of land	××	Negative participation of farmers for the soil conservation activities.	Enforcement of soil conservation programme including farmers' training.
37. Change in surface water hydrology	×××	Proper water allocation in the project will be failed and water will decease in the downstream by the irrigation in the upstream area.	Establishment of water distribution monitoring system.
40. Sedimentation	××	Failure of soil conservation activities will bring it in the downstream.	Enforcement of soil conservation programme including farmers' training.
43. Deterioration of water quality	×××	Insufficient support of farmers for the use of agrochemicals will accelerate it.	Promotion of health education and establishment of monitoring system of water quality.
44. Water eutrophication	××	It will increase with the increase of chemical fertilizer use.	Promotion of watershed management including the improvement of vegetation to filter eutrophic water.

Figure T.2-1

Location Map of Rupingazi Ngerwe Irrigation Scheme

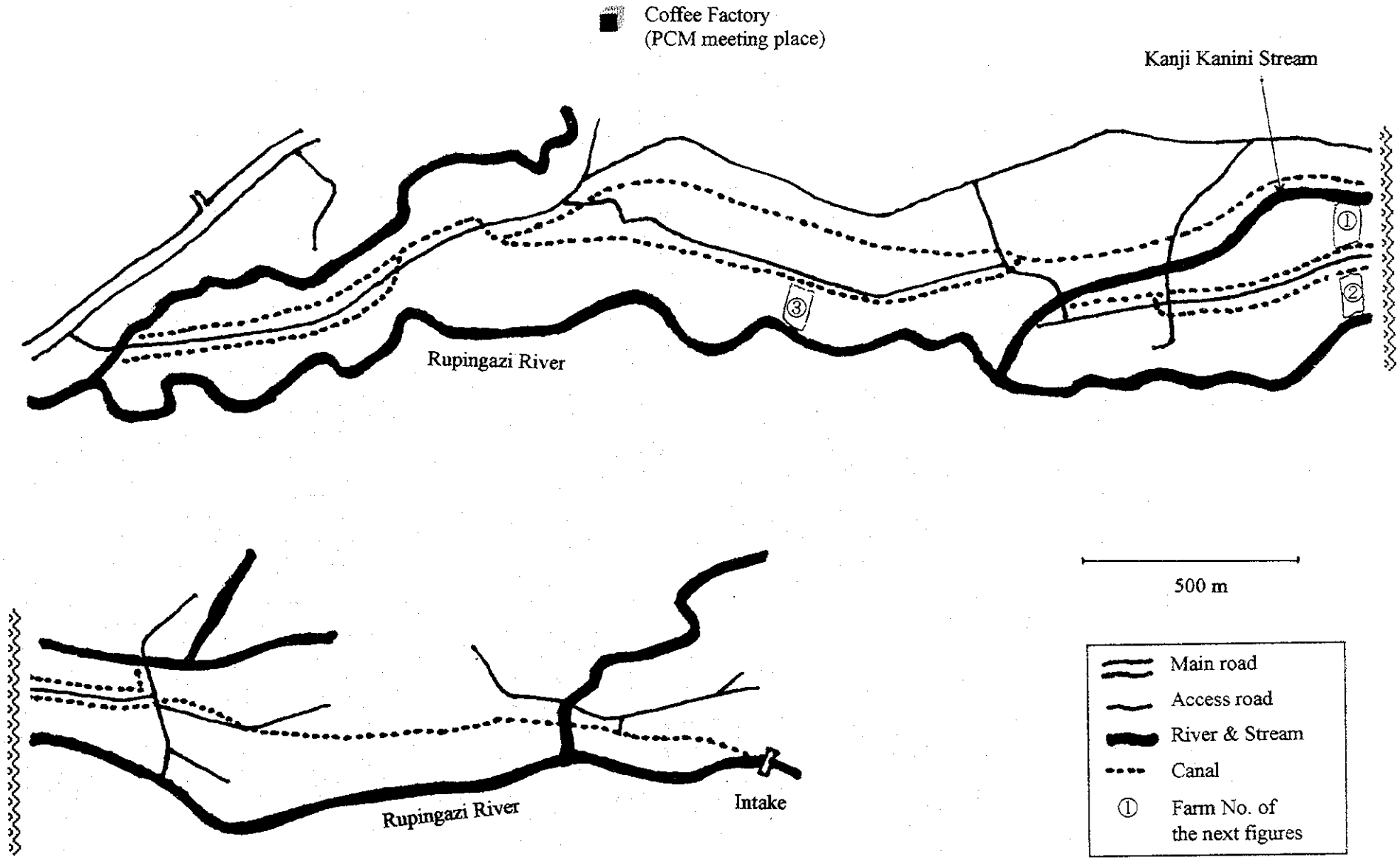
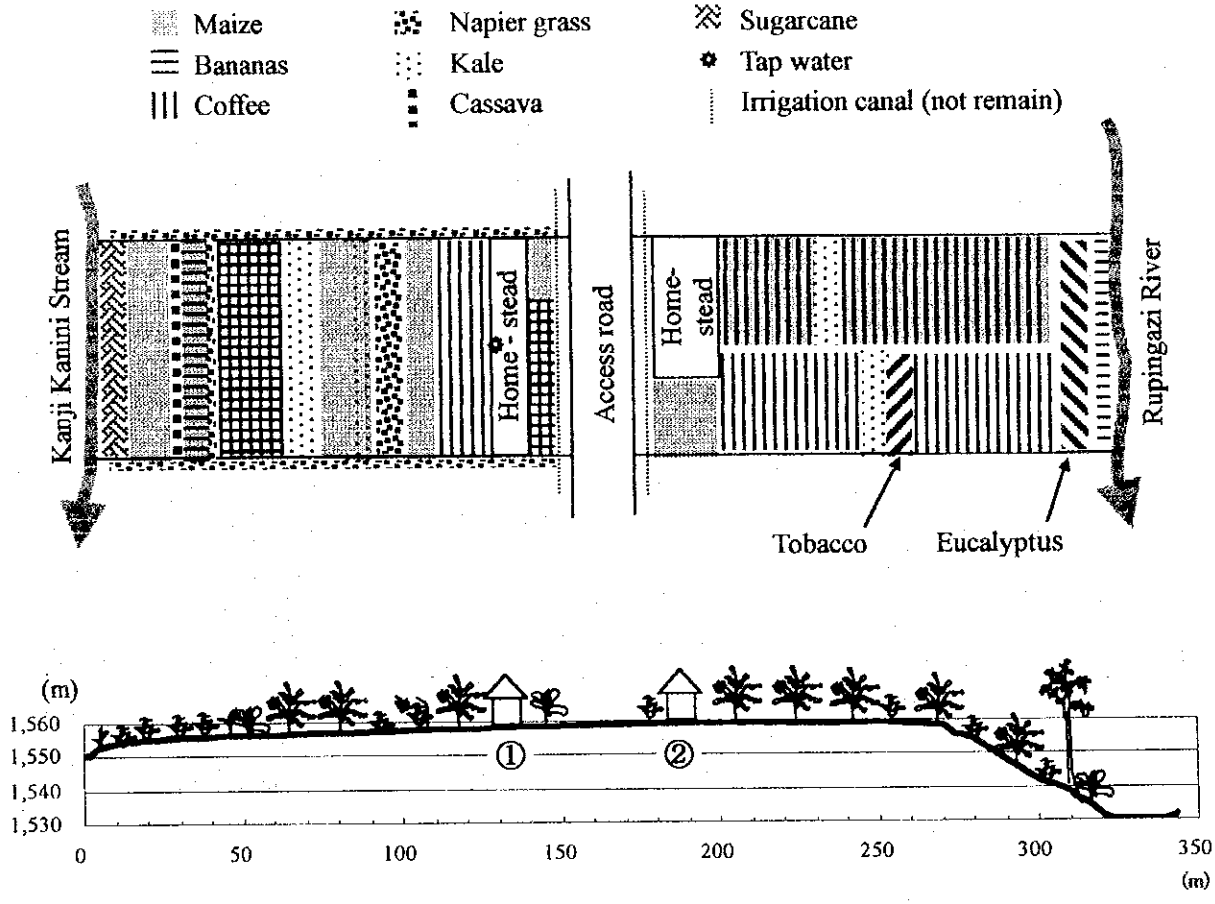


Figure T.2-2 Example of the Land Use in Rupingazi

① The farm of Mrs. Faith Ngendo, 1 acre (left side) and
② The farm of Mrs. Jane Kiini, 1 acre (right side)



Rupingazi Ngerwe Irrigation Scheme is divided into four blocks from Block A of the upstream to Block D of the downstream.

The above two farms belong to the Block B and about 2,200 m down from the intake. The irrigation canals on both sides of the road are completely filled up.

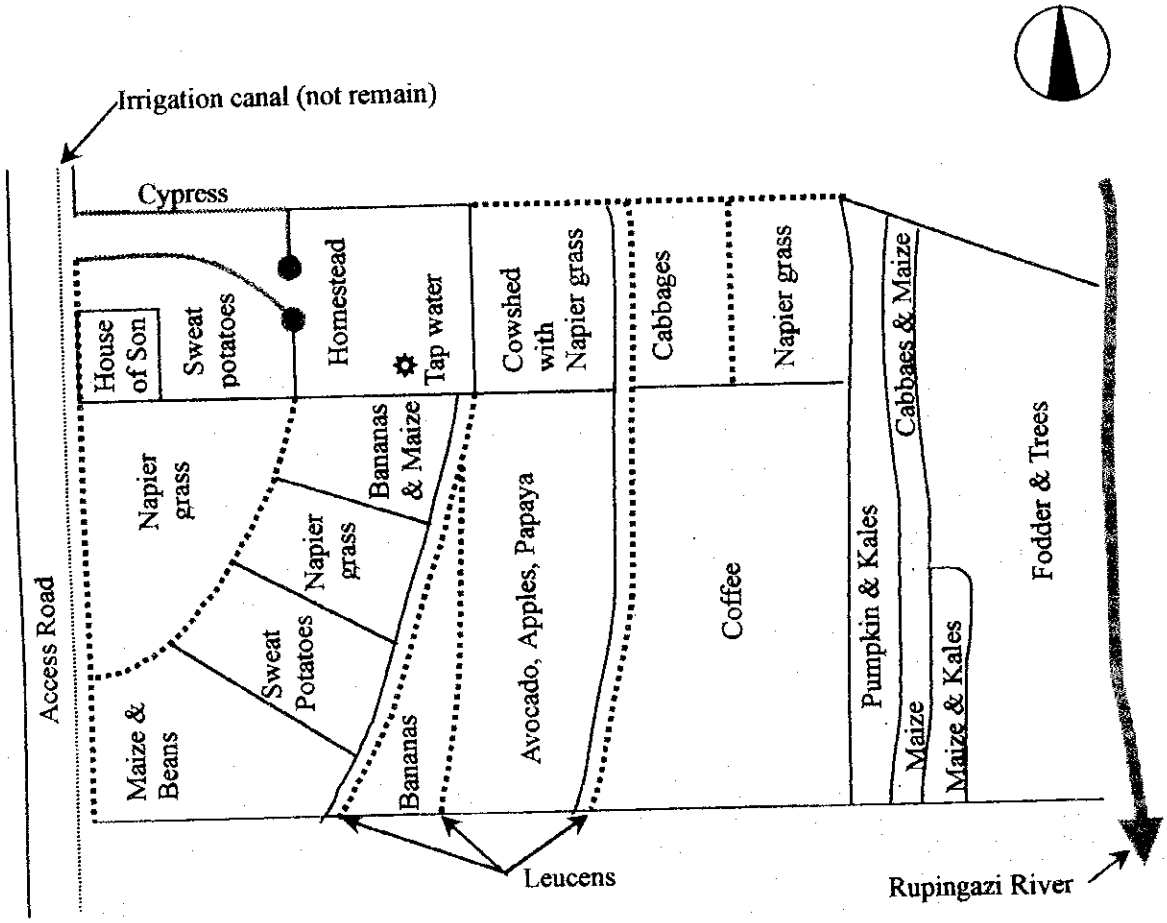
The left farm has two cows and they grow Napier grass for fodder. Though, there is not enough litter for the cowshed and the cows stand in the dung mud. They have a tap water that is allowed for the use of domestic and livestock. Coffee is growing mixed with Bananas in some plots.

The right farm has not a cow and has a goat. Coffee is growing mixed with Maize in some plots. Tobacco is growing for home consumption. The water of Rupingazi River is used as domestic water.

(Surveyed on July 16, 1998)

Figure T.2-3 Effective Land Use for the Soil Conservation in Rupingazi

③ The Farm of Mrs. Purity Wanjiko, 4 acres



Mrs. Wanjiko is the treasurer of the Irrigation Scheme. Her husband is a driver of Ministry in Embu and she manages the farm land.

The land was measured in 1991 by the National Extension Project that has been implemented from 1984 to 1998 (World Bank). At that time, extension officers visited all farmers in this area to explain the project of land measurement. Then, 10 farmers requested the measurement of their lands and only 4 farmers practiced the land adjustment by making of terrace along the contour line. Mrs. Wanjiko is one of 4 farmers. And she became the district winner of the Small Scheme Farmers Competition.

She has three cows with fine fur, one pig and 1 goat in the clean concrete houses. She takes care of them very well and produces a lot of manure from livestock to put in the soil, even in the plot of Napier grass.

She assists the experience of KARI (Kenya Agricultural Research Institute) and grows Leucens that is a kind of fodder to be introduced in this area. One variety did not grow well, but the present variety grows well and she grows it along the plot and contour line.

(Surveyed on July 15, 1998)

Figure T.2-4

Location Map of Ngomano/Nyangati Water Furrow Project

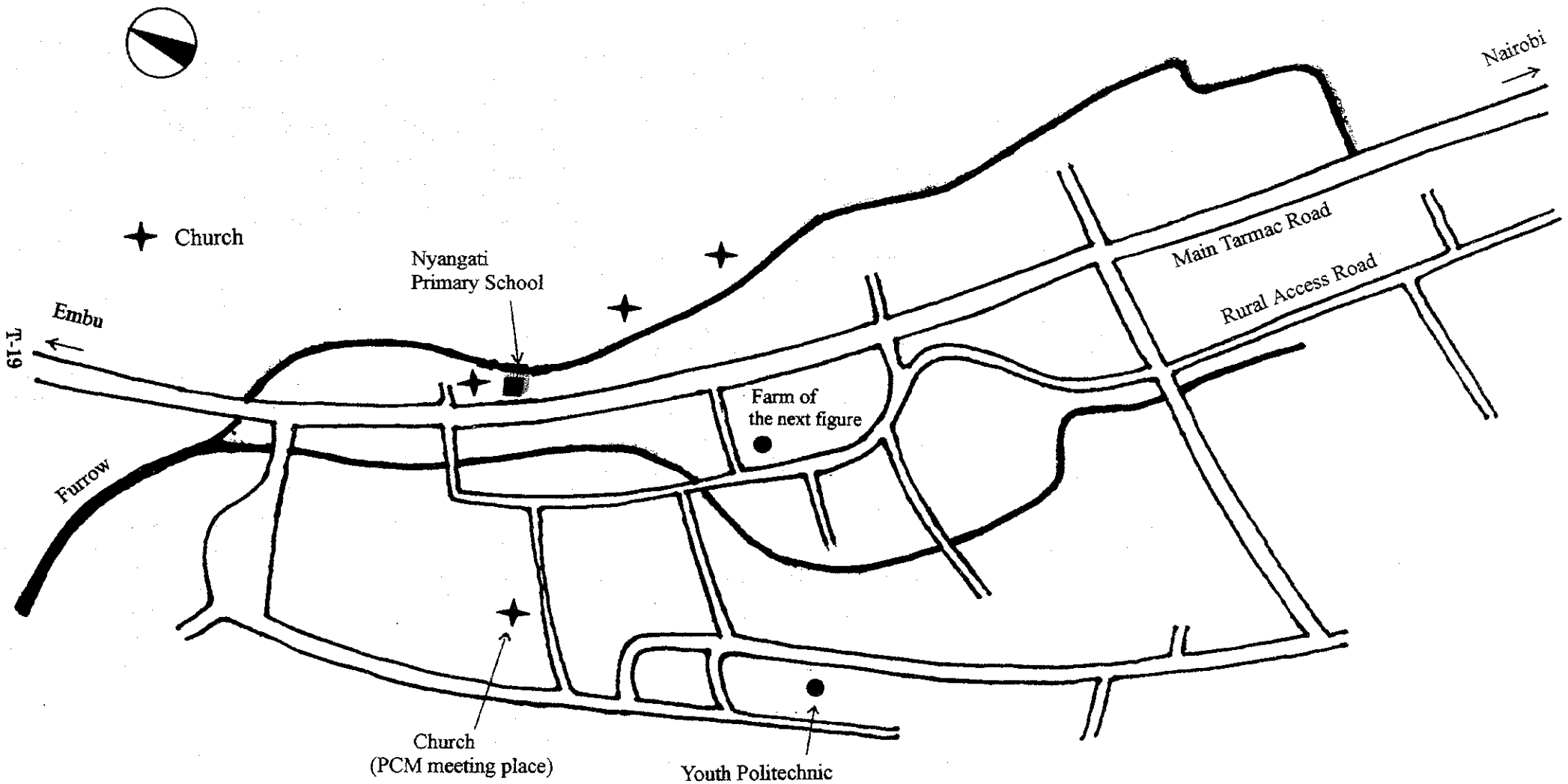
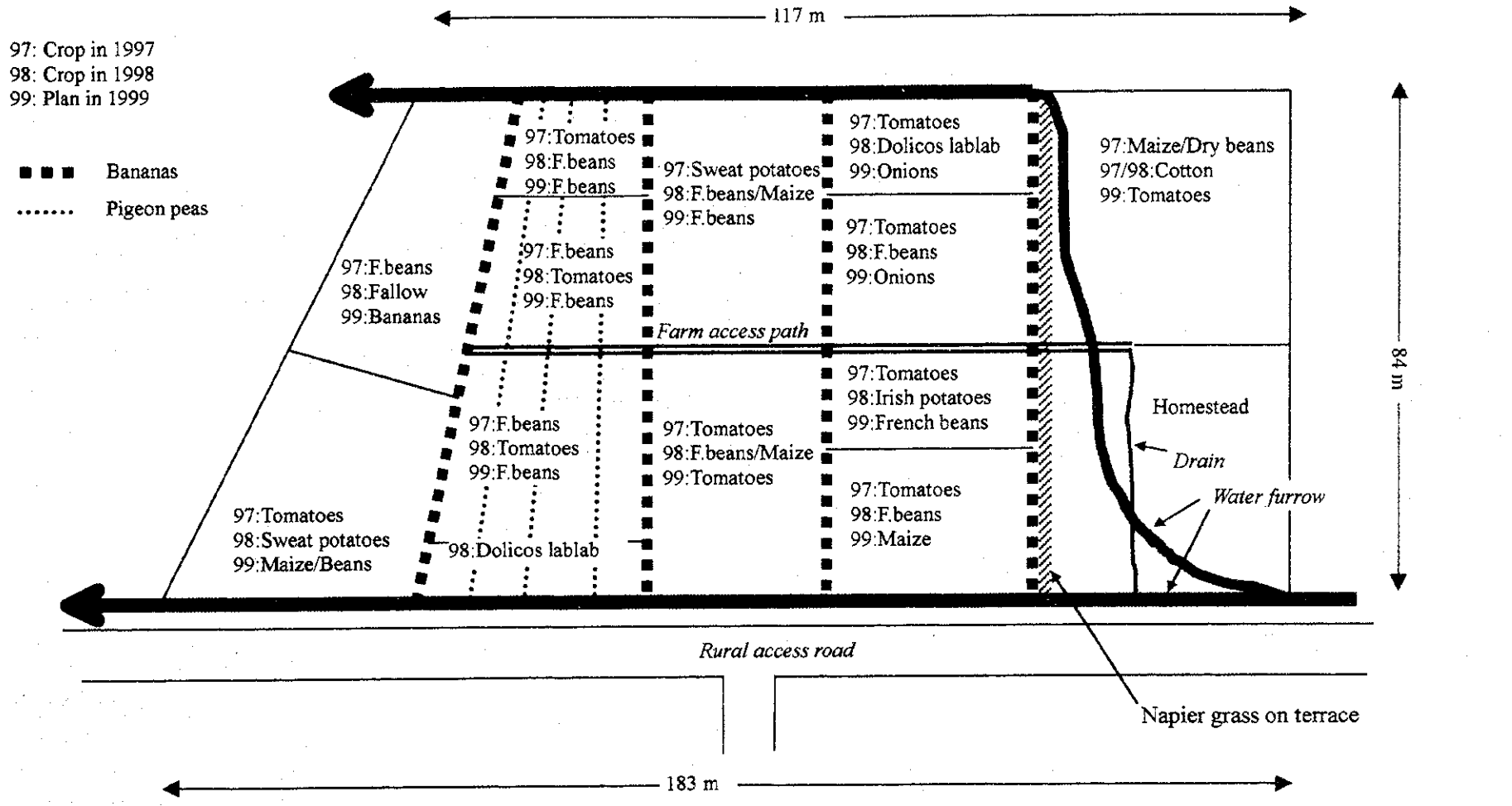


Figure T.2-5 Effective Land Use for the Soil Conservation in Nyangati

The Farm of Mr. Karimi Kaiguri, 4 acres



(Surveyed on July 1, 1998)

Figure T.2-6
Location Map of Nkunjumo Water Project

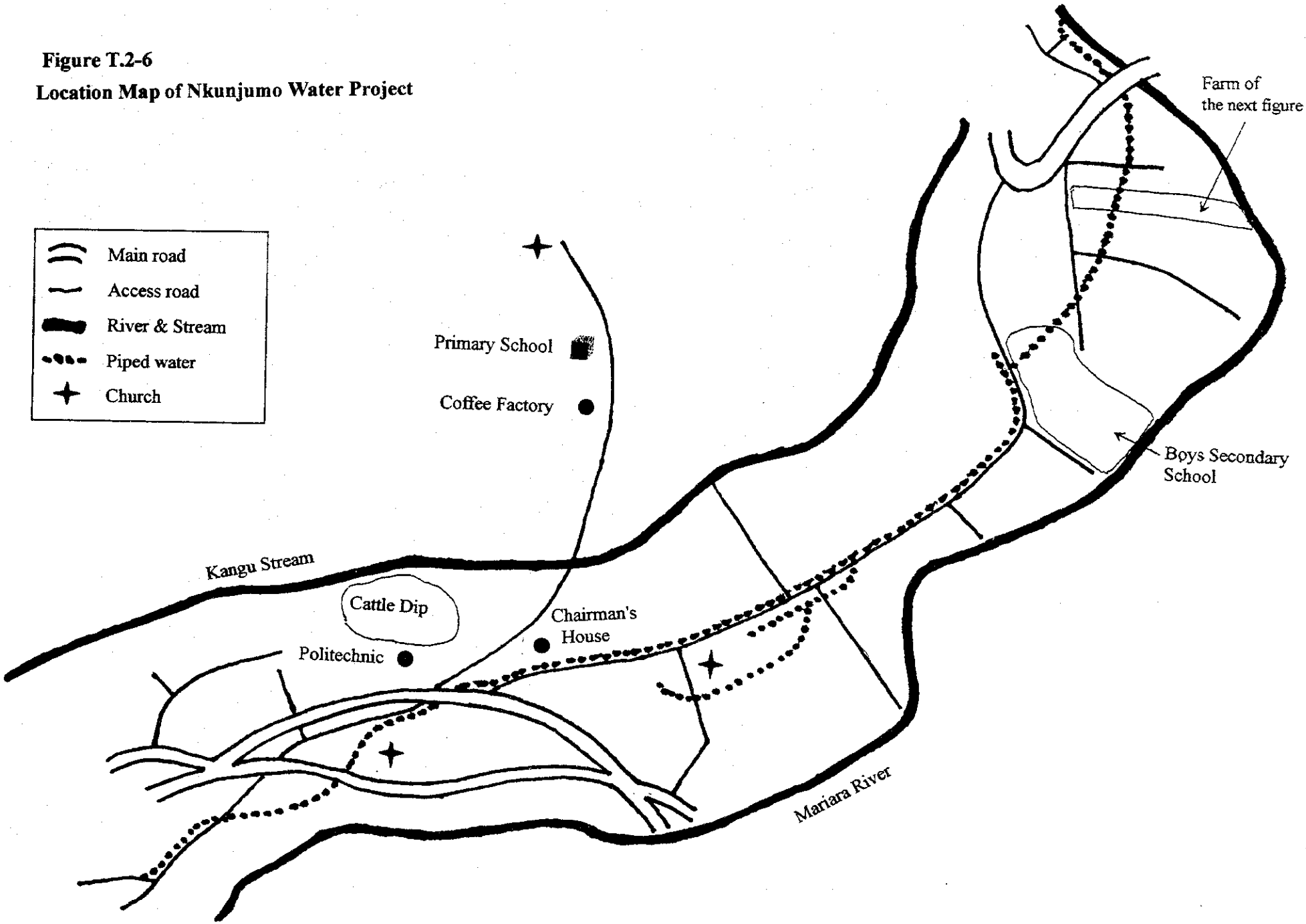
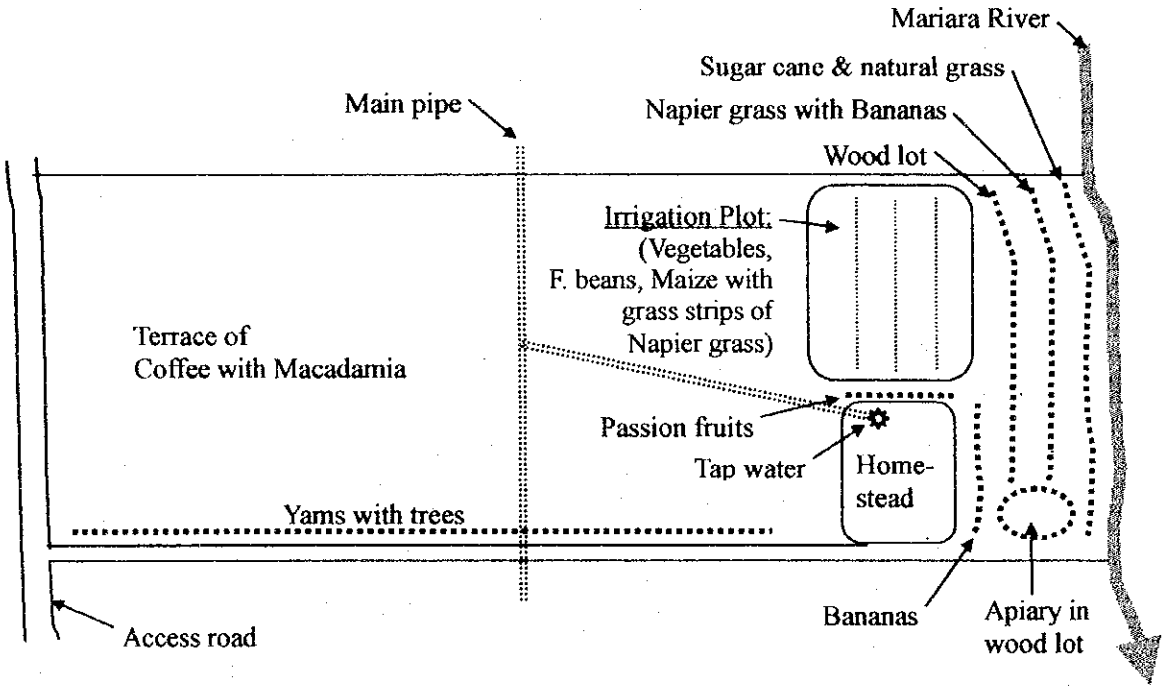
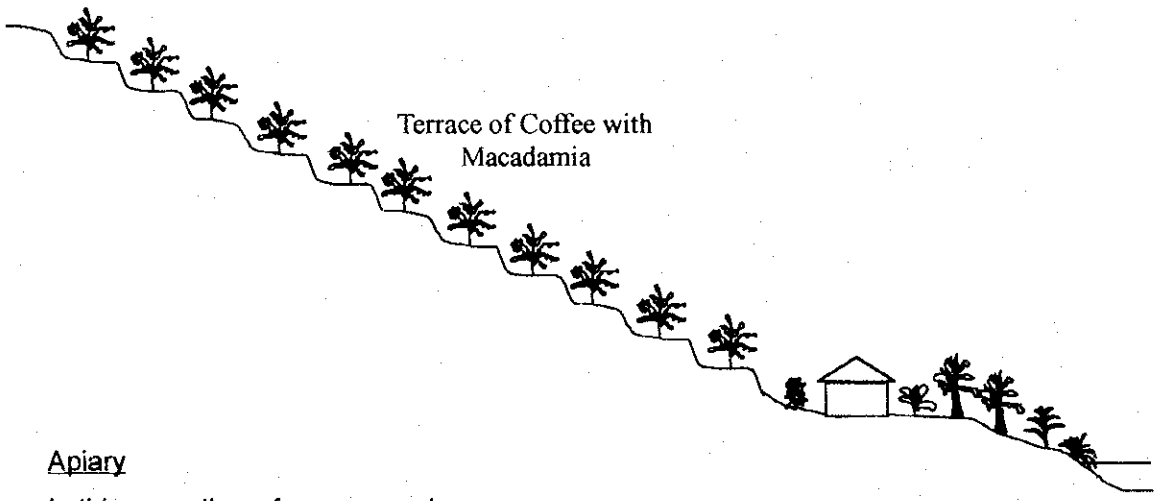


Figure T.2-7 Example of the Land Use in Nkun-Njumo

Farm of Mr. Isaya Kithakwa, 3 acres





Apiary

In this area, three farmers produce honey for home consumption and selling to neighbors. Bored log is used as hive and it is put on the tree.

Mr. Kithakwa has two hives. One hive makes 5 kg of honey and can be harvested 3 times per year. He sells honey at 160sh/kg.

(Surveyed on July 8, 1998)

Figure T.2-8
Location Map of Ruungu/Karocho Irrigation Project

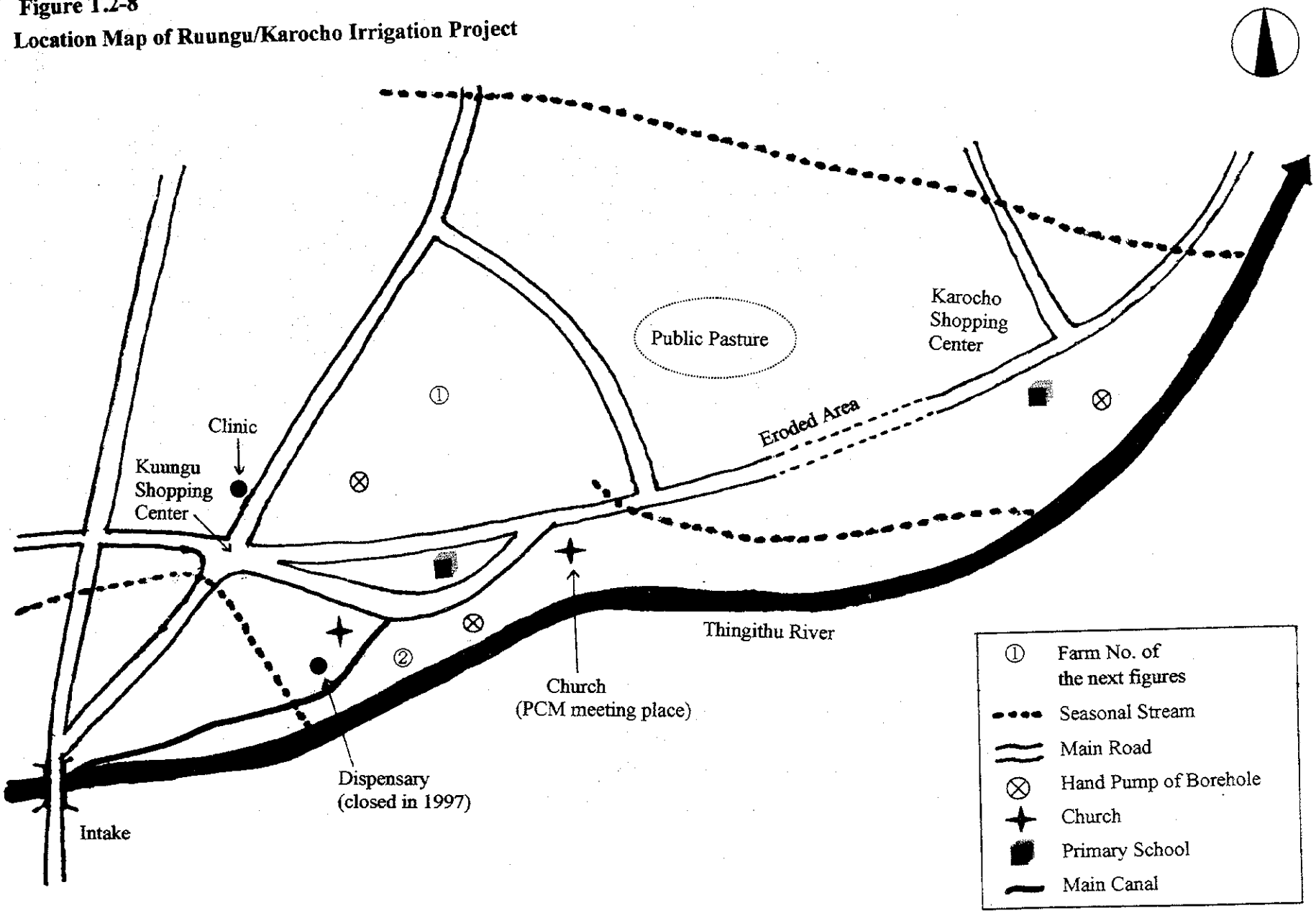
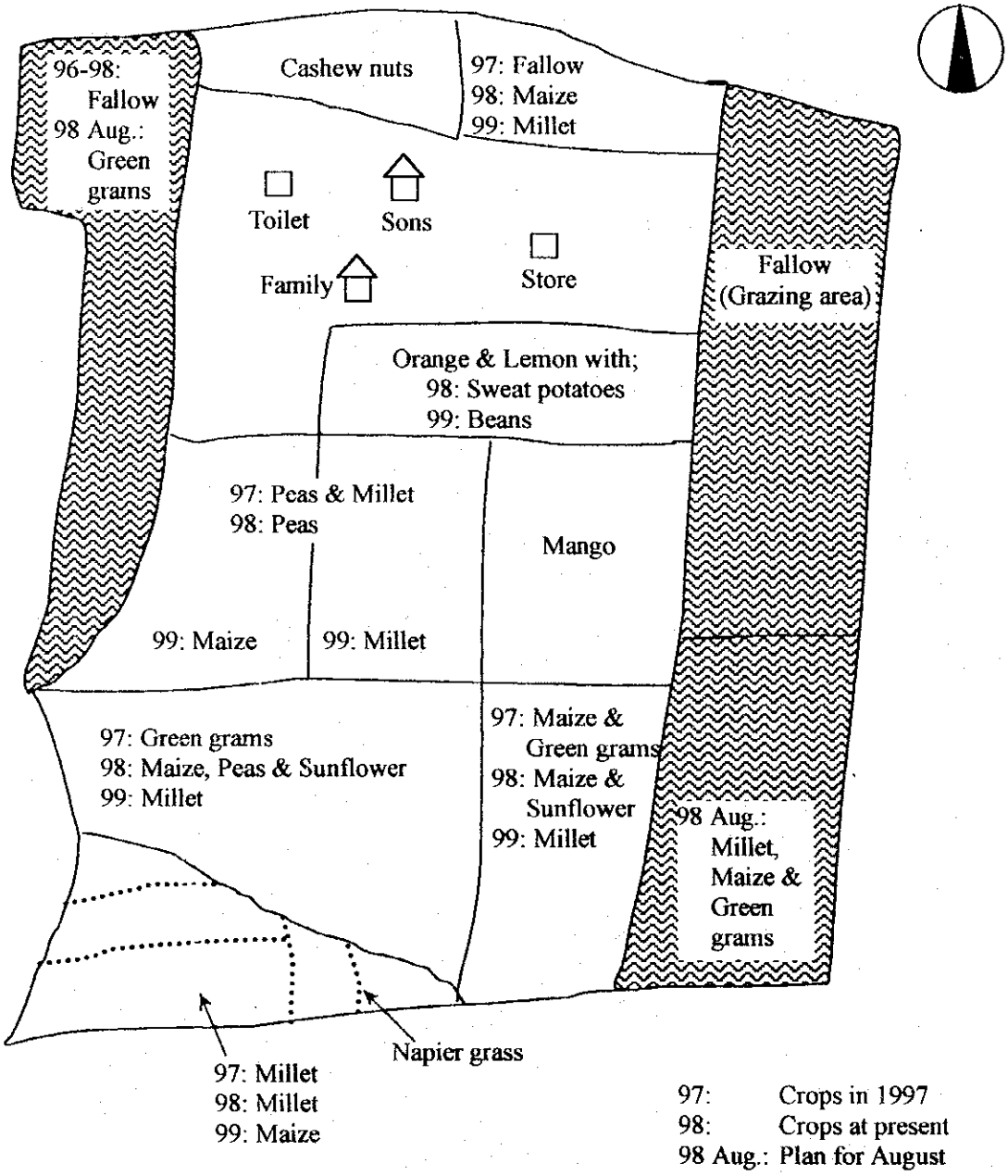


Figure T.2-9 Example of the Land Use in Ruungu

① The Farm of Mr. Japhet Kirugi, 15 acres

Mr. Kirugi is a active farmer and he is growing some trees; Cashew nuts, Mango, Orange and Lemon. He raised Sunflower in this year. He has 5 cows. Their drinking water is from a borehole.

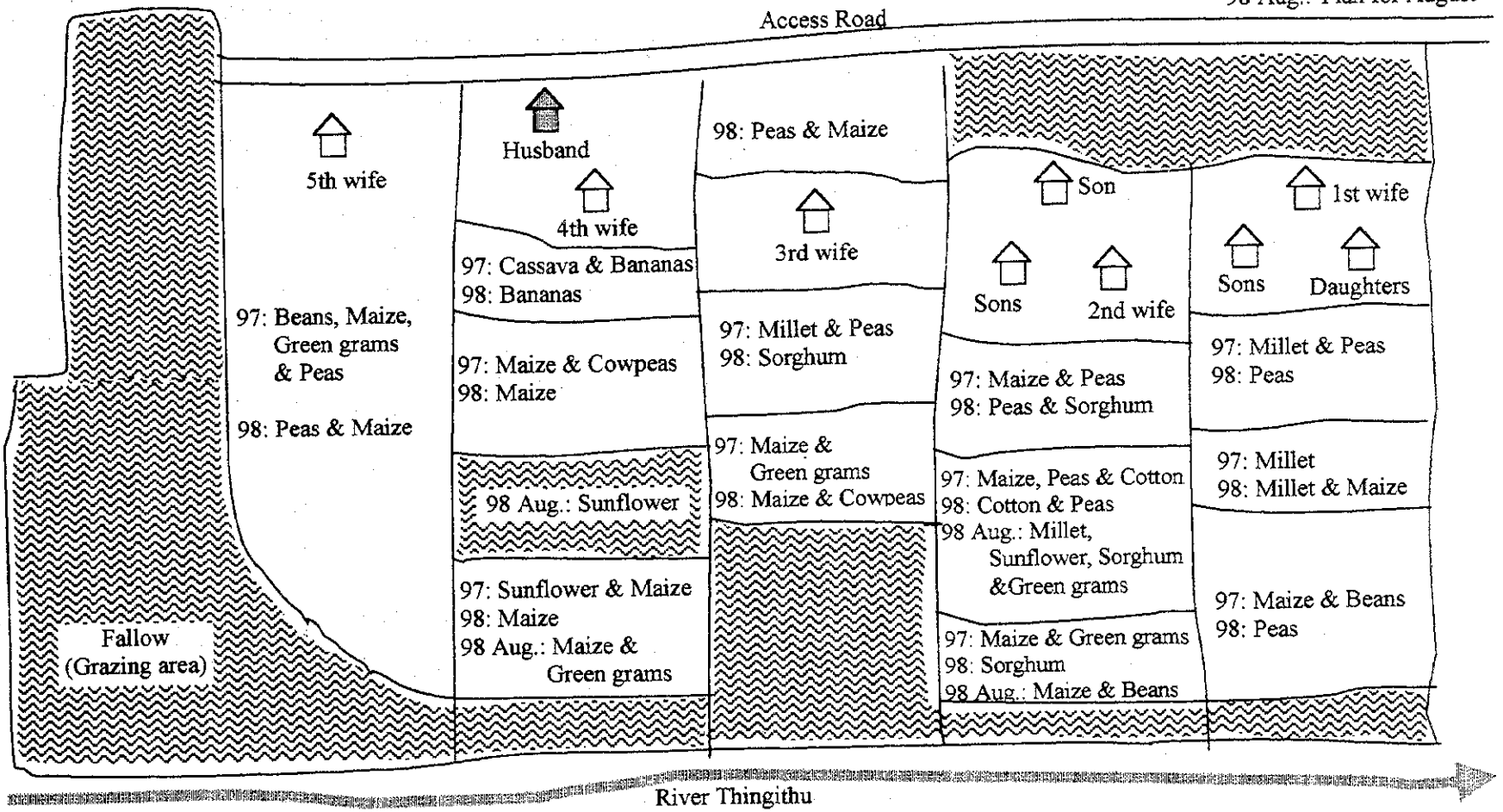


(Surveyed on July 14, 1998)

Figure T.2-10 Example of the Traditional Land Use in Ruungu
② The Farm of Mr. Silas Munyua, approximately 20 acres

Mr. Munyua is one of the first settlers to Ruungu in 1963 and he has the biggest family in this area; 5 wives, 13 sons and 3 daughters. He has 8 goats. He had a cow, but it died last year because of disease. Five wives manage each plot and he stocks their harvest for the shortage of food.
They use the water of borehole nearby for drinking water and they say that the quality is good.

97: Crops in 1997
98: Crops at present
98 Aug.: Plan for August



(Surveyed on July 22, 1998)

Table T.2-1 Result of Water Quality Analysis
Rupingazi Ngerwe Irrigation Scheme

Parameters	Standard	Ru-1	Ru-2	D-W1	D-W2
1. Date of Sampling	-	19.07.98	19.07.98	19.07.98	19.07.98
2. Time	-	10:55	11:55	08:00	12:00
3. Climate	-	cloudy	cloudy	cloudy	fair
4. Air temperature	-	18.5°C	18°C	15°C	24°C
5. Water temperature	-	17.0°C	20°C	18°C	19°C
6. River Width (m)	-	8.0	2.0	-	-
7. River Depth (m)	-	0.5	0.5	-	-
8. River Velocity (m/s)	-	3.5	1.5	-	-
9. pH	6.0-8.5(1)	8.1	7.8	7.9	9.6
10. EC (μmho/cm)	10-10^3(2)	110.0	n.a	140.0	8.1
11. COD (Cr) mg/l	20 or< (2)	n.d	72.0	64.0	n.d
12. BOD (mg/l)	1. or <(1)*	4.0	3.0	1.0	4.0
13. TDS (mg/l)	200-1500[4]	73.0	111.0	270.0	73.0
14. T-SS (mg/l)	25 (1)**	63.0	22.0	9.0	63.0
15. HCO3 (mg/l)	<25(2)	33.6	0.00	137.3	33.6
16. SO4 (mg/l)	2-80(2)	2.6	8.8	16.0	2.6
17. Na+ (mg/l)	200(3)	3.4	6.8	38.4	3.4
18. K+ (mg/l)	10(2)	1.6	2.4	8.0	1.6
19. NO3-N (mg/l)	10(1,3)	4.7	4.4	20.4	4.9
20. PO4-P (mg/l)	0.005 (1)	0.10	0.12	n.d	n.d
21. Copper (Cu) (mg/l)	3(1)	n.d	n.d	n.d	n.d
22. Manganese Mn++	10(1)	n.d	n.d	n.d	n.d
23. CaCO3 (mg/l)	<15(2)	10.0	10.0	5.0	20.0
24. Magnesium (Mg++)	n.v.s.h(3)	n.d	n.d	n.d	n.d
25. Iron (Fe++) (mg/l)	<100 μg/l(2)	0.7	1.7	n.d	0.28
26. Diazinon (μg/l)	10^-2 (2)	n.d	n.d	n.d	n.d
27. Fenitrothion (μg/l)	10^-2 (1)	n.d	n.d	n.d	n.d
28. Malathion (μg/l)	10^-2 (2)	n.d	n.d	n.d	n.d
29. Endosulfan (μg/l)	10^-2 (2)	n.d	n.d	n.d	n.d
30. Coliform/250 ml	Shall be absent[4]	present	present	present	present
31. E.Coli/250 ml	Shall be absent[4]	present	present	present	present

Notes:

1 Environmental Water Quality Standards in Japan
2 Concentration Observed in Unpolluted Surface water (WHO)
3 WHO
4 Kenya Bureau of Standards
* Agricultural water should have BOD of 8 mg/l or less
** Agricultural water should have T-SS of 100 mg/l or less
n.v.s No value set by WHO
n.v.s.h No health related value set by WHO
n.d Not detectable
n.s Not sampled
n.a Not analysed

Ru-1: Intake of Rupingazi River
Ru-2: 11 km downstream from the intake
D-W: Deep well

(Source: EIA Survey, July 1998)

Table T.2-2 Result of Water Quality Analysis
Ngomano/Nyangati Water Furrow Project

Parameters	Standard	Mu-1	Mu-2	D-Well	S-Well	O-Well	Spring
1. Date of Sampling	-	19.07.98	19.07.98	19.07.98	19.07.98	22.07.98	22.07.98
2. Time	-	08:00	09:00	10:15	10:45	09:30	09:00
3. Climate	-	Bright	Bright	Bright	Bright	Fair	Fair
4. Air temperature	-	24°C	23.5°C	24°C	24°C	22°C	22°C
5. Water temperature	-	20°C	20°C	25°C	25°C	21°C	21°C
6. River Width (m)	-	3.0	1.0	-	-	-	-
7. River Depth (m)	-	0.5	0.3	-	-	-	-
8. River Velocity (m/s)	-	0.5	0.5	-	-	-	-
9. pH	6.0-8.5(1)	8.2	8.4	8.1	8.1	7.3	7.6
10. EC (µmho/cm)	10-10³(2)	65.0	135.0	490.0	400.0	110.0	104.0
11. COD (Cr) mg/l	20 or< (2)	n.d	16.0	72.0	-	28.0	n.d
12. BOD (mg/l)	1 or <(1)*	2.0	3.0	3.0	2.0	4.0	1.5
13. TDS (mg/l)	200-1500⁴	72.0	155.0	376.0	342.0	86.0	88.0
14. T-SS (mg/l)	25 (1)**	19.0	26.0	7.0	1.0	n.d	n.d
15. HCO3 (mg/l)	<25(2)	n.d	0.0	170.8	115.9	n.d	n.d
16. SO4 (mg/l)	2-80(2)	0.2	9.0	6.1	8.7	0.6	n.d
17. Na+ (mg/l)	200(3)	4.8	7.4	20.8	17.6	5.8	5.0
18. K+ (mg/l)	10(2)	0.8	1.2	7.0	2.2	0.8	0.6
19. NO3-N (mg/l)	10(1,3)	6.0	7.3	39	53.2	8.0	8.6
20. PO4-P (mg/l)	0.005 (1)	0.02	0.04	0.18	0.4	0.02	0.02
21. Copper (Cu) (mg/l)	3(1)	n.d	n.d	n.d	n.d	n.d	n.d
22. Manganese Mn++	10(1)	n.d	n.d	n.d	n.d	n.d	n.d
23. CaCO3 (mg/l)	<15(2)	15.0	20.0	90.0	85.0	25.0	20.0
24. Magnesium (Mg++)	n.v.s.h(3)	5.0	26.0	72.0	57.0	10.0	21.0
25. Iron (Fe++) (mg/l)	<100 µg/l(2)	2.1	1.8	0.04	n.d	0.1	0.4
26. Diazinon (µg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d	n.d	n.d
27. Fenitrothion (µg/l)	10^{-2} (1)	n.d	n.d	n.d	n.d	n.d	n.d
28. Malathion (µg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d	n.d	n.d
29. Endosulfan (µg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d	n.d	n.d
30. Coliform/250 ml	Shall be absent⁴	present	present	present	present	n.a	n.a
31. E.Coli/250 ml	Shall be absent⁴	present	present	present	present	n.a	n.a

Notes:

1 Environmental Water Quality Standards in Japan
2 Concentration Observed in Unpolluted Surface water (WHO)
3 WHO
4 Kenya Bureau of Standards
* Agricultural water should have BOD of 8 mg/l or less
** Agricultural water should have T-SS of 100 mg/l or less
n.v.s No value set by WHO
n.v.s.h No health related value set by WHO
n.d Not detectable
n.s Not sampled
n.a Not analysed

Mu-1: Intake of Murubara River
Mu-2: 7.5 km downstream from the intake
D-Well: Deep well
S-Well: Shallow well
O-Wel: Open well

(Source: EIA Survey, July 1998)

Table T.2-3 Result of Water Quality Analysis Ruungu/Karocho Irrigation Project

Parameters	Standard	Th-1	Th-2	D-W1	D-W2
1. Date of Sampling	-	17.07.98	17.07.98	17.07.98	17.07.98
2. Time	-	11:50	12:35	13:00	13:30
3. Climate	-	Sunny	Sunny	Sunny	Sunny
4. Air temperature	-	28°C	29°C	30°C	30°C
5. Water temperature	-	22°C	22°C	n.s	n.s
6. River Width (m)	-	15.0	10.0	-	-
7. River Depth (m)	-	0.6	0.5	-	-
8. River Velocity (m/s)	-	2.5	2.5	-	-
9. pH	6.0-8.5(1)	8.0	8.6	8.3	7.3
10. EC (μmho/cm)	10-10^3(2)	85.0	180.0	480.0	160.0
11. COD (Cr) mg/l	20 or< (2)	n.d	n.d	24.0	344.0
12. BOD (mg/l)	1 or <(1)*	10.0	5.0	2.5	5.0
13. TDS (mg/l)	200-1500[4]	77.0	159.0	n.d	249.0
14. T-SS (mg/l)	25 (1)**	13.0	12.0	n.d	n.d
15. HCO3 (mg/l)	<25(2)	0.00	76.3	332.5	79.3
16. SO4 (mg/l)	2-80(2)	7.4	11.6	25.3	13.8
17. Na+ (mg/l)	200(3)	6.4	8.0	54.0	18.4
18. K+ (mg/l)	10(2)	3.8	3.9	30.0	8.0
19. NO3-N (mg/l)	10(1,3)	5.8	6.2	14.8	1.6
20. PO4-P (mg/l)	0.005 (1)	0.8	n.d	0.3	0.3
21. Copper (Cu) (mg/l)	3(1)	n.d	n.d	n.d	n.d
22. Manganese Mn++	10(1)	n.d	n.d	n.d	n.d
23. CaCO3 (mg/l)	<15(2)	10.0	10.0	n.a	n.a
24. Magnesium (Mg++)	n.v.s.h(3)	n.d	n.d	n.a	n.a
25. Iron (Fe++) (mg/l)	<100 μg/l(2)	n.a	1.6	3.1	n.d
26. Diazinon (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
27. Fenitrothion (μg/l)	10^{-2} (1)	n.d	n.d	n.d	n.d
28. Malathion (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
29. Endosulfan (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
30. Coliform/250 ml	Shall be absent[4]	present	present	present	present
31. E.Coli/250 ml	Shall be absent[4]	present	present	present	present

Notes:

1 Environmental Water Quality Standards in Japan
2 Concentration Observed in Unpolluted Surface water (WHO)
3 WHO
4 Kenya Bureau of Standards
* Agricultural water should have BOD of 8 mg/l or less
** Agricultural water should have T-SS of 100 mg/l or less
n.v.s No value set by WHO
n.v.s.h No health related value set by WHO
n.d Not detectable
n.s Not sampled
n.a Not analysed

Th-1: Intake of Thingithu River
Th-2: 5.3 km downstream from the intake
D-W: deep well (40 m)

(Source: EIA Survey, July 1998)

Table T.2-4 Result of Water Quality Analysis
Nkunjumo Water Project and Tana River

Parameters	Standard	Ma-1	Ma-2	Ta-1	Ta-2
1. Date of Sampling	-	17.07.98	17.07.98	19.07.98	21.07.98
2. Time	-	08:10	09:00	12:30	15:30
3. Climate	-	cloudy	cloudy	Fair	Fair
4. Air temperature	-	18°C	18°C	18°C	23°C
5. Water temperature	-	22°C	22°C	21°C	28°C
6. River Width (m)	-	10.0	10.0	77.0	80.0
7. River Depth (m)	-	0.2	1.0	3.0	2.0
8. River Velocity (m/s)	-	2.8	3.5	4.0	4.0
9. pH	6.0-8.5(1)	7.9	7.8	7.7	8.6
10. EC (μmho/cm)	10-10^3(2)	87.0	86.0	120.0	190.0
11. COD (Cr) mg/l	20 or< (2)	112.0	178.0	n.d	n.d
12. BOD (mg/l)	1 or <(1)*	7.5	5.0	2.0	2.0
13. TDS (mg/l)	200-1500[4]	130.0	50.0	92.0	78.0
14. T-SS (mg/l)	25 (1)**	3.0	26.0	19.0	5.0
15. HCO3 (mg/l)	<25(2)	51.9	42.7	54.9	n.d
16. SO4 (mg/l)	2-80(2)	9.6	16.5	0.14	36.4
17. Na+ (mg/l)	200(3)	7.6	6.8	5.2	13.6
18. K+ (mg/l)	10(2)	3.4	3.4	1.4	2.0
19. NO3-N (mg/l)	10(1,3)	6.4	3.5	6.2	4.4
20. PO4-P (mg/l)	0.005 (1)	n.d	0.22	0.22	0.02
21. Copper (Cu) (mg/l)	3(1)	n.d	n.d	n.d	n.d
22. Manganese Mn++	10(1)	n.d	n.d	n.d	n.d
23. CaCO3 (mg/l)	<15(2)	10.0	10.0	20.0	30.0
24. Magnesium (Mg++)	n.v.s.h(3)	n.d	5.0	38.0	28.0
25. Iron (Fe++) (mg/l)	<100 μg/l(2)	n.a	0.6	1.8	4.5
26. Diazinon (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
27. Fenitrothion (μg/l)	10^{-2} (1)	n.d	n.d	n.d	n.d
28. Malathion (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
29. Endosulfan (μg/l)	10^{-2} (2)	n.d	n.d	n.d	n.d
30. Coliform/250 ml	Shall be absent[4]	present	present	present	present
31. E.Coli/250 ml	Shall be absent[4]	present	present	present	present

Notes:

1 Environmental Water Quality Standards in Japan
2 Concentration Observed in Unpolluted Surface water (WHO)
3 WHO
4 Kenya Bureau of Standards
* Agricultural water should have BOD of 8 mg/l or less
** Agricultural water should have T-SS of 100 mg/l or less.
n.v.s No value set by WHO
n.v.s.h No health related value set by WHO
n.d Not detectable
n.s Not sampled
n.a Not analysed

Ma-1: Intake of Mariara River
Ma-2: 7 km downstream from the intake
Ta-1: Tana River (see the next figure)
Ta-2: Tana River (see the next figure)

(Source: EIA Survey, July 1998)

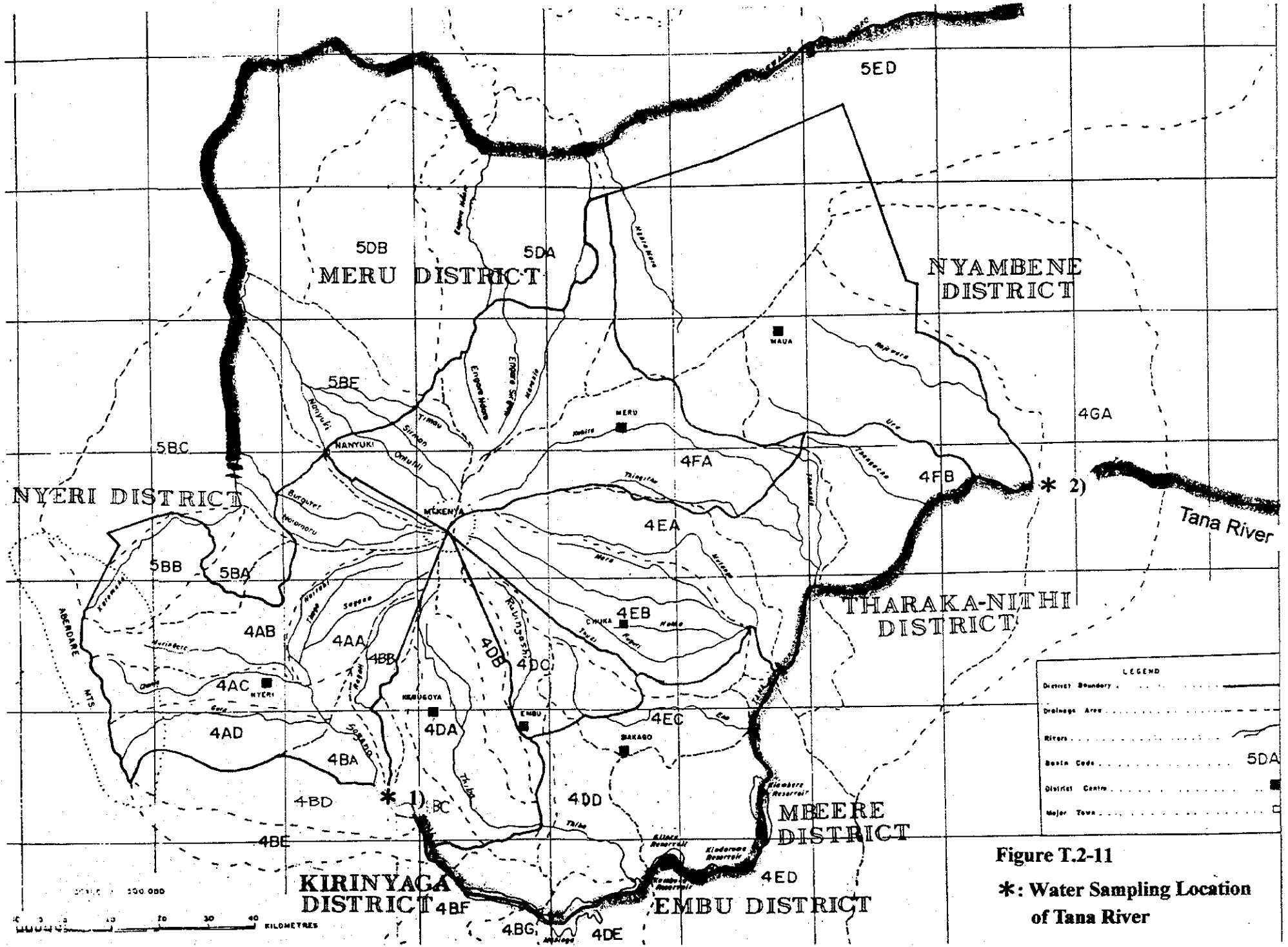


Figure T.2-11

***: Water Sampling Location of Tana River**