

Kenya

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STATUS REPORT

on

REMOTE SENSING CENSUS PROJECT

in

KENYA

November 7, 1975

prepared by

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INTRODUCTION

This is my first report concerning the on-site status of the Kenyan Remote Sensing Census Project. Portions of the material contained within this report may seem as statements of the obvious or as restatements of observations made by past advisors, reviewers, and others involved in the project's administration. The comments made below should add depth to the earlier observations and thus permit a clearer understanding, to all persons involved, of the exact situation of the R.S.C.P.

Preliminary recommendations for bringing the project closer in line with traditional and standardized remote sensing research procedures are being submitted. With reference to developing an operational remote sensing program in Kenya, a tentative research design and simplified work plan have been outlined.

Critical observations have been made concerning the interpretative and map work conducted through September 14, 1975. No attempt has been made to explain the "whys" attributing to the present status of the research. At the outset I can say that the situation is critical with reference to the amount and quality of work heretofore accomplished. The fact that the R.S.C.P. is still without a local Kenyan manager further emphasizes the need for immediate evaluation and action by those persons responsible for the overall administration of the project.

In view of the present project situation and that everyone involved in the design and administration of the R.S.C.P. is seeking scientifically valid results, which will lead to useful applications of remote sensing in Kenya and other advancing nations, it is virtually necessary that the project immediately

take on the format of other traditional research investigations so that some of the original program goals can be realized. This format begins with the statements contained herein.

The following aspects and how they relate to the current status and overall objectives of the R.S.C.P. are discussed in the remainder of the report:

SECTION I. PROJECT RESEARCH APPROACH/THIS ADVISOR'S VIEW

SECTION II. THIS TECHNICAL ADVISOR'S ROLE AS AN INTERIM PROJECT MANAGER, AS NECESSITATED BY THE ABSENCE OF A KENYAN PROJECT MANAGER.

SECTION III. R.S.C.P. STAFF, THEIR TECHNICAL CAPABILITIES, INTERESTS, AND IMMEDIATE INVOLVEMENT IN PROJECT RESEARCH PLANNING

SECTION IV. PROJECT DOCUMENTATION AS RELATED TO PREVIOUS WORK.

SECTION V. LABORATORY CONDITIONS AND SUGGESTIONS FOR OPERATIONALIZATION.

SECTION VI. TENTATIVE RESEARCH WORK PLAN.

SECTION VII. OTHER RESEARCH PLANS AND RECOMMENDATIONS.

SECTION VIII. WORK COMPLETED BETWEEN SEPTEMBER 14, AND NOVEMBER 7, 1975.

SECTION I.

PROJECT RESEARCH APPROACH/THIS ADVISOR'S VIEW

The following discussion attempts to bring about a clarification on how this advisor views the R.S.C.P. objectives and to briefly outline a suggested research approach for the attainment of some of the stated goals of the project.

Presently, I see the R.S.C.P. as one of basic research and applications development. One of the major problems with the interpretative work conducted up to September 14, 1975, is that, as evidence indicates, the basic research phase was not considered, and that a direct application of remote sensing technology was attempted.

Remote Sensing, by its nature, is a complex science in that a wide range of variables and disciplines are closely associated with its proper use. This does not mean that the utilization of remote sensing is limited, but only that the applications to current problems must follow a pre-defined research path which includes basic studies.

Thus, in setting up a research program in an advancing nation such as Kenya, the basic research phase, however elementary, must not be omitted. Controlled feasibility studies must be conducted before applications, which will have reliability can be considered.

In reference to the Kenyan R.S.C.P., I believe that the project should proceed, henceforth, with bi-lateral objectives. The bi-lateral approach for research design should include, in

the formulation of research problems, a program for conducting systematic basic research (feasibility studies) into the areas of program interests, i.e., population, land use and census mapping, and also the means for subsequently applying the findings to demographic and physical resource utilization problems. It is most important that all the while the basic studies are being designed and carried out that the methodologies and techniques for future operational remote sensing applications be considered. Two aspects among those to be considered are least-cost approaches, which are not necessarily capital intensive, and the gradual inclusion into the program of the use of sensing devices (orbital or aerial) which have greater resolution and time-frame monitoring capabilities. By considering these aspects from the beginning, a smoother transition to an operational program should be possible.

In further developing the Kenyan remote sensing program (R.S.C.P.), several other factors must be considered. First, the amount of time remaining in the project, as it is now outlined in the Program Agreement, and second, the present technical capabilities of the Kenyan staff who have been assigned to the project. These two constraints must now, more than ever, be carefully balanced against each other, with reference to the amount and complexity of work to be attempted, to better insure that valid, and quantitatively defensible results will be obtained in the coming months.

Since the working time remaining for the project is obviously limited (less than half of project) this advisor believes that some of the overall objectives can best be accomplished by

conducting thematic studies for small geographically limited areas (test-sites --defined and discussed later) rather than attempting to interpret and comparatively analyze imagery for larger portions of the country. The fact that the technical capabilities of the Kenyan R.S.C.P. staff is very limited, with reference to a background in remote sensing, and that an intensive and extensive training program is seen as prerequisite for upcoming research further emphasizes the need for focusing the forthcoming efforts on well-defined geographic areas and problems.

SECTION II.

THIS TECHNICAL ADVISOR'S ROLE AS AN INTERIM PROJECT MANAGER, AS NECESSITATED BY THE ABSENCE OF A KENYAN PROJECT MANAGER.

Due to the temporary lack of a Kenyan project manager, I have assumed the on-site responsibility of managing the R.S.C.P. Assuming this role was done only after careful consideration of the overall project situation and in full recognition that by doing so would be in conflict with the Program Agreement as signed by the Governments of the United States and Kenya.

The fact that the project still does not have a local manager is, hopefully, a short-term technical problem. The question that had to be answered was what actions should this advisor take, in the absence of a Kenyan manager, to aid in realizing the project objectives. To this advisor it seemed that to assume the temporary role as R.S.C.P. on-site manager would be the optimum solution in the long run. In view of the fact that there was no visible documentable research being conducted, nor evidence of planned work for the technical staff, virtually necessitated this action.

This interim period can be somewhat profitably utilized for conducting background training of the R.S.C.P. laboratory staff as well as a period for putting the project's laboratory into an operational mode.

With reference to getting the whole project moving toward the stated objectives in the Program Agreement, this advisor has begun to formulate a research design and work plan. It is realized that this work should be carried out by the Kenyans, but without a Kenyan project manager and leader this is not feasible.

Therefore, these actions have been taken in hopes that when a Kenyan manager assumes full responsibilities the R.S.C.P. will have a basic research plan with a tentative procedure by which to attain the objectives, and further, a technical staff with a certain level of competence in remote sensing methodologies.

It must be pointed out - and emphasized - that if this advisor has to continue in the role of on-site project manager several important aspects of the overall program are going to be seriously damaged. Because of the technical and administrative requirements of operating a research laboratory, on a day-to-day basis, little - if any - time remains for developing a network of contacts with potential users of satellite imagery and data. These contacts should be in the professional and scientific community in Nairobi and elsewhere in Kenya. More important is that without a Kenyan manager and leader the possibility of Kenyan self-sufficiency, with reference to a continuing operational earth-resources program, is quite unlikely after this or other advisors have returned to the United States. A certain infrastructure needs to be created with and for the Kenyan manager. Developing the infrastructure, which includes making contacts with users, clarifying research ideas and applications, as well as specially focused training (technology transfer), requires a considerable amount of time. The longer the project goes without a Kenyan manager and leader the less chance there is for satisfying these basic needs.

In view of the present situation the following recommendations are being made:

1). To obtain a qualified Kenyan project manager and leader as quickly as possible.

2). For this advisor to continue in the on-site management role until a full-time Kenyan manager and leader is assigned, providing one is obtained within a reasonable time as of this writing. A reasonable time being defined as the appointment of a Kenyan project manager sometime around mid-December, 1975. This would then allow for a two week overlap (for training and orientation of manager) before the commencement of actual research on January 1, 1976.)

3). For this advisor to continue training, whenever necessary, after the Kenyan manager assumes his or her role, but to delegate appropriate training responsibilities to such a manager.

4). Once the Kenyan manager and leader is on full-time duty at the R.S.C.P. laboratory then this advisor should continue to focus on developing further research goals and methods, in close association with the Kenyan manager and assigned technical staff.

5). This advisor should develop additional research interests in the professional and scientific community, especially in the government and universities. The Kenyan manager should be involved in this operation as much as possible. Users should be encouraged to come and work at the laboratory.

SECTION III.

R.S.C.P. STAFF, THEIR TECHNICAL CAPABILITIES, INTERESTS, AND IMMEDIATE INVOLVEMENT IN PROJECT RESEARCH PLANNING.

When I first began to evaluate the on-site status and operation of the R.S.C.P. a number of interviews were held collectively and individually with the assigned technical staff at the laboratory. The purpose of the interviews was to gain an insight into how the staff viewed the project and the work which they have been doing. Several problems became apparent through the interviews:

- 1). That the technical staff did not understand the purpose and scope of their work, nor did they have a work plan.
- 2). That they had not been actively involved in project fieldwork, yet were required to interpret imagery, without guidance, of land areas with which they were not familiar.
- 3). That they have been periodically involved in other cartographic work not directly relating to the R.S.C.P..
- 4). That they have not been exposed to any additional training in remote sensing, land use classification, photographic interpretation or cartographic methods, other than the intensive short-course which was given by Dr. Robert Durland.

These problems were presented to this advisor in the form of complaints. It became evident that the morale and self-identity of the project staff was very low and relatively non-existent.

A further complaint of the staff is that they feel that they have not been given sufficient information on what is going to happen to them when I am brought back to the United States and the Project Agreement is formally terminated in 1977. Some staff

members feel that their careers as civil servants are being jeopardized because of the possibilities of missing advancement opportunities at the Central Bureau of Statistics as a result of being assigned to the K.S.C.P.

The following actions have been taken to aid in correcting the situation:

1). From the outset a direct approach was taken to involve the entire technical staff in the overall concept of the project as well as some of the potential career possibilities that might affect them.

2). Background lectures on remote sensing, land use classification, photo-interpretation etc., were commenced immediately to provide a base for an operational research unit.

3) A field trip was organized with full staff participation in its planning. Purpose of trip was to expose staff to field problems, especially in reference to the relationships that exist between land use, topography, and vegetation. This was the first field trip that the interpretation staff has been on since their assignment to the project.

4). Weekly group discussions (staff conferences) have been held for project planning purposes and to develop the concept of a team approach to problem solving.

In view of the above mentioned problems, and actions taken the following recommendations are being made:

1). There should be continued involvement of the technical staff - not just the Kenyan project manager - in the planning of research problems and the work plan.

2). That the intensive training of staff members be continued on a routine basis and that a special course in remote sensing be organized. The training course should be able to offer a governmentally recognized certificate of competency when the staff successfully complete the course.

3). The technical staff should be directly involved in the planning and operations of field work so that ground data will have the most value to them.

4). The technical staff should be forthrightly appraised of the administrative intentions of the Central Bureau of Statistics, with reference to their job status and career opportunities.

While the R.S.C.P. technical staff is in need of additional background training, an important aspect should be noted. All of the staff members have shown an intensive interest in both the project and remote sensing. They have, on more than one occasion, demonstrated some very clear insights into some of the research problems that have been discussed in the last few weeks. Further, they have shown much eagerness for additional study, including the idea of assignments to be completed on their own time outside of the project laboratory. The staff performed very well together on the field trip and as a team on the field surveying problems that have been given to them. With this kind of interest and cooperation of the technical personnel this advisor strongly feels that much can come out of the project, providing that some of the actions taken and recommendations advanced are continued and followed.

SECTION IV**PROJECT DOCUMENTATION AS RELATED TO PREVIOUS WORK.**

As of September 14, 1975 a number of incomplete interpretative studies had been conducted and some maps sketched out. However, while much effort has been expended, there are several major problems with the past work. The past investigations have been attempted, so far as this advisor can determine, without having any research problems clearly stated, without keeping a record of how the results were achieved. What these aspects point out is that the maps now in existence are of questionable value from an operational and scientific viewpoint. An accuracy figure would be difficult - if not impossible - to obtain for the previous interpretative work. Such technical factors as image density control and color balance, land use classification procedures, and ground data to image interpretation are a few of the variables that have not been carefully considered during the interpretation process and field work.

One area of work that has been done and which shows some utility is the ERTS photomaps. These photomaps use the space imagery and selected printing plates from existing maps made by the Survey of Kenya. The photomaps can be made with overprinting of administrative and census boundaries as well as other cultural or physical features. However, even these few maps have not been prepared on a systematic basis.

As noted in earlier reports on the project, that have been submitted by other persons, several national mosaics (1:1,000,000 scale) have been prepared for Kenya. The mosaic using black and white prints of ERTS imagery is useless, for any serious work, in that it was constructed from ERTS Bands 4, 5, 6, and 7 instead of the band. The false-color mosaic is now in very poor condition

as it was badly damaged at this year's agricultural exposition. It is planned to begin construction of a new mosaic and the traditional methods of compilation and construction will be followed.

The following actions have been taken to develop a basic scientific approach to the research:

1): An extensive review of the past work was conducted to illustrate to the technical staff the need for research documentation and why a systematic approach to interpretation is necessary.

2): As has been mentioned earlier, lectures on land use classification have been given. The lectures focused on U.S.G.S. Circular 671 and each staff member has been given a copy for their own personal files.

3): Some documentation procedures have been illustrated and established.

In view of the problems stated above the following recommendations are being made:

1): To continue to stress the need for research documentation of all aspects of the laboratory activities.

2). To keep complete records of interpretation observations, ground data etc., by having each staff member maintain a systematic record of his work.

3). For the new Kenyan project manager to consider as an integral part of his or her main responsibilities the keeping of a daily record on the project and other information that should be documented.

4). That a set of files be maintained relating to all aspects of the project including management, user contacts and services, imagery, equipment and supplies.

SECTION V

LABORATORY CONDITIONS AND SUGGESTIONS FOR OPERATIONALIZATION.

Upon commencing full-time work at the R.S.C.P. laboratory, I noted that certain materials necessary for a research operation were lacking. These included an insufficient supply of common drafting and interpretation instruments (scales, triangles, magnifying glasses drawing pencils, paper, etc.) and office supplies (stationery, erasers, file folders, pencils, paper clips, etc.). Further, the laboratory does not have a typewriter, thus causing additional problems related to developing proper communication between laboratory staff, this technical advisor, and the project administrators in Kenya and Washington, D.C..

Another aspect observed is the condition of the ERTS imagery. While the largest proportion of imagery was in file envelopes, there was a significant amount of imagery (25 to 30%) misfiled or unfiled. After close examination of the imagery it was found that proper image handling procedures have not been followed, thus resulting in a number of the transparencies, negatives, and prints having scratches, stains, and finger prints to such an extent that, in some cases, the imagery is unusable for detailed interpretations.

The status of the electronic and optical interpretation equipments (density slicer, color additive viewer etc.) is that all are now in working order. The density slicer required some additional work before it was operational. It was found that the connecting cables and wires for the video monitor and analyzer had been mislabeled. This mislabeling resulted in the misconnection of

the television components. This problem has been corrected, and internal calibration adjustments have been made; the equipment is ready for use.

The following recommendations are being made:

- 1). Complete the equipping of the laboratory with drafting and office supplies.
- 2). Promptly establish a comprehensive laboratory procedure relating to equipment and image handling, laboratory procedures for users, and a technical staff work code.

SECTION VI

TENTATIVE RESEARCH WORK PLAN

Preliminary thoughts on the solutions to the various research problems that have been presented in the Program Agreement and other reports and papers are presented here. This advisor believes that the best research work plan to follow is one, as mentioned earlier, of intensive investigation of well-defined study areas or test-sites. In following this line of reasoning, sixteen test-sites and two census-boundary study areas have been delimited for Kenya. Each test-site is rectangular and covers an area 40X60 Km on the earth's surface. The sites are geographically distributed (see attached map) so that they cover most of the different ecological zones of the country as well as population areas of high and low density.

As can be noted from the attached test-site map, several sites have been located so as to coincide with the Primary Sample Units (P.S.U.'s) of the National Sample project. It is hoped that additional statistical data can be obtained from the National Sample as well as the R.S.C.P. developing data that might be of use to the National Sample project.

The size of the sites, which might seem small, was determined for reasons of observability of the site by ground and air. By keeping the sites small (relatively), more intensive observations of land use and population distribution within the site can be made, especially since there are time and staff limitations to consider.

By using the delimited test-site approach, this advisor believes that the major goals of the project can be more effectively realized since a greater proportion of research time

can be allotted to more detailed image interpretation and ground checking. A clearer quantitative expression of interpretation accuracy and comparative cost studies will be permitted by using smaller and identical size test-sites. If time permits the test-sites can be systematically enlarged for studies over broader geographic areas.

The two census boundary study areas were chosen for the purpose of determining the feasibility of using the physical landscape, as expressed in satellite imagery, for preparing and updating census maps. These study areas are delimited at the Kenyan "District" level and will be used for less intensive study. It seems that the previous work being addressed to the census boundary relied on aerial photographs instead of ERTS imagery.

The present and tentative work plan being recommended, by this advisor, for the continuation of the R.S.C.P. research, is as follows:

- 1). Since the test-sites have been selected and delimited, the next phase of work will focus on the acquisition of background information for each site. Information to be collected shall include: topographic and road maps (various scales), soil, geological; hydrological, population, climate, vegetation and settlement scheme reports and maps. Aerial photographs and statistical tabulations will also be accumulated.

- 2). Once the support information is collected and filed, the sites will be divided into two categories - those of immediate research interest and those for which intensive study will come at a later date.

- 3). During and following the collection of the interpretation support data, the sites will be studied in the laboratory to further determine the types of information to be collected by visiting the site.

4). Before image interpretation of a site begins, one or more of the technical staff will be assigned to a site. The interpreter or interpreters will be responsible for all or most of the interpretation work for the site as well as the documentation of the work. Each site will have its own work file and set of records.

5). As the sites are assigned, field trips will be planned and taken to the site under consideration. The person or persons directly involved will be taken to examine the different kinds of land use, geology, vegetation, etc., in the site.

6). After the sites have been examined in the field and the support information studied, the actual interpretations shall commence. It is tentatively planned that the interpretations be done in such a way that comparisons can be made between the accuracy and time requirements of several different interpretation systems or methodologies (electronic and traditional), thus generating some data for input into the cost effectiveness of the interpretative methods and equipments.

7). In following standard procedures, once the interpretative work has been completed, a sampling system will be used to evaluate the accuracy of the interpretations.

8). The final phase of work will consist of the completion of maps, tabulations of statistical data and analysis of the results, as outlined in the Remote Census Program Bar Chart.

It is planned that a similar series of interpretation and map work be conducted for each test-site. Maximum objectiveness in the approach to problem solution should be emphasized. At a later date the actual methodologies for the feasibility studies will be presented for evaluation

The tentative date for the commencement of interpretative work is January 1, 1976. By that time it is hoped that time the project will have had a Kenyan project manager for at least two weeks. Also by that time the laboratory staff will have been exposed to more training and field work.

SECTION VII.**OTHER RESEARCH PLANS AND RECOMMENDATIONS.**Utilization of light aircraft and Hand-Held Oblique
Photography

While the overall objectives of the R.S.C.P. are quite extensive, there is one other investigation that could strengthen the foundation for an operational remote sensing and earth resources observation program in Kenya. This area of interest involves the utilization of hand-held oblique photography (single or multi-hand) taken systematically from a light fixed-wing aircraft.

Because vertical aerial photography is more costly, is taken less often, and does not have the flexibility of photos taken from light aircraft, points to the need for a method of obtaining up-to-date information, for selected areas, on land use and agricultural productivity. It is believed by this advisor that hand-held oblique photography can offer a partial solution to acquiring certain types of current data for input in satellite-monitoring systems.

Basically, the methodology of this concept is that of collecting information along a line or transect across a portion of the earth's surface. This is referred to, in some cases, as a "line sample", and has traditionally been done from the ground. The procedures for procuring the data is simple. By combining the line-sample method units the use of oblique photography, the investigator has a means of acquiring data quickly and relatively inexpensively without extensive flight-plan requirements that are needed for

vertical photography overflights. The methodology includes the exposure of a series of photographs (can be 35 mm) from a certain attitude and along a predetermined transect (random or systematic). The photographs are processed, mounted, and analyzed in the laboratory. With proper yet simple measurements, statistical data on land use, population density (I think), crop cover, and other information as well as a topographic relief complexity factor can be obtained.

To date, this investigator does not know of any other researchers attempting to utilize oblique photography in such a way.

Relating to this project, one use for this method concerns the collection of information on nomadic peoples living in the remote areas of the country. Because of the remoteness and difficulty of ground traverses in these areas, the above-described method might have utility.

Urban Land Use Interpretation

One of the original goals of the R.S.C.P. was the interpretation of land use in and around a major Kenyan urban center. Nairobi and Mombasa were designated as suggested study areas. However, after a first look at the imagery, it was concluded by others that the urban studies portion of the program could not be undertaken because the areas of interest were covered with clouds.

After reviewing a large portion of the ERTS imagery holdings of the R.S.C.P., I located several images in which the Nairobi area is clearly visible.

In the January 12, 1973 image (a color-composite transparency), approximately 98% of the Nairobi area is visible for at least 8 to 16 miles (12.8 to 25.6 Km) in each cardinal direction. Several other images have about 70% of the Nairobi area without clouds.

Therefore it is recommended and planned that urban land use interpretation study be reconsidered as one of the project research objectives. The age of the good image should have no direct bearing on completing an urban land use interpretation feasibility study. Such a study can include urban land use change information as derived from a comparative analysis of high-altitude photographs and the satellite imagery.

It is not presently known by this advisor whether cloud-free image exists of Mombasa. Further checking into the problem will determine this.

SECTION VIII

WORK COMPLETED BETWEEN SEPTEMBER 14, AND NOVEMBER 7, 1975.

Throughout the previous discussion some of the work which has been accomplished since September 14, 1975 has been noted, specifically in the areas of supply procurement and technical staff training.

With reference to operationalizing the project the following things have been started or completed:

- 1). Standard laboratory procedures have begun to be established and followed.
- 2). An inventory of all the ERTS imagery held by the R.S.C.P. has been carried out.
- 3). Work display mounting materials and a standing bulletin board have been requested.
- 4). A tentative delimitation of test sites and census boundary study areas has been made.
- 5). A tentative research work plan for the project has been drafted.
- 6). The collection of interpretation support data has begun.
- 7). Laboratory drafting equipment, supplies and office supplies are being ordered.

CONCLUSION.

In summation, it can be said that the project is really only at the beginning of the research phase. During the first fifty percent of the project's duration, very little research was accomplished that can now be of use in the remainder of the project. However, I believe that the major project objectives can still be attained provided that the recommendations stated throughout this report are carried out. It is recognized that modifications in research personnel and work plans have to be made whenever the situation warrants. But deviations from the original project objectives must now be minimized to bring the program to a successful completion in 1977.

UNITED STATES GOVERNMENT

Memorandum

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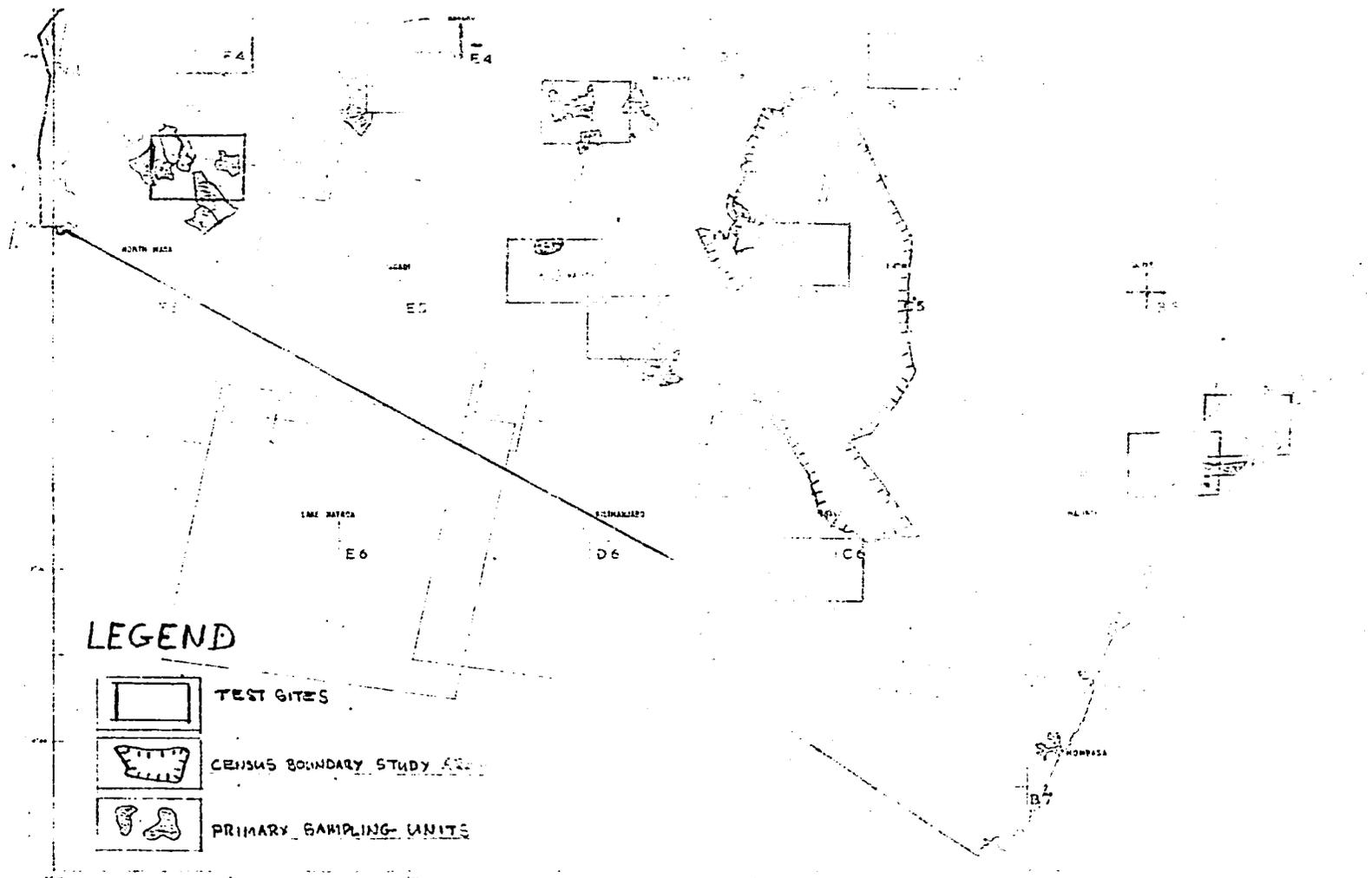
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Attached herewith is my November 7, 1975 report concerning the on-site status of the Kenyan R.S.C.P.. Under separate cover I am forwarding additional information on the latest events that have taken place here in Nairobi.

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