CHAPTER 1 BACKGROUND OF THE PROJECT

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The request was made by the Government of Kenya for "the Project for the Establishment of the Kenya Institute of Surveying and Mapping" (hereinafter referred to as "the Project", training mainly the technical staff members of the Survey of Kenya, under the Ministry of Lands and Settlement and thereby increasing its practical technicians. However, in the background of the request, Kenya is facing the facts that there are shortages of land information and accurate maps, which are required to implement the national development plan, and also shortages of survey technicians to conduct surveying and mapping in Kenya.

1-1-1 National Development and Mapping

One of the most outstanding features of the Kenya's Seventh National Development Plan (1994/96) is the addition of a new chapter ("Chapter 6 Land Use Policy"), in which land use is emphasized as an important element of national development. Land use was not referred to in the Kenya's Sixth National Development Plan nor in any preceding national development plan. In the Seventh National Development Plan, land is not considered just a means of production. The need to make effective use of land in harmony with nature under a proper land use plan is pointed out clearly.

The main theme of the Seventh National Development Plan is "Resource Mobilization for Sustainable Development." In the plan, land is considered one of the three fundamental factors required to implement national development projects, the other two being "manpower" and "capital." Agricultural development projects, urban development projects,

industrialization projects, road construction projects, etc. to be implemented under the national development plan contain elements related to land, and therefore it is necessary to implement the land use policy properly in order to make optimal utilization of land, which is a finite resource, in harmony with nature.

Furthermore, the Seventh National Development Plan points out not only the necessity of such a land use policy but also the following obstacles to be overcome in formulating such a land use policy.

- A shortage of cadastral maps and topographical maps is causing the delay in the formulation of development projects in the course of the implementation of urban development projects.
- Different development projects for the same area are being worked out by different organizations, which makes it difficult to coordinate these projects effectively and efficiently.
- Disputes over land ownership occur frequently in the course of the implementation of development projects, which is stalling the progress of these projects.
- There is a shortage of the latest land information clearly indicating geographical features of land and ownership, and it is necessary, therefore, to collect and review land information whenever a new development project is implemented, which is making development projects expensive and time-consuming.

The Seventh National Development Plan concludes that in order to implement development projects smoothly and effectively by resolving these problems and conflicts, it is important to develop viable land information and that projects to promote the preparation of such land information should be actively promoted.

As stated above, the Seventh National Development Plan attests to the importance of the preparation of land information, namely the importance of surveying and mapping. In this context, the implementation of the Project, which is aimed at training survey technicians, is judged to be of high priority.

(1) Necessity of Mapping

In Kenya, many development projects are going to be implemented in various fields under the Seventh National Development Plan. Here the details of development projects included in the current national development plan and the necessity of mapping are examined.

1) Promotion of Land Registration and Procedures

In the Seventh National Development Plan, the Government of Kenya stresses the need of the promotion of land registration. Reflected in the Government of Kenya's stance on land registration is the fact that disputes over land ownership are generally slowing down the progress of various development projects. Table 1-1 shows the number of cases concerning land ownership disputes that relate to development projects as of 1992.

Table 1-1 Number of Cases Concerning Land Ownership

Cases	Brought from 1991	Filed	Heard	Pending
Committee	2,402	803	1,983	1,222
Arbitration	3,356	1,892	545	4,703
Objection	17,897	5,418	10,947	12,368
Appeal	4,201	841	16	5,026
Total	27,856	8,954	13,491	23,319

(7th National Development Plan)

As shown in the above table, in 1992, there was a total of 27,856 cases concerning land ownership brought forward from 1991 and there

was an additional 8,954 cases brought to court, of which 13,491 were concluded but the remaining 23,319 were carried over to 1993. This means that in areas in the country where disputes over land ownership are not yet settled, development projects are being delayed. In order to implement development projects smoothly, it is important to prepare accurate information on land ownership as early as the planing stages of development projects.

For these reasons, the Government of Kenya has included a review of laws and regulations that apply to land registration and a plan to establish a land information system in the Seventh National Development Plan. In promoting land registration, it is necessary to produce cadastral maps indicating the shape and size of each plot.

Production of cadastral maps is one of the Survey of Kenya's main activities. As shown in Fig. 1-1, as of 1990, about 7 million ha of land had been registered, but there is still a need to expand the scope of the Survey of Kenya's cadastral maps producing operations in keeping with the progress of development projects.

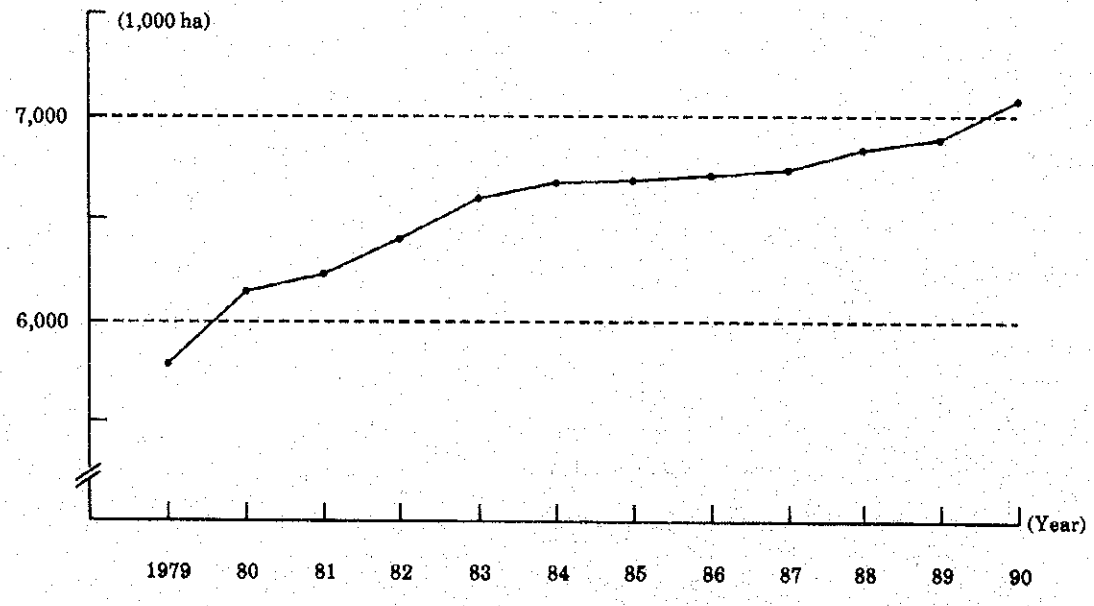


Fig. 1-1 Changes in the Number of Land Registrations (those in Nairobi City not included) (Central Bureau of Statistics)

2) Development of Arid Land and Semi-arid Land

Kenya has a land area of 586,644km^2, of which 80 percent, or 466,115km^2, is the combined total area of arid land and semiarid land and the remaining 20 percent, or about 116,529km^2, is that of arable land. On the other hand, Kenya's population is on the increase, as is shown in Fig. 1-2, with a considerably high population increase rate of 3.8 percent. Most of the country's population is concentrated in arable land, where the population density is about 160 persons/km^2. In arid land and semi-arid land, however, the population density is about 10 persons/km^2. Obviously, there is a wide gap in population density between the two. According to a 1989 survey, it is estimated that about 75 percent of the country's population is concentrated in arable land, which accounts for only 20 percent of the country's land area.

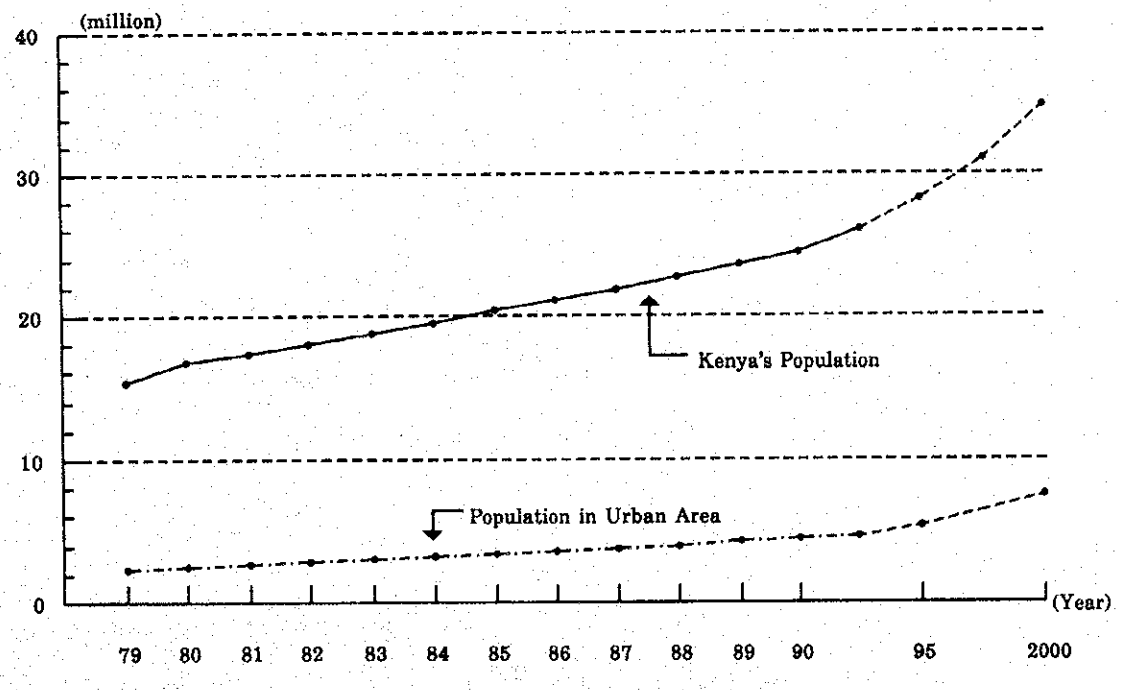


Fig. 1-2 Trends in Kenya's Population (Central Bureau of Statistics)

In view of these facts, the Government of Kenya is in the process of planning and implementing various development projects to increase productivity and create jobs in arid land and semi-arid land with the aim of increasing the number of permanent residents of arid land and semi-arid land.

One of the most important projects in these area are irrigation projects. The Seventh National Development Plan sets the following development targets for irrigation projects.

Table 1-2 Irrigation Projects in Kenya

(Unit: ha)

Category	1944	1995	1996	1997	1998	1999	2000
Irrigation	52,790	55,290	57,790	60,290	62,790	65,290	67,790
Drainage	10,000	12,000	14,000	16,000	18,000	20,000	22,000

(7th National Development Plan)

Topographical maps in a scale of 1:50,000 are useful in working out these irrigation projects. In actuality, however, only out-of-date and small-scale maps 1:100,000 in scale are available in arid and semi-arid land in Kenya. It is impossible, therefore, to supply necessary topographical maps relevant to individual irrigation projects. Moreover, it is expected that demand for the development of arid land and semi-arid land will increase in keeping with the future increase in the country's population. It is therefore urgently necessary to implement surveying and mapping projects in the country.

3) Road Construction Project

"Spatial Dimension of Development" is one of the most important themes of the Seventh National Development Plan, and the development of a comprehensive traffic system is the most important element of the theme. Such a traffic system will connect urban areas and provincial

areas through road networks and promote the development of the manufacturing and farming industries in provincial areas, which in turn will create more job opportunities and products. It will also help stem the in-flow of population into urban areas.

Fig. 1-3 shows trends in road construction in Kenya. The Government of Kenya plans to increase the total length of bitumen roads by 490km to 9,490km during the period of the Seventh National Development Plan.

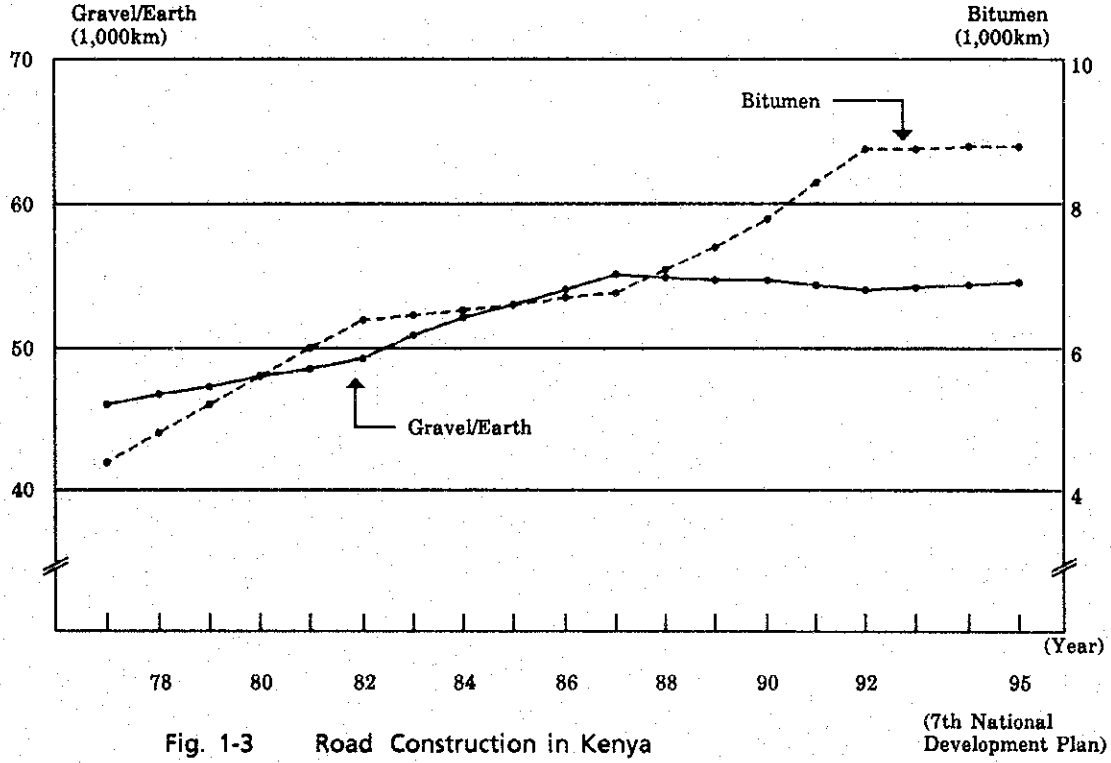


Fig. 1-3 Road Construction in Kenya under the Seventh National Development Plan)

In working out such a road construction plan, it is necessary to prepare aerial photographs on a scale of 1:15,000 to 1:30,000 and to produce topographical maps and cadastral maps of areas near the planned roads. So it is imperative to promote the production of these photographs and maps.

As exemplified by the above-mentioned development projects, many of the development projects which the Government of Kenya plans to implement

under the Seventh National Development Plan require land information based on the latest survey results in the form of various types of maps for their formulation and implementation. It can be said that "mapping" is assuming greater importance as one of the basic projects implemented in the cause of "national development" and "conservation of nature" in Kenya.

(2) Present Situation of Mapping in Kenya

In keeping with the increase in the population and the economic development, land is being used for increasingly advanced applications and a wide variety of development projects, such as agricultural industry promotion projects, infrastructure development projects and urban development projects, are being implemented. Various precise maps, such as topographical maps and cadastral maps, which meet certain standards and accuracies are required for efficient implementation of these projects. In Kenya, the Survey of Kenya, which is operating under the Ministry of Lands and Settlement, is responsible for planning and implementing map production. The present condition of the Survey of Kenya's mapping operations is as outlined below.

1) Topographical Maps

Topographical maps are multipurpose maps that present accurate graphic representations of the conditions of the earth's surface. They are drawn on a scale of 1:50,000 to 1:2,500,000. The following table shows the types of topographical maps owned, and the mapping problems faced, by the Survey of Kenya.

Table 1-3 Present Condition of Topographical Maps

Scale	Covered Area	Remarks
1 : 2,500,000	Whole area	●76cm×57cm, 6-colour maps ●For common use in 3 East African countries
1 : 1,000,000	Whole area	●5-clour maps of area at long. 6° and lat. 4° ●International 1:1,000,000 - scale map
1 : 250,000	Whole area	●67cm×44cm, 6-colour maps ●Contour line intervals: 200 feet and 60m ●The largest scale topographical maps which cover whole land area
1 : 100,000	Northern and northeastern parts	●55cm×55cm, 6-colour map which covers area of long. 30° × lat. 30° ●Cover areas for which 1:50,000,000 scale maps are not available
1 : 50,000	60% of total land area	●5-colour and 4-colour maps ●Cover the central, western and southern parts of Kenya ●A total of 827 such maps are required to cover the total land area, but in actuality only 509 of them are available.

Topographical maps in a scale of 1:50,000 are used widely in various development projects as multipurpose maps, but topographical maps of this type which are produced in Kenya has the following problems.

1. Maps of this type cover only about 60 percent of Kenya's land area, with no maps that cover the northern or northeastern part of the country produced yet.

2. Even the existing maps of this type have different contour line intervals of 10m, 20m, 40m, 50ft., or 10ft.

3. Information indicated in maps of this type is outdated.

Most of the topographical maps owned by the Survey of Kenya were produced by the Overseas Survey Department of Britain, to which those produced under the cooperation of Canada and Japan have been added. In this context, there is a strong need to implement surveying and mapping on a continual basis in the country.

2) Cadastral Maps

Cadastral surveying and adjudication are operations to demarcate owned or leased lots, measure the area of each lot, indicate land ownership and prepare land registers. In Kenya, cadastral maps are produced on the basis of existing aerial photographs and land surveying. Provincial and district offices of the Survey of Kenya are responsible for this operation. Cadastral maps in a scale of 1:10,000 are standard, and those in a scale of 1:5,000 or 1:2,500 are also used for areas where there are so many lot boundary lines. An increasing number of cadastral maps that cover major cities such as Nairobi, Mombasa and Kisumu, their suburbs and the western part of the country are being produced. But the existing cadastral maps have the following problems.

1. Cadastral maps covers only major cities, their suburbs and the western part of the country. It is necessary to expand the scope of cadastral maps production so that it may become a nationwide operation.

2. There is a strong need to introduce computer-aid mapping techniques and develop a database to store land registers. But efforts along these lines are not well under way.

3. Cadastral surveying and mapping is one of the main tasks of the provincial and district offices. But these offices are faced with a shortage of qualified survey technicians, which is delaying the progress of their cadastral map producing operations.

1,318,988 lots, total area of 6,885,329 ha had been registered by 1991 in accordance with the Land Registration Law enforced in 1968. It is imperative for the Survey of Kenya to have lots surveyed and mapped in

the entire northeastern part, the eastern part and the coastal area of the country. It is thus urgently necessary to increase the number of qualified land surveyors.

3) Thematic Maps

Topographical maps and cadastral maps are indispensable for the implementation of development projects in Kenya. The Survey of Kenya is also engaged in production of thematic maps for the use of the general public.

Table 1-4 Present Situation of Special Map in Kenya

Map	Scale	Remarks
City map	1 : 25,000 1 : 20,000 1 : 10,000	• Cover major cities such as Nairobi, Mombasa, Embu, Kisumu, etc.
Tourist map	1 : 1,750,000	• 6-colour map • Prepared for tourist spots across the country
National Park map	1 : 250,000 ~ 1 : 25,,000	• Safari maps covering major national park area in Kenya • Scale varies with the land area
National atlas of Kenya	1 : 3,000,000	• Prepared by revising the maps which were produced in the 1960s and were out print.

At present, these maps are published and sold by the Survey of Kenya, but some of them are hard to obtain because they either have been sold out or are out of print. It is desirable that the system for compiling, printing and selling these maps, which is in great demand, be improved.

4) Aerial Photographs

In Kenya, there are two types of aerial photographs available, one is in a scale of 1:50,000 to 1:90,000 and the other is in a scale of 1:50,000 or less. The following table shows the present situation of aerial photo production.

Table 1-5 Present Situation of Aerial Photographs

Map	Scale	Covered Area	Remarks
Small scale map	1 : 50,000 ~ 1 : 90,000	95% of total land area	• Most of them were prepared for the purpose of producing topographical base maps
Large scale map	1 : 15,000 ~ 1 : 50,000 and 1 : 3,000 ~ 1 : 15,000	30% of total land area	• Most of them cover the southern and western parts of Kenya • 1:15,000 scale maps of urban areas and along national routes. • Most of them were prepared for the purpose of producing cadastral maps and promoting road construction projects.

Aerial photographs in a scale of 1:50,000 to 90,000 were mostly produced by the Royal Air Force before 1970 and their films are not owned by the Survey of Kenya. As regards those in a scale of 1:50,000 or less, films of photos other than those produced by the Survey of Kenya for the production of cadastral maps and those prepared under the cooperation of Japan or Canada for the production of topographical maps are not owned by the Survey of Kenya.

The Survey of Kenya needs to produce more aerial photographs that contain the latest information in the course of production of cadastral maps. It is therefore necessary to raise the technical level of its staff members in charge of photogrammetry and to train such technical staff members.

As can be seen from the above descriptions, maps of various types which are in the possession of the Survey of Kenya are insufficient in terms of geographical coverage and the quality of land information. As is pointed out in the Seventh National Development Plan, topographical maps and cadastral maps are indispensable for the implementation of development projects, and it is imperative to improve the system for production of these maps in the country.

1-1-2 Surveying Technician Training

(1) Surveying Technicians

In Kenya, the introduction of computers and other advanced machines has greatly contributed to labor saving in the field of surveying and mapping. In order to promote the advancement of surveying and mapping programs in the country, however, there still is a strong need to train surveyors and other technicians in fields closely related to surveying. As of 1994, the country had a total of about 2,300 surveying technicians, a breakdown of which is shown in the following table.

Table 1-6 Breakdown of Total Number of Surveying Technicians in Kenya

Technical Field	Nos of Technicians		
	1989	1994	Increase(%)
1. Graduate Surveyors	240	336	96 (40%)
2. Technician Surveyors	779	844	65 (8%)
3. Technician Cartographers	670	742	72 (11%)
4. Technician Photolithographers	205	269	64 (31%)
5. Technician Photogrammetrist	100	111	11 (11%)
Total	1,994	2,302	308 (15%)

(Survey of Kenya)

In Kenya, one out of every 12,500 population is a survey technician. In Japan, on the other hand, there is a total of about 160,000 surveying technicians, or one in every 750 population. As is clear form this simple comparison, there is a serious shortage of surveying technicians in Kenya.

Fig. 1-4 shows an international comparison of populations per surveyor. While the population per surveyor is 3,400 in Japan, it is 38,000 in Kenya. The numbers of surveyors in Kenya is a good illustration of the shortage of surveying technicians in the country.

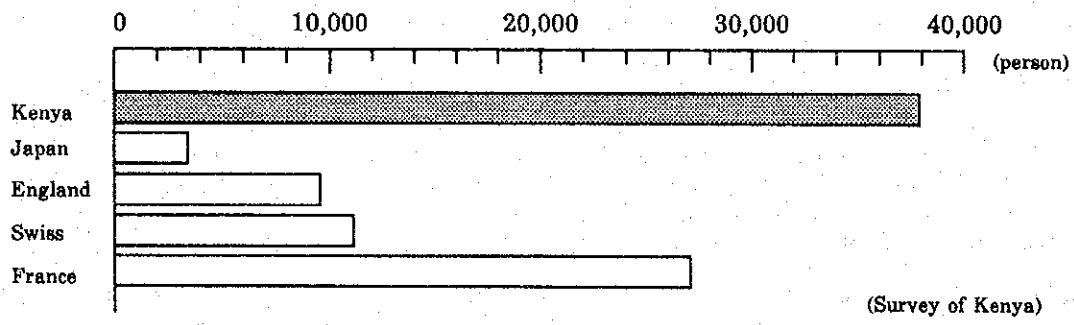


Fig. 1-4 International Comparison of Populations per Surveyor

In view of such a shortage of surveying technicians and the need to produce maps used for development projects, the Government of Kenya has been promoting the training of surveying technicians. In 1987, the President of Kenya, in his address to the national assembly, noted that it was urgently necessary to train 1,000 surveying technicians a year in order to implement Kenya's national development projects smoothly. In response, the Committee on Education and Manpower Training is in the process of working out concrete measures on the assumption that it would be necessary to train 150 surveyors and 250 other surveying technicians a year over a 10-year period from 1988.

(2) Educational Institutions Responsible for Surveying Technician Training

1) Brief History of Surveying Education in Kenya

In Kenya, surveying education started with the founding in 1950 of the Survey of Kenya Training School. The initial objective of the training school was to train European troops stationed in Kenya in surveying. In 1952, the training school was relocated within the Survey of Kenya's Field Headquarters, and in 1954, a total of 24 Kenyan trainees graduated from the training school to become Africa's first native surveyors. In 1956, Royal Technical College, the predecessor of the present University of Nairobi, was founded, where

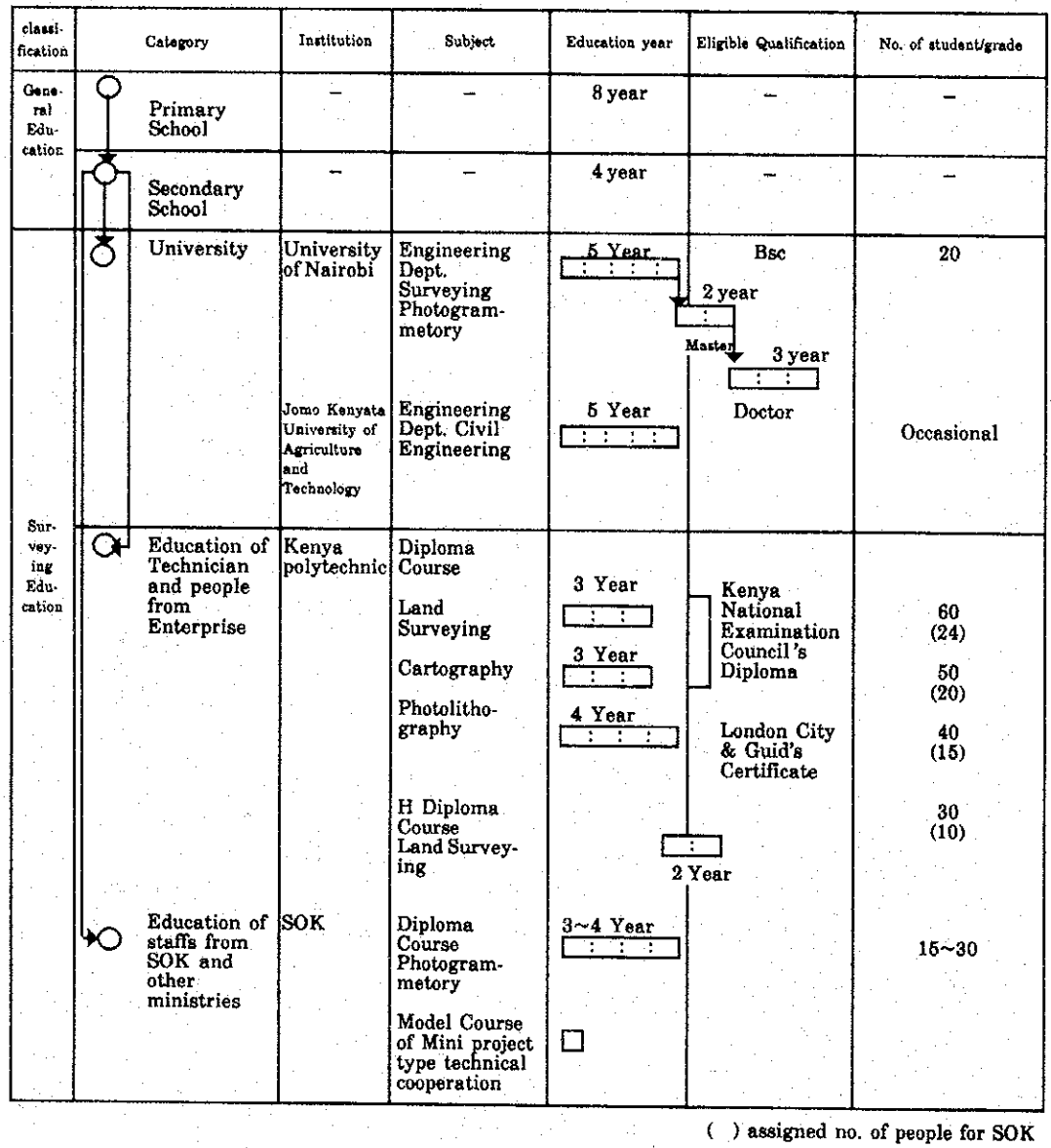
full-blown surveying education was started. Since the university was initially designed to train high-ranking government officials and corporate executives, however, it fell short of producing a sufficient number of surveying technicians. In 1970, therefore, Department of Surveying and Mapping designed to train practical surveying technicians was established within the Kenya Polytechnic.

These three institutions of surveying education have all undergone various reforms. But no other educational institutions to give surveying education have been founded in the country. This means that these three institutions of education are sill functioning as the country's most important institutions of surveying education.

2) Present State of Surveying Education in Kenya

In 1984, Kenya's educational system underwent a major reform. The "7-year primary school education, 4-year lower secondary school education, 2-year upper secondary school education and 3-year college education" system was changed to an "8-year primary school education, 4-year secondary school education and 4-year college education" system. In 1990, adjustment of the final academic years under the new system was completed and the new system was officially started. At present, training of survey technicians is conducted mainly at the University of Nairobi, the Kenya Polytechnic and the Survey of Kenya Training School.

A secondary school diploma under the new educational system is required for application for admission to these institutions. Fig. 1-5 gives an outline of surveying education in Kenya.



( ) assigned no. of people for SOK

Fig. 1-5 Outline of Surveying Education in Kenya

3) University of Nairobi

In the case of University of Nairobi, surveying education is given at the Department of Surveying in the Faculty of Engineering. The department offers undergraduate, master's and doctorate courses in land surveying, geodetic science and geoinformatics. Since first graduating 8 students in 1967, the department has so far graduated about 400 students, of which 60, or 15 percent, were students from other East African countries. At present, 25 to 30 students are

enrolled at the department every year, of which about 20 complete 5 years of study required for graduation. The rate of employment for the graduates of the department is 100 percent. Sixty percent of them are working as would be high-ranking officials at the Survey of Kenya, the Ministry of Public Works and Housing, the Ministry of Environment and other public organizations.

Each student enrolled at the department pays tuition fees in the amount of 6,000 Kshs/year and the government's grants-in-aid in the amount of 25,000 Kshs/year·student are given to the department. The university has hostel-facilities, but only a limited number of students are admitted to them.

4) The Kenya Polytechnic

In the case of the Kenya Polytechnic, surveying education is offered at its Department of Surveying and Mapping. Between 1970 and 1985, the college's Department of Civil Engineering was offering two diploma courses in surveying -- Land Surveying Course and Cartography Course. In 1986, the department added a new course "Higher Diploma" and as a result, the three courses were integrated into a single independent department, which is the present Department of Surveying and Mapping. Training in "Photogrammetry" which should be conducted at the college, is presently carried out at the Survey of Kenya Survey Training School, because of a lack of required training facilities. On the other hand, training in "Map Reproduction" is conducted at the Department of Graphic Art (Photography and Printing Course). The following table gives a summary of the present state of surveying education at the college.

Table 1-7 Present State of Surveying Education at Kenya Polytechnic

Organization	Department	Courses	Student		Term (Year)
Kenya Polytechnic	Surveying & Mapping	Land Survey	60	(24)	3
		Cartography	50	(20)	3
		Land Survey HD	30	(10)	2.5
	Graphic Art	Photolithography	40	(15)	4
Survey of Kenya		Photommetography and Remote Sensing	10		3 (4)

( ): student for SOK

Full quota of each of these courses differs from one grade to another. At present, 175 students/3 grades is the norm for the Land Surveying Course, and 150 students/3 grades for the Cartography Course. Of these full quotas, 80 to 85 percent complete their respective courses. In the case of classes of 30, about 24 complete their respective courses. More than 70 percent of the total number of students enrolled at the department are pre-service staff members of public organizations or private sectors.

More than 60 to 70 percent of the graduates of the department are employees, of which 30 percent are employed by construction companies and other private companies, 50 percent by the Survey of Kenya, and 20 percent by the Ministry of Public Works and Housing, the Ministry of Water Resources and other public organization. Each student enrolled at the department pays tuition fees in the amount of 9,000 Kshs/year. Those students who are pre-service staff members of public organizations or private sectors are exempted from tuition fees. The college has a hostel, but only a limited number of students are admitted to it.

As those in Fig. 1-6, the number of students enrolled at the Kenya Polytechnic is on the increase. It is reported that from 1972 to 1991

the number increased at an average annual rate of 4.4 percent. Therefore, when the Project is implemented, it is possible that the full quota of 69 assigned to the Survey of Kenya's pre-service staff member will open to other students. In this connection, it is desirable that the Project be implemented as soon as possible.

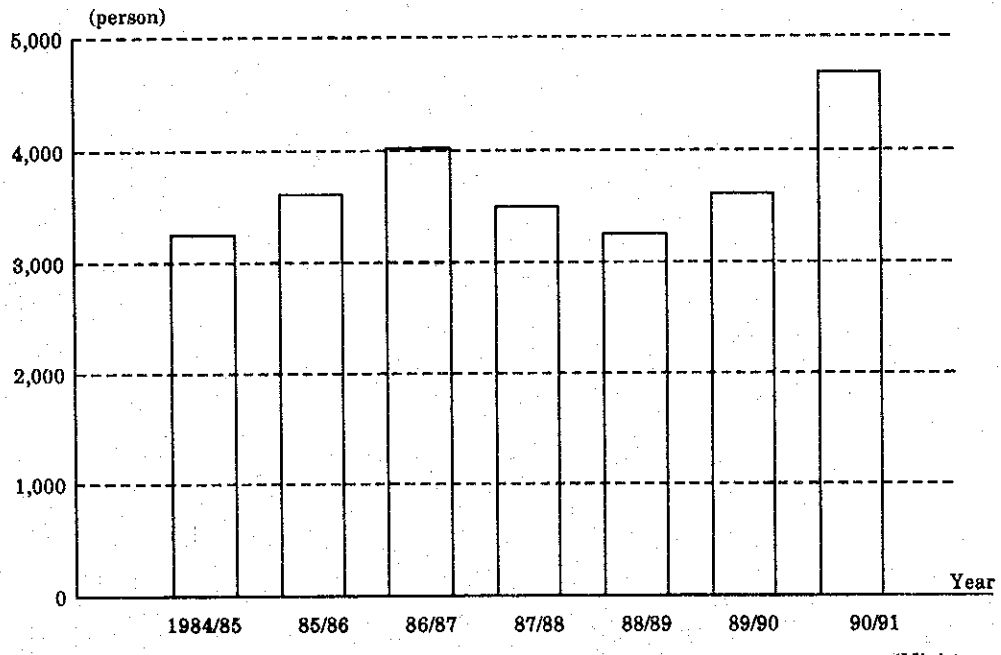


Fig. 1-6 Changes in Student Number at the Kenya Polytechnic (Ministry of Education 1991)

1-1-3 Present State of the Survey of Kenya

The Project is to be implemented with the aim of training the Survey of Kenya's pre-service and in-service staff members in surveying and mapping. The Survey of Kenya is the Kenyan organization responsible for the implementation of the Project. This means that most of the trainees and instructors eligible for surveying training under the Project are staff members of the Survey of Kenya. Since the Project is so closely related to the Survey of Kenya, the Project is reflected in the details of the present state of the Survey of Kenya.

(1) Organization

The Survey of Kenya is operating under the Ministry of Lands and Settlement. Its organizational structure is as illustrated below.

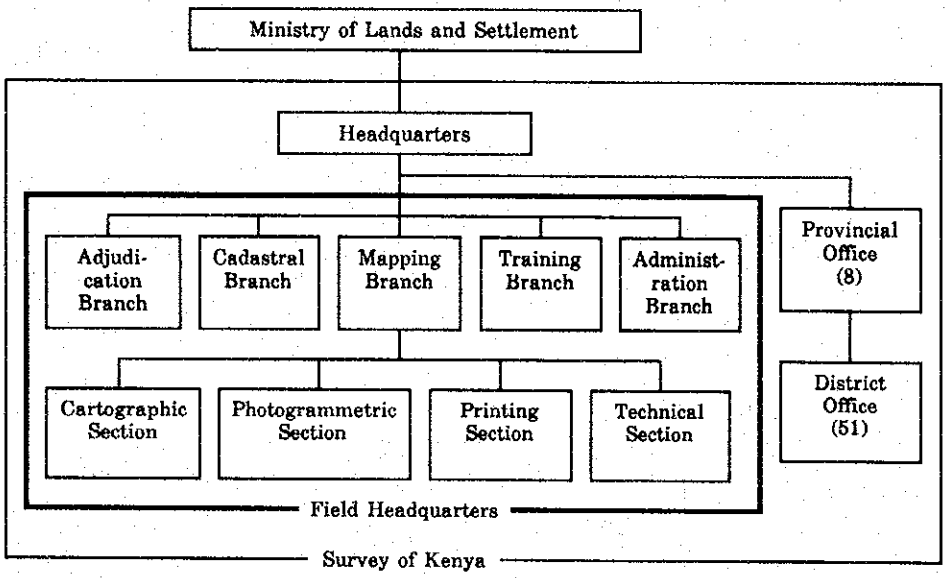


Fig. 1-7 Organizational Structure of the Survey of Kenya

The Survey of Kenya has its Headquarters and Field Headquarters in Nairobi City. Its Headquarters are within the Ministry of Lands and Settlement in the central area of Nairobi City. Its Headquarters' facilities include the director's office, the deputy director's office and other senior managers' offices. Its Field Headquarters are located 6km away from the center of Nairobi City, where are technical departments responsible for surveying and mapping. The Project is to be implemented in one corner of the premises of the Field Headquarters.

(2) The Survey of Kenya's Main Activities

The Survey of Kenya, as one of public organizations, is carrying out surveying and mapping activities in accordance with the following working process.

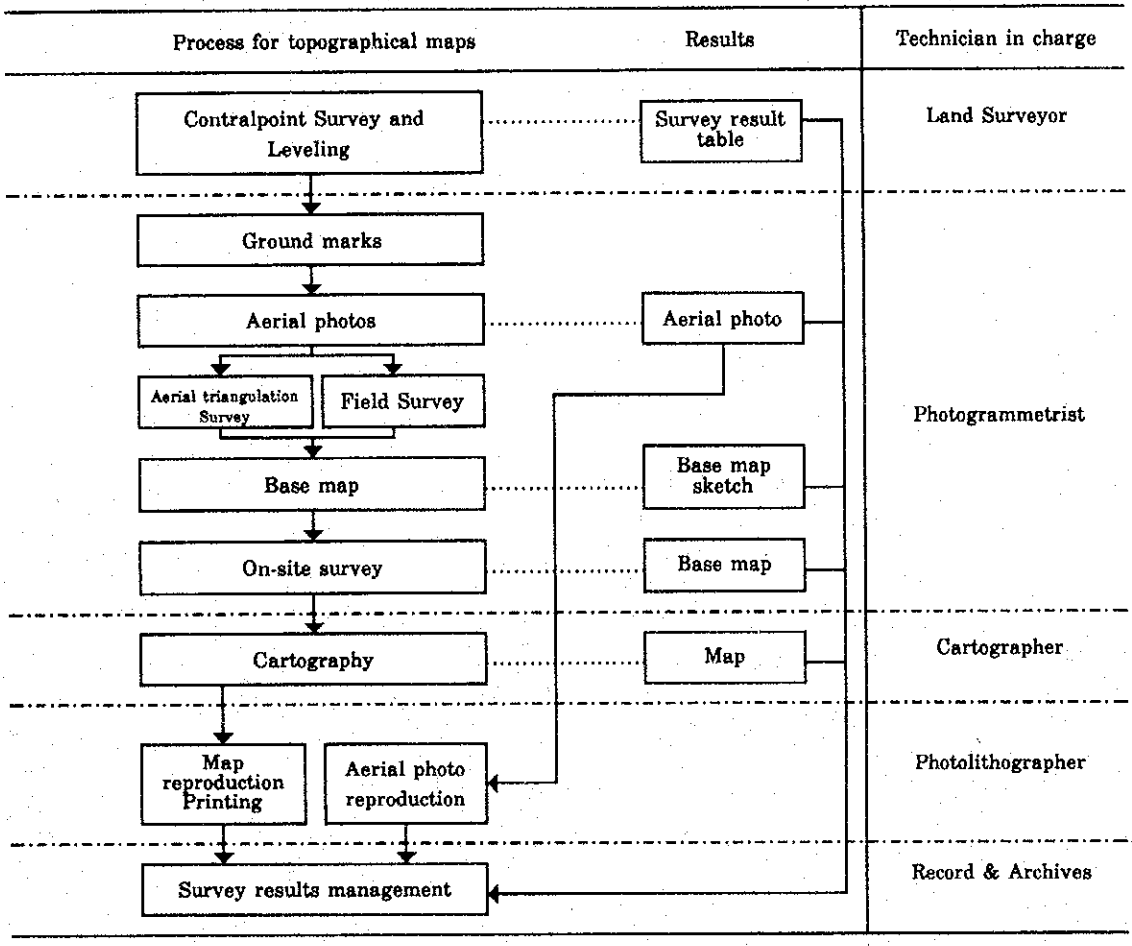


Fig. 1-8 Survey of Kenya's Activities

The details and the actual situation of the Survey of Kenya's activities are as described below.

1) Contralpoint Survey

Determining the correct position of each point on the ground is a precondition for the production of topographical maps. A triangulation point indicates the correct position of a point on the ground relative to the origin of longitude and latitude. The Survey of Kenya has so far established, and is managing, 547 first-order triangulation points, 998 second-order triangulation points and 2,500 third-order/fourth-order triangulation points. However, most of these triangulation points were established by the Overseas Survey

Department of Britain before 1963. Some of them have been destroyed and more than half of them have become less precise. At present, the Survey of Kenya is faced with a need to restore the destroyed triangulation points.

2) Leveling

A bench mark means a mark on a permanent object at a point whose exact elevation is known. Bench marks are established along main roads at intervals of 1km to 2km. The Survey of Kenya has been conducting geodetic leveling since 1949 using the mean sea level as the bench mark. At present, it is reported that the total length of its network of bench marks is approximately 3,500km. The problem is that most of these bench marks are only established on roads running along the Trans-Kenya Railway tracks that start from Mombasa and lead to Tanzania and Uganda.

3) Photogrammetric Survey

Photogrammetric survey is the practices of identifying specific objects and measuring their shapes and heights by the use of aerial photographs. It is conducted in the process of production of base topographical maps. Since at the Survey of Kenya, aerial photographs are used in the production of cadastral maps as basic data, it is imperative to improve the quality of aerial photographs. Most of the aerial photographs owned by the Survey of Kenya were taken by the Royal Air Force before 1970. In the case of aerial photographs taken on a scale of 1:50,000, in particular, they cover only 30 percent of total land area of the country. The Survey of Kenya's Section of Photogrammetry, which is responsible for taking aerial photographs, is

in the possession of plotter, point pricking machine, and aerial cameras.

4) Cadastral Survey

Cadastral Survey and Adjudication are activities to produce maps indicating the boundary line of each owned or leased lot, measure the area of each lot on these maps and prepare land registers. At the Survey of Kenya, cadastral survey is conducted using aerial photographs. Its provincial and district offices are responsible for conducting cadastral surveys. At present, efforts to use a computer for the modification of cadastral maps, to automate demarcation of boundaries and to develop a data base to store land registers are being made at the Survey of Kenya. But these efforts have not yet proven practicable. Cadastral maps, constitute a basic element of land information, are therefore indispensable for the smooth implementation of the country's national land use plan. The problem is that at present, the Survey of Kenya has so far produced cadastral maps and completed adjudication for only 25 percent of the country's total land area.

5) Cartography

Cartography is the practice of compiling base maps and thematic maps based on sketches drawn by the use of a plotter or compiled sketches. At the Survey of Kenya, the Section of Cartography is responsible for this activity. At the section, most of the cartographic activity is conducted manually, and therefore it takes a great deal of time to compile a single map. For this reason, 35 percent of the total number of the Survey of Kenya's technical staff members are cartographers. In this field, however, computerization for example, computer aided

mapping is well under way, and the percentage of computer aided mapping is increasing at the Survey of Kenya.

6) Map Reproduction

At the Survey of Kenya, various maps are printed mostly offset. Its main printing machines are offset system provided under a grant aid in 1989 by the Government of Japan. These offset printers are capable of automatic large-quantity printing, but due to a shortage of printing materials and paper, which is attributable mainly to budgetary limitations, these printers are actually used for small-quantity printing. Printing operations as part of map reproduction are facing stiff technological competition against private sectors and many of photolithographer of the Survey of Kenya retire and move to private sector, which is causing a shortage of these technicians at the Survey of Kenya.

7) Sale of Maps

The Survey of Kenya keeps records of the maps produced and are selling some of them. Tourist maps and other maps are sold at the Survey of Kenya's Field Headquarters, but maps for professional use, such as topographical maps in a scale of 1:50,000, are sold subject to the approval of the director of the Survey of Kenya. The sale of these maps is managed scrupulously, with records of their sales being kept. In line with the economic development in Kenya, demand for maps is growing. It is desirable, therefore, that the Survey of Kenya's map record and archives section be enlarged through, for example, the opening of a sort of map center.

8) Training

The Survey of Kenya has "Training Branch", which is training mainly its pre-service staff members in photogrammetric surveying. The training courses provided by the department are considered equivalent to the diploma courses in land surveying and cartography by the Department of Surveying and Mapping of the Kenya Polytechnic, and those trainees who complete these courses are awarded diplomas. At present, the branch has only two classrooms, and practical training is conducted using the equipment installed in the Survey of Kenya's Field Headquarters.

(3) Personnel

The Survey of Kenya has a staff of 3,446 (as of the end of 1994), including the total number of staff members of the provincial offices, of which 949 are technical staff members eligible for surveying training under this project. The following table shows a breakdown by type of job of the total number of its staff members.

Table 1-8 Breakdown by Type of Job of the Total Number of the Survey of Kenya's Staff Members

Position	Staff	Note
1. Director	1	
2. Deputy Director	1	
3. Assistant Director	6	
4. Superintending Surveyor	10	
5. Survey Technician	381	Technical 949 Staff
6. Land Surveyor	86	
7. Photogrammetrist	58	
8. Cartographer	316	
9. Photolithographer	90	
10. Administration Staff	539	Others 2,497
11. Worker	1,958	
Total	3,446	

The following table shows a breakdown by area of the total number of the Survey of Kenya's staff members.

Table 1-9 Breakdown by Area of the Total Number

Office	Staff	Remarks
1. Head Office	860	Two separate places in Nairobi.
2. Provincial Office	349	8 offices
3. District Office	2,237	51 offices
Total	3,446	

(4) Budget

The following table shows trends in the Survey of Kenya's budget during the past five years.

Table 1-10 Trends in the Survey of Kenya's Annual Budget

Item	90/91	91/92	92/93	93/94	94/95
1. Recurrent	5,730,045	5,756,948	4,046,721	7,863,436	8,685,240
2. Development	1,751,535	1,724,000	463,563	1,271,000	1,025,000
3. Foreign Aid	1,424,000	1,424,000	363,012	1,000,000	675,000
4. Fee (AiA)	593,695	712,430	769,420	846,362	1,355,998
Total	9,499,275	9,617,378	5,642,716	10,980,798	11,741,238

(K£)

During the past five-year period, from fiscal 1990/91 to fiscal 1994/95, the Survey of Kenya's annual budget grew about 25 percent. In other words, it grew about 5 percent annually. Given the annual inflation rates during the five-year period, it can be said that there has been hardly any real increase in its annual budget during the five-year period. One of the main reasons for this was that while its current budget, which covers personnel and facility operating expenses, increased by about 51 percent during the five-year period, its development budget decreased by about 41 percent during the same period. During the five-year period, the Survey of Kenya's budget for the installation of new facilities and

equipment has been cut down, which in turn has resulted a shortage of new facilities and equipment.

The amount of the annual budget for fiscal 1994/95 of the Ministry of Lands and Settlement, which exercises control over the Survey of Kenya, is 29,735,863K£, which is about 39 percent of the amount of the Survey of Kenya's annual budget for the fiscal year.

(5) Problems in the Survey of Kenya

1) Shortage of Technical Staff Members

Of the Survey of Kenya's 3,446 staff members, 949 are technical staff members. Increasing its technical staff is indispensable for the Survey of Kenya's effort to enhance surveying and mapping activities in the country. At present, the Survey of Kenya is recruiting about 45 technical staff (mostly graduates of the Kenya Polytechnic) a year on the average. On the other hand, however, about 22 technical staff (including those who reach retirement age) quit the Survey of Kenya every year on the average. Thus, actually the Survey of Kenya's technical staff is increasing only by about 23 annually. In addition, it is predicted, on the one hand, that the annual number of retiring technical staff will exceed 40 person per year for 10 years after the year 2004 when technical staff members in their age 30s or 40s reach retiring age. On the other, it is difficult for the Kenya Polytechnic, the country's largest institute of surveying education, to increase the number of graduates of its Department of Surveying and Mapping in keeping with the Survey of Kenya's plan to increase its technical staff, because of restrictions on the installation of new facilities and the size of the teaching staff.

2) Need to Retrain In-service Staff Members

In the field of surveying and mapping, many technological improvements are being made and advanced technologies are being introduced one after another. For example, the introduction of computers in this field is phenomenal. Such computerized systems as "Numerical Land Information System," "Geographical Information System" and "Remote Sensing System" have been put to practical use. The Survey of Kenya is therefore faced with the need to introduce such new technologies to conduct surveying and mapping on the international technical level. In this connection, the Survey of Kenya has to re-educate and retrain its in-service staff members regularly.

3) Shortage of Facilities and Equipment Required for Training Survey Technicians

The Survey of Kenya has "Training Branch," which is responsible for training pre-service staff members in "photogrammetry." However, this branch is presently equipped with only two lecture rooms and has not its own training equipment. At the branch, its Field Headquarters' equipment is used for training purposes. On the other hand, the Survey of Kenya is commissioning the Kenya Polytechnic to train its pre-service staff members in land surveying, cartography and map reproduction. It will be therefore more effective for the Survey of Kenya to conduct its own training programs by the use of improved facilities and equipment in training practical surveying technicians to meet its practical activities.

1-2 Outline of the Request and the Main Components

The outline of the Government of Kenya's request for Japanese grant aid cooperation and the main required components for the Project, which have been confirmed as a result of the basic design study, are as follows.

(1) Objective of the Request

The direct objective of the Project is to improving the Survey of Kenya's facilities and equipment for use in training of its technical staff members through the establishment of "the Kenya Institute of Surveying and Mapping." The final goal of the Project is to train the Survey of Kenya's pre-service and in-service staff members to increase the number of its technical staff members, as well as to improve their skills.

(2) Project Implementing Organization

The Project is to be implemented by the Survey of Kenya under the Ministry of Lands and Settlement.

(3) Details of The Project

"The Kenya Institute of Surveying and Mapping." which is to be established under the Project, will carry out the following activities.

1) Training of Pre-service Staff Members

The institute will train graduates of secondary schools under the new educational system so that they may be qualified as pre-service staff members of the Survey of Kenya.

Table 1-11 Pre-service Staff Member Training Courses

Training Course	Term (Year)	Student (per/year)
1. Land Survey	3	48
2. Cartography	3	25
3. Photogrammetry and Remort Sensing	3	15
4. Map Reproduction	3	15
Total		103

2) Training of In-service Staff Members

The institute will also train in-service staff members of the Survey of Kenya for the purpose of enhancing the technical level of these staff members.

Table 1-12 In-service Staff Member Training Courses

Training Courses	Term (Year)	Student (per/year)
1. Land Survey	2.5	10
2. Cartography	2.5	15
3. Photogrammetry	2.5	5
Total		30

(4) Project Site

The project site is a vacant plot of land of the premises of the Survey of Kenya's Field Headquarters. It is located 6km northeast of the center of Nairobi City, at lat. 1° 15'S and at long. 36° 55'E. It is 1,700m above sea level.

(5) Outline of the Requested Facilities and Equipment

The following facilities and equipment for use in surveying training were requested by the Government of Kenya.

1) Facilities

Building	Scale	Major Facility
1. Administration Bldg.	800 m² (2 story)	Administrative office, Meeting room, etc.
2. Laboratory Bldg.	1,240 m² (2 story)	Classrooms, Laboratories, Lecture hall, Library, etc.
3. Hostel	1,120 m² (3 story)	Hostel, Canteen, Kiosk
4. Others	150 m² (2 story)	Garage, Guard house
5. Play ground	—	Soccer ground

2) Equipment

Training course	Equipment	Q'ty
General use equipment	1. Tables and chairs for classrooms, lecture hall and laboratories	1 set
	2. Electric typewriter	1 set
	3. Overhead projector	1 set
	4. Slide projector	1 set
	5. Duplicating machine	1 set
	6. Audio visual equipment (video camera, video deck, etc.)	1 set
	(Other 14 items)	
Land survey equipment	1. GPS equipment	5 sets
	2. Theodolite (3 types)	37 units
	3. EDM equipment (3 types)	13 units
	4. Level (6 types)	28 units
	5. Calibration system	1 set
	6. Equipment for physics laboratory	1 set
	7. Total station	3 sets
	8. Tachymeter	3 units
	(Other 26 items)	
Cartographic equipment	1. Planimeter (2 types)	20 units
	2. Pantograph (2 types)	4 units
	3. Stereo zoom transferscope	2 units
	4. Light table (2 types)	40 units
	5. Duplicating machine (A0 size)	2 units
	6. CAC equipment	1 set
	(Other 29 item)	

Training course	Equipment	Q'ty
Photogrametric and remote sensing equipment	1. Analytical plotter (for training purpose)	2 units
	2. Analytical plotter	1 unit
	3. Aerial camera simulator	1 unit
	4. Point pricking machine	1 unit
	5. Mirror stereoscope	12 units
	6. Twin stereoscope	12 units
	7. Software for image analysis	1 set
	8. Software for aerial triangulation	1 set
	(Other 16 items)	
Map reproduction equipment	1. Proofing press	1 unit
	2. Printing press	1 unit
	3. Colour scanner	1 unit
	4. Desktop publishing system	1 set
	5. Process camera (small size)	1 unit
	6. Film processor	1 unit
	7. Plate processor	1 unit
	8. Printing ink testing machine	1 unit
	(Other 62 items)	
Library equipment	1. Magazine storage box	240 pcs.
	2. Reading table and chair	1 set
	3. Map filing cabinet	2 units
	4. Monograph card catalogue duplicating machine	1 unit
	5. Unit shelves	50 units
	(Other 31 items)	
Computer laboratory equipment	1. Personal computer	25 units
	2. Printer	25 units
	(Other 4 items)	
Vehicles	1. Minibus	2 units
	2. 4WD wagon	6 units
	3. Pickup truck	
	(Other 5 items)	

1-3 Project and/or Program of Other Donors

1-3-1 By The Government of Japan

Shown below is an overview of the Government of Japan's assistance to the fields of surveying and mapping in Kenya.

(1) Provision of Equipment

- 1984 Provision of Equipment
  (a set of surveying instruments)
- 1987 Provision of equipment
  (a set of surveying instrument)
- 1988 Grant aid cooperation "Project for Procurement and Installation of Survey Equipment"
  (a set of surveying instruments worth ¥518 million)
- 1989 Provision of equipment
  (a set of surveying instruments)
- 1991 Provision of portable equipment
  (a set of surveying instruments)

(2) Technical Cooperation Projects

- 1975~80 "Project for the Production of Base Maps of the Eastern Area of Kenya"
  (production of 37 topographical maps of the eastern part of Kenya; scale 1:50,000)
- 1987~90 "Project for the Production of Base Maps of the Southern Part of Kenya"
  (production of 54 topographical maps of the southern part of Kenya; scale: 1:50,000)

(3) Dispatch of Japan Overseas Cooperation Volunteers' Members

- 1987~94 6 members

(4) Survey Training Program

- Period : April 1991 to March 1994
- Dispatch of experts: long term experts: a total of 5
  short term experts: a total of 8
- Acceptance of Kenyan counterparts:
  5 persons
- Provision of equipment:
  a total of ¥51 million

(5) Project-type Technical Cooperation ("Kenya Institute of Surveying and Mapping Project")

- Period : October 1, 1994 to September 30, 1999 (5 years)
- Dispatch of experts:
  long term experts: 8 fields
  1. Chief Advisor
  2. Coordinator
  3. Training Planner
  4. Geodesic Surveying
  5. Cadastral Surveying
  6. Cartography
  7. Photogrammetry & Remort Sensing
  8. Map Reproduction

  short term experts: 4 fields
  1. Land Surveying
  2. Cartography
  3. Photogrammetry & Remort Sensing
  4. Map Reproduction
- Provision of equipment:
  Part of training equipment for use in four fields of land surveying, cartography, photogrammetry and remote sensing, and map reproduction

1-3-2 By The Government of France

For the Survey of Kenya, a technical cooperation program for the provision of equipment for use in computer mapping and the dispatch of short term experts was implemented by the Government of France. Since 1991, however, aid-providing countries have frozen their respective technical cooperation programs due to the delay in structural adjustment within the Government of Kenya. The Government of France has also frozen the above-mentioned technical cooperation program. The freeze was removed in 1994. The Government of Kenya requested the Government of France to resume the technical cooperation program, and the Government of France has resumed the computer mapping program in due time. The program is designed to make the Survey of Kenya's surveying and mapping operations more efficient. In order to enhance the effect of the introduction of new mapping technology by the Government of France, it is necessary to nurture and train the institution's technical staff members under the Project.

CHAPTER 2 OUTLINE OF THE PROJECT

CHAPTER 2 OUTLINE OF THE PROJECT

2-1 Objectives of the Project

Under the Project, the Kenya Institute of Surveying and Mapping, which is a training facility for technical staff members of the Survey of Kenya, will be established. The Survey of Kenya is a public organization responsible for the production of various types of maps, including topographical maps and cadastral maps, required to promote the land use plan in the country. The main objectives of the Project are as follows.

2-1-1 Staff Increase Plan

(1) Trends in the Number of Staff Members of the Survey of Kenya

At present, the Survey of Kenya has a staff of 3,446, a breakdown by type of job and full quota of which is as shown in Table 2-1.

Table 2-1 Number of Staff Members of the Survey of Kenya

Position	in 1994	Scheduled	Shortage
Director	1	1	0
Deputy Director	1	1	0
Assistant Director	6	6	0
Superintending Surveyor	10	16	6
Land Surveyor	86	108	22
Survey Technician	381	477	96
Photogrammetrist	58	68	10
Cartographer	316	405	89
Photolithographer	90	118	28
Administration Staff	539	618	79
Labour	1,958	2,088	130
Total	3,446	3,906	460

On the other hand, trends in the number of technical staff members of the Survey of Kenya during the period from 1987 to 1993 are as shown in Table 2-2. The table shows that the number of Survey of Kenya's staff members increased by about 23 per year on the average during the period.

Table 2-2 Trends in the Number of the Technical Staff Members of the Survey of Kenya

Item	Total Nos during 1987~1993	Average Annual Increase	Remarks
Recruits	320	45	Recruited mainly from among the graduates of the Kenya Polytechnic.
Retirees	149	22	Ten years from now, the annual number of retirees will be 40.
Increase	171	23	

If the number of the Survey of Kenya's technical staff members is to increase at the present rate, it will take more than 10 years to recruit the required additional 250 technical staff members. It will therefore be difficult for the Survey of Kenya to attain the goal of recruiting an additional 1,000 technical staff members.

Moreover, as shown in Fig. 2-1, many of the Survey of Kenya's technical staff members are in their 30s or 40s. There are 40 of them on the average in each age within this age bracket.

This means that for 10 years after the year 2004 when those in this age bracket reach retirement age, about 40 will retire every year and that the yearly increase in the number of the institute's technical staff members will be only 5.

For this reason, the Survey of Kenya plans to train 103 pre-service staff members in surveying and mapping every year by implementing the Project in parallel with a project-type technical cooperation program.

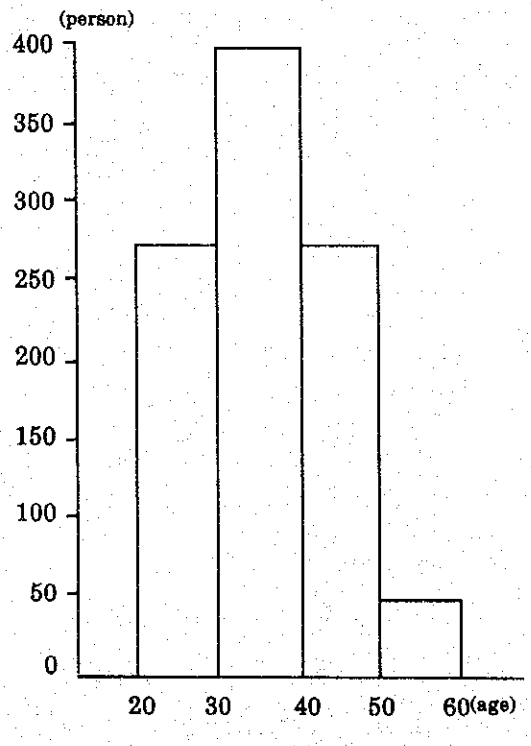


Fig.2-1 Age distribution of the Technical Staff Members of the Survey of Kenya

(2) Staff Increase Plan under this Project

When the training of pre-service staff members is carried out under the Project, it is expected that about 60 pre-service staff members will be recruited every year by the Survey of Kenya. Under the Survey of Kenya's training plan, 103 pre-service staff members are to take the diploma courses. Judging from the past records of other surveying and mapping educational institutions in the country, about 60 percent, or about 60 of the 103 trainees, namely the trainees other than those fail to pass the graduation examination and those who work for other organizations after graduation, will be recruited by the Survey of Kenya after graduation.

On the other hand, judging from the present percentage composition of the Survey of Kenya's technical staff members, about 22 will retire every year during 10 years from now, and about 40 during the next 10 years.

Under those conditions described above, the Survey of Kenya's staff increase plan for the years after the implementation of the Project is thus as shown in Fig.2-2. As is clear from this Fig., given that 60 pre-service staff members will be recruited every year by the Survey of Kenya from 1999 when the first graduates of the planned institute are to be recruited by the Survey of Kenya, there can be 70 more graduates recruited by the Survey of Kenya 5 years later, in 2004, than in the case of the present annual rate of increase in the number of these technical staff members.

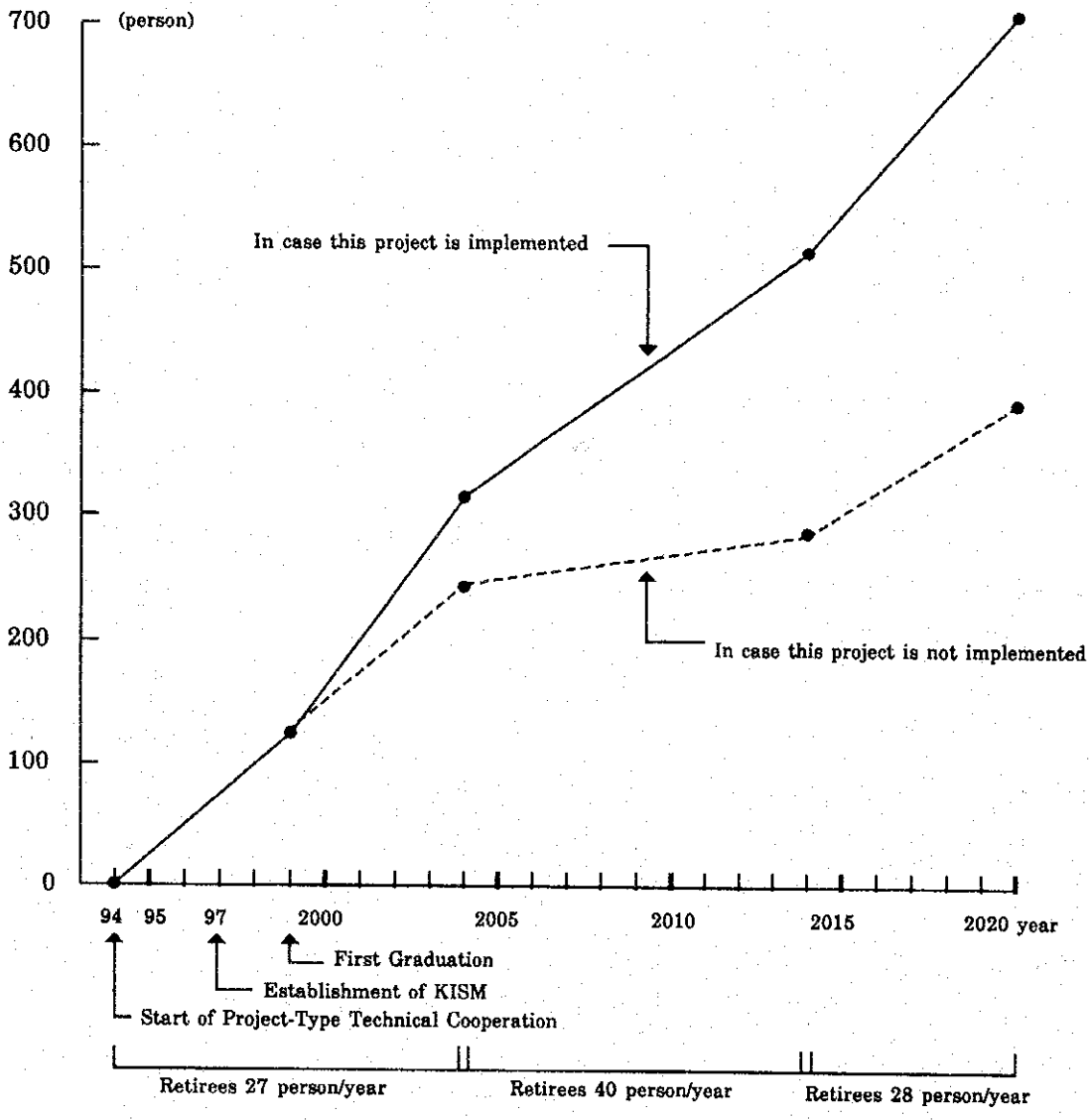


Fig. 2-2 Staff Increase Plan

2-1-2 Training Programs

The direct objective of the Project is to train mainly the technical staff members of the Survey of Kenya by establishing the Kenya Institute of Surveying and Mapping in parallel with the Government of Japan's project-type technical cooperation program. The planned institute's training programs are divided broadly into those for the Survey of Kenya's pre-service staff members and those for its in-service technical staff members. Both types of training programs are to be carried out within the

framework of the Government of Japan's project-type technical cooperation, and their respective contents are as stated below.

(1) Training Program for Pre-service Staff Members

This program consists of 4 diploma courses for the Survey of Kenya's pre-service staff members. It consists of 4 courses, and is to be implemented under the following scale and curriculum. Since the Kenya Institute of Surveying and Mapping is to be established as a formal educational institution of Kenya, the contents of its curriculum will become formal after they are reviewed and approved by the Kenya Institute of Education.

Table 2-3 Subjects in 4 Diploma Courses

Diploma Course: 4 department, 103 trainees/grade, 3 years (2,970 hours)									
Subject	Hours				Department				Remarks
	Lecture	Lab.	Field	Total	Land Survey (48)	Carto-graphy (25)	Photogram-metry (15)	Map Re-production (15)	
Social Studies	88	–	–	88	○	○	○	○	General
Entrepreneurship	124	–	30	154	○	○	○	○	
Communication	88	–	–	88	○	○	○	○	
Computer	48	30	10	88	○	○	○	○	
Mathematics	198	–	–	198	○	○	○	○	
Physics	77	77	–	154	○	○	○	○	
Geography	124	–	30	154	○	○	○	○	
CAM	40	26	–	66	○	○	○	○	
Management	88	–	–	88	○	○	○	○	
Photogrammetry	80	52	–	132	○	○	○	○	
Land Law	88	–	–	88	○	–	–	–	Land Survey
Survey Instrument	60	50	–	110	○	–	–	–	
Topo-Surveying	50	60	22	132	○	–	–	–	
Cadastral Survey	33	77	–	110	○	–	–	–	
Engineering Survey	66	88	–	154	○	–	–	–	
Survey Control	132	176	–	308	○	–	–	–	
Project	33	33	–	66	○	–	–	–	
Cartography	62	70	–	132	○	–	○	–	

Subject	Hours				Department				Remarks
	Lecture	Lab.	Field	Total	Land Survey (48)	Carto-graphy (25)	Photogram-metry (15)	Map Re-production (15)	
Land Survey	62	70	–	132	–	○	○	–	Cartography
Applied Cartography	138	170	–	308	–	○	–	–	
Cartographic Reproduction	60	66	6	132	–	○	–	–	
Cadastral Cartography	170	280	12	462	–	○	–	–	
Project	33	33	–	66	–	○	–	–	
Remote Sensing	128	190	12	330	–	–	○	–	Photogram-metry
Photogrammetry	240	310	18	638	–	–	○	–	
(not available)				1,232	–	–	–	○	Map Reproduction
Industrial Attachment				660	○	○	○	○	

The detail of training program for each of the four courses, which is designed to be implemented under the project-type technical cooperation program is as shown in "Annex" attached at the end of this report.

(2) Training Program for In-service Staff Members

Two training courses which are Higher Diploma Course and Short-term Training Program will be available to in-service staff members. Those who complete Higher Diploma Course and pass the qualifying examination will be awarded higher diploma certificate. The contents of the curriculum of this course will also need to be reviewed and approved by the Kenya Institute of Education. Subjects shown in the following table are those for the courses in Land Surveying. Those for the courses in Cartography (full quota: 15/grade) and Photogrammetry and Remote Sensing (full quota: 5/grade) are to be determined in the future under the project-type technical cooperation program.

Table 2-4 Subjects of Higher Diploma Course

Higher Diploma Course: 3 department, 30 person/grad, 2.5 years (1,215 hours)								
Subject	Hour				Department			Remarks
	Lecture	Lab.	Field	Total	Land Survey (10)	Cartography (15)	Photogrammetry and Remort Sensing (5)	
Mathematics	198	-	-	198	○	-	-	
Physics	77	77		154	○	-	-	
Cartography	186	66	8	260	○	-	-	
Programming	30	36	6	72	○	-	-	
Plane Surveying	60	70	8	138	○	-	-	
Photogrammetry	280	110	13	403	○	-	-	
Field Astronomy	60	12	-	72	○	-	-	
Land Law	72	-	-	72	○	-	-	
Related Studies	72	-	-	72	○	-	-	
Total	809	371	35	1,215				

2-2 Study and Examination on the Request

2-2-1 Examination of the Contents of the Project

(1) Examination of the Appropriateness and Necessity of the Implementation of the Project

The appropriateness and necessity of the implementation of the Project are examined in terms of major problems to be resolved in promoting surveying and mapping in Kenya and the present state of the technical staff of the Survey of Kenya, which is the Kenyan organization responsible for the implementation of the Project.

1) Problems to be Resolved in Promoting the Advancement of Surveying and Mapping in Kenya

The Government of Kenya's 7th National Development Plan (1994/96) includes a new chapter, "Land Use Policy", which chapter emphasizes land use as an important element of the national development policy. It is stated in the new chapter that topographical and cadastral information should be developed and utilized in the planning stages of various development projects so that these development projects may be carried out smoothly and effectively keeping in harmony with natural conditions. However, maps owned by the Survey of Kenya are insufficient in terms of the areas covered and do not include the latest topographical and cadastral information. For example, topographical maps in a scale of 1:50,000, which are used widely as multipurpose maps cover only 60 percent of the country's total area. Moreover, most of these maps were prepared before 1980. In Kenya, it is expected that various development projects implemented in keeping with the growth of the economy of the country. The Survey of Kenya, therefore, needs to expand the scope of its activities in order to be

able to provide precise land information that complies with its quality standard.

2) Present State of the Survey of Kenya's Technical Staff Members

In order to expand the scope of the Survey of Kenya's activities, it is necessary to increase the number of its technical staff members. In the 7th National Development Plan, it is pointed out that cadastral maps, clearly indicating land ownership, must be prepared as soon as possible if development projects are to be carried out smoothly and effectively. In order to develop such cadastral maps, it is necessary to have a large number of land surveyors stationed in many parts of the country. On the other hand, the Survey of Kenya currently has a total of 949 technical staff members and plans to increase the total number of its survey technicians to 1,200. However, the Survey of Kenya has so far increased the total number of its technical staff members by 20 to 25 a year on the average. In addition, since the number of technical staff members who reach retirement age is on the rise, it will be very difficult for the institute to realize a substantional increase in the number of pre-service staff members. If no significant changes are made in the above-mentioned situation, it is expected that 10 years from now, the yearly increase in the total number of its technical staff members will fall to between 5 and 10. It is therefore necessary for the Survey of Kenya to increase the number of its pre-service staff members.

(2) Examination of the Necessity of Survey Training

The Survey of Kenya is commissioning the Kenya Polytechnic to conduct training of its pre-service staff members. Education given at the Kenya Polytechnic, however, is not intended solely for the training of the

Survey of Kenya's staff members. Consequently, surveying education offered at the college is not completely in line with the practical training requirements of the Survey of Kenya. The college's Department of Surveying and Mapping has only 16 lecturers, which number is not sufficient for the number of students enrolled at the department. Moreover, the department is not provided with sufficient facilities and equipment and many of them are superannuated. The college is thus not in a position to give surveying education at the level required by the Survey of Kenya. Due mainly to a lack of fiscal resources, there is little prospect of the department being expanded or becoming able to meet the training requirements of the Survey of Kenya.

If systematic surveying training is given within the Survey of Kenya, it will be the most effective way of providing practical surveying training that covers all the branches of the field of surveying and mapping technology.

(3) Examination of the Project Implementation Plan

When the Kenya Institute of Surveying and Mapping is established under the Project, most of its lecturers and clerical staff members will be recruited from among the present staff of the Survey of Kenya, with few additional staff members being newly recruited. On the other hand, since the planned institute is to operate as a part of the Survey of Kenya, it will be necessary to secure the budget for the maintenance and management of its facilities by increasing the amount of the Survey of Kenya's operating expenses accordingly. Stated below are the results of the examination of the Kenyan side's staffing and budget plans and their feasibility.

1) Staffing

Under the Survey of Kenya's staffing plan for the Project, the planned institute is to start with a staff of 197, including 67 lecturers. These staff members are to be recruited from among the present staff of 3,446 of the Survey of Kenya. Since the initial staff of the planned institute accounts for only 5.7 percent of the Survey of Kenya's present staff, there will be no problem with the staffing plan for the Project. The teaching staff of the planned institute accounts for about 7 percent of the Survey of Kenya's technical staff of 947. In view of the fact that the main objective of the planned institute is to offer practical training in surveying and mapping, its lecturers must be proficient in the practical aspects of surveying and mapping. It will be therefore possible to recruit such lecturers from among the Survey of Kenya's technical staff members.

2) Budget

It is expected that a sum of 556,637 K£ will be appropriated for the operation of the facilities of the planned institute as a recurrent budget, of which 374,339 K£ will be personnel expenses. As the staff members of the planned institute are to be recruited from among the Survey of Kenya's staff members, the implementation of the Project will not result in a significant increase in the Survey of Kenya's recurrent budget. The Survey of Kenya's operating expenses will be increased by 182,298 K£ (556,637 K£ - 374,339 K£), which makes up only 2.1 percent of the Survey of Kenya's present recurrent budget of 8,685,240 k£ for fiscal 1994/95.

(4) Examination of the Requested Facilities

The results of the examination of each requested building and each requested room are as stated below.

1) Training Block

The training block consists of classroom, laboratories, a lecture hall, and a library. These facilities are requested with the total floor space of 1,240m^2.

① Classrooms

At the planned institute, lecture will be given in 5 classes in each grade (15 classes in 3 grades) in the diploma courses for the pre-service staff and in 3 classes in each grade (6 class in 2.5 grades) in the Higher Diploma Course. Classrooms are to be used for these lectures. Under the Government of Kenya's initial plan, each class has its own classroom, namely homeroom, and it is required 21 classrooms in total. In the diploma course for pre-service staff members under the training program, however, lectures in the second and third grades account for only 30 percent of the total number of school hours. It was concluded, therefore, that it would not be economical to provide a classroom for each class from the standpoint of effective use of facilities. Under this project, the number of classrooms is to be determined on the assumption that a classroom may be shared by a certain number of classes and that the rate of utilization of classrooms will be more than 60 percent.

Classrooms should be divided into two groups, those for classes of 25 students and those for classes of 15 students, and the walls of some classrooms should be movable partitions so that they may be used for

joint lectures for two classes (50 students or 30 students) by removing the partitions.

② Laboratories

In the Government of Kenya's request, the required types of laboratories are not specified. Judging from the contents of the training program, laboratories of various types should be built mainly for use in the diploma courses for pre-service staff members of the four departments. Table 2-5 shows the types of laboratories required by the four departments.

Table 2-5 Types of Laboratories Required by the Four Departments

Department	Admitted Person	Training Room	
		Room Name	Remarks
1. Land Surveying	24	Land Surveying Lab.	• Locate on the ground floor, since the colimeter installed in the Lab. requires anti-vibration structure. • Require a storage for surveying equipment
2. Cartography	25	Cartography Lab., Computer Lab., Drawing Rm.	• Training on computer mapping • To place 25 drafting tables
3. Photogrammetry · Remote Sensing	15	Photogrammetry & Remote Sensing Lab.	• To install large machine such as analytical plotter
4. Map Reproduction	15	Map Reproduction Lab.	• To place various precision instrument • To attach a photo studio (Photographing, development, print)

In the case of the Higher Diploma Course, lectures account for more than 70 percent of the total number of training hours and training is to be given not at laboratories but at facilities in the Survey of Kenya. For this reason, no laboratories will be required for the course.

③ Lecture Hall

In the Government of Kenya's request, the desired size of the lecture hall is not specified. During the discussions between representatives

of both sides at the time of the basic study, a lecture hall with a seating capacity of 360 was requested by the Kenyan side so that all the trainees taking diploma courses for pre-service staff members and all the lecturers may be assembled in it. Under the Project, it will be appropriate to build a lecture hall with a seating capacity of about 150 so that about 100 trainees taking a diploma course for pre-service staff members of one grade and 50 lecturers may be assembled in it. The floor of the lecture hall should be flat so that the lecture hall may be used for various purposes. Storage, a stage and an anteroom should be attache to it.

④ Library

The Government of Kenya requested a library provided with about 250 seats and 50,000 books so that it may meet the reading requirements of about 400 trainees, 50 lecturers, about 1,000 staff members of the Survey of Kenya and 500 other users. For the following reasons, however, it will be appropriate to build a library provided with about 80 seats and 30,000 books.

- The Project is for the establishment of the Kenya Institute of Surveying and Mapping, which is to accommodate a total of 400 trainees and 56 lecturers.

- Judging from the actual condition of other similar libraries in Kenya, it will be appropriate to assume that 15 to 20 percent of these trainees and lecturers will use the library regularly.

- The Survey of Kenya presently owns about 10,000 volumes. A library operating budget in the amount of 9,500 K£ will be available under the Project for the procurement of the required additional number of books, and in addition, it will be possible to procure some

additional number of books under the ongoing project-type technical cooperation program. So the appropriate number of books is estimated at about 30,000.

The planned library is designed to function also as a "map center" where atlases and maps issued by the Survey of Kenya, as well as world atlases and maps are offered for public inspection.

⑤ Lecturers' Rooms

Lecturers' rooms for the use of a total of 67 lecturers will be included in the training block. The Kenyan request in this respect is that except for the offices of the heads of the four departments, lecturer's rooms should be one open room so that they may cope with future increases in the number of lecturers and possible changes in furniture arrangement. As a result of the examination of the contents of the Kenyan request in this respect, it was proposed that even the department heads' offices should be located in the open room rather than being private rooms provided with a space for a secretary. This arrangement will make the entire space for lecturers more flexible and at the same time make it possible for the department heads to share a single secretary, which is turn will help minimize the size of the teaching staff.

2) Hostel Block

The Kenyan request included the construction of hostel facilities with a total floor space of 1,120m^2. The required facilities included a hostel, a canteen, and a kiosk.

① Hostel

The Survey of Kenya requested a hostel capable of accommodating 400 trainees, including those of Higher Diploma Course, on the grounds that the planned institute will be operated under the residential system. However, it is expected that some of the institute's trainees will be residing in Nairobi City. Furthermore, the Kenya Polytechnic, which is commissioned by the Survey of Kenya to train 70 pre-service staff members every year, is not residential. It is therefore of relatively low priority to procure such hostel facilities as requested by the Survey of Kenya. At present, the ratio between the number of the Survey of Kenya's staff members residing in provincial areas and that of those residing in Nairobi City is 3:1. It will be appropriate to estimate the number of the institute's trainees to use the planned hostel facilities at about 300 on the assumption that the above-mentioned ratio will apply to the institute's trainees.

As regards the scale of the planned hostel facilities, on the other hand, a total floor area of 1,120m^2 that is specified in the request by the Government of Kenya is too small for the number of 300 trainees, although it would be a scale to accommodate only about 70 trainees. In this plan, each room will accommodate 4 trainees with 2 double-decked beds as is the case with other similar institutes, such as NYS, so that full use may be made of the total floor space.

② Canteen

The Kenyan side requested that the hostel's canteen be large enough to supply meals to a total of 600 persons, including all trainees and lecturers. However, the existing facilities of the Survey of Kenya, which is located adjacent to the planned institute, include two

canteens for its staff, and it is expected that both of these existing canteens will continue to be in operation. It will be appropriate, therefore, to design the canteen on the assumption that, in principle, it will supply meals to the trainees and lecturers only. If the canteen is to supply meals to one-third of the total number of trainees and lectures, which is about 450, at a time, the required number of seats for use in the canteen is about 150.

3) Administration Block

The administration block's facilities requested by the Kenyan side are an administration building with a total floor space of 800m^2, which consists of the principal office, the administration office, the central control room, and other related facilities with a total floor space of 150m^2, which include a garage and a guard house.

① Administration Office

Upon completion of this project, a total of 197 staff members of the institute will be recruited from among the Survey of Kenya's staff members, of which about 40 will occupy the office room as clerical staff members. The size of the office room will be determined taking that number into account. The office room should be large enough to be able to cope with future increases or decreases in the size of the clerical staff.

② Principal's Office and Deputy Principal's Office

Both the principal's office and the deputy principal's office will be private rooms, each provided with a space for a secretary, as is the case with other public organizations in Kenya. The team leader's office for a project-type technical cooperation program which is to be

implemented concurrently with the Project should be also be a private room, since the team leader is of the same rank as the principal of this institute.

③ Clinic

During the basic study, the Kenyan side added the inclusion of a clinic in the administration building to its request. Since the Kenyan side has included budgetary appropriations for two nurses in the staffing plan, there will be no problem with the operation and management of the planned clinic. Indeed such a facility is indispensable for this kind of the institute. It is appropriate, therefore, to include a clinic in the architectural design for the administration building.

(5) Examination of the Requested Items of Equipment

The request for equipment is based on the purposes of training in project-type technical cooperation program and the number of trainees. An examination was made on appropriate levels and quantities of items of equipment requested by Kenyan side to cope with in grant aid cooperation. The followings are the results of the examination regarding main items of equipment.

1) General Use Equipment

Classrooms, lecture hall, and laboratories are planned to be equipped with lecture tables and chairs according to their seating capacities. Though equipment for hostels and canteens was not mentioned specifically in the request, which considered it ancillary to the facilities, the following items of furniture are considered indispensable, and included in the equipment plan.

- Double-decked beds
- Lockers
- Hostel desks and chairs
- Dining tables and chairs

2) Land Survey Equipment

- GPS equipment

GPS refers to the Global Positioning System, which utilizes artificial satellites. The system has been spread over the world in recent years, as a means of obtaining very accurate positional coordinates. It has been used also in Kenya, where a maintenance system is now being established. In view of this situation, it has been concluded that GPS equipment is suitable in high-level practice in land surveying. Three sets of receivers (for two waves), laptop type personal computers (including software), etc., will be provided.

- Calibration system

The testing of measuring instruments is a basic technique important for surveyors, and indispensable in maintaining accuracy of equipment. One set of calibration apparatus for measuring instruments will be installed in the land surveying laboratory. The testing apparatus will be of that scale which can check measurement of frequency, measurement of angles with a collimator.

- Laser level, Total station

These items require high techniques in operation. Since other equipment can cover their function, and besides, maintenance will be concerned, these items will not be introduced for the Project.

3) Cartographic Equipment

- CAC (Computer Assisted Cartography) equipment

In cartography, computer assisted technology has been rapidly put to practical use, and spread over the world. CAC equipment is to become integral part of a geographical information system, together with numerical topographical mapping in photogrammetric surveying and image processing and analysis technology in remote sensing. It is concluded that CAC equipment must be introduced as early as possible, for the purpose of establishing basic technology in this field. The CAC equipment to be planned is of a basic composition suitable for practical training composed of computer, digitizer, plotter, and related software.

4) Photogrammetric and Remote Sensing Equipment

- Analytical plotter (for training purpose)

An analytical plotter is the generic name for apparatuses which change photographic coordinates of aerial photographs to geodetic coordinates, or geodetic coordinates to photographic coordinates. The requested analytical plotter for training purpose is especially designed so that trainees can learn analytical plotting according to procedure. This type of plotter is used in international surveying training institutions, and fits with the purpose of training. Therefore, two units of this items will be introduced. There will be no problem in planning them, because many of technical staffs of the institutions concerned have experience in operating this type of plotter, and a maintenance and service system has been established in Kenya.

- Aerial camera simulator, Mirror stereoscope, Point pricking machine

These items will be introduced, since they are considered to be basic equipment necessary in learning how to manipulate cameras. They have been widely used in Kenya, and it is ascertained that a maintenance and service system has been established.

- Analytical plotter (for practical use) and Ortho-photography apparatus

These items are not recommended for the Project, since they have not been practically used in Kenya, and efficient use of other equipment is expected to cover this item.

5) Map Reproduction Equipment and Ortho-photography

- Phototypesetting machine, Bromide paper processor

As a result of comparison between the reason of the request and the map reproduction process, it is concluded to introduce the following items, in place of the above-mentioned equipment.

  - ○ Desktop publishing system (including scanner and printer)
  - ○ Film processor

- Proofing equipment (kwikproof type), Developing outfits (aerial type), Photo-electronic printer, Paper testing equipment

These items are decided to be excluded. Because they are not necessarily appropriate in view of the purposes of planned training, and other items of planned equipment are expected to cover this.

- Proofing equipment (cromaline type), Colour scanner, Plate processor, Equipment for applying light sensitive coating

These items are indispensable in learning photo processing in a dark room and techniques pertaining to plate making and printing. Therefore, it is concluded that one unit of each item will be introduced.

6) Library Equipment

Among the items mentioned in the request, a library book security system, a microfilm reader/projector and carrel desks will not be included, in view of capability of maintenance and insufficient space. Regarding bookbinding equipment, there has been a request also from the map reproduction department, and as it is expected to be used frequently, one set of apparatuses will be installed for common use. Other items for books and maps are shown below.

- ○ Unit shelves
- ○ Magazine storage racks
- ○ Reading tables and chairs
- ○ Monograph card catalogue duplicating equipment
- ○ Map filing cabinets

7) Computer Laboratory Equipment

Twenty-five sets of personal computers is planned to be installed as means of learning basic operation of desktop-type computer and application software. The configuration of each set is of general type composed of a main unit, a serial printer, and software. And they should be of types which can be maintained in Kenya soon after installation. In consideration of the power supply situation in Kenya, each computer will be provided with an UPS (uninterruptive power system) capable of about 5 minutes' backup. Other peripheral devices such as laser printer, digitizer, scanner, and plotter which

are planned to be installed in the cartography and photogrammetry department will be available for common use.

8) Vehicle for Field Training

The following three types of vehicles are decided to be provided.

- Minibus

As a means of providing a transportation service for the trainees to field survey and other facilities, two minibuses with about 30 seats and one minibus with about 20 seats are necessary.

- 4WD Wagon

Five 9-seater 4WD wagons is concluded to be provided. these are judged indispensable in surveying in wasteland and hilly regions.

- Pickup truck

One truck with a leading capacity of 1 ton and one with 3-ton capacity will be provided, for conveying field training materials and equipment.

2-2-2 Cooperation Plan

As a result of the above-mentioned examination, the expected effects of the Project, its practicability and Kenyan side's ability to implement it were verified. Also, the Project is judged to meet the requirements of the Government of Japan's grant aid cooperation system. It is appropriate, therefore, to implement the Project under the government of Japan's grant aid cooperation. Thus, the outline of the Project will be examined and the basic design for the Project will be executed on the assumption that the Project will be implemented under the Government of Japan's grant aid cooperation. It should be noted, however, that, as stated earlier, some of the contents of the Project as shown in the Kenyan side's request have been modified.

2-3 Project Description

2-3-1 Execution Agency and Operational Structure

(1) Executing Agency

The executing agency of the Project is the Survey of Kenya, in the Ministry of Lands and Settlement.

(2) Operational Structure

The Kenya Institute of Surveying and Mapping will be established expanding the function of the Training Branch of the Survey of Kenya. As such, the planned institute is to operate under the control of the Survey of Kenya, not as an independent organization. For this reason, the planned institute's staff members are to be recruited from among the Survey of Kenya's staff members, with few additional staff members being newly recruited.

The institution's operational organization and its position within the Survey of Kenya are as illustrated below.

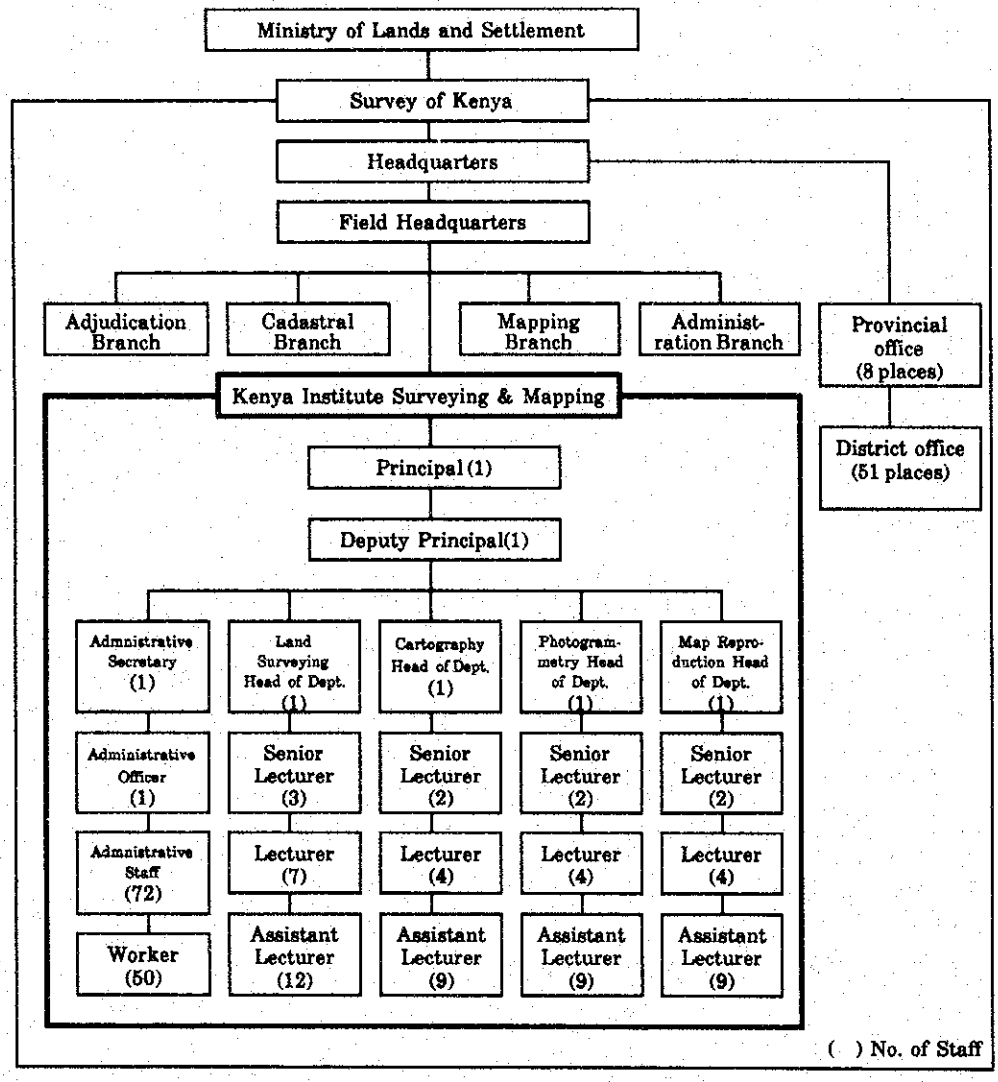


Fig. 2-3 Operational Organization of the Kenya Institute of Surveying and Mapping

2-3-2 Plan of Operation

(1) Staff Assignment

The staff assignment by job type and position for the Kenya Institute of Surveying and Mapping is as shown in the following table.

Table 2-6 Staffing Plan for the Kenya Institute of Surveying and Mapping

Position	Rank	No. of person	Remarks
Principal	P	1	
Deputy Principal	N	1	
Administrative Secretary	N	1	
Head of Department	N	4	To appoint one person each for four departments
Senior Lecturers	M	9	
Lecturers	K/L, J	19	to appoint from technical staff of SOK
Assistant Lecturers	J, H/J/K	39	
Administrative Officer	K/L~M	1	
Administrative Staff	L~E	72	including librarian, nurse and telephone operator
Drivers	D~G	10	
Watchmen	A~D	10	
Common Worker	A~D	30	including janitor and cook
Total		197	

Most of the above-mentioned 197 staff members are to be recruited from among the Survey of Kenya's 3,446 staff members. Since the staff of the Kenya Institute of Surveying and Mapping accounts for only 5.7 percent of that of the Survey of Kenya, there will be no problem with the appointment and placement of the planned institute's staff members. The planned institute's 67 lecturers are to be recruited mostly from among the Survey of Kenya's technical staff members. Since the planned institute's teaching staff makes up 7.0 percent or so of the Survey of Kenya's technical staff of 947, it will be possible to recruit that number of lecturers.

(2) Budgetary Allocation

Upon opening of the Kenya Institute of Surveying and Mapping, the Survey of Kenya will appropriate a total of 1,886,637 K£ (about ¥83 million) for the operation of the institute. A breakdown of the budget is as shown in the following table. However, the institute's budget is first

to be incorporated into the Survey of Kenya's budget, from which it is then to be allocated to the institute

Table 2-7 Budget of the Kenya Institute of Surveying and Mapping

Item	Budget	
1. Recurrent	556,637	(29.5%)
Salary	(273,027)	
Allowance	(101,312)	
Supply & Equipment	(83,225)	
Others	(99,073)	
2. Development	1,328,000	(70.4%)
3. Income	2,000	(0.1%)
Total	1,886,637	(100%)

(Unit: K£)

Of the budget of the Kenya Institute of Surveying and Mapping, the recurrent budget covers personnel expenses, facility operating expenses, expendable supplies expenses, and electricity and fuel expenses. Since most of the staff members of the institute are to be recruited from among the Survey of Kenya's staff members, the personnel expenses (salary and allowance expenses) in the amount of 374,339 K£ will not be considered an increase in the Survey of Kenya's budget. It is estimated therefore, that the operation of the institute will cause an increase of 182,298 K£ (about ¥ 8 million) in the Survey of Kenya's budget. The development budget is a special budget required to implement the Project, and it covers the costs of the execution of the work to be carried out by the Kenyan side and the procurement of furniture and the like. For this reason, after the completion of the institute's facilities, the development budget is expected to decrease and so there will be no need to secure a budget of the size as shown in Table 2-7 every year.

All in all, the increase in the Survey of Kenya's annual budget which is expected to result from the operation of the planned institute accounts for only about 1.6 percent of the Survey of Kenya's budget in the amount

of 11,741,238 K£ for fiscal 1994/95. It will thus be possible to secure a sufficient budget for the planned institute. As regards the development budget, it is agreed that when the implementation of the Project is decided formally by the both governments of the two countries, the development budget will be approved by the Ministry of Finance.

2-3-3 Location and Condition of the Project Site

(1) Location

The project site is located 6km northeast of the center of Nairobi City, in the premises of the Survey of Kenya's Field Headquarters.

(2) Natural Conditions

1) Geography and Topography

Kenya is situated in the eastern part of the African Continent across the equator, at lat. 4° N. to lat. 4° S. and at long. 34° E. to long. 41° E. The country borders on Somalia, Ethiopia, Sudan, Uganda and Tanzania. The land area of the country is 582,644 km^2, which is about 1.5 times as large as that of Japan.

2) Climate

Kenya is situated right on the equator. Its climate varies widely from one region to another because of the differences in land height. Nairobi City, the capital of the country, is 1,700 meters above sea level and has a favorable climate of low temperature and low humidity. On the other hand, the western lakefront of the country has a climate of high temperature and high humidity, and the eastern region, which is in arid and semi-arid area, has climate of high temperature and low

humidity. The coastal region, where Mombasa is situated, has a climate of high temperature and high humidity.

In the country, the rainy season is divided into the major rainy season (March to June) and the minor rainy season (October to November). The average annual rainfall in Nairobi City is 762mm.

Table 2-8 Meteorological Data of Nairobi City

	Temperature (°C)			Humidity (%) at 12:00	Rain fall (mm)	Rain (day)	Lightening (day)	Sunshine (Hour)	Remarks
	Max.	Min.	at 12:00						
Jan.	26.6	11.9	25.5	43	49	4	2	9.4	
Feb.	27.7	12.4	26.6	39	52	4	2	9.5	
Mar.	27.6	13.2	26.4	41	72	8	5	8.5	
Apr.	26.0	14.5	24.7	52	144	13	5	7.2	
May	24.6	13.5	23.4	54	127	8	3	6.1	
Jun.	23.6	11.5	22.5	53	25	3	1	5.3	
Jul.	22.5	10.7	21.4	54	12	1	1	4.1	
Aug.	23.1	10.8	21.9	52	15	4	1	4.1	
Sept.	25.6	11.0	24.4	44	20	3	2	5.9	
Oct.	26.7	12.6	25.5	41	38	4	1	7.3	
Nov.	25.2	13.3	23.8	52	134	12	2	7.1	
Dec.	25.5	12.7	24.4	49	74	7	2	8.7	
Ave.	25.4	12.3	24.2	48	762	71	27	6.9	

Note: 12:00 in the table indicate GMT

(3) Infrastructure

1) Electric Power

In Kenya, Kenya Power and Lighting Co., Ltd. (KPLC) is responsible for the supply and management of electric power. Nairobi City is provided with a high-tension electric power supply network called "Nairobi Network System." At present, an 11kV high-tension power cable is installed along the road running on the southern side of the project site, to which it is possible to connect a service line from the project site.

Electric power is supplied to the Survey of Kenya's existing facilities via a transformer installed on an electric light pole located near the institution's housing for its senior staff members.

2) Telephone

Kenya Posts and Telecommunication Corporation (KPTC) is responsible for the supply of telephone service. A 800-circuit telephone terminal board is installed on the THIKA Road that runs in front of the project site. At present, the Survey of Kenya is utilizing a total of 7 circuits, 3 circuits for its operational facilities and 4 for the housing for its senior staff members.

KPTC plans to increase the number of circuits from the present 800 to 1,200, and there will be no problem with the number of circuits to be utilized at the planned facilities. A 35-circuit telephone line from the telephone terminal board is already connected to the Survey of Kenya's existing facilities. It will be possible to connect this telephone line to the planned facilities via one of the existing manholes.

3) Water Supply

In Nairobi City, city water is supplied and managed by the Nairobi City Council (NCC). A 225Ø water main is laid along the THIKA Road running along the southern side of the project site. City water is supplied to the Survey of Kenya's existing facilities from the Karura Waterworks which is taking water from the Chania River. A 100Ø water pipe from the premises is connected to a 225Ø water main. Since water supply to its existing facilities is inadequate, the Survey of Kenya is planning to replace the present 100Ø water pipe with a 150Ø one.

4) Sewerage

At the Survey of Kenya, waste water from the housing for the senior staff members and that from its existing facilities and housing for its other staff members are discharged separately. The two sets of drains meet in the drain installed on the premises of the General Service Unit, which is situated on the eastern side of the project site. Since this drain sometimes clogs up, however, it is difficult to discharge additional waste water into the drain. For this reason, waste water from the planned facilities is to be discharged via new drain to be connected to a 400Ø drain for use in the forests, which is located about 250meters north of the project site.

Shown below is the outline of infrastructure development around the project site.

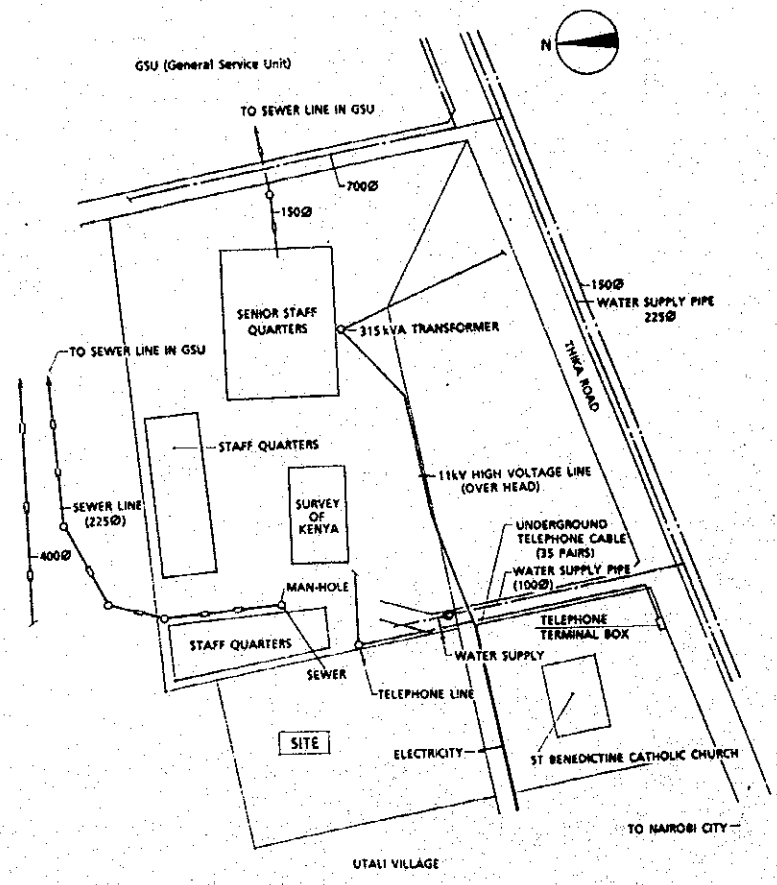


Fig. 2-4 Outline of Infrastructure Development around the Project Site

2-3-4 Outline of Facility and Equipment

The Project is aimed at establishing the Kenya Institute of Surveying and Mapping, procuring facilities and equipment required to provide training in surveying and mapping, and thereby increasing the technical staff of the Survey of Kenya. The training programs to be implemented at the planned institute were developed under the project-type technical cooperation program. The scope of the facilities and equipment to be procured under the Project also reflects the above-mentioned training programs.

(1) Facility Plan

The Kenya Institute of Surveying and Mapping needs to be provided with the following facilities in order that all the developed training programs may be carried out at the institute.

Table 2-9 Outline of the Facility Plan

Department	Outline of the Facility	
Training	Lecture Bldg. :	Classrooms, Lecture Hall, Lecturer's Room, Library
	Laboratory Bldg.:	Land Surveying Lab., Cartography lab., Map Reproduction Lab., Computer room, Drawing Room
	Outdoor :	Survey Equipment Calibrating Field
Hostel	Hostel Bldg. :	Male Hostel, Female Hostel, Superintendent Room
	Canteen :	Canteen, Kitchen, Kiosk
Administ-ration	Office Bldg. :	Office, Principal's Room, Deputy Principal's Room
	Garage :	Garage, Office, Storage
	Service Facilities:	Electric Room, Pump Room, Guard House etc.

(2) Equipment Plan

Equipment required to carry out the training programs is to be procured under the project-type technical cooperation program, as well as under the grant-aid program. For this reason, in working out the equipment plan, it is necessary to determine the types and items of

equipment to be procured by clearly dividing them into those to be procured under the Project and those to be procured under the project-type technical cooperation program. Judging from the contents of the training programs to be implemented at the planned institute, the following equipment should be procured under the Project.

Table 2-10 Equipment Plan

Category	Main equipment
General use equipment	Tables and chairs for classrooms, lecture hall and laboratories, Dining tables and chairs, Bunk bed, Dormitory desks and chairs, Locker
Land survey equipment	GPS equipment, Theodolite, EDM equipment, Level, Calibaration system, Equipment for physics lab., Software for survey calculation
Catrographic equipment	Planimeter, CAC equipment, Stereo zoom transferscope, Light table
Photogrammetric and remote sensing equipment	Analytical plotter, Digital image scanner, Aerial camera simulator, Point pricking machine, Mirror stereoscope, Software for aerial triangulation
Map reproduction equipment	(Photo processing equipment) Colour scanner, Desktop publishing system, Proofing equipment, Contact printing machine, Process camera, Film processor (Plate making and printing equipment) Proofing press, Printing ink testing machine, Printing press, Plate processor, Equipment for applying light sensitive coating
Library equipment	Magazine storage rack, Reading tables and chairs, Map filing cabinet, Monograph card catalogue duplicating machine, Unit shelves, Book binding equipment
Computer laboratory equipment	Desktop type computer, Printer
Vehicle for field training	Minibus, 4WD wagon, Pickup truck

2-3-5 Operation and Maintenance Plan

(1) Facility/Equipment Operation and Maintenance Plan

As part of the staffing plan, the Survey of Kenya is in the process of securing a budget for the placement of the following staff members to take charge of the operation and maintenance of the facilities and equipment procured under the Project.

Table 2-11 Staffing Plan for Operation/Maintenance Personnel

Post	Rank	Staff Nos.	Remarks
Supplies Officer	J/K	1	To take charge of management of maintenance equipment
Supplies Assistant	H	2	
Maintenance Officer	H/J	1	To repair the buildings/equipment
House Keeper	H/J	1	To maintain the buildings
Assistant maintenance Officer	G	1	
Assistant Housekeeper	E/F/G	3	
Store-man	E/F	2	To keep record of goods
Mechanic	D/E/F/G	2	To repair vehicles
Boiler Attendant	C/D/E	2	
Gardener	A/B/C	4	To maintain outdoor facilities
Sanitary Cleaner	A/B/C	4	To clean indoor facilities
Total		23	

The facility/equipment operation and maintenance plan is to be developed on the basis of the above-mentioned staffing plan under the consideration to the following.

1. To secure a budget for facility/equipment operation and maintenance so that the stock of expendable supplies and spare parts may be replenished sufficiently and that the facilities and equipment may be operated continually.

2. To raise the technical level of each facility/equipment maintenance and management staff member.

3. To clearly define the procedure for repairing, including contacting manufacturers for repairs, particularly in the case of equipment maintenance.

(2) Methods of Operation and Maintenance

1) Facility Operation and Maintenance

Parts of the facilities to be inspected and their intervals are as shown in the following table.

Table 2-12 Operation and Maintenance Plan

Part of facility	Item	Points to note	Intervals
Roof	Leak	The cause of the leak is investigated and the results of the investigation are notified to the c contractor.	Any time
	Roofing tiles	Strong windows will make some roofing tiles slip out of place. Steps should be taken to prevent such roofing tiles from falling down.	Any time
	Gutters	Gutters should be inspected for cracks in joints caused by dead leaves and dust.	6 months
Exterior walls	Surfaces of exterior walls	Surfaces of the exterior walls should be inspected for cracks in joints.	1 year
	Metal parts	Repairs by the use of paints and rust-inhibitor	1 year
Interior finishing	Floors	Floors should be inspected for cracks.	1 year
	Interior walls	Interior should be repaired by the use of paints every 5 years.	1 year
	Ceilings	Ceilings should be inspected for deflections and stains.	1 year
Fittings	Doors	Doors should be inspected for loosening of locks, knobs and hinges, and for detachment of paints.	1 year
	Windows	Windows should be inspected for difficulty in opening and closing, loosening of locks and leaks.	1 year
Equip-ment	Deep pipe wells	The pumps, the wall of the well and so on should be inspector.	6 months
	Water tanks	Water tanks should be inspected for stains and alien substances.	3 months
	Drainpipes and manholes	Drainpipes and manholes should be inspected for clogging.	3 years
	Transformers	The tap switch of the transformer should be inspected.	1 year

2) Equipment Operation and Maintenance

① Operations Carried Out under Equipment Maintenance and Management Plan

The following operations are generally carried out under a standard equipment operation and maintenance plan.

- Cleaning

Equipment should be cleaned carefully each time it is used. Especially, Map Reproduction Equipment which used with chemicals should be cleaned thoroughly. Chemicals disposed from the equipment shall be stored in a polyethylene tank and taken to the treatment facility as occasion demands.

- Inspection

In accordance with the manuals, the movement of equipment should be inspected. Especially, large scale of machines such as printing press and guillotine and trimmer should be inspected periodically for the sake of safety. Moreover lubrication and overhaul shall be carried out periodically.

- Replacement of expendables

Backup batteries, lamps and other expendables should be replaced in accordance with the instruction manual or the machine's alarm.

② Methods of periodical inspection and maintenance

- Inspection and maintenance by operators

The inspection/maintenance manuals should be available to the operators of the equipment so that they may inspect and maintain the equipment in accordance with them.

- Inspection by outside experts

Equipment can be inspected and maintained by its manufacturers' or its distributors' inspection/maintenance engineers.

- Maintenance contract

In the case of computers and other items, maintenance contracts should be concluded with their distributors under which the distributors shall offer proper after-sales services.

- Secure budget

Budget for consumables and maintenance contract should be allocated in the yearly maintenance budget.

(3) Operation and Maintenance Expenses

Most of the cost for the operation of the Kenya Institute of Surveying and Mapping is to be paid out of the national budget. However, because of the need to comply with the World Bank's structural adjustment plan ("Independent Operation of Public Organizations"), the Survey of Kenya is currently reviewing its original plan to pay the cost of operation of the planned institute out of the national budget, and is considering the trainees' payment of part of tuitions fees and collection of boarding fees from the trainees to use the hostel. The Survey of Kenya estimates the total cost of facility/equipment operation, excluding the personnel and training expenses, at about 3,506,500 Ksh (about ¥7.7 million). Judging from the size of the planned facilities, the estimated total sum of the operation and maintenance expenses can be as shown in the following table.

Table 2-13 Operation and Maintenance Expenses

Item	Operating Cost	Planned by SOK
1. Facility Operating Expense		
① Electricity	824,000	300,000
② Telephone	50,000	360,000
③ Water	257,000	(not allocated)
④ Sewerage	62,000	(not allocated)
⑤ LP Gas	580,000	(not allocated)
⑥ Fuel	504,000	546,500
2. Facility Maintenance Expense		
① Building Maintenance Expense	302,000	300,000
② Material Cost	137,000	300,000
③ Equipment Maintenance	850,000	1,700,000
Total	3,566,000	3,506,500

(Unit: Kshs)

1) Facility Operating Expenses

① Electricity Charges

Max. electricity demand: 320kVA

Average monthly max. electricity demand: 320kVA×0.5=160kVA

Annual electricity consumption:

320kVA×0.2×8 hour/day×250day/year = 128,000kVA·h/year

Charges:

(1,500Kshs/month×12months)+(160kVA/month×160Kshs/kVA×12months)+128,000kVA·h/year×3.9Kshs/kVA·h)≒824,000Kshs/year

② Telephone Charge

Number of Persons who use telephone:

Lecturers	67
Clerical staff members	40
Japanese experts	8
Total	115

Duration:

115 person×0.5×3 min×1 time/day×250day/year≒43,000min/year

Charges:

43,000min/year×3.5Kshs/3min≒50,000Kshs/year

③ Water Charges

Daily Consumption:

Hostels	300 persons×140ℓ/person·day	=	42,000ℓ/day
Commuting students			
	100 persons×60ℓ/person·day	≒	6,000ℓ/day
Clerical staff members			
	130 persons×60ℓ/person·day	≒	7,800ℓ/day
Lecturers	67 persons×80ℓ/person·day	≒	5,400ℓ/day
Water supply for trainees		≒	7,000ℓ/day
Total		≒	68,000ℓ/day

Monthly Consumption:

The monthly water consumption is estimated as follows taking into account the monthly number of training hours and the monthly facility utilization rate.

68,000ℓ/day×25day/month×0.6×0.9=918,000ℓ/month

Monthly Water charges:

• 0~15,000ℓ	7.95Kshs/1,000ℓ×15	≒	120Kshs/month
• 15,001~30,000ℓ	12.35Kshs/1,000ℓ×15	≒	190Kshs/month
• 30,001~45,000ℓ	18.30Kshs/1,000ℓ×15	≒	270Kshs/month
• 45,000ℓ or more	23.50Kshs/1,000ℓ×(918-45)	≒	20,520Kshs/month
Total		≒	21,100Kshs/month

Rental fee for the 150Ø water meter: 300Kshs/month

Charges:

(21,100+300)Kshs/month×12month=257,000 Kshs/yea

④ Drainage Charges

Sewerage Water Quantity:

918,000ℓ/month×0.8=734.000ℓ/month

Monthly Charges:

• 0~15,000ℓ	4.2Kshs/1,000ℓ×15	≒	60Kshs/month
• 15,001~30,000ℓ	4.2Kshs/1,000ℓ×15	≒	60Kshs/month
• 30,001~45,000ℓ	5.5Kshs/1,000ℓ×15	≒	80Kshs/month
• 45,000ℓ or more	6.9Kshs/1,000ℓ×(734-15)	≒	4,960Kshs/month
		≒	5,200Kshs/month

Charges:

5,200Kshs/month×12month≒62,000Kshs

⑤ LP Gas Charges

Consumption:

• Quantity of LP gas used for the kitchen equipment

17.6kg/h×4.5h/day×0.8365day/year ≒ 24,000kg/year

• Quantity of LP gas used in training

1.6kg/h×1h/day×90day/year ≒ 150kg/year

Total	≒	24,150kg/year

Charges:

24,150kg/year×24Kshs/kg≒580,000Kshs/year

⑥ Fuel

Fuel expense for 10 behicles for field training shall be counted.

Average ruuning distance of each vehicle : 30km/day

Average fuel consumption per liter : 4 km/ℓ

Fuel cost : 28 Kshs/ℓ

Charges:

30km/day×20days/month×12months×10×28Kshs/ℓ÷4km/ℓ

= 504,000Kshs/year

2) Facility Maintenance Expense

① Building maintenance costs

Assumed average maintenance cost of the new facilities for the next 20 years: 40Kshs/m^2·year

7,550m^2(including corridors)×40Kshs/m^2=302,000Kshs

② Facility maintenance costs (Generator, Lamps, Pumps, Ventilation Fans, Piping etc.)

Assumed average maintenance cost of the new facilities for the next 20 years: 20Kshs/m^2·year

6,850m^2×20Kshs/m^2=137,000Kshs

③ Equipment maintenance costs

Following expenses shall be counted.

• Expanse for repairs and expendable parts (mechanical and electrical parts)	170,000 Kshs/year
• Expense for expendable materials (paper, ink, chemicals, etc.)	380,000 Kshs/year
• Expnse for maintenance for computerized equipment	300,000 Kshs/year
Total	850,000 Kshs/year

2-4 Technical Cooperation

This project is designed to support the implementation of the training plan formulated under a project-type technical cooperation program named "Kenya Institute of Surveying and Mapping Project," which was launched by the Government of Japan in October 1994. For this reason, the contents and scale of the facilities and equipment to be procured under the Project are determined on the basis of the types of training, the contents of the curriculum and the number of trainees, all of which are specified in the above-mentioned training plan. On the other hand, the project-type technical cooperation was formulated on the assumption that the Project was to be implemented under the Government of Japan's grant aid cooperation and that the Project was to be completed at the end of fiscal 1997, and therefore the training plan is closely related to the Project. Thus the Project is going to be implemented in close interrelation with the project-type technical cooperation program. It is necessary, therefore, to determine the details of the Project, particularly the contents of the planned facilities and the selection of relevant items of equipment reflecting the contents of their program.