


REPUBLIC OF KENYA
REPORT OF FEASIBILITY STUDY
FOR
FM BROADCASTING NETWORK EXPANSION PROJECT

November, 1977

JAPAN INTERNATIONAL COOPERATION AGENCY

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P R E F A C E

In compliance with the request of the Government of the Republic of Kenya, the Government of Japan decided to carry out a feasibility study for FM Broadcasting Network Expansion Project as part of its overseas technical cooperation and this study was executed by Japan International Cooperation Agency (JICA).

JICA dispatched a study team of ten experts headed by Mr. Masao Shiga of the Radio Regulatory Bureau of the Ministry of Posts and Telecommunications to Kenya from March 10 to April 17, 1977, and conducted a feasibility study for the project.

The field survey in Kenya was carried out smoothly with the extensive cooperation of the Government of Kenya.

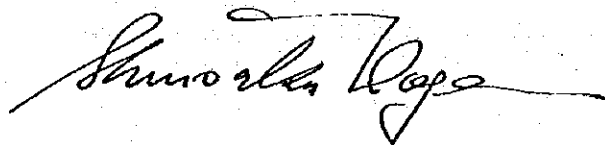
After returning to Japan, the study team finalized the feasibility report, based on the results of the survey and discussions made in Kenya with the persons concerned.

I sincerely hope that this report will contribute to the progress of the project in future and promote friendly relations between Kenya and Japan.

Finally, I would like to express my deep gratitude to all the people who participated in this study and to the Government of Kenya for helpful cooperation extended to the team.

November, 1977

Shinsaku Hogen



President

Japan International Cooperation Agency



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SECTION 1 SUMMARY

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1. Scope of Work

1-1 Purpose of Study

Broadcasting service in the Republic of Kenya is presented by the VOK (Voice of Kenya) which belongs to the Ministry of Information and Broadcasting. Radio broadcasting service in the country is made by medium waves mainly over the southern densely-populated regions, covering about 50% in population and about 20% in area.

Most of the broadcast facilities in use have been already superannuated and awaiting for renewal.

The Government of Kenya has been making a plan for the expansion of its national broadcasting networks as a part of its national development programme. This plan is such a huge-scale plan that will cover the entire land of the country by 34 stations of radio and television broadcasting services. The Government of Kenya, intending to start with the development of radio broadcasting service as a first step, has requested the Japanese Government for cooperation in the construction of 20 radio broadcasting stations in Phase I. In this plan, a VHF /FM radio network will be established instead of medium-wave radio network in consideration of frequency allocation and programme transmission in Kenya.

By the request of the Government of Kenya, the Japanese survey team conducted survey activities in Kenya for a period of 39 days from March 10 1977 for the purpose of feasibility study of this plan for offering technical cooperation to the country.

This study report is prepared in order to contribute to the implementation of the plan by clarifying necessary technical and economic conditions for the FM Broadcasting Network Expansion Project.

1-2 Background

The Japanese technical cooperation toward the Government of Kenya in the field of broadcasting was initiated by the technical discussion made with VOK staff by the preliminary survey team of

three members headed by Mr. Tateno who visited Kenya for a period of 22 days from May 9 to 22 in 1974 in answer to the request of the Government of Kenya for the study of the plan issued by the Government of Kenya in October 1973 on the basis of the so-called Swedish Report (SYSTEMS SURVEY FOR BROADCASTING AND INFORMATION NETWORK).

The governments of Kenya and Japan discussed the plan afterwards. Meanwhile, the Government of Kenya notified the Japanese government of its intention of changing the TV project in the plan (TELEVISION NETWORK EXPANSION PROJECT) prepared in March 1976 to a radio network expansion project (RADIO VHF/FM NETWORK EXPANSION PROJECT) in August 1976. The Japanese government accepted his change and determined to send a study team for studying the feasibility of the project.

1-3 Principles of Study

The study consists of site survey in Kenya and later analysis and report making in Japan.

1-3-1 Site Survey

(1) Survey for location of stations

1) Site survey was conducted at the following 20 locations:

LIMURU, KITUI, EMBU, MERU, NYERI, WAMBA, NAKURU, TIMBOROA, KAKAMEGA, KAPENGURIA, KISII, MBWA HILL, KIBWEZI, VOI, MAZERAS, MALINDI, LAMU, GARISSA, MADO GASI, and GALOLE.

2) Survey items

- a) Topographical conditions of locations expected to be transmitting points and their surroundings
- b) Scales of transmission
- c) Frequency allocation
- d) Programme transmission
- e) Transmitting facilities
- f) Requirements for construction of transmitting stations

(2) The following items were examined mainly in NAIROBI.

- 1) Laws and regulations, organization and management
- 2) Programme planning
- 3) Planning for popularization
- 4) Personnel planning
- 5) Economic evaluation

1-3-2 Analysis and Report Making in Japan

After completion of survey in Kenya, the study team field and analyzed in Japan technical data, references, and other types of information acquired in Kenya and prepared a report covering mainly the following items.

- (1) FM broadcasting network expansion project
- (2) Installation procedure, construction expenses and operating expenses
- (3) Broadcasting laws and regulations, programme planning, popularization planning, personnel planning, and economic evaluation

1-4 Survey Team

Head	Masao Shiga from Ministry of Posts and Telecommunications (General Management)
Member	Takashi Sugiura from Ministry of Posts and Telecommunications (Station Location Planning)
Member	Shoji Takami from Ministry of Posts and Telecommunications (Frequency Allocation)
Member	Yukio Kato from Ministry of Posts and Telecommunications (Broadcasting Laws and Regulations)
Member	Tomiyasu Suenaga from NHK (Japan Broadcasting Corporation) (Broadcasting Equipment)
Member	Yoshio Katsurayama formerly NHK staff (Broadcasting Equipment)
Member	Kaoru Oka from NHK (Japan Broadcasting Corporation) (Broadcasting Facilities Planning)

- Member Toshihiko Kusaba from The Overseas Economic
Cooperation Funds (Economic Evaluation)
- Member Hiroshi Tsukada (Akio Ito) from Japan International
Cooperation Agency (General Coordination)

1-5 Survey Schedule

March 11 ~ 18, 1977:

- Visit to the Ministry of Information and Broadcasting, the
Ministry of Finance and Planning, and Embassy of Japan for
salutation
- Meeting with the VOK on survey schedule and collaboration

March 19 ~ 23:

- Site survey at NAKURU, TIMBOROA, KAKAMEGA, and KISII

March 24 ~ 28:

- Site survey at KITUI, EMBU, MERU, and NYERI
- Meeting with the VOK

March 29 ~ April 2:

- Site survey at MBWA HILL, KIBWEZI, MALINDI, and MAZERAS

April 4 ~ 7:

- Site survey by a chartered plane at WAMBA, GARISSA, MADO GASHI,
GALDLE, LAMU and KAPENGURIA

April 8 ~ 13:

- Preparation of interim report
- Meeting with the VOK

April 14:

- Submission of interim report to the MIB

April 15:

- Left Kenya for Japan

2. Recommendations

By summarizing the results of the survey in Kenya and later analysis in Japan, the study team has prepared the "FM Broadcasting Network Expansion Project" as titled in the following section in this report. This paragraph outlines the concept of the study and major problems to be discussed for the implementation of the project.

2-1 Coverage

Construction of the 20 stations where survey was conducted will allow covering about 90% of the total population of Kenya and about 40% of the entire area of the country. In consideration of the population distribution, it may be said, at least as far as radio broadcasting is concerned, that the whole country of Kenya will be covered excluding the northern area with the center being MARSABIT.

2-2 Programme Transmission

Transmission of the "NATIONAL" and "GENERAL" programme from the NAIROBI Studio to the respective transmitting stations should be conducted as follows in consideration of quality degradation due to transmission and convenience of maintenance and management. Transmission to MAZERS and GARISSA should be made by utilizing the multiplex system belonging to the East African Posts & Telecommunication Corporation (hereinafter referred to as EAPT), although a link in GARISSA should be constructed for transmission from the EAPT terminal station to the transmitting station. LIMURU and these two stations will be made as the key stations and programmes will be retransmitted to other stations. When the EAPT links are used, the bandwidth should be made as wide as 10kHz ~ 15kHz for high-quality transmission.

2-3 Station Sites

Planning is made on the basis of such station sites that seem to be most suitable among those sites surveyed in the limited period of time. In some cases, however, it may be necessary, for final decision, to conduct more detailed survey. For instance,

MBWAHLL, KIBWEZI, VOI, and WAMBA are planned to become unattended stations in consideration of the topographical conditions of these sites, but if it is desired that they should be attended stations, it will be necessary to survey different sites. Propagation test should be performed between LAMU and MALINDI. Likewise, detailed examination should be conducted for VOI Station by fixing an oscillator at TAITA.

2-4 Frequency Plan

Two FM broadcast frequencies to be allocated to each station are selected in an 87.5 ~ 100MHz range on the basis of the "Regional Agreement For The African Broadcasting Area." However, in executing the project it is necessary to take the procedure, in advance, to IFRB for partial change of the frequency allocation plan specified in the Annex of the Agreement. It is also necessary to transfer or remove frequencies which are included in or near the allocation plan and which are used at present for purposes other than broadcast use should be restored, in advance, to their proper frequency bands where they should be allocated.

2-5 Stereo Broadcasting

Although the project is intended for monaural broadcasting, due consideration is given to allow stereo broadcasting in future by expansion of required equipment.

2-6 Use of Station Buildings and Towers in Common for FM and Television

Station buildings and steel towers/masts of as many transmitting stations as possible are designed to facilitate modification for their future use in common for both FM and television broadcasting.

2-7 Schedule and Required Expenses for Construction

About 3 years will be required for completing this project: one year for closing the contract and two years for construction. However, this is a standard schedule and it is very important to

effect smooth, efficient progress in fund raising, preparation of the project schedule, preparation of tender specifications, assessment of proposals, following contract procedures, etc. Especially, the time of the completion of building construction will give a large influence to the entire term of work.

The expected construction expense is about 5828 million yen as quoted in Section 2, Paragraph 3.

2-8 Programme Plan

The expected average broadcasting time per day is 17 hours in the case of the "NATIONAL" service and 12.5 hours in the case of the "GENERAL" service. These figures may be satisfactory ones when compared with examples of various countries in the world.

However, as far as broadcast programmes are concerned, quantitative development must be followed by qualitative development. In advancing the present project, the qualitative development of broadcast programmes is one of the most important themes. For this purpose, the following measures should be taken.

- (1) Establishment of broadcast programme council
- (2) Establishment of broadcast programme investigation organization
- (3) Production of programmes by utilization of the characteristics of FM broadcasting

2-9 Popularization Plan

In order to achieve the spread of FM receivers, the following should be considered in addition to the qualitative development mentioned in the foregoing item.

- (1) Distribution of receivers to public institutions
- (2) Procurement of low-cost receivers and their standardization
- (3) Strengthening of servicing such as repair of receivers

2-10 Training Plan

A number of competent personnel will be required in the

fields of programme production, engineering, administrative management in order to synthetically develop and manage broadcasting services including the FM service to be established by this project. For this purpose, it is necessary to make a long-term personnel plan, adopt a proper employment plan, advance positive personnel training, and effect proper personnel management.

A concrete measure for achieving personnel training necessary for the execution of the FM broadcast expansion project may be the expansion of the KIMC.

SECTION 2 DETAILED DESCRIPTION

SECTION 2 DETAILED DESCRIPTION

1. Planning for Location of Stations

1-1 Principles of Planning for Location of Stations

Planning for the location of stations is made on the basis of the following principles for the suitability of station sites for FM broadcasting stations, transmitting conditions which determine the service areas required in the regions, and the methods of programme transmission to respective stations.

1-1-1 Station Sites

The proposed site for each transmitting station has been selected through site survey and study while taking due consideration for the following.

- (1) The area to be covered should be open to the eye.
For this purpose, a mountain or hill having a considerable height should be selected as much as possible.
- (2) The transmitting station should be so located as is suitable for sending high-quality programmes to the next stations by off-air relay.
- (3) When the transmitting station is constructed near an airport, it is necessary to observe obstruction laws and regulations and to give no loss to human life and property.
- (4) As much advantageous location for the utilization of the main power, and transportation should be selected to ensure economy and efficiency.
- (5) Site selection should be made with due consideration for the convenience of operation and maintenance of broadcasting facilities and for the living conditions of operating and maintenance personnel.
- (6) The station site should desirably not be near any existing radio station.

1-1-2 Transmitting Conditions

(1) Scale of transmission

The scale of transmission, which depends on the output power of the transmitter and the type, configuration, gain, and height of the aerial, is determined by the service area to be covered.

The scale of transmission is planned in consideration of the following.

- 1) The service area to be covered should be proper in consideration of future expansion of population distribution.
- 2) Overlapping of service areas with adjacent ones should as much be avoided.
- 3) A low-power transmitter should be used by using a high-gain aerial, etc., thus for achieving high-efficiency operation and maintenance.
- 4) Since the height of the steel tower/mast gives a large influence to the construction budget, minimized height of the tower should be selected in consideration of the required service area, transmitting output power, and off-air relay.

(2) Service area

A standard of required field strength of the received FM broadcast signal is set and the area where the field strength exceeds the standard is determined to be the service area.

1) Required field strength

In the presence of interference			In the absence of interference
In rural areas	In urban areas	In large cities	
48 dB μ	60 dB μ	70 dB μ	34 dB μ

Note: The above applies to the case of monophonic broadcasting with the height of the receiving aerial being 10 meters.

The standard of required field strength is given by ITU's "Regional Agreement for The African Broadcasting Area (1963, Geneva)." In applying this table to Kenya, the standard value of the required field strength in the service area is made 48dB μ since the cities in Kenya are not so large excluding NAIROBI and the population is rather sparse in the fringe area of each service area.

2) Field strength estimation

In estimating each service area, the field strength curve (Fig. 1-1) specified in the above-mentioned "Regional Agreement For The African Broadcasting Area" is employed as the standard for field strength calculation, and compensation is effected through the observation of topographical conditions on the maps of 1/50,000 and 1/250,000 and by experience.

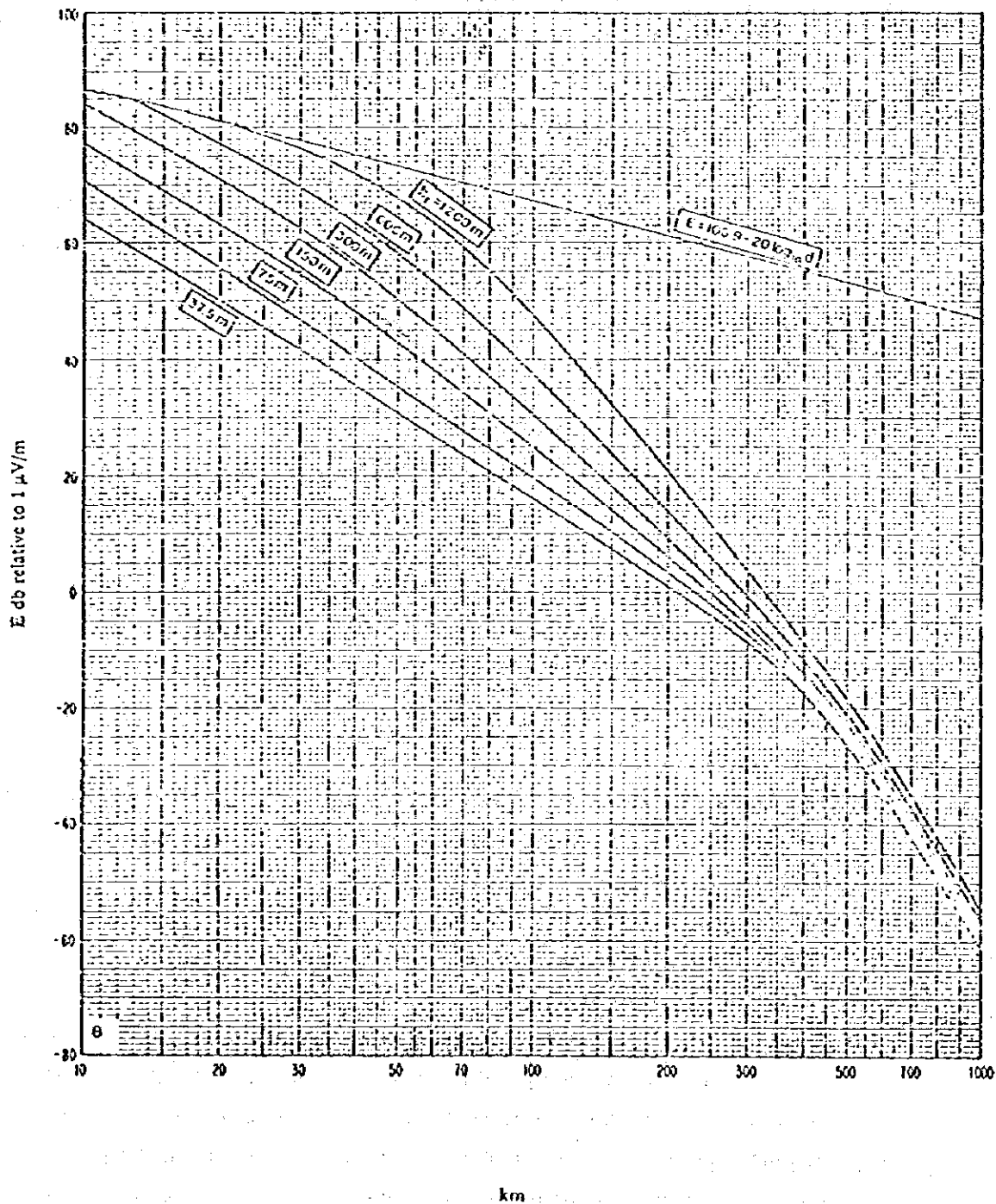
1-1-3 Programme Transmission Systems

FM broadcasting by VHF is advantageous in presenting high-quality broadcasting service.

Programme transmission to the respective stations is planned as follows with due consideration for securing this advantage and from the standpoint of planning for the location of station sites as well.

- (1) When high-quality programme transmission is achievable, the off-air relay is adopted in principle.
- (2) The number of hops in an off-air relay link is limited to 3 or 4 at the maximum in consideration of the prevention of transmission quality degradation and, also, convenience of operation and maintenance.
- (3) Station sites are located so as to minimize distortion due to multi-pass propagation.
- (4) Each span between stations is designed with sufficient margin against interference by abnormal propagation of VHF signals. In addition to these principles, such a requirement that the signal-to-noise ratio of the demodulator output shall be 60dB for establishing a high-quality off-air relay system is met.

Fig. 1-1 Field Strength Curves



1-2 Survey for Location of Stations

The survey team conducted site survey on the basis of the principles for the selection of station sites which are mentioned in the foregoing item 1-1 and, at the same time, the field strengths of the TV and FM broadcast signals received for the time being were measured. This survey was conducted in order to grasp the propagation characteristic of the VHF band for estimating the service areas of the proposed stations and determining whether the off-air relay is suitable or not.

1-3 Planning for Location of Stations

1-3-1 General

The results of the study made on the basis of data obtained by the site survey are as follows.

(1) Station Sites

The details of the proposed locations of the respective stations are shown in the Table 1-1.

(2) Transmitting Conditions

The scale of transmission is determined by setting major service areas for the respective transmitting stations in consideration of the population density of the surroundings. For details of the scale of transmission of each station, see Table 1-2.

Service areas in which the required field strength (48dB μ) is obtained when broadcasting is performed at the respective stations on the basis of the scales of transmission given in the table are shown in Fig. 1-2.

The total area to be covered by the FM broadcasting when this project is implemented is estimated to be about 40% of the land and the population to be covered in the broadcasting areas is estimated to be about 90%. In addition, since interference due to noise is estimated to be small over considerable wide areas outside the service areas, sufficiently good reception will be available by ordinary FM receivers.

Table 1-1 Plan for Location of Stations

Station	Location		Altitude (meters)	Remarks
	Longitude	Latitude		
Limuru	36°38'55"E	1°09'05"S	2257	In existing FM and TV station
Nakuru	36°04'40"E	0°15'10"S	2190	
Timboroa	35°31'15"E	0°02'50"N	2892	In existing TV station
Kapenguria	35°11'40"E	1°15'55"N	2546	
Kakamega	35°43'55"E	0°16'25"N	1560	
Kisii	34°47'20"E	0°42'40"S	1996	
Mitui	38°01'35"E	1°11'30"S	1642	
Embu	37°38'00"E	0°40'50"S	1551	
Meru	37°52'30"	0°14'05"N	2515	
Nyeri	36°54'25"	0°24'35"S	1551	In existing TV station
Wamba	37°21'10"E	0°56'30"N	1739	
Mbwa Hill	37°12'40"E	1°50'15"S	1786	
Kibwezi	37°55'00"E	2°20'40"S	1390	
Voi	38°33'00"E	3°21'40"S	929	
Garissa	39°43'15"E	0°22'50"S	229	
Mado Gashi	39°11'50"E	0°39'00"S	305	
Galole	39°59'45"E	1°30'30"S	66	
Mazeras	39°32'10"E	3°58'15"S	167	In existing TV station
Malindi	40°3'30"E	3°03'40"S	170	
Lamu	40°54'20"E	2°17'30"S	56	

(3) Programme Transmission

The programme transmission system for use from the studio in NAIROBI to each transmitting station and the relay network are shown in Fig. 1-3. The required field strength for obtaining the signal-to-noise ratio of 60dB at the demodulator output of the receiver for off-air relay use (in the case of monaural broadcasting) is more than 20.4dB. This value is a standard one obtained with ordinary receivers for off-air relay use.

Example

Received frequency:	100MHz
Receiving antenna gain:	9dB
Feeder and filter loss:	5dB
Noise figure of receiver:	6dB
Space noise temperature:	1500°K

The estimated field strengths to be obtained by the implementation of this project are given in Table 1-3.

Table 1-2 Scales of Transmission

Station	TX Power (kW)	Antenna					ERP (kW)	Average Height (meter)	Scale of Transmission $h\sqrt{ERP}$ (dB)
		Mast Height (meter)	Panels x Stacks	Directivity	Power Distribution Ratio	Gain (dB)			
LIMURU	10	150	4 x 3	ND	1:1:1:1	6.0	40.0	790	104.0
NAKURU	1	120	4 x 2	0°, 90° 180°, 270°	3:3:3:1	4.5	2.8	450	87.5D
TIMBOROA	10	100	4 x 2	0°, 90° 180°, 270°	4:1:4:1	5.8	38.0	850	104.4D
KAPENGURIA	1	50	4 x 2	0°, 90° 180°, 270°	3:3:3:1	4.5	2.8	600	90.1D
KAKAMEGA	1	100	4 x 2	ND	1:1:1:1	4.3	2.7	290	83.5
KISII	10	100	4 x 2	0°, 90° 180°, 270°	1:4:4:1	5.8	38.0	500	99.8D
KITUI	1	50	4 x 2	0°, 90° 180°, 270°	1:1:3:3	5.5	3.5	470	88.9D
EMBU	1	50	4 x 1	ND	1:1:1:1	1.5	1.4	250	79.5
MERU	1	75	4 x 1	ND	1:1:1:1	1.5	1.4	1000	91.5
NYERI	1	50	2 x 1	35°, 145°	1:1	4.5	2.8	500	88.5D

(Continued)

Station	TX Power (kW)	Antenna					ERP (kW)	Average Height (meter)	Scale of Transmission h / GP (dB)
		Mast Height (meter)	Panel x Stacks	Directivity	Power Distribution Ratio	Gain (dB)			
WAMBA	1	50	4 x 1	ND	1:1:1:1	1.5	410	83.7	
MBWA HILL	1	100	2 x 1	80°, 170°	1:1	4.5	660	90.9D	
KIBWEZI	1	100	1 x 1	147°	—	7.5	580	92.7D	
VOI	1	150	2 x 1	180°, 27°	1:1	4.5	500	88.5D	
GARISSA	10	150	2 x 1	160°, 310°	1:1	4.5	220	91.4D	
MADO GASHU	3	150	1 x 1	38°	—	7.5	150	85.8D	
GALOLE	1	150	2 x 1	165°, 345°	2:1	5.2	150	78.8D	
MAZERAS	10	150	3 x 1	32°, 212° 302°	1:1:1	2.7	320	92.9D	
MALINDI	10	150	2 x 1	47°, 168°	1:1	4.5	320	94.6D	
LAMU	1	150	2 x 1	0°, 270°	1:1	4.5	210	80.9D	

Legend: "ND" in the "Directionality" column denotes nondirection.

Table 1-3 Estimated Field Strengths at Respective Stations

Station	Master Station	Distance (km)	Estimated Receiving Field Strength (dB μ /m) (Receiving antenna height: 10m)	Remarks
NAKURU	LIMURU	118	62	
TIMBOROA	NAKURU	69	74	
KAPENGURIA	TIMBOROA	139	79	
KAKAMEGA	TIMBOROA	92	82	
KISII	TIMBOROA	117	80	
KITUI	LIMURU	154	75	
EMBU	LIMURU	119	79	
MERU	EMBU	105	66	
NYERI	LIMURU	86	59	
WAMBA	MERU	97	67	
WAMBA HILL	LIMURU	99	81	
KIBWEZI	WAMBA HILL	95	70	
VOI	MAZERAS	124	55	
MADO GASHI	GARISSA	127	33	
GALOLE	GARISSA	128	33	
MALINDI	MAZERAS	116	47	
LAMU	MALINDI	126	36	

Fig. 1-2 Service Area of FM Broadcasting

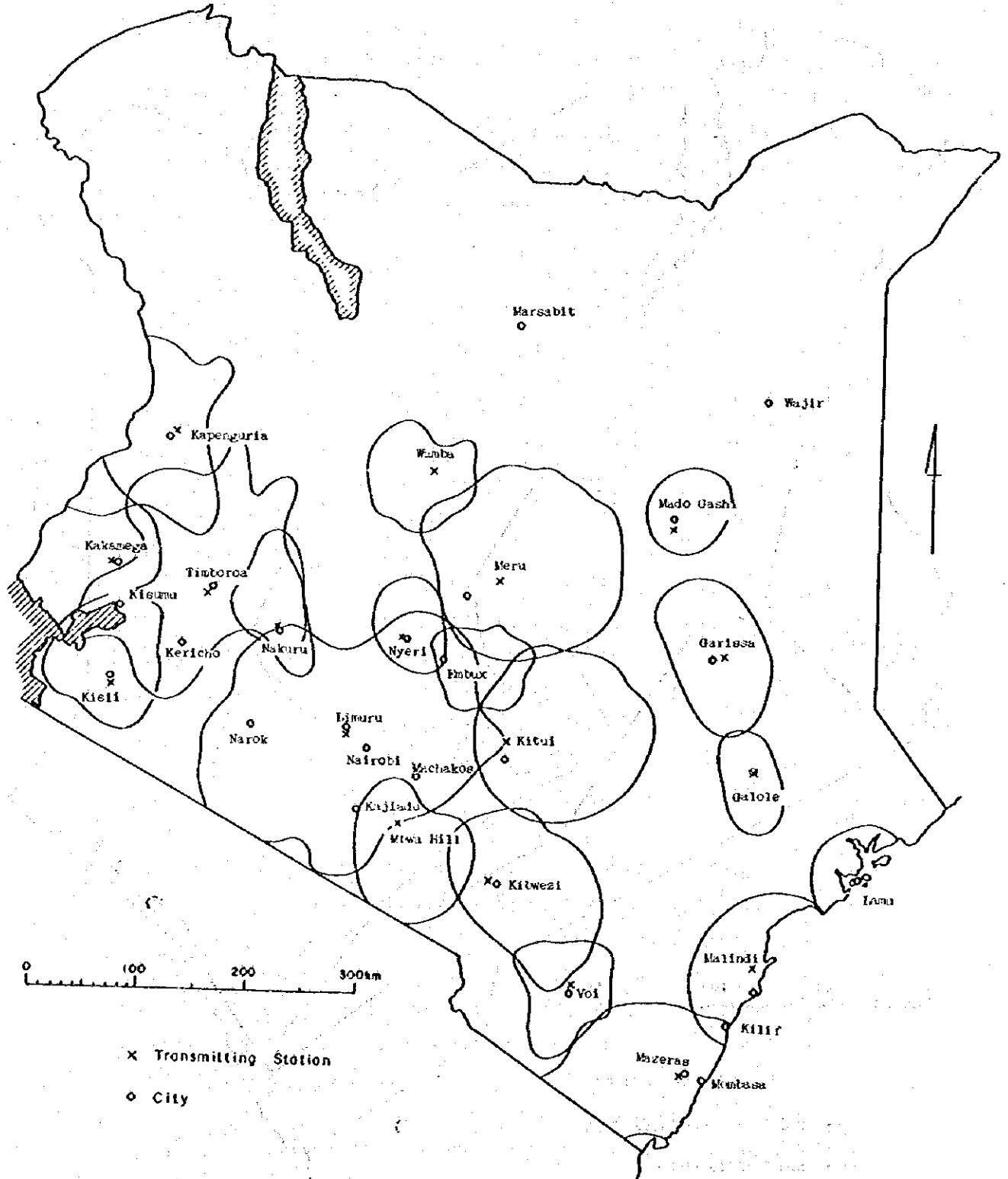
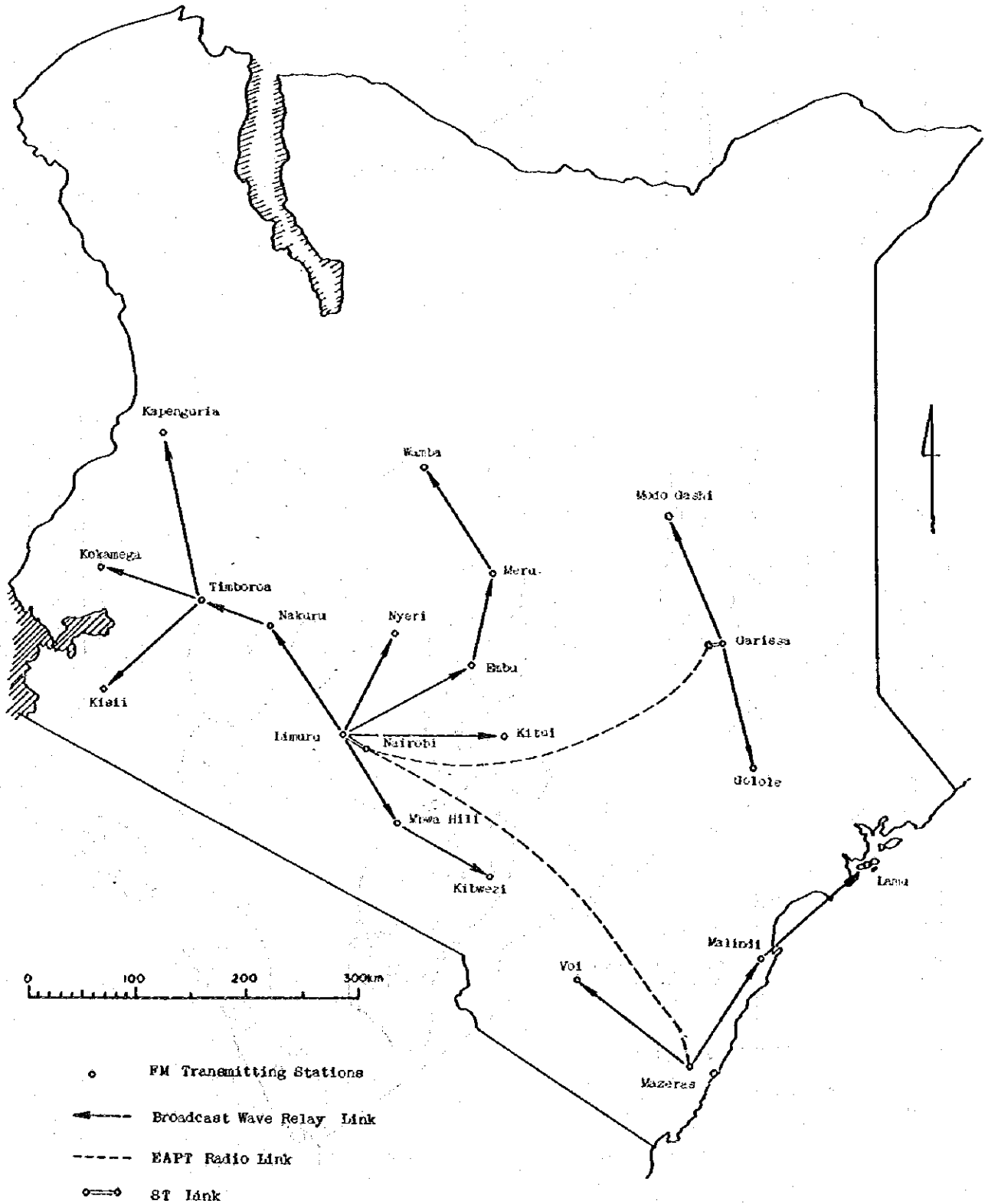


Fig. 1-3 System Diagram of FM Radio Programme Transmission Networks



2. Frequency Plan

2-1 Relationship with Frequency Assignment Plans Specified in the "Regional Agreement For The African Broadcasting Area (1963)"

In regard to VHF frequencies intended for sound broadcasting, the "Regional Agreement For The African Broadcasting Area Concerning the Use of Frequencies by the Broadcasting Service in the Very High Frequency and Ultra High Frequency Bands" has assigned frequencies of the 87.5~100MHz range in Band II to FM broadcasting. Furthermore, Section 5 in Annex III of the Agreement sets out that the frequency range contains a total of 144 channels assigned at intervals of 86kHz from Channel 1 (87.604MHz) through Channel 144 (99.902MHz).

In addition, Section 2 in Annex II of the Agreement sets out the frequency assignment plans for the respective broadcasting stations in the respective African countries for the respective channels. In the case of Kenya, 56 different frequencies are assigned to a total of 60 broadcasting stations that the country planned when the Agreement was signed.

Accordingly, among 20 stations of Phase I (in terms of frequency assignment plan, they are 40 stations because each station requires 2 frequencies for national service and general service), those stations which are listed up in the 87.5~100MHz₂ Band FM Broadcasting Frequency Assignment Plan of Section 2 in Annex II of the Agreement (including those specified by longitude and latitude) should be assigned the same frequencies that the Plan assigned to the respective stations unless particular reasons exist.

Of the 20 stations to be covered in Phase I, those stations not specified in the frequency assignment plans will enter into the prepared operation of new stations specified in Article 3 of the Agreement. Frequency selection for these new stations should be made from among frequencies assigned to Kenya in the frequency assignment plans in consideration of stations in the neighboring countries for preventing interference to and from being caused or for achieving smooth coordination with other countries which signed the Agreement through I.F.R.B. on the basis of Article 3 of the Agreement.

2-2 Technical Standards for Frequency Selection

In the present FM broadcasting network expansion project, a broadcasting station for the "NATIONAL" service and that for the "GENERAL" service will be constructed in the same place in each station site.

In each station site one transmitting antenna will, in principle, be used in common for both broadcasting stations, which is technically available and advantageous from the economical standpoint.

Seventeen stations with the exception of three key stations, that is, LIMURU Station to which programme transmission will be made by using the existing 7GHz radio circuit of the VOK and MAZERAS and GARISSA Stations to which programme transmission will be made by using the EAPT radio link, should consist of an off-air relay system which receives the programme signal emitted from the key station and rebroadcast or re-rebroadcast to the next station by only converting the carrier frequency.

Frequency assignment to the respective broadcasting stations mentioned in item 2-1 should be effected on the basis of the following technical standards as well as on the basis of the above-mentioned two fundamentals.

- 2-2-1 The frequency difference between two broadcasting stations to be constructed in the same station site shall be set in a 1MHz ~4MHz range so as to ensure the wideband transmission characteristics of the transmitting aeriels and maintain the VSWR to be less than 1.06 and, also, so as to facilitate frequency discrimination for the two stations upon reception in one broadcasting area.
- 2-2-2 The frequency difference between the transmitting frequency of the station concerned and the transmitting frequency from the master station (or receiving frequency of the station concerned), although it varies with the magnitude of the field strength of the signal received at the station concerned from the master station, shall be set at more than 800kHz in the present project in consideration of ease of the design of the RF filter to be

used for the separation of the transmitting and receiving frequency at the station concerned and from the economical standpoint.

2-2-3 As much low frequencies should be assigned to LIMURU, MAZERAS, and GARISSA Stations, which will be key stations in off-air relay system, for the purpose of maintaining necessary service area with a given output power and minimizing the propagation loss to the slave broadcasting station.

2-2-4 When assigning a frequency, which is assigned to a Kenyan station in the frequency assignment plans, to a station not specified in the frequency assignment plans, that frequency should be assigned to an inland station located far away from borders with the neighboring countries so as to prevent interference with stations in the neighboring countries or should be assigned to a station geographically adjacent to the station to which that frequency is assigned in the frequency assignment plans.

Frequency selection should be made with due consideration for the above-mentioned four items and for the minimization of change of frequency in the frequency assignment plans.

2-3 Proposed Frequency Plan

Frequency selection for the 20 stations (or 40 frequencies) of the FM broadcasting network expansion project should desirably be made as follows on the technical standards mentioned in item 2-2.

(1) LIMURU Station:	87.690MHz and 89.066MHz
(2) NAKURU Station:	98.354MHz and 99.730MHz
(3) TIMBOROA Station:	88.636MHz and 90.442MHz
(4) KAKAMEGA Station:	95.516MHz and 99.472MHz
(5) KISII Station:	91.990MHz and 93.968MHz
(6) KAPENGURIA Station:	95.344MHz and 97.752MHz
(7) MBWA HILL Station:	94.828MHz and 98.784MHz
(8) KIBWEZI Station:	90.872MHz and 93.022MHz
(9) NYERI Station:	96.462MHz and 97.580MHz
(10) KITUI Station:	96.806MHz and 99.214MHz
(11) EMBU Station:	93.452MHz and 95.774MHz
(12) MEBU Station:	90.270MHz and 92.076MHz

(13) WAMBA Station:	94.226MHz and 98.182MHz
(14) MAZERAS Station:	90.356MHz and 94.312MHz
(15) VOI Station:	96.462MHz and 97.838MHz
(16) MALINDI Station:	92.506MHz and 95.688MHz
(17) LAMU Station:	87.862MHz and 89.410MHz
(18) GARISSA Station:	88.206MHz and 89.840MHz
(19) GALOLE Station:	94.914MHz and 96.978MHz
(20) MADOGASI Station:	92.334MHz and 95.258MHz

Fig. 2-1 shows a system diagram of the off-air relay system for the 20 stations to be constructed in Phase I of the FM broadcasting network expansion project and frequencies to be assigned to these stations.

2-4 Existing VHF/FM Communication Frequencies in 87.5~100MHz Range

At present, the VOK uses, for VHF/FM communication and VHF/FM high quality programme circuit, about 12 frequencies which are integral multiples of 100kHz in the 87.5~100MHz range and are allocated to sound broadcasting service in the VHF band.

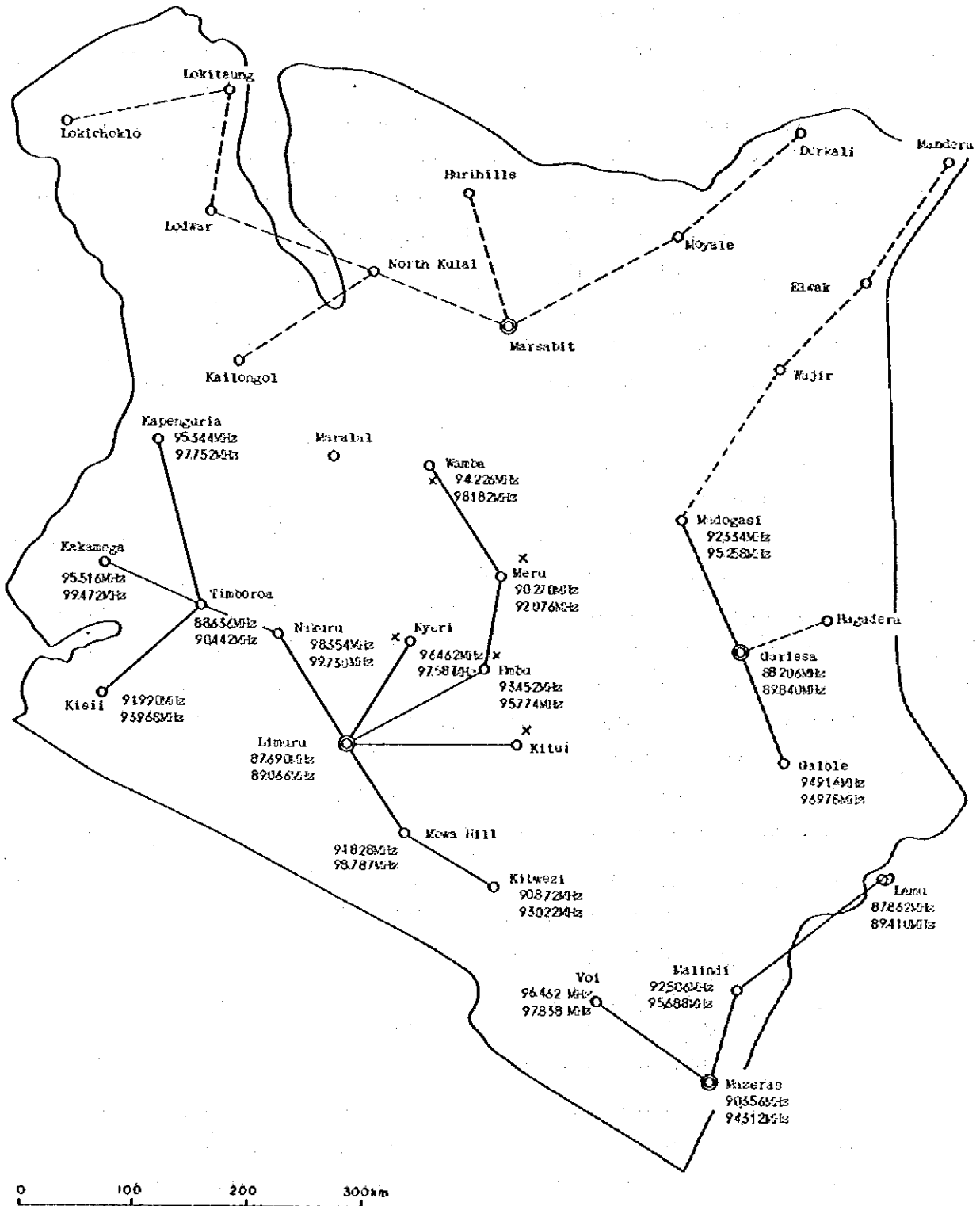
It may be said that all these frequencies are used for fixed or mobile service for their purposes.

According to the frequency allocation table in Article 5 of the Radio Regulations annexed to the International Telecommunication Convention, the 87.5~100MHz range is allocated to broadcasting service and is not suitable for such use as for fixed or mobile service. In addition, the following hindrance may be caused in assigning frequencies specified in the frequency assignment plans to 20 Kenyan stations to be constructed in Phase I of the FM broadcasting network expansion project.

2-4-1 In the case of TIMBOROA Station, the frequency assignment plans assign 88.636MHz to this station and the proposed frequency plan also sets out the use of 88.636MHz for one of the two frequencies.

However, 88.7MHz and 87.7MHz are used for the existing TIMBOROA-NANDI HILLS high-quality FM programme transmission system and

Fig. 2-1 Frequency Plan (Proposed)



the frequency separations from the 88.636MHz frequency for broadcasting use are only 0.064MHz and 0.936MHz respectively, so that compatibility with the broadcasting services (especially with the former frequency) will not be achieved.

Likewise, the 98.2MHz frequency used for the programme transmission from NANDI HILLS to TIMBOROA is separated 154kHz from 98.354MHz frequency intended for use for broadcasting from NAKURU Station. Even if the occupied bandwidth of the broadcasting service is 180kHz, it may be said, in consideration of the passband characteristic of the receiver for off-air relay broadcasting and the occupied bandwidth of the frequency for FM communication from NANDI HILLS to TIMBOROA, that hindrance may be caused to the reception of the broadcast wave from NAKURU Station. The frequency used for programme transmission and broadcast frequencies are given in Fig. 2-2.

2-4-2 In the case of LIMURU Station we can select 87.690MHz and 89.066MHz as the lowest two frequencies in the 8 frequencies assigned to LIMURU Station (NAIROBI) in the frequency assignment plan on the basis of the technical standards for frequency selection. By this, however, hindrance will be caused to the 89.5MHz, 89.7MHz and 89.9MHz frequencies used at present between BROADCAST HOUSE and LANGATA in the high-quality FM programme transmission system used by the VOK and to the 88.2MHz, 88.55MHz, and 88.7MHz frequencies intended for outside relay use.

That is, each frequency separation will be less than 900kHz as follows, giving hindrance to the reception of broadcast signals.

$$88.2\text{MHz} - 87.690\text{MHz} = 0.510\text{MHz}$$

$$89.066\text{MHz} - 88.55\text{MHz} = 0.516\text{MHz}$$

$$89.066\text{MHz} - 88.7\text{MHz} = 0.266\text{MHz}$$

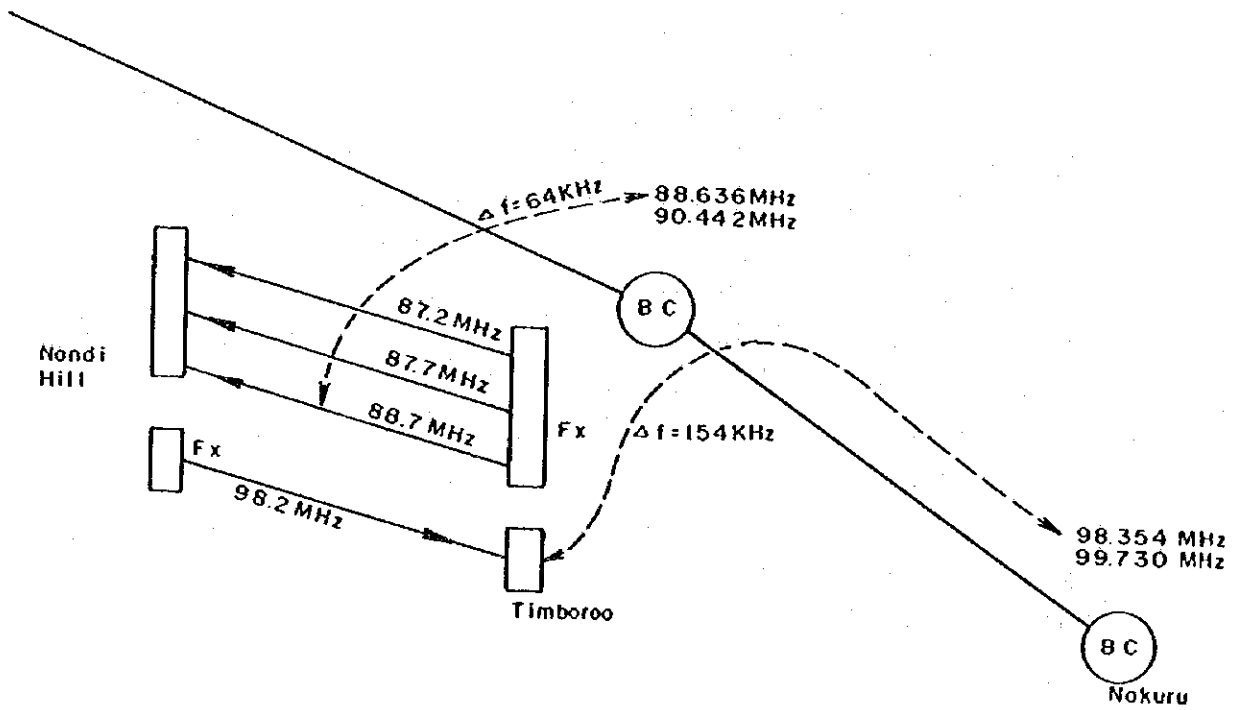
$$89.066\text{MHz} - 89.5\text{MHz} = 0.434\text{MHz}$$

$$89.066\text{MHz} - 89.7\text{MHz} = 0.634\text{MHz}$$

$$89.066\text{MHz} - 89.9\text{MHz} = 0.834\text{MHz}$$

It may be necessary that such hindrance that may be caused upon receiving broadcast waves should be prevented and that the frequencies used for the fixed or mobile service should be shifted into a frequency band allocated to the fixed or mobile service

Fig. 2-2 Frequencies for Programme Transmission and Broadcast Frequencies



adjacent to the frequencies used at present, for example, a 75.2 ~ 87.5MHz range, before the FM broadcasting network is completed so as to meet the frequency allocation table in the Radio Regulation.

2-5 Procedure for Change to Frequency Assignment Plans Specified in Annex II of the "Regional Agreement For The African Broadcasting Area 1963"

Of the 20 stations (40 frequencies) to be constructed in Phase I of the FM Broadcasting Expansion Network, the following nine stations are identical to those specified in the frequency assignment plans: LIMURU (NAIROBI), NAKURU, NYERI, TIMBOROA, KISII, MERU, MAZERAS (MOMBASA), MALINDI, and LAMU.

Other eleven stations (22 frequencies) are not covered in the frequency assignment plans and are "new" stations as mentioned in the Agreement. Thus, it is necessary that the radio administration of Kenya should initiate necessary procedure for the operation of new stations to the I.F.R.B.

Strictly speaking, necessary procedure should also be taken to the I.F.R.B. for the change in the characteristics of the stations specified in the frequency assignment plans since the frequencies of these stations specified may be assigned to other stations not specified in the frequency assignment plans.

3. Planning of Facilities

3-1 Equipment

3-1-1 Transmitters

The technique of solid state circuitry in FM broadcast transmitters has been advanced greatly and all solid state transmitters are achievable in output powers of up to about 1kW. In case of transmitters of higher output power, an electron tube is employed but only in the final power amplifier.

Transmitters of three different output powers are proposed through the present study and in consideration of ease of maintenance: 10kW, 3kW, and 1kW transmitters. Accordingly, the 1kW transmitters are of all solid state type, and 3kW and 10kW transmitters are of semi-solid state type using electron tubes only in their final output power amplifiers.

For the purposes of convenience of maintenance and economy, the antenna gain is raised as far as practicable and the transmitter output power is minimized.

In the case of a 10kW output power, the use of two 5kW transmitters in parallel running is not greatly different in price from the use of one 10kW main transmitter and one 10kW stand-by transmitter. In addition, the power lowers to 2.5kW in case one of the two 5kW transmitters in parallel running fails, which is particularly undesirable in the case of an off-air relay network. Thus, two main transmitters and two stand-by transmitters are proposed for each two programmes to be transmitted from each of the 20 stations.

Switch over from the main to stand-by transmitter is automatized in consideration of ease of maintenance and the adoption of unattended operation when desired. Start and stop of operation can also be automatized by the adoption of a clock timer or squelch unit. Cooling of the equipment may be achieved by either forced or unforced cooling. In high-temperature, high-humidity districts or deserts where ambient conditions are rather severe, due consideration should be taken for proper airconditioning in the design of station buildings.

In this project air conditioners are provided for the stations where the attitudes are lower than 1000 m A.S.L.

The transmitters provide performance which meet CCIR Recommendations for monophonic broadcasting and can readily provide stereo broadcasting performance in future by adding required equipment for stereo broadcasting. Thus there is no problem for future stereo broadcasting.

3-1-2 Power Facilities

In principle, main power will be used and power from an engine generator will be used when it is difficult to obtain the main. In addition, a stand-by engine generator should be provided against failure of the main power.

The capacity of the engine generator for each transmitter output power is given below.

<u>Transmitter output power</u>	<u>Capacity of engine generator for the station</u>
1 kW	20 KVA
3 kW	50 KVA
10 kW	130 KVA

3-1-3 Transmitting Aerials

High-gain, wideband aerials are necessary for this project. For this purpose, twin-loop aerials having particularly wideband characteristics are proposed.

The gain of a twin-loop aerial is 7.5dB per stage, 10.3dB per 2 stages, and 12dB per 3 stages.

3-2 Schedule for Construction Work

In planning the time schedule for construction work, the following have been taken into consideration.

(1) The total term of construction work is made about 3 years: the first year for civil work and building construction and the 2nd and 3rd years for equipment installation and others.

(2) Rainy season

The proposed time schedule for construction work is shown in Table 3-1. This schedule is prepared on the basis of the following conditions.

- (1) The contract for civil work and building construction should be made prior to that for broadcast equipment since civil work and building construction must be completed before equipment installation starts.
- (2) Planning for civil work and that for building construction after making the contract are to be completed by 3 and 6 months, respectively.
- (3) For civil work and building construction, about 3 months is assigned to access roads (all weather roads) and site construction and 10 months to building construction. Since civil work and building construction are to be carried out at two different sites at a time, it will take 10 months for completing the work.
- (4) Main power distribution work will be started upon starting civil work at all sites. The expected term of the main power distribution work is maximum 10 months.
- (5) For equipment manufacture and installation, the expected term for the equipment manufacture is 10 months, that for transportation 3 months, and that for installation 2 months. Installation is to be carried out by three teams.
- (6) Tower foundation work is to precede tower construction work by 4 months.

3-3 Construction Expenses

The total construction expense necessary for this project is 5828 million yen (167 million KS), of which 4592 million yen (131 million KS) will be covered by foreign fund and 1236 million yen (35 million KS) by the local fund as shown in Table 3-2. These construction expenses are estimated on the basis of the following conditions.

- 1) Reckoning of the construction expenses is made for the time of June 1978.

- 2) Price rise during the term of work will be covered by a part of the Contingency.
- 3) Money exchange rates employed in this survey report are as follows.

K.S. 1 = ¥35

The expenses for the respective types of work are as follows.

a) Construction of access roads and buildings:	367 million yen (10.5 million K.S.)
b) Construction of power line:	279.9 million yen (8.0 million K.S.)
c) Equipment & installation:	4060.6 million yen (116.0 million K.S.)
d) Inland transportation & storage:	60 million yen (1.7 million K.S.)
e) Consultant fee:	300 million yen (8.6 million K.S.)
f) Contingency:	760.1 million yen (21.7 million K.S.)

3-3-1 Expenses for Construction of Access Roads and Buildings

The expenses quoted for the construction of access roads and buildings are given in Table 3-3.

The quotation is made on the basis of the following conditions.

- 1) Site areas and floor spaces of buildings are made minimum.
Each site area is calculated by adding an area of a width of 5 meters around the floor space to the floor space.
Expenses for procuring the sites are not quoted.
- 2) The unit cost per kilometer for the construction of access roads is expected to be 2 million yen (Th K.S. 57) in the cases of 3.5-meter-wide roads.
- 3) The expense for leveling of ground is included in the expense for the construction of access roads.

3-3-2 Expense for Construction of Main Power Lines

The expenses for the construction of main power lines or electric work are given in Table 3-4. These expenses are reckoned on the basis of the following conditions.

- 1) When a power line is to be used in common for both TV and FM radio broadcasting services, the expense for a power line of 500 meters is quoted additionally for the FM transmitter output of 10kW and the expense for a power line of 200 meters for the FM transmitter outputs of 2kW and 1kW.
- 2) The unit price of the electric work for the main power is 2 million yen (Th K.S. 57) per kilometer.
- 3) The power capacity of the main power will be 20KVA ~ 60KVA.

3-3-3 Expense for Equipment

The expense for equipment comprises the prices of steel tower or masts, transmitting station equipment, link equipment, engine generators, link system equipment, measuring instruments, spare parts etc., the cost for the installation and adjustment of these items of equipment, and also the cost for training personnel to be engaged in operation and maintenance of equipment.

For programme transmission from NAIROBI Studio to LIMURU Transmitting Station, the existing link will be used. For programme transmission to MAZERAS Transmitting Station, the EAPT system will be used. Thus, only the link system from the EAPT terminal station to the FM transmitting station in CARRISA is quoted. Table 3-5 gives expected expenses for equipment for the respective stations.

3-3-4 Expense for Inland Transportation and Storage

A 10% of the expense for equipment is quoted as the expense for the inland transportation and storage of equipment.

3-3-5 Consultant Fee

The consultant fee is to be required for consultation for the implementation of this project. Consultant shall be engaged in planning for the implementation of the project plan, preparation of tender documents, assessment of proposals, supervision for work, attendance to acceptance inspection etc., in cooperation with the Government of Kenya.

An about 5% of the total expense of the project, that is 300 million yen, is quoted for the consultation.

3-3-6 Contingency

A 15% of the total expense of the project is quoted as contingency to cover price rise during the term of work etc.

3-3-7 Budget Plan for Respective Fiscal Years

Table 3-6 shows a budget plan for respective fiscal years.

3-4 Operation and Maintenance Budget Plan

Table 3-7 shows a budget plan for the operation and maintenance cost. The operation and maintenance cost is quoted on the basis of the following conditions. The operation and maintenance cost is to be covered by the local fund.

- 1) Operation and maintenance expenses necessary for 6 years after starting operation are estimated. It is supposed that all stations will be opened simultaneously at the beginning of the year.
- 2) The equipment maintenance budget is the budget for the maintenance of all items of equipment including aerial steel towers. A 0.5% of the equipment foreign fund is quoted as the annual expense.
- 3) The programme transmission budget (EAP & T) and miscellaneous expense are expected figures.
- 4) Budget increase rate is expected to be 10% per 2 years in the cases of the programme transmission budget, which is a public utility charge, and miscellaneous expenses and 6% per year in other cases.

Table 3-1 Construction Schedule

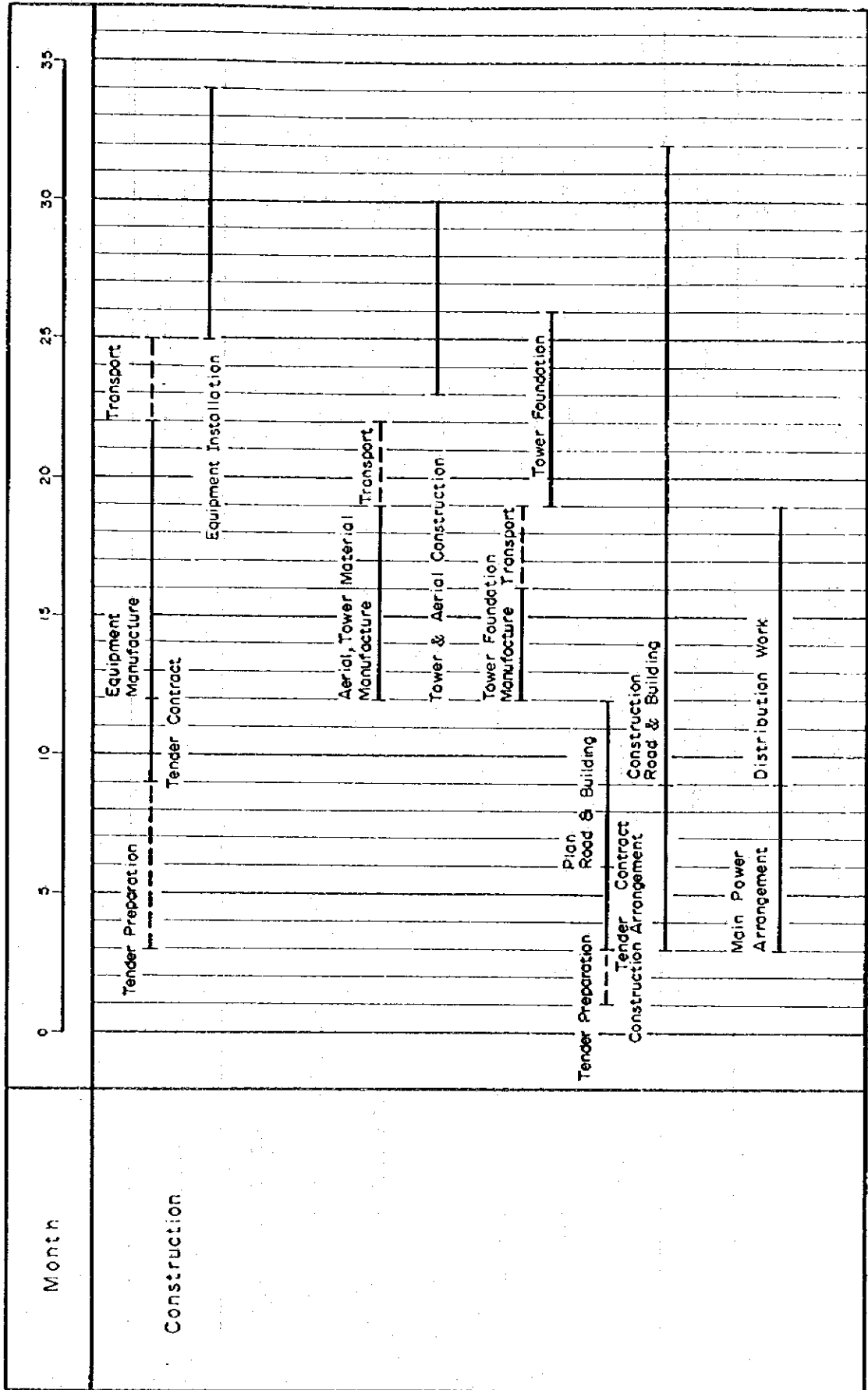


Table 3-2 VOK-FM TOTAL BUDGET PLAN

ITEM	FOREIGN FUNDS	LOCAL FUNDS	TOTAL
(1) EQUIPMENT	2,813.7		2,813.7
(2) INSTALLATION	648.2	598.7	1,246.9
(3) CONSULTANT FEE	300.0		300.0
(4) CIVIL WORK	28.0	338.9	366.9
(5) ELECTRIC WORK	202.9	77.0	279.9
(6) INLAND TRANSPORTATION & STORAGE		60.0	60.0
(7) CONTINGENCY	598.9	161.2	760.1
TOTAL	4,591.7 (Th.K.S 131,192)	1,235.8 (Th.K.S 35,308)	5,827.5 (Th.K.S 166,500)

Table 3-3 CIVIL WORK

No.	STATION	LAND (m ²)		ACCESS ROAD (km)		BUILDING (m ²)		COOLING CAPACITY (K cal)	LAND WORK (Th.K.S.)		ACCESS ROAD WORK (Th.K.S.)		BUILDING (Th.K.S.)		AIR CONDITIONER (Th.K.S.)	AIR CONDITIONING ACCESSORY & WORK (Th.K.S.)	TOTAL (Th.K.S.)
		TX House & E/G	Tower/mast	Const- ruction	Repair	TX House	E/G		TX House & E/G	Tower/ Mast	Const- ruction	Repair	TX House	E/G			
1	LIMURU	232	25 (Mast)			0	27.3		7.6			0	62.8			70.4	
2	KITUI	741	25 (Mast)		6	122	28		24.1	0.8		510.0	280.6	64.4		879.9	
3	EMBU	741	25 (Mast)	4		122	28		24.1	0.8	456.0		280.6	64.4		825.9	
4	MERU	741	441 (Tower)		2	122	22		24.1	14.4		170.0	280.6	50.6		539.7	
5	NYERI	741	25 (Mast)			122	22		24.1	0.8			280.6	50.6		356.1	
6	WAMBA	400	25 (Mast)	4		41	28		13.0	0.8	456.0		94.3	64.4		628.5	
7	NAKURU	741	25 (Mast)		3	122	22		24.1	0.8		255.0	280.6	50.6		611.1	
8	TIMBOROA	268	625 (Tower)			0	38.6		8.7	20.4			0	88.8		117.9	
9	KAKAMEGA	741	25 (Mast)		4	122	22		24.1	0.8		340.0	280.6	50.6		696.1	
10	KAPENGURIA	741	25 (Mast)	1.5		122	28		24.1	0.8	171.0		280.6	64.4		540.9	
11	KISII	800	25 (Mast)	0.3		137	27.3		26.1	0.8	34.2		315.1	62.8		439.0	
12	MBWA HILL	459	625 (Tower)			41	28		15.0	20.4			94.3	64.4		194.1	
13	KIBWEZI	41	225 (Tower)		1	41	28		1.3	7.3		85.0	94.3	64.4		252.3	
14	VOI	378	4,096 (Tower)	1.5		41	34	13,100	12.3	133.0	171.0		94.3	78.2	64.0	117.4	670.2
15	MAZERAS	282	4,096 (Tower)			0	43.2	46,653	9.2	-			0	99.4	208.0	133.1	449.7
16	MALINDI	741	25 (Mast)	0.5		122	34	36,000	24.1	0.8	57.0		280.6	78.2	168.0	117.4	726.1
17	LAMU	741	25 (Mast)	0.5		122	34	13,100	24.1	0.8	57.0		280.6	78.2	64.0	117.4	622.1
18	GARISSA	741	25 (Mast)	0.1		122	34	36,000	24.1	0.8	11.4		280.6	78.2	158.0	117.4	680.5
19	MADO GASHI	780	25 (Mast)	0.1		122	40	13,100	25.5	0.8	11.4		280.6	92.0	64.0	117.4	591.7
20	GALOLE	780	25 (Mast)	0.1		122	40	13,100	25.5	0.8	11.4		280.6	92.0	64.0	117.4	591.7
TOTAL		11,830	10,458	12.6	16	1,765	608.4		385.2	205.9	1,436.4	1,360.0	4,059.5	1,399.4	(800.0) Mil.¥28.0	837.5	10,483.9 (Mil.¥366.9)

Table 3-4 ELECTRIC WORK

No.	STATION	MAIN POWER LINE (km)	MAIN POWER DISTRIBUTION BOARDS (KVA)	MAIN POWER LINE CONSTRUCTION (Th.K.S.)	MAIN POWER DISTRIBUTION BOARDS & INSTALLATION (Th.K.S.)	TOTAL (Th.K.S.)
1	LIMURU	0.5	200	28.5	1,050.0	
2	KITUI	NO	NO	NO	NO	
3	EMBU	NO	NO	NO	NO	
4	MERU	10	50	570.0	206.0	
5	NYERI	8	50	456.0	206.0	
6	WAMBA	NO	NO	NO	NO	
7	NAKURU	0.6	50	34.2	206.0	
8	TIMBOROA	NO	NO	NO	NO	
9	KAKAMEGA	1.5	50	85.5	206.0	
10	KAPENGURIA	NO	NO	NO	NO	
11	KISII	1.5	200	85.5	1,050.0	
12	MBWA HILL	NO	NO	NO	NO	
13	KIBWEZI	NO	NO	NO	NO	
14	VOI	2.5	80	142.5	206.0	
15	MAZERAS	0.5	300	28.5	1,050.0	
16	MALINDI	2	150	114.0	706.0	
17	LAMU	0.5	80	28.5	206.0	
18	GARISSA	11	150	627.0	706.0	
19	MADO GASHI	NO	NO	NO	NO	
20	GALOLE	NO	NO	NO	NO	
TOTAL		38.6		2,200.2 (Mil.¥77.0)	(5,798) (Mil.¥202.9)	7,998.2 (Mil.¥279.9)

Table 3-5 Construction Budget Plan for Each Station

Million *

NO. STATION	FOREIGN FUND FOR EQUIPMENT BUDGET (CIF)				FOREIGN FUND FOR INSTALLATION				LOCAL FUND FOR INSTALLATION				TOTAL
	TX	Link	Tower /Mast	Sub- total	TX	Link	Tower /Mast	Sub- total	TX	Link	Tower /Mast	Sub- total	
1	115.4		65.8	181.2	27.1		15.4	42.5	25.0		14.3	39.3	263.0
2	88.1		22.9	111.0	20.7		5.4	26.1	19.1		4.9	24.0	161.1
3	88.1		17.5	105.6	20.7		4.1	24.8	19.1		3.8	22.9	153.3
4	81.0		32.3	113.3	19.0		7.6	26.6	17.6		7.0	24.6	164.5
5	81.0		15.1	96.1	19.0		3.5	22.5	17.6		3.3	20.9	139.5
6	88.1		15.1	103.2	20.7		3.5	24.2	19.1		3.3	22.4	149.8
7	81.0		49.5	130.5	19.0		11.6	30.6	17.6		10.7	28.3	189.4
8	131.3		49.1	180.4	28.1		11.5	39.6	25.9		10.6	36.5	256.5
9	81.0		38.9	119.9	19.0		9.1	28.1	17.6		8.4	26.0	174.0
10	88.1		22.9	111.1	19.0		5.8	24.8	17.6		4.9	22.5	158.3
11	119.5		40.1	159.6	28.1		9.4	37.5	25.9		8.7	34.6	231.7
12	88.1		45.1	133.2	20.7		10.6	31.3	19.1		9.8	28.9	193.4
13	88.1		43.4	131.5	19.0		10.2	29.2	17.6		9.4	27.0	187.7
14	81.0		68.2	149.2	19.0		16.0	35.0	17.6		14.8	32.4	216.6
15	115.4		71.8	187.2	27.1		16.8	43.9	25.0		15.6	40.6	271.7
16	119.5		52.1	171.6	22.1		16.3	38.4	20.0		15.2	35.2	245.2
17	102.1		50.2	152.3	23.9		11.8	35.7	22.0		11.0	33.0	221.0
18	115.4	18.4	52.1	185.9	21.2	4.2	16.3	41.7	19.5	3.9	15.2	38.6	266.2
19	104.1		48.5	152.6	19.0		15.9	34.9	17.6		14.8	32.4	219.9
20	88.1		50.2	138.3	19.0		11.8	30.8	17.6		11.0	28.6	197.7
TOTAL	1,944.4	18.4	850.8	2,813.7	431.4	4.2	212.6	648.2	398.1	3.9	196.7	598.7	4,060.6

Table 3-6 Construction Budget Plan for Fiscal Year

FUNDS	ITEM	TOTAL				Mil.*
		1	2	3	4	
	(1) Equipment	2,813.7	2,813.7			
	(2) Installation	648.2		324.1	324.1	
	(3) Consultant Fee	300.0	100.0	100.0	100.0	
	(4) Electric Work	230.9	230.9			
	(5) Contingency	598.9				
	Sub-total	4,591.7				
	(1) Installation	598.7	299.4	299.4		
	(2) Civil Work	309.6	185.8	92.8		
	(3) Electric Work	106.3	95.7			
	(4) Inland Transportation & Storage	60.0	30.0	10.0		
	(5) Contingency	161.2				
	Sub-total	1,235.8				
	Grand Total	5,827.5				

Table 3-7 Operation & Maintenance Budget Plan

Item	Consecutive Fiscal Year						Th.K.S. (MIL \$)
	1	2	3	4	5	6	
1. Equipment Maintenance	394 (13.8)	418 (14.6)	443 (15.6)	470 (16.4)	498 (17.4)	528 (18.5)	
2. Main Power	153,369 (6,367.9)	153,369 (5,367.9)	153,369 (5,367.9)	153,369 (5,367.9)	153,369 (5,367.9)	153,369 (5,367.9)	
3. Engine Generator Fuel	141 (4.9)	149 (5.2)	158 (5.5)	167 (5.9)	178 (6.3)	188 (6.6)	
4. Programme Transmission (EAP & T)	571 (20)	571 (20)	629 (22)	629 (22)	691 (24.2)	691 (24.2)	
5. Miscellaneous Expense	57 (2)	57 (2)	63 (2.2)	63 (2.2)	69 (2.4)	69 (2.4)	
6. Personnel Payment (25 Engineers)	1,519 (53.2)	1,610 (56.4)	1,707 (59.7)	1,809 (63.3)	1,918 (67.1)	2,033 (71.1)	
Total	156,050 (5,461.8)	156,173 (5,466.1)	156,368 (5,472.9)	156,506 (5,477.7)	156,722 (5,485.3)	156,877 (5,490.7)	

4. Management

4-1 Programme Planning

4-1-1 Present State of Broadcasting

At present, Kenya has two systems of national broadcasting, "GENERAL" and "NATIONAL" services, each of which uses medium wave, shortwave, and FM in combination. In addition to these national services, vernacular services by 16 tribal language are presented over local regions.

The "GENERAL" service is broadcast in English for 12 hours and 30 minutes every weekday, 18 hours and 10 minutes on Saturdays, and 16 hours and 40 minutes on Sundays.

The "NATIONAL" service is broadcast in Swahili for 17 hours and 10 minutes every weekday, 18 hours and 10 minutes on Saturdays, and 16 hours and 40 minutes on Sundays.

In the case of the medium-wave broadcasting, relay stations are located at NGONG (NAIROBI Area), NYALI (MOMBASA Area), NANDI HILLS and KISUMU (Western Area) and the population coverage of the "NATIONAL" service is 56% (estimated). The FM broadcasting service has only one broadcasting station in NAIROBI and its population coverage is 15% (estimated).

One television broadcasting service is presented for about 5 hours and 30 minutes usually from 5:30 p.m. to 11:00 p.m. Television programmes are broadcast in English and Swahili. In the case of television broadcasting, relay stations are located at LIMURU (NAIROBI Area), MAZERAS (MOMBASA Area), NYERI (NYERI Area), and TIMBOROA (Western Area).

The population coverage of the television broadcasting service is 48% (estimated).

4-1-2 VHF/FM Radio Broadcasting Network Expansion Project

The present VHF/FM Radio Broadcasting Network Expansion Project (or FM broadcasting network expansion project) is intended to construct, in Phase 1, relay stations for FM broadcasting at 20 different locations in Kenya so as to obtain a population coverage of about 90% and an area coverage of about 40%. By the implementation of this FM broadcasting network expansion

project, broadcasting will be spread in the country and the effect of broadcasting will be brought about throughout the nation, which will contribute to the achievement of the three purposes (education, newsreporting, and entertainment) aimed by the VOK and also to the unification of the nation.

4-1-3 Compilation of Broadcasting Programmes

The air time of the "NATIONAL" service is 120 hours and 40 minutes per week (17 hours per day in average).

The air time of the "GENERAL" service is 97 hours and 20 minutes per week (12 hours and 30 minutes per day in average).

The air time of, for example, the "NATIONAL" service, may be satisfactory in consideration of various examples of air times employed in the world.

Reference 1: Radio Broadcasting Hours per day in Major Cities of the world

London	BBC Radio First Programme:	18 hours and 30 min.
Paris	Radio France:	17 hours
Tokyo	NHK First Programme:	19 hours and 02 min.
	NHK Second Programme:	18 hours and 30 min.
	NHK FM:	18 hours and 01 min.

However, broadcasting programmes should see not only quantitative development but also qualitative development. In advancing the FM broadcasting network expansion project, the qualitative development of broadcasting programmes will be one of the most important themes.

(1) Educational Programmes

Educational programmes are broadcast by the Ministry of Education through the "NATIONAL" service using the VOK's broadcasting facilities. On the other hand, the VOK broadcasts educational and cultural programmes for adults. (For the time being, television broadcasting to schools is not performed but is expected to be introduced in the next fiscal year.)

Education by broadcasting compensates for the shortage of school facilities and teachers and contributes to the spread

of education and rise in the educational level. Particularly in Kenya, the Government is making efforts in education by applying 27% of the working budget to educational investment, and broadcasting will make an effective means in school education in elementary schools and others and also in the field of technical education for adults.

Accordingly, the VOK is desired to utilize the broadcasting system to be constructed by the present FM broadcasting network expansion project in the compilation of educational programmes for school broadcasting in close cooperation with the Ministry of Education and, at the same time, make further development in providing educational and cultural programmes for adults as well.

(2) News Programmes

News programmes should be reported rapidly and properly. In the case of the VOK, the Ministry of Information and Broadcasting is engaged in the collection and delivery of domestic and foreign information, so that information for news programmes can be obtained comparatively easily. The VOK should make efforts in achieving the mission of news reporting by making the most of its characteristics and utilizing the local organizations of the Ministry of Information and Broadcasting (such as FIO and DIO).

(3) Entertainment Programmes

Entertainment programmes enliven people, comfort them for their daily efforts, and recreate them for tomorrow. In Kenya where comparatively less entertainment facilities are available, entertainment programmes will play an important role in leading healthy life.

Also, to broadcast high-quality music programmes by FM broadcasting will promote an interest in FM broadcasting and greatly contribute to the spread of FM receivers.

4-1-4 Programme Allocation

The programme allocation (in average per day) of the present radio broadcasting in Kenya is as follows.

(1) "GENERAL" service

Education and culture:	1.5 hours (24%)
News reporting:	3 hours (12%)
Entertainment:	7 hours (56%)
Advertizing:	1 hour (8%)
Total:	12.5 hours (100%)

(2) "NATIONAL" service

Education and culture:	3.5 hours (20.6%)
News reporting:	3.5 hours (20.6%)
Entertainment:	8 hours (47.1%)
Advertizing:	2 hours (11.7%)
Total:	17 hours (100%)

In compiling broadcasting programmes, the rates of educational, news, and entertainment programmes should be determined in consideration of the purpose of the broadcasting service in the country, the nature of the broadcasting system, the opinions of listeners, etc.

In the present FM broadcasting network expansion project, stress should be given to educational and cultural programmes and news programmes as mentioned above but in order to achieve the spread of FM receivers a considerable stress should be given to entertainment programmes. Thus it is recommended to make the air time allocation as follows:

Educational and cultural programmes:	40%
News programmes:	20%
Entertainment programmes:	30%

Reference 2: Programme Allocation of NHK (in average per day)

	Medium-wave Broadcasting (NHK First Programme)	FM Broadcasting
Education and culture	34.2%	59.7%
News reporting	40.2%	14.1%
Entertainment	25.6%	26.2%
Total	100%	100%

(By the "Broadcasting Programme Statistics" issued by NHK in 1957)

4-1-5 Qualitative Development of Broadcasting Programmes

In compiling broadcasting programmes, efforts should be made to upgrade broadcasting programmes by positively and properly grasping the opinions of listeners. It is recommended to take the following measures in the present FM broadcasting network expansion project too.

(1) Establishment of broadcasting programmes council

VOK should establish a deliberative council consisting of leaders in the fields of politics, economics, education, art, etc., and the council should advise the basic principles of the compilation of broadcasting programmes for the purpose of developing and rationalizing broadcasting programmes in response to the request of VOK. Answers by the deliberative council to advices and suggestions should be greatly respected in the execution of broadcasting.

(2) Broadcasting programme investigation organization

In Kenya, audience survey is conducted to know the effect of broadcasting (1970). This survey requires a considerable cost and, in general, the effects of broadcasting programmes are examined by direct interviews by the VOK staff or by letters and telephones from listeners. However, in order to achieve qualitative development of broadcasting programmes, periodical, scientific investigations should be made on broadcasting programmes. Accordingly, it is desirable to establish such an organization that will conduct research and survey of broadcasting programmes, audience rating survey, public-opinion survey, and the survey of public life, etc. Also, measures should be taken for the effective use of data obtained by these surveys and investigations (establishment of broadcasting programme center, etc.).

(3) Programme production by utilizing the characteristics of FM broadcasting

The VOK produces radio broadcasting programmes by itself nearly 100%. Of all television programmes of the VOK, 70% are self-produced and 30% are imported programmes. The fact

that nearly 100% of all radio programmes of the VOK shows how high is the programme producing capability of the VOK.

Although the same programmes are broadcast by both medium-wave broadcasting for the time being, it may be recommendable to produce programmes by utilizing such a characteristic of FM broadcasting that allows obtaining excellent sound quality not subject to noise in future separately from the medium-wave broadcasting.

Introduction of stereo broadcasting may be recommendable in future as a method of broadcasting by utilizing the specific characteristic of FM broadcasting. By this, distinguished acoustic effect will be achieved, which will contribute to the spread of FM receivers.

4-2 Plan for Spread of Receivers

The number of radio receivers spread in Kenya is estimated to be about 1500 thousands (by the "Ministry of Information and Broadcasting Annual Report" issued in 1972).

In 1970, the former receiving charge system was abolished and instead each purchaser of a radio receiver is required to pay 20 K.S. (¥700) as the charge for the permission of reception upon purchasing a receiver and each purchaser of a TV receiver is requested to pay 60 K.S. (¥2100) upon purchasing a TV receiver (by the "Broadcast Receiving (Apparatus) Act). It seems that this new charging system has been adopted so as to avoid the difficulties and complicatedness of collecting receiving charge and, at the same time, achieve the spread of receivers. The number of radio receivers permitted each year since 1970 is as follows.

Reference 3: Number of Radio Receivers Permitted Each Year

1970:	32,657
1971:	74,824
1972:	84,650
1973:	85,243
1974:	77,869
1975:	87,997

Some examples of the prices of radio receivers are given below. In general, FM receivers are more expensive and fewer in kinds than other types of receivers.

Reference 4: Examples of Prices of Radio Receivers

	<u>Receiver System</u>	<u>K.S. (Yen)</u>
Example 1:	AM/SW (1CH)	320 (11,200)
2:	AM/SW (2CH)	420 (14,700)
3:	AM/SW (4CH)	620 (21,700)
4:	AM/SW (4CH)/FM	2,000 (70,000)
5:	AM/SW (5CH)/FM	5,063 (177,187)

The number of radio receivers having been manufactured each year in Kenya since 1970 is as follows (including imported ones).

Reference 5: Number of Radio Receivers Manufactured Each Year

1970:	48,785
1971:	52,932
1972:	45,818
1973:	62,260
1974:	84,163
1975:	57,493

In order to achieve the spread of FM receivers under these circumstances, it may be necessary to make such qualitative development of broadcasting programmes as mentioned in item 4-1-5 and, at the same time, take the following measures.

(1) Distribution of receivers to public institutions

Distribution of FM receivers to public institutions such as schools and local public organizations in the service area of the FM broadcasting will give local inhabitants chances of enjoying the FM broadcasting, which will greatly contribute to the spread of FM receivers. Although such a measure has been already taken but partially, it is desired to positively expand it in this project.

Also, production of local programmes by picking up familiar themes of the local society and local culture in FM broadcasting will result in attracting people in the local society to the FM

broadcasting, contributing to the spread of FM receivers.

(2) Price reduction and standardization of receivers

In Kenya, receivers are still expensive as mentioned above, which prevents FM receivers from being spread. Although abrupt price reduction by increase of import may not be achievable because of the policy of protecting domestic industries, spread of high-quality, low-priced receivers should be effected through reduction of the tax to receivers and standardization of receivers.

(3) Strengthening of servicing such as repair of receivers

In Kenya servicing of radio receivers is not conducted sufficiently. In order to achieve the spread of FM receivers carefully thought out measures, such as the training of repair engineers of receivers and the establishment of patrol consultations for improvement and guidance on receiving facilities for complaint against troubles in reception, should be taken.

4-3 Training Plan

4-3-1 Personnel Employment Plan

In order to plan and manage broadcasting services synthetically from now on including the present project, a number of competent personnel will be required in the fields of programme production, equipment operating techniques, and management and administration.

Accordingly, the VOK should first provide a personnel plan for respective fields and then make an employment plan through examination of required personnel in respective sections and the total number of employees on the basis of the personnel plan.

4-3-2 Training of Personnel

Good training should be conducted for personnel to be able to exert their knowledge and capabilities sufficiently in their fields of work.

For personnel training, the following may be recommended.

(1) Expansion of KIMC

The Ministry of Information has a training organization

of KIMC (Kenya Institute of Mass Communication). At present, KIMC has six courses and eight teachers for teaching a total of 62 trainees. Personnel graduated from KIMC are assigned to applicable departments of the Ministry of Information which include the VOK.

For the training of personnel necessary for the execution of the FM broadcasting network expansion project, the expansion of KIMC would be desirable. It will also be helpful to utilize KIMC for the re-training of VOK personnel.

For this, expansion of KIMC facilities and training of teachers will be necessary.

(2) Sending VOK staff to overseas for training

It will also be effective to send competent personnel selected from among VOK personnel as trainees to an experienced country for the acquirement of necessary knowledge and techniques for broadcasting.

Conveying the knowledge and techniques thus acquired by these personnel during overseas training to other personnel in field training, etc., will result in developing the technical level of all personnel.

(3) Invitation of experts from advanced country

It may be extremely effective for smooth management of broadcasting industry to invite experts from a developed country for the guidance and training of personnel as to broadcasting technology, programme production, broadcasting network planning, operation and maintenance.

4-4 Broadcasting Laws and Regulations

Kenya has the Kenya Broadcasting Corporation (Nationalization) Act which may corresponds to the Japanese Broadcast Act. The Kenya Broadcast Corporation Act sets out that the VOK should broadcast in English, Swahili, and other languages approved by the Minister of Information and Broadcasting and that different political opinions, if met, should undergo a fair balancing in time allotment, etc. Broadcasting has an extremely strong influence to the public because of its finiteness, simultaneity, and diffusiveness.

Accordingly, in order for broadcast laws and regulations to be easily understood by those engaged in broadcasting service and general public, it may be desirable to specify the purposes and basic doctrines of broadcasting in laws, clarify as much as possible rules and regulations on compilation of broadcasting programmes so as to achieve the establishment of broadcasting laws and regulations.

5. Economic Evaluation

5-1 Effects of Investment

The FM broadcasting network expansion project is intended for the enforcement of the unification of the nation among different tribes, progress of economic and industrial development, spread of education, promotion of the sale of commodities, provision of entertainment, etc., for the development of public life by constructing FM radio broadcasting stations in 20 major cities populated densely thereby utilizing the simultaneous, wide-range transmission capability of broadcasting.

The expected population coverage by this project is about 90% and expected area coverage is about 40%.

The effects of investment of this project will range wide and in various directions. Some major effects of investment will be as follows.

5-1-1 Unification of Nation among Different Tribes

Transportation and communication for conveying people, materials, and information are none other than arteries in the Governmental administration and economic circulation and the development of national systems greatly depends on the functions of transportation and communication. At present, 42 tribes exist and many languages are used in Kenya. It is one of national requirement to spread the force of control and jurisdiction of the Kenya Government throughout the country. The establishment of an instantaneous information transmission network by radio broadcasting has the function of promoting the spread of common sense indispensable for political administration since such information as provided by radio broadcasting is closely connected to daily life of the habitants in the area and also the function of standardizing the culture and language in the area. In this sense, the FM broadcasting network expansion project is significant for organizing inhabitants in the area.

5-1-2 Promotion of Economic and Industrial Development

The Government of Kenya is now progressing the Third 5-Year Development Programme ranging from 1974 to 1978.

This programme is intended to achieve an annual GDP growth of 7.4% for the purposes of growing intensive industries, promoting the development of local industries, spread of education, and economical development.

The establishment of a wide-area information network by the implementation of this project will not only raise the public will of participation in the above-mentioned development programme but also allow effective conveyance of various kinds of information and knowledge and promote rational arrangement of circulation paths so as to build up the foundation for the social and economical development of Kenya.

5-1-3 Spread of Education

Broadcast media will make a strong means for the spread of school education which has been greatly stressed since the independence of the country.

The Government of Kenya has assigned 27% of the recurrent expenditure or 4% of the development expenditure to educational investment so as to develop the educational level. Meanwhile, Kenya Institute Education (KIE) is now undertaking the Third Educational Project by drawing credit from the International Bank for Reconstruction and Development. This educational project, intended for the promotion and improvement of school broadcasting, training of teachers, adult education by means of broadcast media, development of agriculture, and acquirement of knowledge on health, is expected to be completed in 1980.

Expansion of the broadcasting network to be achieved by the implementation of the project will further develop the effect of the spread of education by the accomplishment of the above-mentioned educational project so as to greatly contribute to the programmes of the national educational standard.

5-1-4 Promotion of Sale of Various Commodities by Advertisement

The VOK, which is the national broadcaster in Kenya, charges no reception fee but charges licence fee and advertising fee. In general, the presense of commercials induces mass consumption and mass production, lowering the prices of commodities, then causing export drive, and causing quality improvement because

of competition.

In Kenya where such major advertisement media as newspaper, magazines and television have not yet spread throughout the country, radio commercials not only bring advantages to the manufacturers and sales agents of the advertized commodities but also have the important functions of developing the economic potential of Kenya and of allowing consumers to buy better commodities at lower prices.

5-1-5 Entertainment

In Kenya, theaters and movie theaters are limited to some major cities. Entertainment directly makes people find their life worth living. To let people enjoy entertainment is very important.

In this sense, entertainment programmes presented by broadcast media will be very important for cultivating the nature and emotion of the people of Kenya as well as for presenting news, cultural, and educational programmes.

5-2 Economic Evaluation

Broadcasting industry, being a public industry producing public benefits, resembles infrastructure industries such as electric industry, waterworks, railway industry, and harbor works.

However, broadcasting industry is quite different from other public industries at the point that it gives mental, cultural and creative actions to people. Indeed, broadcasting give various influences and effects to people. Accordingly, it is extremely difficult to measure the values of different types of information and to weigh the degrees of contribution to education, culture, regional development, etc. From this standpoint, the economic evaluation of this project may be limited to only some measured benefits and the entire benefits and advantages to be brought about seem to much exceed the measured ones.

The economic evaluation of this project is made by the method of using Internal Rate of Return for a project life (or the period of evaluation) of 20 years. Costs and benefits are calculated on the following bases and premises.

5-2-1 Benefits

(1) Charge for License Fee

At present, the charge for license fee is rated 20 K.S. per radio receiver and payed upon purchasing a radio receiver or receivers.

This charge for the permission of reception is expected to be unchanged for 20 years for the purpose of promoting the popularization of receivers.

The total number of radio sets is expected to be increased 6% annually. Calculation of the total amount of charge for license fee to be paid every year is based only on the demand for new radio sets not including replacement demand (in which superannuated radio sets will be replaced with new sets).

° Estimation of Spread of Radio Receivers

The spread of radio receivers can be estimated from the relationship with the GDP per person as is the case with the estimation of spread of telephones.

For this project, the examples of 25 countries, which are mostly developed countries, are sampled and the relationship between the GDP per person and the rate of spread of radio receivers is obtained by the method of least squares.

The sampling regression formula thus obtained is as follows.

$$\log y = 0.4361 + 0.3362 \log x \dots\dots\dots (1)$$

$$y = 2.7296x^{0.3362}$$

where y: number of radio sets per 100 persons

x: GDP per person

Equation (1) is shown in Fig. 5-1.

The GDP/CAP of Kenya of fiscal 1975 is \$218 and the number of radio sets per 100 persons is about 11. In consideration of the estimated annual population increase of 3% and the estimated annual GDP/CAP increase of 4% which are specified in the Third 5-Year Development Programme, the GDP/CAP of Kenya in 2000 is estimated to be about \$595 and the number of radio sets per 100 persons about 23.

The annual increase in the number of radio sets estimated on the basis of these premises is 6% (see Table 5-1).

(2) Radio Commercials

It can be estimated that demand for radio commercials will increase by the completion of this project. The rate of increase in radio commercial charge is made as equal to the rate of increase in overall advertising charge in Kenya (6.8%).

All remaining values of the existing three medium wave stations are summed up as the cost and all commercial incomes achievable after completion of this project are added up as benefits.

° Estimation of Demand for Commercial Rates

Since the estimated rate of annual increase in commercial charge is also correlated with the GDP per person as is the case with the rate of spread of radio receivers, the same method as applied to the estimation of the rate of spread of radio receivers can be adopted to the estimation of the commercial charge. Thus, the sampling regression formula is obtained as follows by sampling examples of 25 countries, which are mostly developed countries.

$$\log y = -3.6307 + 1.4307 \log x \dots\dots (2)$$

$$y = 2.3405 \times 10^{-4} x^{1.4307}$$

where y: Amount of expenditure for commercials per person

x: GDP per person

Equation (2) is shown in Fig. 5-2.

From Equation (2) the estimated commercial payment per person is \$2.11 to the GDP/CAP of \$595 and the estimated annual rate of increase in commercial charge is 6.8%.

(3) Educational benefits

Kenya has making efforts in the spread of education since its independence, but the abrupt increase in the number of students and pupils is surpassing the supply of teachers, so that shortage of teachers is filled up by the employment of unqualified teachers. Broadcasting programmes for schools by the completion of this project will remedy the shortage of

teachers. That is, students to be covered by the broadcasting service will be given same level of instruction at school even under unqualified teachers as is provided under qualified teachers, with the help of educational broadcasting programme. Benefits in school education obtainable by the project are calculated for primary schools on the basis of the following premises.

The number of pupils expected to enter into the broadcasting coverage newly will be about 990 thousand.

Suppose a class has 35 pupils (which is the average number of pupils in Kenya in 1975) and educational broadcasting programmes for schools are listened by each class for 40 minutes every day and five days a week, then the pupils listen to educational programmes for schools for a total of 70 hours a year.

Suppose a teacher teaches pupils for 30 hours a week and 700 hours a year, then educational programmes for schools will give an effect equivalent to that given annually by 2800 teachers (here, the educational effect to be given by educational programmes for schools is considered 50% of that to be given by teachers).

The economical benefit obtainable by employing educational broadcasting for schools instead of teachers is 3050 K.S. per teacher, providing a total annual benefit of 8540 thousand K.S. (suppose the average payment to a teacher is 9900 K.S. and that to an unqualified teacher 3800 K.S. with the annual increase in their payment being 6%).

5-2-2 Expenses

In estimating expenses required for this project, the prices of equipment are all given by CIF prices and money exchange is made by the official exchange rate.

The separation between official and free quotations is within 15% in average and the estimated unemployment rate of unskilled laborers is less than 5%, so that the "Shadow Price" is not adopted.

(1) Construction expenses

The amount of 5,354 million yen (152,973 thousand K.S.) obtainable by deducting the consultant fee and price escalation from the total fund required for this project is the construction expenses.

(2) Consultation fee

Consultation engineers will implement all consulting operations including plan making, preparation of tender specification, assessment of proposals, supervision of work, and attendance to acceptance test and inspection. The estimated consultation fee is 5% of the total fund.

(3) Operation and maintenance expenses

◦ personnel expense (Wages)

Of those personnel to be assigned to broadcasting stations, 25 persons will be engaged in the operation and maintenance of equipment. The estimated total amount of wages for these personnel is 38 million yen (1071 thousand K.S.) with the expected annual wage increase being 6%.

◦ Expenses for maintenance of equipment and antenna tower

The expenses for the maintenance of equipment include expenses for repair of equipment and purchase of consumable parts. The expenses for the maintenance of the steel towers include inspection of bolts for being tightened and re-painting. The estimated total amount of all these expenses is 0.5% of the equipment price in this project.

◦ Equipment operation cost

The power consumption of the respective transmitters are:

10KW stations	60KVA (4 stations)
3KW stations	30KVA (2 stations)
1KW stations	10KVA (14 stations)

The total amount of electric fees for these transmitters is estimated equal to fuel expenses to be charged when all stations are operated from engine generators plus the prices of the engine generators.

(4) Expenses for use of multiplex links

The EAPT link will be used for programme transmission between LIMURU and MOMBASA and between LIMURU and GARISSA. The estimated total amount of expenses for the use of the links is calculated on the basis of the expenses for the transmission of TV programmes and is 20 million yen (571 thousand K.S.) annually.

(5) Depreciation of medium-wave broadcast stations

Although the facilities of the existing three medium-wave stations can be considered to have been already depreciated, the remaining values of the equipment and facilities of the three stations in service are estimated to be 1/10 of their purchase prices and those of station facilities 1/5 of the construction prices in depreciating these stations.

5-2-3 Conclusion

The economic evaluation of this project resulted in obtaining an IRR of 14%, demonstrating the feasibility of this project from the standpoint of national economy. (For IRR calculation, see Table 5-2. For the expected expenses and benefits for each fiscal year, see Tables 5-3 and 5-4.)

The result of the economic evaluation thus obtained is limited to measured benefits and the overall value will much exceed the IRR. Hence, it is anticipated that this project should be implemented at an early stage.

Fig. 5-1 Estimated Number of Radio Receivers to be Popularized

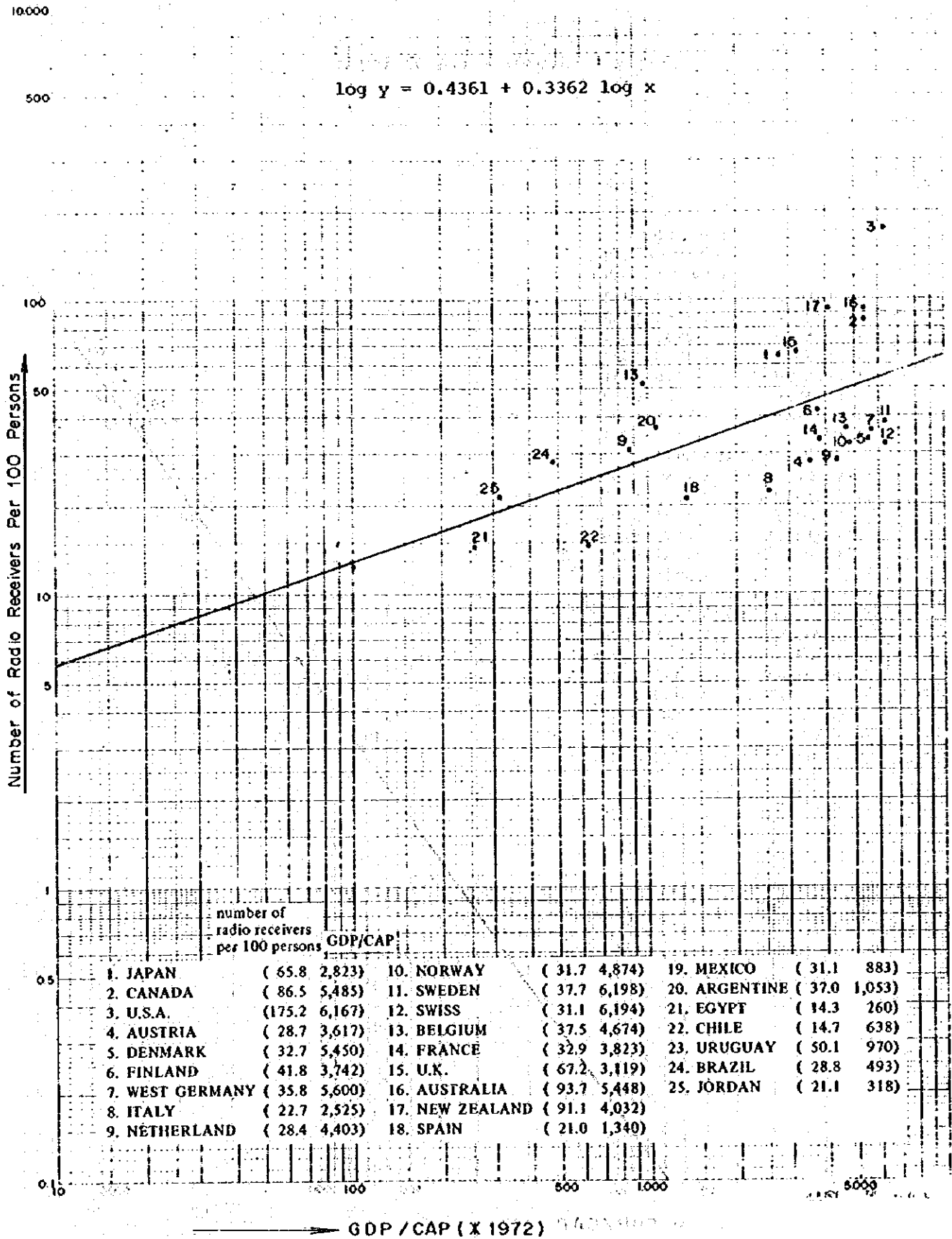


Fig. 5-2 Estimated Demand for Commercials

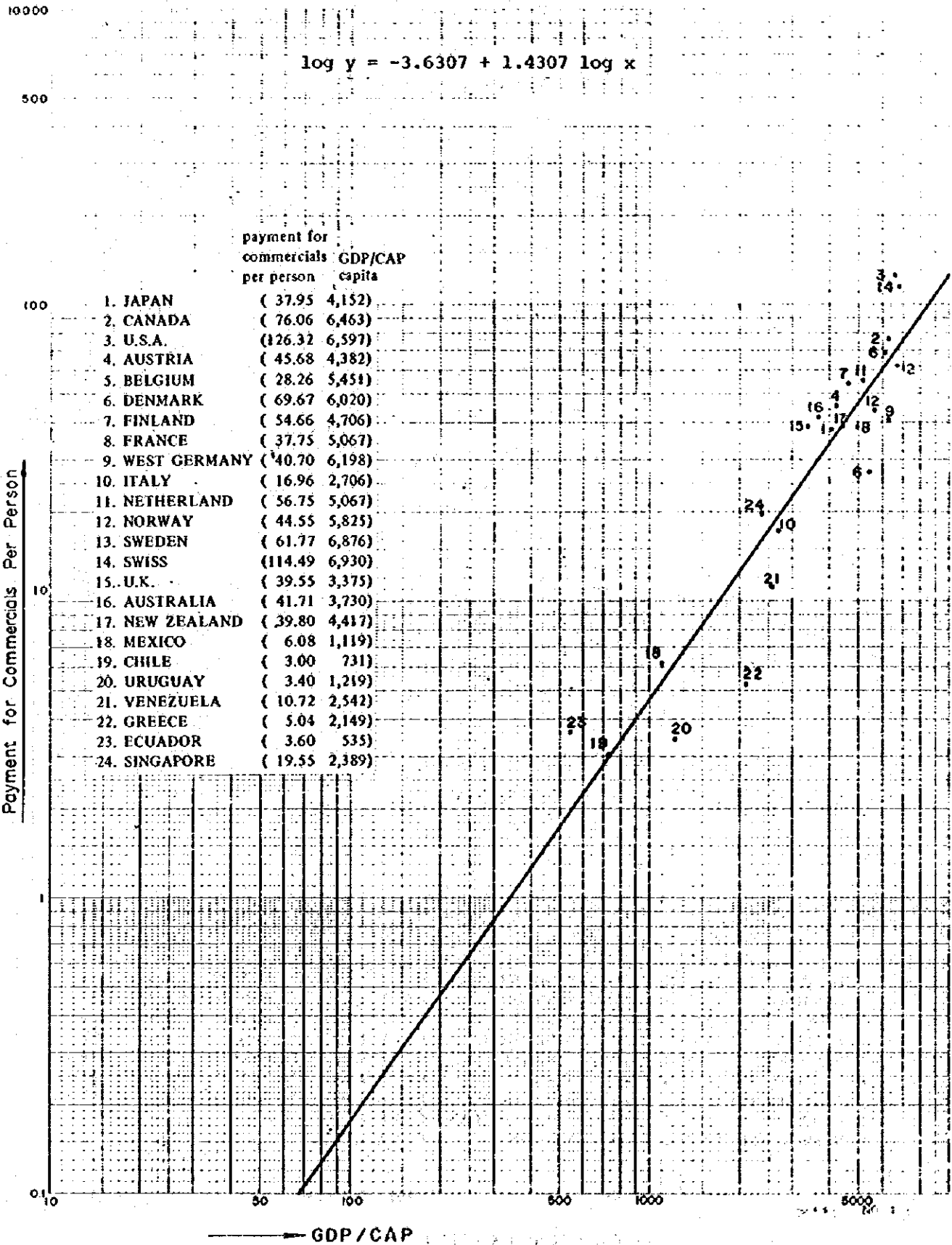


Table 5-1 Estimated Increase in Number of Radio Sets

F.Y.	Population (Increase:3%)	No. of Radio sets (Unit:1,000)	No. of Radio sets per 100 persons	Increase in No. of Radio sets	Licence Charge (Unit:100 K.S.)
1975	13,413	1,500	11	-	
76	13,815	1,590	12	90	1,800
77	14,230	1,685	12	95	1,900
78	14,657	1,787	12	102	2,040
79	15,096	1,893	13	106	2,120
1980	15,549	2,007	13	114	2,280
81	16,016	2,128	13	121	2,420
82	16,496	2,255	14	127	2,540
83	16,991	2,391	14	136	2,720
84	17,501	2,534	14	143	2,860
85	18,026	2,686	15	152	3,040
86	18,567	2,847	15	161	3,220
87	19,124	3,018	16	171	3,420
88	19,697	3,199	16	181	3,620
89	20,288	3,391	17	192	3,840
1990	20,897	3,595	17	204	4,080
91	21,524	3,810	18	215	4,300
92	22,170	4,039	18	229	4,580
93	22,835	4,281	19	242	4,840
94	23,520	4,538	19	257	5,140
95	24,225	4,811	20	273	5,460
96	24,952	5,099	20	288	5,760
97	25,701	5,405	21	306	6,120
98	26,472	5,730	22	325	6,500
99	27,266	6,073	22	343	6,860
2000	28,084	6,438	23	365	7,300

Table 5-2 Estimation of Internal Rate of Return of the Project

(Unit: 1000 K.S.)

F.Y.	Cost	Discount Rate		Benefit	Discount Rate	
		14%	15%		14%	15%
1977	19,648	19,648	19,648			
1978	107,324	107,324	107,324			
1979	23,884	20,951	20,769			
1980	12,117	9,324	9,162			
1981	5,685	3,837	3,738	27,296	18,424	17,948
1982	5,989	3,546	3,424	29,011	17,177	16,587
1983	6,374	3,310	3,169	30,888	16,042	15,357
1984	6,714	3,059	2,902	32,835	14,959	14,195
1985	7,145	2,855	2,686	34,938	13,963	13,134
1986	7,528	2,639	2,461	37,164	13,028	12,149
1987	8,010	2,463	2,277	39,543	12,160	11,241
1988	8,440	2,277	2,086	42,062	11,346	10,397
1989	8,979	2,125	1,930	44,750	10,589	9,619
1990	9,464	1,964	1,769	47,618	9,884	8,230
1991	10,070	1,833	1,637	50,635	9,219	8,230
1992	10,613	1,695	1,500	53,891	8,607	7,616
1993	11,290	1,582	1,387	57,321	8,030	7,051
1994	11,899	1,462	1,272	60,995	7,496	6,518
1995	12,659	1,365	1,176	64,906	6,997	6,031
1996	13,344	1,262	1,078	69,029	6,527	5,578
1997	14,194	1,177	997	73,459	6,093	5,162
1998	14,965	1,089	914	78,172	5,688	4,776
1999	15,916	1,016	845	83,145	5,307	4,418
2000	16,782	940	775	88,496	4,955	4,089
Total	369,033	198,743	194,926	1,046,154	206,491	188,996

IRR = 14.2%

Table 5-3 Estimated Expenses for Each Fiscal Year

(Unit: 1000 K.S.)

Item F. Y.	Construc- tion	Consultant Fee	Personnel Expense	Mainte- nance	Administration/ Operation	EAPT Link	Other Expenses	Deprecia- tion of MF	Total
1977	15,362	2,857						1,429	19,648
1978	107,324								107,324
1979	21,027	2,857							23,884
1980	9,260	2,857							12,117
1981			1,519	394	3,144	571	57		5,685
1982			1,610	418	3,333	571	57		5,689
1983			1,707	443	3,533	628	63		6,374
1984			1,809	469	3,745	628	63		6,714
1985			1,918	497	3,970	691	69		7,145
1986			2,033	527	4,208	691	69		7,528
1987			2,155	559	4,460	760	76		8,010
1988			2,284	592	4,728	760	76		8,440
1989			2,421	628	5,011	836	83		8,979
1990			2,567	666	5,312	836	83		9,464
1991			2,721	706	5,631	920	92		10,070
1992			2,884	748	5,969	920	92		10,613

(Continued)

(Unit: 1000 K.S.)

Item F. Y.	Construc- tion	Consultant Fee	Personnel Expense	Mainte- nance	Administration/ Operation	EAPT Link	Other Expenses	Deprecia- tion of MF	Total
1993			3,057	793	6,327	1,012	101		11,290
1994			3,240	840	6,706	1,012	101		11,899
1995			3,435	891	7,109	1,113	111		12,659
1996			3,641	944	7,535	1,113	111		13,344
1997			3,859	1,001	7,988	1,224	122		14,194
1998			4,091	1,061	8,467	1,224	122		14,965
1999			4,336	1,125	8,975	1,346	134		15,916
2000			4,597	1,192	9,513	1,346	134		16,782
Total	152,973	8,571	55,884	14,494	115,664	18,202	1,816	1,429	369,033

Table 5-4 Benefits per Fiscal Year (Expected)

(Unit: 1000 K.S.)

	Increase in No. of Radio Sets (Unit: 1000)	License Charge	Commercial Rates	Educational Benefits	Total
1975			8,600	8,540	
1976	90	1,800	9,185	9,052	
1977	95	1,900	9,809	9,596	
1978	102	2,040	10,476	10,171	
1979	106	2,120	11,189	10,781	
1980	114	2,280	11,950	11,428	
1981	121	2,420	12,762	12,114	27,296
1982	127	2,540	13,630	12,841	29,011
1983	136	2,720	14,557	13,611	30,888
1984	143	2,860	15,547	14,428	32,835
1985	152	3,040	16,604	15,294	34,938
1986	161	3,220	17,733	16,211	37,164
1987	171	3,420	18,939	17,184	39,543
1988	181	3,620	20,227	18,215	42,062
1989	192	3,840	21,602	19,308	44,750
1990	204	4,080	23,071	20,467	47,618
1991	215	4,300	24,640	21,695	50,635
1992	229	4,580	26,315	22,996	53,891
1993	242	4,840	28,105	24,376	57,321
1994	257	5,140	30,016	25,839	60,995
1995	273	5,460	32,057	27,389	64,906
1996	288	5,760	34,237	29,032	69,029
1997	306	6,120	36,565	30,774	73,459
1998	325	6,500	39,051	32,621	78,172
1999	343	6,860	41,707	34,578	83,145
2000	365	7,300	44,543	36,653	88,496
Total		88,620	511,908	445,626	1,046,154

