METHODS OF LAND USE SURVEYS FOR RAPIDLY DEVELOPING SETTLEMENTS)(KENYA)

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This thesis is my original work and has not
been presented for a degree in any other University.

SIGNED. . . . . .

This thesis has been submitted for Examination
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A c k n o w l e d g e m e n t s

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A b s t r a c t

The aim of this study was to seek a workable method(s) for quick compilation of land use maps and data for rapidly developing settlements. The settlements viewed ranged from those of typical rural setting to those of typical urban development.

The assumptions and limitations of the study are outlined followed by the analysis of the problem to be looked into in the study. Because the study was based on aerial photographs the analysis of previous work, hitherto carried out in various countries was analysed for its application to the Kenyan situation.

The evolution, description and classification of land uses is studied extensively, Next the current situation as regards mapping reference maps and aerial photographs in Kenya is looked into. The patterns of settlement are next analysed in a conceptual framework. This is followed by the survey techniques necessary for land use data gathering in each of the settlement types.

Finally, the conclusions of the study, and the recommendations are made.

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1. INTRODUCTION

1.1 Hypothesis: The hypothesis may be stated as: There exists a quick method of procuring. Land use data and information and compilation of a land use map for rapidly developing settlement patterns.

1.1.1 Assumptions

Most maps used by the physical planning Department and prepared by the Survey of Kenya are either out-of-date or rapidly turn out-of-date.

The existing aerial photographic cover of Kenya is not being exploited to its full potential for land use and related studies and the acquisition of partial data and information.

The use of conventional methods of land use surveys renders the Survey out-of-date by the time the information is required for decision making and the eventual publication of reports or plans.

Land use data collected for the sake of data gathering without specific purpose leads often to the collection of either more or less data than required and hence makes the whole exercise unduely time consuming and costly.

There is lack of skilled manpower or confidence in working with aerial photographs in the ranks of planning agencies. This limits the proper use of aerial photographs for land use planning.

Hitherto, land use studies carried out in Kenya have tended to be agriculturally oriented or aimed at producing plans for specific townships. There is need to make a comprehensive and coordinated national land use survey. This survey will facilitate the next stage of a comprehensive resource survey.

1.1.2 Limitations: As the title implies, this study is confined tO land use survey methods and mapping in a dynamic situation.

This is inevitable because the settlement patterns are neither homogeneous nor static. Therefore, a combination of surveys and mapping is essential.

Thus the study is confined to the use of existing references such as maps, approved plans, the use of aerial photographs and ground survey methods. These techniques are the ones readily available to the planner.

This study is a case study of the Kenyan situation. This strategy makes the study cohesive and harmonious.

The study does not embrace resource surveys. This should be the follow up of a comprehensive national land use survey.

Remote sensing is useful for land use mapping at small scales of the order of 1:400,000. This study is concerned with land use survey at large scales of the order of 1:10,000.

Data baking for automated land use studies is not immedialtely applicable in a situation where there is unemployment. Secondly, the field officer requires methods that can readily be applied manually.

It is the aim of the author to continue research on the application of aerial photographs. In particular to resource use, traffic generation in conjuction with land use, remote sensing for resource use and land use data banking for automated and manual systems. Therefore, inview of the above considerations, the author has chosen to deal specifically with those methods which will render themselves readily useable in the field office.

1.2. Analysis of the Problem:

1/2.1 Statement of the Problem -

The problem may be stated as: "How to prepare an up-to-date land use map and obtain quantitative and/as well as qualitative data and

information for rapidly developing areas within resonable time and cost limits.

This problem raises questions worth of attention in the study. Those are: How can aerial photographic coverage of a country like Kenya be used optimally to aid in land-use data acquisition and mapping? How much field work in the form of ground surveys and interviews should be conducted? How can existing data be used valuably with field methods of procuring data? How can data and information be kept and updated for the benefit of planning agencies? What relevant land-use classification for the Kenyan situation should be used? What coding system of land-use data should be used to facilitate the use of modern computing techniques? How can land use data be up-dated and monitored to keep pace with development for planning purposes? At what stage should a land use map be compiled?

1.2.2 Significance of the Problem -

Planning is concerned with the development of land, its use and control of its use. Studying and mapping the existing land use pattern in existing settlement patterns is fundamental to the misuse and abuse of land is likely to take place. The present distribution of land uses must firstly be appreciated as a product of past growth, history and current activities of the area in question.

The intimate knowledge of the make up of an area will provide the essential prerequisite to rational planning. Such knowledge will equip the planner with a tool to make sound planning decisions. The need is one of understanding the existing distribution and structure of land uses, its capabilities, and the trends of land use pattern development. Physical planning, be it regional, rural or urban, must therefore, be based on accurate knowledge of existing land uses. Maps and diagrams must be prepared showing the predominant use to which land is put in the entire planning are. A record of all significant changes should be maintained.

The situation in Kenya and in most developing countries is dynamic. Political changes have demonstrated that they can rapidly and effectively affect and influence land uses. Policy formulation from time to time, directly or indirectly, affects the pattern of land use; for example: through revised land tenure arrangements cropping patterns may change in response to changes in prices, upgrading of towns and urban centres to higher status, changes in capital cities of nations, technological progress which has even further reaching consequences, policy on settlement patterns, all alter land use patterns. During such an evolutionary process information and data is needed all the time and ways must be found to provide it more and more cheaply, regularly and in a useable form. It is these factors that make the process of land use mapping of paramount importance in planning at both the regional and local level.

1.2.3 Reasons for Choice of the topic -

Four main reasons led to the choice of this study.

Firstly, land surveyors when called upon to carry out a land use survey have a tendency to make the surveys more elaborate and accurate than they really need to be for planning purposes. This consequently, leads to undue time and energy consuption. This can not be afforded in consideration of limited funds and lack of technically skilled manpower. There is, therefore, need for a faster method within the planners's capability, time limits, financial resources and other constraining factors without necessarily having to resort to the services of a land surveyor.

Secondly, many development plans have been delayed for lack of suitable land use maps, data and information on which to base the decisions. It is not uncommon that a planner has to start from nothing or from scratch when preparing a development plan because valuable information on land use is missing or is not within his reach. Hence such a vast quantity of information as is contained on aerial photographs will minimize such delays if combined with a prepared classification of land uses and questionnaire samples.

Thirdly, abundant information on land use exists but is out-dated. Equiped with the techniques of land use surveys and the knowledge of settlement patterns, the planner should readily be able to overcome this problem.

Fourthly, no comprehensive land use classification has been arrived at yet in Kenya.

1.2.4 Objectives of the Study -

The purpose of the study is to seek and provide a workable and ready method for quick land use data gathering and compilation for planning purposes.

The ultimate objective is to provide, through this systematic study, a guide to land use surveys based on the experiences of this study. By extracting portions of this study, planners will find readily useable material for land use surveys with modifications to suite their particular need.

Through this study it is hoped that the conceptual framework of Kenyan settlement patterns will be arrived at.

It is also the purpose of the author to provide a land use classification to facilitate the ease of storing data which can easily be computer processed in future thus leading to automated mapping.

1.3 Study Methodology -

Firstly, past and present studies on land use surveys and mapping were studied and there relevancy to the problem spelled out was noted.

Then interviews where carried out in both the planning and surveying agencies. This was at the departments of Urban and Physical Planning and the Survey of Kenya, both of the Ministry of Lands and Settlement. The author also drew much information from past experience of serving

in the Survey of Kenya and field trips carried out in various parts of Kenya, and from a land use survey carried out for a Nairobi industry.

After the specific interviews on mapping and planning, other interviews related to the study were carried in the following offices: Nairobi City Council, Department of Surveying and Photogrammetry, Faculty of Engineering; Housing and Reasearch and Development Unit, Department of Urban and Regional Planning, Faculty of Architecture - University of Nairobi.

After the interviews the current situation in Kenya was studied based on past studies. The main sources of data were: photogrammetric and engineering journals. So far land use mapping is a current topic of research and as such it was difficult to get any textbooks or written reports save those published in journals. Extensive use of the indexes for Economic Activities prepared by the United Naions and the East African Posts and Telecommunications Telephone Directory was made.

The review of relevant literature was made in relevance to the Kenyan situation.

Then the evolution of land uses and their classification was made.

It was necessary and apparent at this stage to study the concept of settlement patterns in Kenya. This was done, logically leading to the evolution of the techniques of survey for land uses. At this point previous questionnaires for infrastructural data with bearing on land use were analysed and adopted for the study.

The questions raised at the start of the study were constantly borne in mind which led ultimately to the conclusions and recommendations.

1.5 Synthesis -

Based on the study the author arrived at the conclusion that there exists a quick method of carrying out land use survey for rapidly developing settlements. This method is the judicious combination of referrence maps, aerial photographs and field surveys at each stage of land use studies.

The problems that underlie a study like this one are many. The topic was broad and therefore difficult to keep within balance of both the survey and planning requirements. Furthermore to come up with a uniform or standard classification and method of carrying out land use planning surveys to suit every office within the country is a difficult matter. This created a problem of a tendency to overcome generalize in the hope that modifications where necessary can be made to suit each field officers requirements.

Procuring data on land use, compiling it and using it for Planning decisions are many. But it became apparent during the study that the optimal method is to combine whatever useful techniques are availabe but based primarily on base maps, aerial photos and ground surveys and interviews.

2 ANALYSIS OF THE APPLICATION PREVIOUS STUDIES

In this chapter, the applicability of previous studies to developing methods for urban and rural land use surveys and mapping will be examined. Their relevancy to the Kenyan situation will be instigated.

2.1 Aerial Photography for Urban Land use Studies

Several air photo studies are at present being carried out in the University of Leeds, Great Britain. The objective is to try and make an impartial investigation to assess to what extent aerial photographs might be of value in a number of multisciplinary studies. The study carried out by W. Gordon Collins and Aly H.A. El-Beik* is particularly relevant. This study was carried out in 1971. The value of a set of "Split vertical" air photos, at an approximate scale of 1:10000, as a source of urban land use information for part of the city of Leeds was made.

Firstly, they compiled a key in the field, based on three specially selected aerial photographs; then the subsequent urban land use information. Secondly, they carried out a more detailed and extensive air photo survey of industial activities. The survey was made in an area of about 70 square miles. Finally, they carried out a field check to ascertain the accuracy of the two maps, and examined critically some of the problems affecting air photo work. These problems are of significant importance in all photo-interpretation work and will be analysed.

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*"The aquisition of Urban land use information from aerial photographs of the City of Leeds (Great Britain)." PHTOGRAMMETRIA 27, (1971) pp 71-92. Elsevier Publishing Company, Amsterdam.

The study determined that there was considerable variation in the ease with which the different items in the two keys could the different be identified on the aerial photographs. The main factors which influenced this were: first, the scale and the quality of the photograph; secondly, the ability of the interpreter; and thirdly the extent to which the form of the photo image reflected its function.

The quality of the photographs was not very good; it is admitted as being of mediocre quality. The scale was 1:10000; but was the most up-to-date photography obtainable at the start of the project The scale should have been large enough particularly for a developed area as the one studied. A large scale would be of the order of 1:2500. In Kenya the photo enlargement size acceptable and readily used by planners is 1:2500.

Enlargement alone does not improve on the quality. Nor does it improve clarity. The ideal thing is to take photographs at the scale of 1:2500 for built-up areas. The costs thus incurred will be offset by the less time spent in interpretation and the field checks. Thus in determining the scale of photographic coverage. The scale used proved inadequate as the objects on the photographs were neither large enough to permit proper recognition. Use of large scale photographs readily overcomes this problem.

The ability of the interpreter improved with experience. It is significant therefore, that planners have some knowledge of photo interpretation. They should be able to work with photographs in general with the aid of simple inexpensive tools. Such tools as the pocket stereoscope, the mirror stereoscope, the sketch master and for that matter a magnifying glass will facilitate quick interpretation. This also calls for air photo coverage geared to meet the planners' needs. By centralization and coordination of air photo cover of the country and suitable scale photography so available the problem is reduced to one of determining the function of building on the basis of the form that they

A further determining factor is lack of sufficient evidence on the air photo to permit even a tentative identification. For example museums, public libraries and law courts do not exhibit characteristics which apply solely to each, and without the presence of unique features, identification is not possible. In Kenya it is slightly better at least on the aspect that these uses change least as they are housed in particular buildings and on particular sites. Surrounding features and the total view, afforded by the air photo may permit a rapid assessment of the site and situation. This is often a most useful aid in the identification of a particular building. For example, purpose built modern office blocks are readily identified, because, although they might be confused, the flats, often have features, such as adjacent playing field areas, washing lines, landscaped gardens and associated garages which are not associated with the former usually.

The nature of the use may render its identification difficult. For instance, in general, the commercial buildings constructed for other purposes, especially converted houses, were found to be difficult to identify. The Leeds study revealed that in a predominantly commercial (office) area near the centre of the city were several blocks 3- and 4- storey terraced houses in which the front gardens were paved over and fully used as car parking space then. The combination of site, of settlement had been replaced by one of office use, and this was confirmed by field work.

The uniqueness of features of a number of structures as evident on air photos was found to be a property which greatly aids in the determination of use. For, example, the asphalted playing grounds of city schools, often showing pitch markings stand out remarkably well.

In those towns in Kenya where recreational grounds are set out well such as hockey pitches, tennis courts, stadia and football

exhibit on the photograph. As a result land use studies are speeded up.

The accuracy achieved in the interpretation studies was found to depend largely upon the extent of the relationship between forms and function in any particular item and how far this relationship once identified in the key area is replaced in similar items throughout the study area.

The factors, found, affecting the accuracy of interpreting were: Many buildings, for example, purpose-built for one function, may change their function. One had changed into a temporary computing centre with no external evidence to show the change whilst the other had timber stocked on the site and was consequently recorded as a wordworking industry, later revealed, to be a veneer factory by field work. In Nairobi this factor is exemplified by one church in a residential area that changed its function and now is used as a nightclub. Another example in Nairobi is a change from hostel. This is where field surveys and checks help to rectify, confirm or correct decisions made in the office using air photos.

Another factor affecting the accuracy of identifying individual items was the multiplicity of use of that item, for example, shops found together with offices. In Nairobi and other large towns in Kenya it is common in neighbourhood shopping centres to find this to be the case. For example office blocks are found in residential areas. In shopping centres the first floor or ground floor is used for shopping whilst the top floor(s) may be used for residential purposes or offices. In other situations the front is used for shops, and the back used for residential. Care is needed before generalizing the use into one category*.

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*The relevancy of this problem of multiplicity of use will be dealt with under the section of land use classification.

pitches they are readily visible and lead to the understanding of the function of the surrounding areas. The study revealed particularly that hospitals, government offices and universities covered route ways of the hospitals, the predominance of single storey buildings of varying facilities, and the buildings function that were usually to be found in a university.

Land use category is a further relevant noteworthy factor that affects accuracy of interpretation. In certain instances it is possible to identify correctly the major item in the classification, but yet one cannot be sure of its subcategory. In the study for example, an area that had been identified as predominantly an industrial estate, there were some buildings that sufficient direct evidence was furnished (that of plant, raw materials or stock piles) to indicate the type of industrial activity being carried on in them. It is suggested that in such areas, it is necessary to look for indirect evidence in order to make a tentative identification. A number of clues may help to determine whether particular building is used for light or heavy industry. Light industry as compared to heavy, is housed in multi-storey as opposed to single storey buildings, has few chimneys whose smoke may be seen, smaller roof spans, and much more car parking space for its workers. Heavy industry is also more likely to have direct rail links.

Residential use of buildings is yet another factor which affects accuracy of interpretation. From the study it is revealed that virtually all types of housing were easily identified, and in most cases it was possible to distinguish various types of settlements listed in the key. For example, two or three storeyed terraced housing, those with front gradens and those with garages. However, care has to be taken in looking out for uses associated with housing that may be overlooked. For example, one commonly finds that the ground floors of certain back-to-back or terraced houses have been coverted to small shops or that even small corner shops do occur incidentally with the residential blocks

in a housing estate. In estates in Nairobi such as the Buru Buru and Kariobangi housing estates many activities occur incidentally within the residential blocks. For example one room in the house is used as a tailor shop. In another house a similar room may be used as a shop in another house it will be used as a laundry; all of which are commercial activities. Evidence for the occurance of such uses should be sought and used when judging function of buildings. For example, the presence of a front garden, the existence of sunblinds which may be visible on air photos taken on sunny day will aid greatly.

The permanency of use is yet another very significant factor which affects accuracy. There are, obviously, a few structures which can not economically be modified or even converted to another use. Cases in this category include power stations and transformer substations, sewage works, water works and gasworks and petrol stations and oil refineries. Each of these shows such a marked relationship between form and function as to readily permit accurate identification from air photo.

2.2 Aerial photography for rural land use

A "wave" of aerial rural land use surveys took place in the 1960's. In particular these took place in the United States of America, Western Europe Canada, Chile and Ceylon. These projects will be reviewed in as far as they are relevant to the problem at hand.

2.2.1 Projects in U.S.A.*

Air photos have been, and continue to be, used rather extensively as base maps for field mapping, very often in connection with land classification projects. In other cases, land use has been mapped by actual air photo interpretation without or with a limited amount of field checking. Consequently, such procedure yields broad land use categories only

*Use of air photographs for Interpreting and Mapping Rural Land, Use in U.S. Article submitted by D. Stener and published by Elsevier publishing Company Amsterdam in PHOTOGRAMMETRIA, 1965, pp 65 - 80.

It should be noted that in these early projects detailed interpretation of land use types was not attempted very often and research on the identification of individual crops was rather scanty. The reason for this was the requirement of special photography. Through considerable improvement of such materials as infrared and colur fims in the recent past and the application of multi-photography a growing interest in detailed crop identification has been shown. In the U.S. both land use mapping procedures applied to practical works and research studies on the potential use of air photograpy for land use interpretation have been extensively undertaken.

2.2.1.1 Practical Work in Land Use Mapping:

Marschner's map "Major Land uses in the United State, 1:5000000 (MARSCHNER, 1958) is the only example anywhere in the world in which an extremely small scale land use map for a whole country has been prepared directly from air photographs without field control.

Another example of a land use map prepared entirely on the basis of air photographs is the "Land Use Categories in Pennsylavania, 1:250000" under KLIMM 1958. All areas smaller than ¼ mile were neglected.

In both cases it will be seen that the mapping was generalized as the scales were small. This method cannot be adequetely used for urban settlements where generalization can be dangerous.

For detailed large-scale land use mapping the identification of types of uses has usually been done in the field and the air photograph used solely as a base map. This is a slow procedure for massive land use mapping; much faster than conventional field mapping is surveying from a light aircraft; i.e., making visual observations, recording them on existing air photos, and /or taking oblique photos with 35 mm hand Camera. Later this technique will be described in more detail and an actual example carried out in Kenya given. This method was suggested by MACFADDEN (1949) and used successfully in a full scale land use survey of Santa Maria Valley, California. This method saves time considerably.

2.2.1.2. Land Use Mapping activities of the US Department of Agriculture for Acreage Determination and Related Projects:
Noteworthy points from these projects are: that the photo cover of the whole country has to be done at regualr intervals and the minimization of costs by use of photos for interpretation instead of field surveys using the aerial photos. However, proper timing of the photography is vitally important and as well the training of photo interpreters.

The interpretation approach has been used successfully, in the preparation of riceland maps for irrigation districts in California. It was found that rice fields can be recognized most easily on infrared minus-blue photographs at the time the fields are flooded (MAYER, 1963). Although special photography is required for these rice surveys, this approach is much cheaper than conventional methods of plane tabling.

2.2.1.3 Land Use Mapping in Conjunction with Land Use Classification Projects:

Land classification surveys have been carried out in various parts of the U.S. during the past decades. In a majority of cases the area studied was covered compeletely by field work and air photos had merely the function of base maps.

In Michigan, the objective was to map soil conditions and present land use in the northern part of the state in order to get a planning basis for the improvement of the extensive cut-over areas which formerly had been in forest. When the first air photos became available in the years of the survey, they were used as base maps, since adequate maps were lacking (FOSTER, 1935), field mapping was done mostly by car traverses and the observations were recorded in code notation. Generalized land use was mapped as one of the elements.

2.21.4 Mapping Changes in Land Use:

The great value of air photography as a historical document has been fully recognized in the U.S. and for this reason all pre-war photographs are now kept in the National Archives. The following example show what kind of information can readily be gained from the comparative study of repeated aerial photography:

1) studying progress in land reclamation and land development - In order to study the extent of change in land use and to estimate costs and benefits from clearnce of vast woodland areas by farmers in North Carolina since World War II, ANDERSON and DILL (1961) compared 1:20000 photos taken in 1939 and 1954 respectively. Types of clearings, clearing operations under progress, the layout of drainage systems and the use made of thus improved land could be recognized by photo interpretation. Areas of change were outlined and measured with a dot grid overlay.

2) expansion of irrigated land - Marchner's book on land use in the U.S. (1958) contains a map of Llano Estacado, Texas, which displays the status of irrigation in 1949. Since World War II pump irrigation, as a relatively recent innovation, has rapidly spread over the U.S.

2.2.1.5 Urban Impact on Rural Areas:

In a time of increasing urbanization air photography becomes a very valuable tool for studying the shift from rural to urban land use at the outskirts of cities. WAGNER (1963) used air photo analysis to measure land use conversions within circles of three miles in diameter around highway interchanges. Areas were measured with a dot grid. Such studies have been undertaken in the States, New York and California.

In a developing country such as Kenya and most other third and fourth World countries where urban sprawl is on the increase air photos will doubtless be the tool for studying urban land use impact on rural land.

RESEARCH ON LAND USE IDENTIFICATION ON AIR PHOTOGRAPHS

There has been, so far, only very little substantial research on the application of film materials other than panchromatic for the purpose of land use interpretaion and, accordingly, these materials have not found any wider use in practical studies as yet. It is only now that various agencies and institutions are becoming interested in the possible use of these materials and, as a result, several research projects are now underway.

From a comparison of panchromatic and infrared materials, COLWELL (1960) arrived at the following conclusions: infrared photos are superior for separating marshland grass species, identifying bodies of fresh water, recognizing individual orchard trees, separating standing grain from stuble fields, and locating drainage swabs and fallow ground.

The successful application of colour film has been hampered for a long time by various technical limitations. Within the last decade considerable efforts have been made to improve the quality of the film material and techniques of colour photography. There can be no doubt that colour photography would be a very useful tool for land use interpretation. COLWELL (1956) in a report on the detection of crop diseases, published a few sample of colour photography and showed for example, that different types of small grain are recorded in different shades of green at the time when they do not display any significant contrast on black-and-white photography.

2.2.2 Projects in Western Europe:-**

Aerial photographs have been used for land use studies, and the research studies on basic interpretation problems are particularly noteworthy.

Few studies have been made for the inventory of land use. On the

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**Airphoto Interpretation of Rural Land Use in Western Europe. Article Submitted by Harold Haefur. Published in PHOTOGRAMMETRIA, 1967 pp 143-152, by Elsevier Publishing Company Amsterdam.

other hand, numerous institutions are engaged in photo-interpretation research, such as the technical aspects of aerial photography and the methods of land use interpretation.

2.2.2.1 Basic Research Work:

A fundamental knowledge of photogrammetric and photographic parameters and their variability as a function of a variety of factors is a prerequisite for successful interpretation results. In a number of studies, attempts have been made in establishing specification (film and filter, season, time of day, scale) for the type of special-purpose photography needed for detailed land-use mapping and in developing methods of extracting information from the photographs with a maximum rate of reliability.

2.2.2.2. Interpretation Criteria:

Photo interpretation of land use is accomplished firstly by using direct indicators, and these are shape, size, tone, texture, shadows, and stereoscopic effect. It is necessary to study the usefulness and the variability of these single parameters as well as the possibilities of combining them into a successful interpretation key in detail.

Tone

In viewing a black-and-white photo, the observer tends to base his conclusion upon gray tones as they form the most conspicuous part of the ima
However, the scale of tones is influenced by a variety of factors which bring about a degradation of their value as an interpretation criterion unless the effects of these factors are known.

At the University of Zurich (BOESCH and STEINER, 1959; STEINER, 1961), sources of variation, such as haze, lens and shutter characteristics, characteristics of negative and positive photographic materials, and terrain reflectance as a function of the angle of observation and of illumination conditions were investigated as to their effect on photographic gray tones. The study involved field mapping of land use as

ground control in various parts of Switzerland, extensive densitometric measurements on air photo negatives and a statistical evaluation of the results of measurements. Ideal density values were computed, arranged according to a standard phonological time scale and presented in graphic form. Also the discrimination of land use types at different times of the year was expressed in terms of probable rates of success. Consequently, in conjunction with results obtained from similar studies concerning texture and stereo effect, the season best suited for land-use interpretation would be determined.

To know the likely variability of tones of terrain cover types is of paramount importance when attempting to establish the theoretical basis for an automatic land-use mapping system. STEINER AND HAEFNER (1965) showed the degrading influence of "tone distortion," taking place within a single photographic frame, on the separability of cover types. A solution to this problem can be found either by restricting the analysis to a small central portion of each photograph or by introducing corrections on the basis of the location of measured points with a coordinated system established on the photograph (MAURER, 1965).

Texture

It is difficult to give a systematic classification of the parameter in such a way that it would be an efficient help for interpretation. The value of commonly used descriptive terms, such as "woolly," "dotted", "striped", etc, is in most cases restricted to the person who is setting up the classification.

Investigations (RUPERT and LEHMANN, 1961) seem to indicate a promising possibility of classifying texture more objectively. Density profiles across various land-use units are measured with a micro-densitometer on negatives and recorded in graphical form. Methods for converting such microdensitometer traces into numerical terms still have to be developed. Before any definite conclusions may be drawn as to the

value of quantitative textural parameters for a land-use type separation, many experimental data are still needed, and the influence of such factors as scale of photography and size of measuring spot should be determined.

Stereoscopic Effect:

Data on the presence or absence of a stereo effect have been obtained from theoretical calculations by STEINER (1961). These are based on phenological observations in the field (height of crops) and an analysis of photographic factors influencing the stereoscopic picture.

Reflectance Measurements and the Selection of Suitable Film-filter Combination:

A knowledge of the spectral reflectance of land use types is important when attemps are made at predicting the best season and best film-filter combinations for a given purpose. Spectral remission curves have been measured and published for a variety of crops. However, many of these data are of limiting values only, since measurements have been carried out on single plants or leaves under laboratory conditions. The intricate pattern of leaves, flowers, shadows, field etc, under natural conditions (natural) in the field might give different results. Consequently, reflection measurements should always be taken in the field under natural illumination, if possible from a low-flying aircraft. STEINER (1961) applied a simple and inexpensive method of measuring terrain reflectance by using luxmeter cell with a tube mounted on it. Sample fields were measured sequentially during one growing season and the results presented in graphical form as seasonal curves. Spectral reflectance measurements on rural land-use types in the field or from the air comparable to those in the US and USSR have not been made so far in Western Europe, however.

Phenological Observaion:

Phenological data constitute basic information needed in the planning of photographic flight and in the interpretation of given photographs.

Tone contrasts may be enhanced at particular times of the year owing to differences in the development between crops or to special phenological phenomena such as flowering, heading of grains, leaves colouration, etc. Likewise average dates of sowing, harveating etc., are of importance. "Once a phenological standard time scale had been established for a certain region, the situation in a particular year can be related to it by taking phenological sample observations in the field.

Seasonal Changes and Seasons Most Suitable for Photography:

During the growing period crops change their appearance rather quickly. In order to achieve best results, these changes have to be taken into consideration when one deals with photo interpretaion of land use. If already existing photography is to be used, the interpretation prospects for the given date of flight showed be known. On the hand the season providing a maximum amount of information can be selected if a special coverage is flown. Because of the variability of the weather from year to year, seasonal specifications should be expressed in terms of stages of phenological development rather than in terms of calendar days.

Available data on seasonal effects and seasons favourable for specific photo-interpretaion purposes are still scanty and there is great need for a further accumulation of relevant knowledge.

In an urban context photography may be taken at any time of the year in Kenya but cloud cover conditions must be considered when the scale and other factors thus far discussed are considered and determined.

Scale of Photography

The problem of scale and its influence on the content information in the photographs has not been studied systematically in Western Europe so far. It is commonly agreed upon, however, that the combination of general photographic coverage on a smaller scale (1:25000 - 1:40000) for an overlay with large scale photographs 1:10000 or larger for

detailed studies and/or the application of sampling methods is desirable. High altitude small-scale photographs are useful for regional synthesis of land-use features (STEINER, 1962).

Special types of Film:

Most of the studies carried out so far have been concerned solely with panchrometic film. Obviously similar research with other types of film, is badly needed. Investigations comparing the effeciency of various materials taken simultaneously have been in progress at Munich Institute of Technology, at Delft...? and in Switzerland.

At Munich, studies using panchromatic, infrared, and true-colour photos taken at various seasons have been made. Land-use data for the area were collected by students in the field and served as a basis for the verification of the interpretation results later on. The interpreter was allowed to inspect only a sample area in detail. He then classified the land-use units into groups of typical tone-texture combinations and predicted the likely type of use for the whole area. The aacuracy abtained for the field-by-field identification was 89% on the panchromatic and 95% on the colour film (LEHMANN, 1961: RUPPERT and LEHMANN, 1961; RUPPERT nad MEIENBERG 1964).

2.2.2.3 Studies of the Rural Landscape:

With a careful study and description of the present situation of the cultural landscape one will always be able to detect traces of older agricultural systems. Very often old land utilization systems, field patterns, abandoned settlements and road networks may be revealed by air photos.

Very old elements are usually barely visible and it is a laborious undertaking to reconstruct the related agricultural systems. The selection of favourable seasons and day-times is of paramount importance, since the detection of such old features is based upon crop, soil and shadow marks, which may be recognizable only under specific conditions.

On the other hand, a reconstruction of more recent developments can be conducted with much greater ease, as it can be based on written and printed documents. Here again the air photo is of great value in that old photo coverages record the exact spatial distribution of cultural features. Facts about historical evolution should always be a part of the basic information gathered for regional planning.

2.2.3 Projects in Ceylon [4]

The fact that Ceylon (now SRI LANKA) lies in tropics and is a developing country makes the review of this report particularly significant. Many relevant points will be noted which are pertinent to the situation in Kenya.

An air photographic survey was carried out in Ceylon to obtain information on the current land-use and forest cover conditions. It was possible to limit field-work to just a few checks, thus making the ratio of time spent in the office to that in the field very satisfactory.

The major categories which were mapped conformed to those prescribed by the commission on a World Land Use Survey of the International Geographical Union.

A reconnaissance land-use and forest cover survey of Ceylon was undertaken by a photographic survey corporation. The land-use survey formed only one aspect of a comprehensive survey programme which included aerial photographic coverage of the whole island, geophysical surveys, detailed management inventory of specific virgin forest and inventories of a few other forest reserves, in addition to

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4) Interpretation and Mapping of Rural Land Use from Air Photographs in Ceylon, Submitted by S. Sridas. Published by Elsevier Publishing Company, Amsterdam, PHOTOGRAMMETRIA, 1966 pp 77 - 82.

reconnaissance resource surveys of certain river basins.

The purpose of the survey was to obtain information on the current land-use conditions and the problem areas with reference to soil, water and forest conservation needs. The ultimate objective of the survey was to ensure proper resource management and the proper use of arable land for maximum production of food with due consideration to the maintenance of soil fertility.

The feasibility of the application of aerial photo interpretaion techniques for such surveys in Ceylon was successfully tested in the South-Central part of the island which provided the full range of the diverse landscape types of the country associated with different topographic and physiographic features, climate, rainfall regimes and other factors. Though the initial stages of the land use studies were of exploratory and experimental nature with regard to the status of aerial photographs in the project, the land-use survey refers to the practical land-use mapping of the whole of Ceylon, utilizing aerial photos as the chief source of infromation.

Five major points may be noted from the above concerning land use mapping:

(1) The ratio of time spent in the office to that in the field should be satisfactory in order to justify the method.

(2) Land-use categories should conform to those prescribed internationally as far as possible, with local modifications, if the mapping is to be of any use outside the country.

(3) Land-use survey should form one aspect of a national comprehensive survey programme.

(4) The survey should seek to obtain information on current conditions and the problem areas and to ensure that the results thus obtained are employed to bring about proper resource management 'inter alia'.

(5) The feasibility of the application of aerial photo-interpretation techniques should be tested on a pilot area representative of a larger area.

On taking photographs the following points should be borne in mind:

(i) The time of the year
(ii) The firm(s) to do the aerial photography or government agencies.

(iii) Purpose(s) of the photography.

(iv) Scale of the photography.

(v) Time of the day and type of film to be used.

(vi) Stereoscopic and side overlaps to be specified.

On interpretation guide it should be noted that for this project no specific interpretation key was compiled. The interpreters had to draw from their personal experience gained by field visits. However, they point out that the shape of units, tone, texture and stereoscopic appearance were the important criteria of interpretation, each of which may be deemed equally important criteria of interpretation, in the identification of different units.

The most important factor should be noted as found in the project, "associative elements". This should be rated high in its contribution to accurate identification. This may refer to the conjunction of land-use units to other cultural features, the correlation to other landscape elements or their relative position within a vertical or horizontal zoning.

For field work it should be noted that, although at the initial stages a fair proportion of field check had to be done, as the work progressed it was possible to rely more on the photo interpretation and limit the field to checks of "doubtful" or "problem" areas and a general check, occasionally. The field annotation was done with the photographs in hand. Most frequently the field corrections of boundaries of interpreted units which had, since the time photography, either expanded or receded or become modified, warranting mapping under a different category altogether.

With such a rich background from which to draw the following chapters will seek to apply the information in establishing a land use

classification of aerial photographs and other forms of surveys for land use studies. However, the situation of reference maps aerial photographic coverage as is currently in Kenya will be reviewed for planning purposes. Conditions and factors that have led to the present land use patterns will also be reviewed.

2.2.4 BEGINNINGS AND SCOPE OF EARLY LAND USE SURVEYS:

No adequate planning scheme can be prepared for a place unless there has been some sort of preliminary survey.

Geddes' Edinburgh survey led the way in Britain. The survey first emerged into public view at the great Town Planning Exhibition of 1910.

In Patrick Geddes words: "The plain practical man might say that he knew his town from pillar to post, he knew its history and he knew its present extent, in his head, where the brain can review and compare without the cumbrous machinery of maps. But actually he knows no more about it than his tongue does about the state of his teeth; in one instance a large area near the town hall of big city was well known to contain factories of what is called a 'light' frequently combined with wholesale shops: in amongst them were some old houses which required demolishing. A simple mapping of the industries of that area revealed astonishment to those who thought they knew it thoroughly; no one realized how completely interpenetrated by industry it was and the medical offer at once decided that no new houses should be built there. If the actual state of a spot that one passes through everyday can escape exact appreciation, how much more does a region containing the citizens of many towns, and the peasants and villagers of its countryside, require a graphic presentation before its requirements can be understood.[5]

5) TOWN AND COUNTRY PLANNING by Sir Patrick Abercroubie, 3rd Edition, London Oxford University Press, 1961, pp 129, 130.

W. R. Adams (1952) maintained that all town and country planning should be preceeded by a preliminary enquiry into existing conditions and problems. While the ultimate purpose of such planning is its guidance to some form of development that is conceived to be desirable and practicable, the design root of effective town planning from its inception has been the knowledge of the facts and tendencies of growth in the area to be planned. It is this sort of attitude that led the pioneers of town planning to initiate and emphasize on surveys first before a plan.[6)]

Sir P. Abercrombie (1959)[7)] recognized two paricular advantages of fully documented and vividly illustrated survey: (1) To stress the local requirements - the basis or background behind a planning scheme, and (2) The attention it draws to the interrelation of activities.

He then recommended that a "surface utilization" diagram, in which the use to which every plot of land is put is shown upon the same plan - a sort of omnibus user of the ground. But in general, however, separate diagrams, drawn to similar scales and capable of being superimposed or compared will give the clearest result.

General Considerations in Making the Surveys:[8)]

Coincident with recent advances in legislation, education and research, and the consequent development of town planning as special field of professional work, there has naturally, developed a greater understanding of the technique of conducting surveys as well as formulating designs.

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6) MODERN TOWN AND COUNTY PLANNING, by W. R. Adams. Published by J. & A. Churchill, 1952. p. 72

7) TOWN AND COUNTRY PLANNING by Sir Patrick Abercroumbie p. 130 - 131

8) MODERN TOWN AND COUNTRY PLANNING. by W. R. Adams pp. 72-86.

There may be reasons to question the degree of elaboration to which some surveys are carried.

The science of making regional or civic survey is distinct from the art of planning. It has been repeatedly said that it is a more difficult and more important task to know a problem than to solve it when it is known. The best technique applied to planning may lead to a wasted effort unless the planner is guided in his design by knowledge of the existing facts and, what is even more important, by an intelligent analysis and interpretation of these facts. In this connection the proper collection and presentation of the data collected are essential to a clear understanding and an accurate estimate of the value of each brand of investigation.

The town planner must, also, have a background of general knowledge of what characteristics of towns in general of what may be called their anatomy and their biological development. Towns and villages, being living and growing organisms, cannot be planned like buildings as complete and finished works of art.

They have to be designed with due regard to their dynamic character It is this element of growth in the town planner should make a study of past conditions and present tendencies before finally preparing his design. The value of such a study, as a guide in prediction of future needs, will be proportionate to the ability of the planner to interpret the relation between the facts collected, and to comprehend the nature of the tendencies which they reveal. It is lack of this ability that leeds to much wasted effort.

The plain fact is that, however, high may the ability of a person, to make town planning surveys and designs, he cannot do it effectively by sporadic and piecemeal methods.

There are two types of surveys that should be made:

1) Preliminary survey - which is more restricted inquiry than is usually comprehended when the term is used. This is actually of a reconnaissance type.

2) Comprehensive regional or Civic Survey which is more or less intensive study of physical, economic and social conditions.

Comprehensive Regional and Civic Surveys:

In the early days of the town planning movement, and, to a large extent since,, the study of existing conditions has not been carried out in any logical way. Information in many areas has been gathered in a haphazard fashion.

Patrick Geddes has the credit of initating regional and civic surveys on comprehensive lines, although perhaps covering a wider field of investigation than was necessary for town planning purposes. His study of Edinburgh and Dunfermline were admirable reports on the historical, physical and archeological features of these cities. In his "Cities in Evolution" Patrick Geddes has elaborated his theory of regionalism. Under his leadership at first and later under that of other social workers, the socialogical Society made numerous surveys of towns in England.[8)]

Features to be Studied:

The features that need to be studied in making a complete land use survey are, with minor variations, alike whether the area is a region or a town. Assuming that a preliminary survey has been made to determine the boundaries of the area, including the delineation of any parts within the other boundaries which it is necessary to exclude, the following features require to be studied in each area as far as they partain to land use:

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8)

Agriculture and horticulture.
Surface mineral workings
Residential and shopping districts.
Parks and open spaces, game reserves.
Airports.
Cocks.
Military and defence training areas.

Amount of Detailed Study:

There is some diversity of opinion as regards the extent of elaboration that is desirable in any survey, and it is possible to enter into too much detail in collecting and studying facts. No proper plan can be prepared unless the essential facts are collected before or during the pereparation of the plan. It may be that in some cases a town planner is so well informed regarding the characteristics that are common to all communities in given categories that he does not require to make special studies of certain features. Also, he may have discovered that certain details are of less importance than others or that some data when they are obtained are of insufficient value to justify the cost of collecting them. It should be part of his responsibility to decide what should be done or left undone in each case and to enlist the services of local authorities, land, owners and others in supplying existing data.

A great deal of information needed will exist in most areas, and needs only to be assembled and analysed.

Whilst surveys should not embrace those fields of inquiry that are not essential as a basis for land use a mistake may be made by omitting essential investigations. In the art of inquiry, knowledge of what to eliminate or include in the ascertainment of facts and their analysis and presentation are important.

3. EVOLUTION, DESCRIPTION AND CLASSIFICATION OF LAND USES IN KENYA

3.1. Evolution of Land Uses

Before analysing the evolution of the uses to which land in Kenya has been put it is fitting to examine the background of classification of the land in a legal sense. This is necessary because in Kenya, like anywhere else, ownership to a large extent determines the use, non use, misuse or abuse of land. It is ownership or lack of it that determines illegal or legal development. Township also determines land uses in Kenya

There are in Kenya three main classifications of land:- Government Lands, Trust Land, and Private Land.

During the period of Colonial Government in Kenya a distinction was made between those parts of the country which were inhabited by the indigenous people and in which they were in effective occupation and those parts of the country, where as far as could be ascertained, there was only sparse population and spasmodic land use. The former areas which were designated by the Colonial Government as Native Reserves now in substantial part constitute the Trust Land. The latter areas, formerly known as Crown Land, now constituted Government Land. There is one outstanding exception to this general division, in that the northern areas of Kenya which in Colonial times constitued a sing Northern Frontier Province and were classified as Crown Land, have now become Trust Land falling within the Rift Valley, Eastern and North-Eastern Provinces.

With few exceptions, it was the policy of the Colonial Government of Kenya until 1960 to alienate Crown Land on leasehold terms and much of the present Government Land area, especially in what was formerly known as the "White Highlands" consists of farms leased for term of years. At the end of the term the land reverted to Government. Since 1960, alienation of Government Land for agricultural purposes has been for an inital development leasehold period followed by a grant in [illegible] freehold, taking the farms concerned from the category of Government

Land and placing them instead in the category of Private Land. A few freehold agricultural properties in the preponderantly Government land areas have also existed since the earlier stages of the country's colonial development. At the present time, all high potential agricultural Government Land has been alienated and the remaining areas oa unalienated agricultural Government Land are, in the main, of low potential and will require sabstantial investment of capital before they can be put to economic use.

The Trust Land areas are vested in the county Councils whose responsibility it is to preserve the Trust Land for the benefit of the people who have a customary ritht to occupy it. A rapid transition is, however, taking place in all Trust Land areas of high and medium agricultural potential, since through a programme for adjudication of customary rights and interest in land, the people are being enabled to become private freehold owners with the security of registered land titles. This process has been completed in some areas whilst in others substantial progress has been made, like Central, Western, Nyanza and Rift Valley Provinces.

The Private Land in Kenya comprises the freehold land in what hiterto were Trust Land areas as well as certain freehold properties on the Kenya coast. The coastal freehold land is land which was recognized as being in exclusive private ownership, mainly by people of Arabia origin at the time when the Kenya Protectorate was established.

Apart from the three main classifications of the land there are the country's National Parks, Game Reserves and Forests. The National Parks might also be classified alienated Government Land

Kenya's Gazetted forests again might be classified as Go vernment Land to the extent that they are vested in the Government but the special provision of forests Act govern activity within the forest areas.

The table below shows land areas as at December 31, 1961. The year 1961 has been chosen because it just before independence: a turning point in the history of Kenya.

Land Areas as at December 31, 1961 sq. miles

A. Trust Land (Special Areas):	
Trust Land	49867
i) Forest Reserves	998
ii) Township and Trading Centres	47
iii) Agricultural, Veterinary, Outspans, Railways and other Government Reserves	17
iv) Alienated Land	37
v) Open Water	86
B. Government Land (Crown Land) (Special Reserves):	
Special Reserves	358
Temporary Special Reserves	494
Special Leasehold areas	1,012
Commercial Reserves and Special Areas	528
C. Non-Special Areas:	
Forest Reserves	5,077
Municipalities, Township and Trading Centres	562
Agricultural, Veterinary, Outspans, Railways and other Government Reserves	415
Alienated Crown Land	11,986
Royal National Park	8,524
D. [illegible] part of which is suitable for Alienation Unalienated Crown Land	
All other Areas including Norther Frontier and Turkana (but includes Swamps, Ripurian and National Reserves)	17,856
Northern Frontier and Turkana	120,744
Crown Land earmarked for Africans	898
Open Water (other special areas)	5,085
Private Land	1,043
Crown Land Additional to Trust Land	6666 11
Total Area	224,960

Source: Kenya Lands Department, Annual Reports

3.2 Ecological Potential:

While the legal ownership of land in Kenya has hitherto determined the use of land on a broad basis, the ecological potential of the land has determined the use of land unit by unit.

The factor determining the inherent potential of a unit of land are its climate, topography and soil. Kenya may be divided conveniently into six climatic zones which the housing Research and Development Unit University of Naïrobi has recognized in the study in Design for climate (HOOPER, 1975) [1]. These are:

(1) Coast Zone:

Location: belt of land up to 50 kilometres wide bording Indian Ocean plus off shore islands.

Altitude: mostly below 150 metres.

Vegation: Green, well wooded mangrove swamps cover parts of the coastline and most of the islands, coconut palms and mango trees are abundant along the narrow and heavily cultivated coastal strip and in the shimba and Kaloleni hills, while wooded bush and forest predominate over the coastal belt plain.

Leading Townships: Mombasa, Malindi and Lamu.

(2) Semi-Desert Zone:

Location: North-East half of Kenya plus Magadi area.

Altitude: mostly between 150 and 500 mm

Landscape: desolate, vegetation: forbidding.

Population: Sparse.

Vegetation: Forbidding and baries from a desert type of scrub to dry forms of bushed grassland and dry and often leafless woodland. The sesolate and forbidding landscape of the zone together with itst hot dry

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1) Design for climate, Guidelines for the Design of Low Cost houses for the climates of Kenya by Charles Hooper, January, 1975. Housing Research and Development Unit, University of Nairobi.

dry climate create an environment that is basically hostile to man.

Leading Townships: Garissa, Lodwar, Wajir and Magadi.

(3) Savannah Zone:

Location: between Semi-desert and Highland zones.

Altitude: mostly between 500 and 1,250 metres.

Population: Sparse

Vegetation :dry woodland and bushland. The landscape is broken by the Kitui and Taita Hills which are better and greener than their surroundings.

Leading Townships: Voi, Makindu, Isiolo and Kitui.

(4) Lake Zone:

Location: area around Lake Victoria.

Altitude: between 1,133 and 1,250 metres

Topography: flat lake plains and rolling hills.

Vegetation: bush and cultivated lands. A green and often dense bushland vegetation is interspersed with cultivated land.

Leading Townships: Kisumu and Homa Bay

(5) Highland Zone:

Location: Lower parts of Eastern and Western Highlands plus the raised Rift.

Altitude: between 1,250 and 2000 metre.

Population: dense

Vegetation: the hilly areas are well vegetated. The zone also includes the Taita Hills, Mount Marsabit and a few other outlying hills, but excludes a small area of dry savannah that lies between 1,250 and 1,500 metres. It is by far the most pupulated and urbanized zone and it is extensively cultivated. The variable though though mostly well wooded vegetation

is green but not luxaricant during rainy seasons, but may wither and turn brown during long dry spells. The latter is particularly true of the savannah plains of the raised Rift and Kajiado.

Leading Townships: Nairobi, Nakuru, Kericho, Kitale and Nanyuki.

(6) Upper Highland Zone:

Location: all parts of Kenya beyond the highland zone including Aberdares, Cherangany, Mau Escarphment and Mounts Kenya and Elgon.

Altitude: Above 2000 metres

Population: few people live over 2,750 metres.

Vegetation: forest together with derived grassland and bushland are the predominant vegetation forms in the habitable parts of the zone. Barren land exists above the forest line often covered with rock and snow in the case of Mt. Kenya

Leading Townships: Eldoret and Kapenguria.

The author has chosen to follow this zonation for the description of the settlement types. This is so because for each zone there emerges as will be seen different house types, different farming patterns and economic activities which influence the settlement layout. Secondly, the zones can be identified - see Map. 3.1 - as continuous wholes and unlike the zonation used in the National Atlas of Kenya.

Six broad ecological zones emerge. In exact terms, these are eco-climatic zones, defined in terms of climate but described by reference to their vegetation and land-use. Climate and especially rainfall is the primary factor which determine land potential in Kenya and it is climate which must therefore be given first considerations in planning land-use.

The six classes by vegetation and land-use are as follows: [2]

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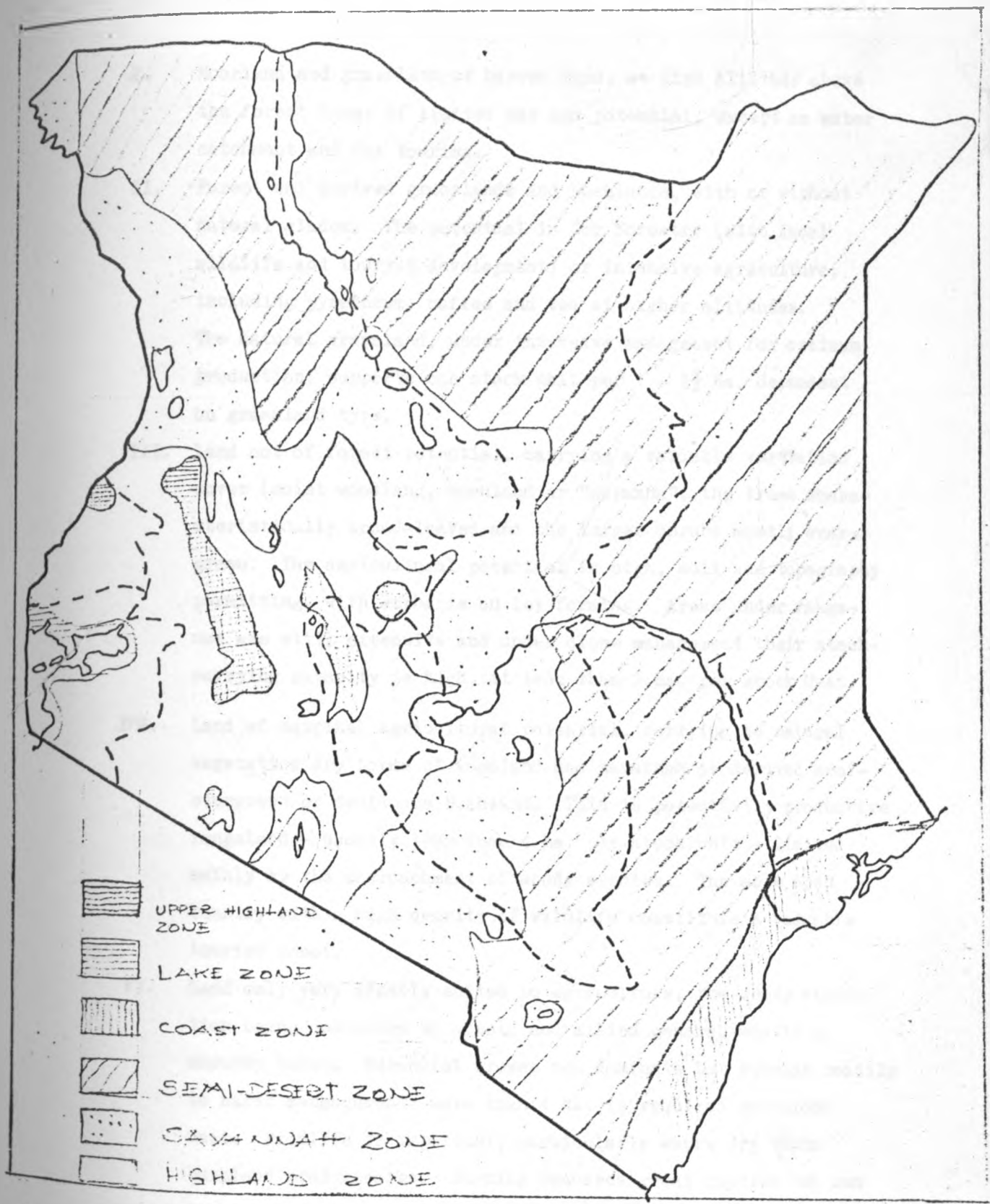
2) National Atlas of Kenya. Third edition 1970. Drawn, printed and published by Survey of Kenya.



MAP 3.1~ DESIGN FOR CLIMATE ZONES (KENYA)
GSOA 1976

I. Moorland and grassland or barren land, at high altitude above the forest line; of limited use and potential, except as water catchment and for tourism.

II. Forest and derived grasslands and bushlands, with or without natural glades. The potential is for forestry (with local wildlife and tourist development) or intensive agriculture, including pyrethrum, coffee and tea at higher altitudes. The natural grassland, under intensive management for optimum production, supports one stock unit per 1 - 1½ ha. dependent on grassland type.

III. Land not of forest potential, carrying a variable vegetation cover (moist woodland, bushland or "savanna", the trees characteristically broad-leaved and the larger shrubs mostly evergreen. The agricultural potential is high, soil and topography permitting, with emphasis on ley forming. Areas under range-use are still extensive and under close management their stock-carrying capacity is high, at less than 2 ha. per stock Unit.

IVH. Land of marginal agricultural potential, carrying as natural vegetation dry forms of woodland and savannah or derived semi-evergreen or deciduous bushland. This is potentially productive rangeland - usually less than 4 ha. per stock unit - limited mainly by the encroachment of woody species. The more open country with a high density of wildlife constitute a valuable tourist asset.

V). Land only very locally suited to agriculture, the woody vegetation being dominated by acasia and allied genera, mostly of shrubby habit. Perennial graase can dominate but succumb readily to harsh management; more than 4 ha. is required per stock unit. Wildlife is important, particularly where dry thorn bushland predominates. Burning requires great caution but can be highly effective in bush control.

VI. Rangeland of low potential, the vegetation being dwarf shrub grassland, or a very dry form grassland, [illegible] of bushed grassland with acacia often confined to water courses and depressions with barren land between. PEREnnial grasses are localized within a predominantly annual grassland, productivity is confined

largely to unreliable seasonal flushes and grazing systems must be based on nomadism. The populations of both wild and domestic stock are restricted severely by the environment.

It should be noted that climatic zone VII, which is true desert does not occur in Kenya.

3.3 Emergent Land use pattern:

From the foregoing it will be seen that land in Kenya is divided up into five broad uses:

(1) Forest areas.
(2) Game reserves and National Parks.
(3) Urban Areas.
(4) Cultivated areas.
(5) Namadic pastoral areas.

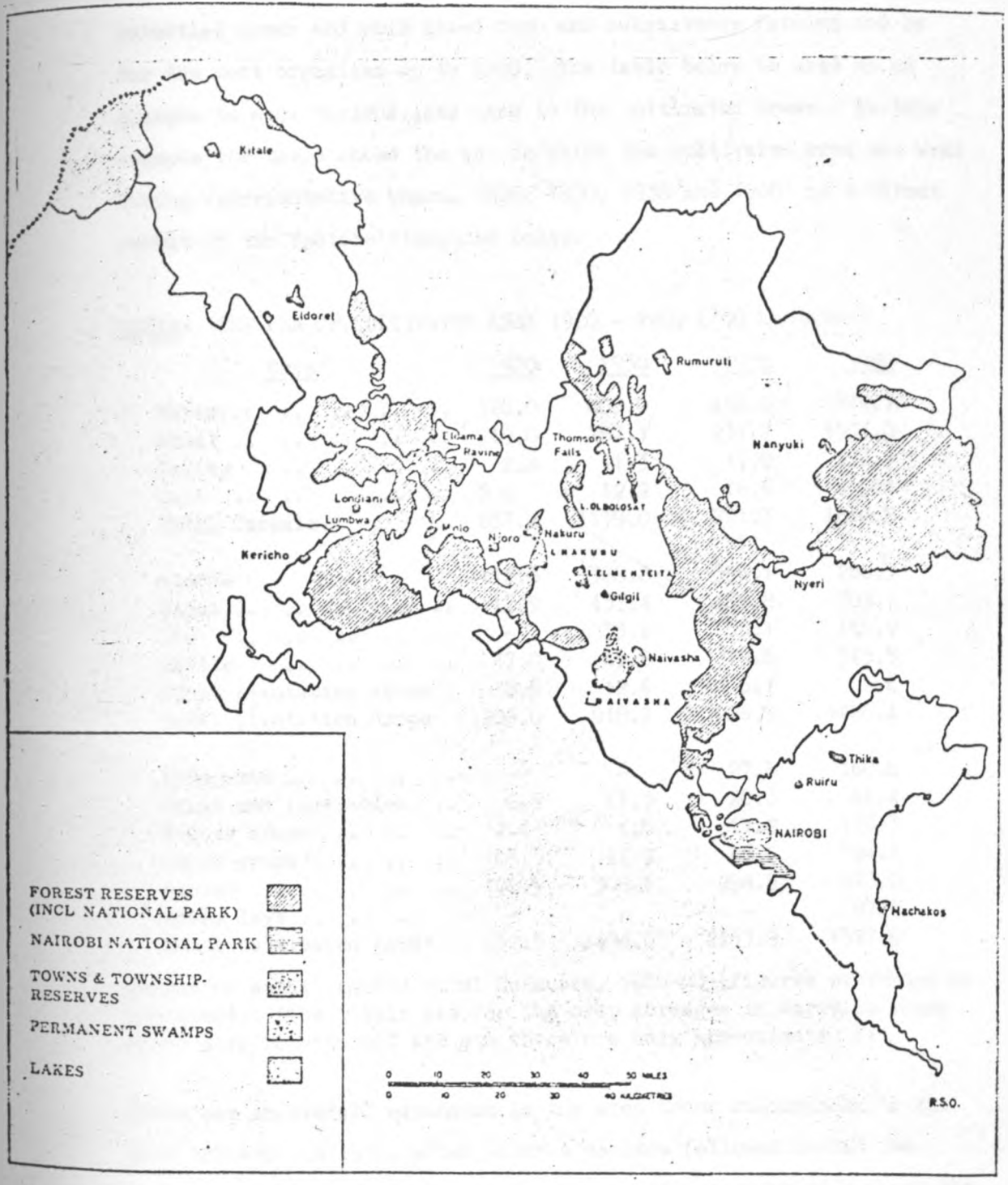
Within the urban, cultivated and nomadic postoral areas' settlemt patterns have emerged which have given rise to various land uses.

Nomadic pastoral areas may be divided into those areas which are purely nomadic pastoral and those that are nomadic pastoral with a few crops grown in suitable areas.

3.31 Cultibated Areas:

One of the most striking facts about Kenya is the smallness of the agricultural as opposed to the pastoral areas in the country. Apart from the restricted medium to high potential agricultural lands at the coast and in the neighbourhood of Lake Victoria, the majority of the agricultural districts are located in the highlands.

Land in the cultivared areas was devoted to perennial cash crops and subsistence crops. The main cash crops have been coffee, tea, pyrethrum sisal, wattle and coconuts.



SOURCE~ R.S.ODINGO, DEPT. OF GEOGRAPHY, UNIVERSITY OF NAIROBI

MAP 3.2 — Non-agricultural land 1960

The White Highlands shown on Map 3.2 was the area with most agriculture potential areas and with mixed cash and subsistence farming and by far the most organized up to 1960. The table below is used as an example to show various land uses in the cultivated areas. In this example the table shows the way in which the cultivated area was used during representative years, 1920, 1930, 1938 and 1960 as a direct result of the factors discussed below.

Table: THE USE OF CULTIVATED AREA 1920 - 1960 ('00 hectares)

Crop	1920	1930	1938	1960
Maize	128.0	808.0	456.0	574.7
Wheat	19.0	287.1	231.7	1004.0
Barley	2.4	11.3	17.0	126.7
Oats	2.0	12.2	16.6	113.4
Total Cereals	851.4	1119.0	721.3	1818.8
Coffee	112.6	388.8	396.1	288.3
Sisal	117.5	437.4	488.8	703.1
Tea	-	33.6	55.1	149.9
Wattle	47.0	45.8	79.8	345.5
Other plantation crops	8.9	12.6	6.1	1.6
Total plantation crops	286.0	918.2	1026.9	1488.4
Pyrethrum	-	-	27.5	160.8
Fruit and vegetables ..	8.9	11.3	20.3	62.4
Fodder crops	2.4	4.5	17.8	139.3
Other crops	105.3	42.9	46.6	394.1
Fallow	108.5	308.6	298.5	473.0
Grass leys	-	-	-	87.1
Total cultivated land*	662.5	2404.5	2157.9	4623.9

Source of data: Agricultural Censuses, 1920-60 (figures converted to hectares). *The totals are for the crop acreages in various years which were rounded off and are therefore only approximate. 3)

There was an overall expansion in the area under cultivation to the peak achieved in 1930, after which a decline followed during the depression of the thirties as shown by the figures for 1938, with the exception of plantation crops which continued to rise, at least tempo-

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3) Source of Table:

raryly. In the second post war period there was a general expansion in "cultivated land." But this did not affect the individual crops uniformly, and smaller areas than were the case in 1930 were recorded for maize among ceareals, and coffee among the plantation crops. The appearance of grass leys in 1960 indicated a new trend in agriculture: cultivated grasses had been included in the farming system in earlier periods, but they were not recorded separately. The expabsion of land devoted to fodder crops, most marked between 1938 and 1960, is also noteworthy and may be taken as indicated of the increase in dairy farming in this period. 4)

3.3.2 Urban Areas:

The growth of urban settlements in Kenya is traced back to the early settlements along the coast. A chain of independent city states for trading centres served also as administrative centres. Examples of this settlement type are Mombasa, Lamu and Malindi.

The construction of the Kenya-Uganda Railway from Mombasa to Kisumu led to the establishemt of Nairobi midway of the line and Kisumu as the Port Terminus. Several smaller stations were then established throughout the length of the route.

Later as the Colonial Government took hold many townships were started for administrative purposes. Moreover, Mombasa became the Capital of what was then British East Africa. This meant its rapid growth as it carried out a dual function of administrative capital and harbour for the hinterland it commanded. Other administrative towns effectivelly housed the Provincial and District Commissioners, police stations and posts. Nairobi also took a more administrative role later becoming the Capital.

Yet others have grown almost purely for agricultural reasons. Such townships as Nakuru, the "capital of the farming areas, Kitale and

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4) OSWGO, R.S., The Kenya Highlands, Land Use and Agricultural development, E. African Publishing House, 1971

Eldoret with Kericho suffice as examples. The market and trading centres were started to service the farming areas as well as serve as collecting centres for farm produce and purchase of farm requirement.

Although industry in general and mining industry in particular has not been the mainstem of the Kenya economy, few towns owe their development and expansion partly to mining. Such townships as Magadi and Maalder Mine. Kakamega expanded in the 1930's (would depression period) owing to the alluvial gold rash.

Webuye has grown out of an agro-industrial base so has Mumias and Chemelil and Miwani. Smaller townships have been started inevitably due to the newly opened up settlement schemes throughout the country generally and particularly in the former white dominated areas.

Government realizing the need for expansion set aside land both in the scheduled and Non-scheduled areas for the expansion of municipalities and trading centres. Within such demarcated areas uses immediately emerged such as the central, commercial and cultural areas, administrative and public use areas, residential, recreational and educational area uses. Most Government secondary schools were established at provincial and district towns. Vacant land was also often times set aside for future expansion along industrial lines. Airports and airstrips have also been associated with urban development.

Other uses such as primary schools religions building, health centres, and dispensaries have been accommodated on land given by the local population. Following will be the development of aland use classification to accommodate the emergent land-uses as seen above.

3.4 Developing a land use classification scheme:

An intergral part of any land use mapping programme is the selection of a suitable classification scheme for use at a specified scale, for a designated area, and within the capability of the information gathering techniques being used.

Past efforts of land use classification research in various countries are strewn with many valiant attempst to find an all purpose classification scheme for mapping land-use which would satisfy the great variety of needs that exist for land-use maps. Although it is very unlikely that one ideal classification of land use will ever be developed, there is a growing appreciation for the advantages of more standardized approaches to land-use classification for urban and regional planning and other purposes that is easily understood and readily useable.

With computer technology now widely abailable, it may be appropriate for geographers to re-examine carefully the possibilities of identifying and classifying land uses in relation to other major attributes of land which are associated with its use. Often such relationships need to be identified and classified. Thus today, a ch scheme for the classification of land use should be developed and tested in the context of the greater need to provide a more comprehensive approach to the analysis of land resources.

3.4.1 Criteria for evaluation:

Some points of consideration for the setting up of such a classification are set out below as criteria for evaluation of such a scheme.

1. A minimum level of accuracy - this should be agreed upon and be consistent with other methods already employed.
2. A well-balanced reliability of interpretation for the several categories included in the classification scheme should be attained.
3. Repeatable or repetitive results should be obtained from one interpreter to another and from one time of photography to another. This is to say that the scheme should seek to have clear and sharp definitions of land-use categories which can be used without major modifications from one time to another. It must be assumed that many persons will be involved in the interpretative process. It will also be very important to have a scheme of classification that can yield comparable results each time the photographs is repeated for a given area.

4. The classification scheme should be useable or adjustable for use over an extensive area.

An open-ended approach which will permit a great deal of flexibility will be highly desirable. Categories will need to be added as the classification is applied over a larger area. Thus the classification in Kenya should be adaptable for use on a world-wide basis by adding appropriate categories. Where varying combinations of land uses are included in the same category, it is very difficult to extend the application of the scheme of classification beyond the area for which it was originally intended.

This is a very difficult requirement to attain satisfactory in a land-use classification scheme to be used over a wide range of physical and cultural conditions. Either the categorization may become highly generalized and prejudicial and rather meaningless or so detailed that comparisons from one set of physical and cultural circumstances to another will not be possible. A recognition of the need for different classification schemes for such contrasting circumstances as are present in the high latitudes, humid mid-latitudes, dry lands and wet tropics is a possible solution. Such an approach to the classification of land uses over an extensive area would of course need to accommodate problems of overlapping categories in transitional situations.

5. The categorization used in the classification scheme should permit vegetation and other cover types to be used as surrogates for activity - oriented categories whereover possible.

This standard will be difficult to meet uniformly but in a number of important instances information avaliable from their source can be used to make such a transfer possible. For example in an area where statistical information available for a given a real unit, such as a location, indicates that nearly all short grass rangeland is being grazed, it will be possible to use grazed, it will be possible to use vegetation cover type of short grass as a surrogate for land used for grazing. However,

mixing of categories from morphological and functionally oriented classification schemes should be avoided.

6. The classification scheme should be suitable for use with photography taken at different times during the year. This becomes a significant problem when the photography is one of remote sensing. The aim here is to minimize weather conditions such as cloud cover.

   Studies into this area will be required to determine the probability at various times of the year of getting satisfactory photography for the identification of many land uses as possible. This is the problem that needs a solution for differing weather situations which markedly affect effecive remote sensing operations. In some localized areas there may be little likelihood of obtaining any imagery at all.

7. The classification should permit effective use of sub-categories that can be obtained from ground surveys or from the use of imagery available at larger scales or with the use of colour photography. Generally, this standard will not be difficult to fulfil. None the less, caution will be needed in using categories having combinations of uses in order to premit meaningful subcategories.

8. A need to collapse or synthesize the categories of the classification scheme into a smaller number of categories must also be recognized. This is especially so when one moves from mapping for a local purpose to mapping for an international or even a national level.

9. Comparison with land use infromation compiled at earlier points in time and with data that will be collected in the future should definitely be possible. In order to premit the careful analysis of the dynamics of land-use, it will be extremely important to

have a refinement in the definition of categories as much as possible.

10. The classification should recognize the multiple-use aspects of land use whenever possible. This has been an extremely difficult criterion to meet in developing classification schemes for use with ground or field surveys. Therefore, it is perhaps expecting too much to assume that initial efforts in developing a classification scheme for use with smaller scales as obtained from high altitude photography will yield concrete results. Yet an ever growing need exists for this kind of information about land use in the context of both local and regional planning studies. Therefore, this criterion should be regognized as a standard to be met at least partially if possible.

Land use classification systems, like other types of classifications, are designed to fit specific needs. There will be as many classification systems as there are agencies trying to evolve the classification system. Although numerous attempst have been made to standardize land use classification, no single system exists which is generally suitable for all purposes. A lack of standardization in terminology among systems in use even, compounds the problem for both compiler and user of land use data, further. The overiding guidline should be that the classification system should solve the land use study or facilitate it for any job at hand.

3.4.2. Problems faced by interpreter and Suggested Remedies:

The image interpreter who tries to interpret land use is placed in a difficult situation because he is "confronted by persistent and predominant problems of terminology and classification as well as problems inherent in image identification. A section will be devoted to photo interpretation aids later.

Problems of terminology appear to be of two kinds - those associated with the incompatability of terms used in different systems, and those where the same term may be used differently in several system. A good example of the former is the use of such words as ARABLE, C

CULTIVATED and CROPLAND; all of which are similar but do not necessarily mean exactly the same thing. The later problem is illustrated by the varying meanings that are attached to a word like IDLE in agricultural land use. This category may or may not include fallow cropland, abandoned land and land in consevation reserve programmees.

Even though interpretation involes assigning land parcesls to use categories, the process of identification and its associated problems can be separated from those involved in establishing classification systems. Classification enables us to name things transmit information, and make inductive generalizations, but classification systems with their hierachies of classes are required only for latter. A classification system cannot be derived without establishing orders or hierarchical categories, but this is not a necessary prelude to indentification. For example, an image interpreter may recognize maize without having to classify it into a land use classification system.

The process of classification can be drined as the creation of classes based on common properties or relationships. As thus defined, classification systems can be defined and developed deductively through logical division or inductively through grouping objects according to similarity of relationship. Most land use classification systems are produced by the former method. Admittedly, logical division has the advantage that the system needs to be no more detailed than the immediate problem demands. However, certain disadvantages are inherent in the approach (1) utility of the data is severely limited because the classes are likely to be incompatible with other systems, (2) the system may have built into it subconcious culture and personal bias; and (3) by nature, logical division must exhaust all possibilities thus there must be a MISCELLANEOUS category.

Land use is a functional concept. In a strict sense it may be defined as the end to which land is allocated, assuming a concious decision to use it for a desired end. It may also be defined as man's activities

on land which are directly related to the land. Thus, while natural qualities of land, improvements, tenure, intensity of use, and other factors are related, they are not part of the central core.

Interpretation of use from photos must be accomplished from image forms because function is seldom shown. Therefore, few deductively derived land use classifications are appropriate for use with photography. Even those deductive systems that have been formulated specifically for use with photos are not generally applicable for a wide variety of uses due to variations in scale, resolution, time, location and imaging system.

Admittedly, land use mapping may be divided into two classes - rural land use mapping and urban land use mapping. The former may be considered as macro and the latter micro. Thus it is appropriate to develop two fitting classification systems. The first, should be a national rural land use classification in which urban land and non-agricultural land would be one of the categories within the classification. The second, proposal classification would cater exclusively for urban land and related settlements.

3.5 Rural Land use Classification:

In order to meet the evaluation criteria set out earlier the classification relevant to Kenya should comply to the Master Key set out by the International Geographical Union Commission (IGUC) on world land use Survey (1949). There classification was an attempt to get a standardized method for recording data in the field and its presentation in map form so that there might be an internationally common language for the ways in which land is used or occupied whatever the climate or mature of the terrain.

IGUC's ultimate concern was agriculture or agricultural potential for this was the time when interest was awakening keenly to the problem of world food supplies, and possible widespread starvation in the years that lay ahead.

The master Key was found sufficient for maps on the scale 1:1,000,000 and for remote areas, but it was always envisaged that it should be further sabdivided to meet local conditions and larger sdales of maps. Thus any enlarged specifications should always be such that they could be correlated with the (international) master Key.

The classification of categories of land-use recommended by the commission to be recognized and mapped were as follows:

1. Settlements and associated non-agricultural lands (dark and light red).
2. Horticulture (deep purple)
3. Tree and other perennial crops (light purple)
4. Cropland: a) Continual and rotation cropping (dark brown)
   b) Land rotation (light brown)
5. Improved permanent pasture (managed or enclosed) (light green)
6. Unimproved grazing land:
   a) Used (Orange)
   b) Not used (Yellow)
7. Woodlands: a) Dense (dark green)
   Open (medium green)
   c) Scrub (olive green)
   d) Swamp forest (blue green)
   e) Cut over or burnt over forest areas (green stipple)
   f) Forest with subsidiary cultivation (green with brown dots)
8. Swamps and marshes (fresh - and salt-water, non-forested areas) (blue)
9. Unproductive land (grey).

3.5.1 Proposed Rural Land Use Classification:

The following classification has been arrived at by expanding the nine categories recommended by the IGU commission(6). The expansion is made to fit those uses that occur within Kenya settlement patterns. This classification is intended to be used for land use surveys and mapping at small scales ranging from 1:10.000 and smaller.

CATEGORY 1 DISCRIPTION

Settlement and associated non-agricultural Land

Built-up area: cities, towns, villages, manufacturing plants, railyards, airports, airstrips, military and quasi-military camps.

Mines, quarries, sand and murram pits used now and in the past.

Outdoor recreation: parks, beaches, lakes, golf courses. to be classified as public or private.

CATEGORY 2

Horticultural Land:

Vegetables, small fruits, market gardens, sod gardens of farms, flower gardens,

To be described as commercial or domestic, irrigated or not irrigated. Single crops or a combination of them should be shown. They inclusde the following:(6) Pineapples, avocadoes, passion fruit, french beans, capsicums, okra, brinjals, karelas, mooli, dudhi, chillies, artichokes, and asparagus, courgettes, suran and sweet potatoes, sweet corn - garden maize, melons, flowers, carrots, flowers.

CATEGORY 3

Tree and Other perennial crops:

Fruits, coffee, tea, wattle, sisal, cinchona, cashewnuts, coconuts, plalms, mango, apple, pear, plum, macadamia.

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5) New possibilities and Techniques for Land Use and Realted Survey Occasional papers No. 9, p.82 Edited by I. H. Cox. Geograpraphical Publications Limited, 1970.

(6) Economic Review of Agriculture, Volume 7 No. 3 July-September,1975 p. 75 Published by the Economic Planning Division of Ministry of Agriculture, Kenya

To be described as irrgated or not irrigated; commercial or domestic.

CATEGORY 4

Cropland:

Maize, millet, cassava, cotton, wheat, sugar cane, pulses, sweet potatoes, barley, yams, arrow roots, rice, pyrethrum, sunflower, oats.

To be described as commercial or domestic; rotated or not rotated, fallow land; feed grain; irrigated or not irrigated; shifting cultivation.

CATEGORY 5

Improved permanent Pasture:

Natural, planted, cut for hey, enclosed or open, private or public, type of grass.

CATEGORY 6

Unimporoved Grazing Land:

Natural, rough, scrub, savannah, semi-cleared, cultivated, vegetation cover sparse or dense, swampy or dry.

CATEGORY 7

Woodlands:

Mangrove, mvule, malundu, camphor, cedar, mukui, bamboo, pine.

To be described as natural forest, planted forest, irrigated or not irrigated, cut forest, second growth, brash, commercial or domestic.

CATEGORY 8

Swamps, marshes and Water:

Lake, pond, dam, swamp, wet land, marsh.

To be described by/as surface of subsurface, vegetation cover, seasonal or perennial, natural or man made, fresh or salt.

CATEGORY 9

Unproductive Land:

Land that is biologically unproductive in its present sate including sand flats, dunes, rock barrens, badlands, eroded river banks and beds, permanently snow covered.

3.6 Urban Land Use Classification:

Within the urban context the term land use assumes a norrower meaning and particularly in recent times planners have become more and more concerned with space use within buildings. Traditionally the survey has been concerned with the use of ground space. The classification has been according to functional activities carried on within the urban centre. Activities on the other hand, have been closely associated with land use and generally liked to diverse classes in an intuitive and generalized manner. Thus there are several categories to represent industrial use, commercial, public, residential and perhaps recreational.

Recently, the planner has been seeking classification systems compatible with a whole range of new tools. The interest now is the classification and assembly of data about the use of space inside building (floor space) as well as on the land (ground space). Further concern is with the use of land as descriptive tool and space uses as they reflect specific clusters of human activities. Thus the classification and inventory of space must be done in a manner which is meaningful in terms of activity systems. The plan should seek to classify and record uses as they tie into both local and non-local activity and communication systems. In total he requires a classification scheme which is compatible with these systems of interaction and which at the same time will serve as an all-purpose approach to investigating land use whether it is a survey of ground space use of for floor space.

The great variation amongst uses necessitate a systematic basis of classifying and recording land and space uses. The classification will give rise to a coding system of modern data - data processing methods are to be used. Coding would be defined as a systematic means of recording land uses in line with predetermined purposes. The coding system used in recording land use should be distinct from coding systems used in recording characterstics of the parcel or structure.(7)

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(7) "Urban Land Use Plaaning" 2nd Edition, 1972, by F.S. Chapin

Preceeding the final adoption of a system of classification much thought and study must go into the detail and form in which data are needed in both immediate and ultimate applications. Too narrowly a conceived system, too bound to one kind of application severely handicaps a planning agency/ programme as later correction changes can create problems.

Chapin recognizes two advantages of a standard classification:(8) Firstly, it simplifies problems of communication among members of of the profession and with the general public; and in a profession where there is the degree subordinate ranks in the town planning field, there is less waste motion in intergrating new personnel into staff operation.

Secondly, it assists in determining the transfer value of analytical methods successfully employed in one town for use in the solution of problems in other towns offering opportunities for comporative studies and more systematic research into urbanization trends.

On the contrary, blind adherence to a standard classification system can result in an entirely inadequate appraisal of land use characteristics peculiarly local in nature or of special local interest. Further, standardization can involve cumbersome and time consuming formalities in the initial adoption and subsequent amendment of a system, with incilliary dangers of inflexibility and delays in the methodology of keeping the system up-to-date.

Two considerations, mainly, must be borne in mind. Firstly, the storage of data whether on punch card or otherwise and secondly on presentation wheter graphic or statistical.

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(8) "Urban Land Use Planning" 2nd Editition, 1972, by F.S. Chapin Jr. University of Illinois Press, pp 264, 265, 271.

3.6.1 Proposed Urban Land Use Classification

Hitherto, to the author's knowledge, one attempt (9) has been made in Kenya to evolve a land use classification and code based on the international standard industrial classification (ISIC). In this study the major divisions have been retained. Major Division (0) which is recommended for activities not adequately defined has been used for residential use. The four - digit coding system has also been used as recommended by ISIC. Only those uses relevant to Kenya have been retained. Other uses applicable to Kenya have been added.

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(9) To quote Jim Eastwell, who prepared a modified land use classification, he said,

> As far as possible the following land use coding is in accordance with the international Standard Industrial Classification (ISIC) of economic activities. Since not all land uses are related to economic activities however, new classifications for land uses such as residential (0) and pubilic open space (5) have had to be created resulting in the necessity for transferring ISIC Code 5, construction, to code 4, electric, gas and water Where the ISIC classification is not suitable for asing as a land use code and it would be more appropriate for planning purpose to include a certain group of activities in a different category, the ISIC classification system has been modified. Thus for example, hotel, rooming houses.

The author has chosen to retain the divisions and groupings so that should there be any need of international comparison national statistics, very little alterations would be required.

The ISIC of all economic activities is primarily a statisitcal classification of establishments according to their major economic in activity. The original ISIC Was adopted in 1948 by the United Nations Economic and social council on the advice of its statistical Commision. Since then the classification has been revised in 1958, at the request of the statistical Commission, the statistical Office prepared numeric

and camps have been included in Residential (0) instead of in wholesale and Retail Trade (6).

Although the first and second digit of the Land Use Code follows the ISIC fairly closely, the third digit represents a classification worked out to suit land use planning puposes primarily and bears little correspondence with the ISIC system. Other modifications of ISIC have been made to accommodate activities peculiar to Kenya (10).

Office prepared numeric and alphabetic indexes. With the second revision of the ISIC in 1968 the origin indexes became outdated. 1968 revision brought the indexes up-todate.(11)

In the opinion of the author hotels and restraurants should not xx be included under residential since the services there are sold on retail basis.

The Kenya Telephone Directory was found to be particularly useful in the preparation of the land use code. (12)

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(10) See Appendix 3.6.1 for Jim Eastwells Version of Land use classification.

11) Index to the International Standard Industrial Classification of All Economic Activities, United Nations Publication, Series M. No. 4 Rev. 2, Add. 1, 1971 p.iii.

(12) "The Nairobi Handbook Vol. IX No. 12, April 1976, English Press was also useful. Also, 'What's On', Published by Nation Newspapers Limited.

Division	Major Group	Group	Major Dvision 0. Residential
00			Residential
	000		Vacant residential plot
	001		Residential premises under construction
	010		Vacant single family house
		0101	Single family house
		0201	Two family dwelling
	030		Vacant maisonette or flat
		0301	Maisonette or flat
	040		Vacant Apartment
		0401	Apartment
	050		Vacant Institutional Housing
		0501	Dormitory
		0502	Hostel
		0503	Hall of residence
	060		Vacant official residence
		0601	State Houses
		0602	Embassy Residence
		0602	United Nations residence
	070		Uncontrolled housing

Major Division 1. Agriculture, Hunting, Forestry and Fishing (13)

10			Unregistered Land
11			Agriculture and Hunting
	111	1110	Agriculture and livestock production Field crops: tea, coffee, sisal, pyrethrum, fruits, nuts, nurseries. Raising of livestock: Dairy, sheep and goats, pigs, poultry, bees.

			Production of: beef, milk, wood, eggs, honey, mutton, prok
	112	1120	Agricultural services: Agricultural, animal husbandry and horticultural services on a fee or contract: harvesting, threshing, husking and shelling
			Pest destroying: locust, termite, army worm
	113	1130	Hunting and poaching
			Game Reserve
			National Park
	114	1140	Ranch
	115	1150	Co operative Farm
	116	1160	Large Scale Farm
	117	1170	Small Scale Farm
	118	1180	Feedlot, breedet, greenhouse
	119	1190	Un used land: water areas, lakes, reservoirs, riperian reserves, Unused Government land
12			Forestry
	121	1210	Forest Reserve
			Forest: nurseries
	122	1220	Charcoal burning in forest
	123	1230	Forest station

13	130		Fishing
		1301	Ocean and coastal fishing: commercial fishing in ocean, coastal, offshore and estuary water; sea weeds, sea shells, oysters, crabs, shellfish, sharks
		1302	Fishing not elsewhere classified: commercial catching in inland waters; fish hatcheries, ponds and preserves; fishery services on a fee or contract basis.

Major Division 2. Mining and Quarrying

21	210	2100	Coal mining
22	220	2200	Crude petroleum and natural gas wells
23	230		Metal ore mining
		2301	Iron ore mining
		2302	Non-frrous ore mining
24	240		Non-metallic mining
		2401	Precious stones: ruby, garnet
29	290		Other mining
		2901	Stone quarrying, clay and sand pits, building stone
		2902	Chemical and fertilizer mineral mining: fluor spar, soduim bicabornate diatomite
		2903	Salt mining: quarrying rock salt and evaporating salts in satl pans
		2909	Mining and quarrying not elsewhere classified: gypsum, asbestos, mica quartz, graphites, talc, soapstone.

Major Division 3. Manufacturing

31 Manufacture of Food, Beverages and Tobacco

311-312 Food manufacturing

3111 Slaughtering, preparing and preserving meat:
Abattoirs and meat packing
Killing, dressing and packing cattle , pigs, sheep, goats, poultry, small game
Curing, smoking, salting

3112 Manufacture of dairy products:
Creams, butter
Cheese
Condensed, powdered milk
Fresh and preserved cream
Ice cream, other milk desserts
Pasteurizing, homogenizing, vitaminizing, bottling and packaging

3113 Canning and preserving of fruits, fruit juices and vegetables:
Fruits and vegetables
Fruit and vegetable (jices) juices
Jams and jellies
Sauces
Soups
Dehydrated and frozen fruits and vegetables

3114 Canning, preserving and processing of fish and similar foods:
Salting, drying, dehydrating, smoking, cury, canning

3115

3115 Manufacture of vegetable and animal oils and fats:
Crude vegetable and nut oil - sunflower, coconut
Extraction of fish and other marine animal oil and fish meal production
Refining of oils and fats, hydrogenation
Production of margarine

3116 Grain milling products:
Flour Flour - maize (posho) mills, wheat
Husing and polishing of rice
Coffee factories

3117 Manufacture of bakery products
Manufacture of bread, cakes, pies, and similar perishable bakery products,
Biscuits, crackers, and similar 'dry' bakery products
Macaroni, spaghetti, noodles and similar products

3118 Sugar factories and refineries:
The manufacture of raw sugar, syrup and granulated sugar from sugar cane
Juggery factories

3119 Manufacture of swets sweets and sugar confectioneries
Sweets toffee
Sugar covered nuts, salted nuts, stuffed dates
Chewing gum

	3120	Manufacture of potato chips, pop corn
	3121	Manufacture of food products not elsewhere classified:
		starch
		Baking powder
		Flavouring products and extracts
		Yeast
		Codiments, vinegar, spices
		Coffee roasting
		Processing of tea leaves - tea factories
		Edible salt refining
	3122	Manufacture of prepared animal feeds:
		For chicken, dog, cats
313		Beverage industries
	3133	Breweries
	3134	Soft drinks and carbonated
		Waters industries: non alcoholic
		beverages such as soft drinks, including
		fruit flavoured and carbonated
		furit drinks and mineral waters
314	3140	Tobacco manufactures
315	3115	Sisal Processing
316	3160	Pyrethrum processing
32		Textile, Wearing Apparel and Leather industries
321		Manufacture of textiles
	3211	Cotton ginning: spinning, waving
	3212	Manufacture of made - up textile goods
		except weaving apparel: house furnishings,
		Textile bags
		Canvas products

		Flags
	3213	Knitting mills: Sweaters, underwear, nightwear, laces
	3214	Manufacture of carpets and rugs: Of sisal or any textile
	3215	Rope industry: of sisal
	3216	Manufacture of sisal cloth
	3217	Manufacture of woollen cloth
	3219	Manufacture of textiles not elsewhere classified
322	3220	Manufacture of wearing apparel, except footwear: Hats, gloves, rain coats, belts, handkerchiefs, the atrical costumes.
323		Manufacture of leather and products of leather:
	3231	Tannaries and leather products and leather substitutes, except footwear and wearing apparel: luggage handbags, pocket books, cigarette and key cases, coin purses; saddlery and harness whips;
324	3240	Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear
33		Manufacture of wood and wood products, Including Furniture
331		Manufacture of wood and wood and cork products, except furniture

	3311	Sawmills, planing and other wood mills
	3312	Manufacture of wooden and cane containers: Boxes, crates, drums; baskets, reed or willow containers
	3319	Manufacture of wood and cork ppducts not elsewhere classified: cork; footwear; ladders; handles, pins rods, carvings, picture and mirror frames; coffins
332	3320	Manufacture of furniture and fixtures except primarily of metal: For home and office Upholstered furniture Sofa beds and chairs Mattresses and bedsprings
34		Manufacture of Paper and Paper Products: Printing and Publishing
	340	
340		Pulp and Paper mill
341	Man	Manufacture of paper andpaper products
	3411	Manufacture ofp paper and paper board
	3412	Manufacture of containers and boxes of paper and paperboard
	3419	Manufacture of paper and paperboard articles not elsewhere classified: bottle caps; unprinted cards, envelopes, stationery; wall paper; towels, toilet paper; straws
342	3420	Printing publishing and allied industries: Commercial printing; book binding, photo engraving, manufacture of printed cards

35 Manufacture of Chemicals and of Chemical, Petroleum, Coal, Rubber and Plastic Products

351 Manufacture of industrial chemicals

3511 Manufacture of industrial chemicals: tanning and dyeing materials

3512 Manufacture of plastic materials and man-made fibre except glass

352 Manufacture of other chemical products

3521 Manufacture of paints, varnishes and lacquers; paint removers, patty, filling material

3522 Manufacture of drugs and medicines: vaccines; serum; antibiotics; vitamins; veterinery medicines

3523 Manufacture of soap and cleaning preparations, perfumes, cosmetics and other toilet preparations; detergents, shampoos and shaving products; cleansers, wasting and scouring powders

3529 Manufacture of chemical products not elsewhere classified: polishes, waxes, deodorants, glues, candles, inks

353 3530 Petroleum refineries: producing petrol, lubricating and grease

354	3540	Manufacture of miscellaneous products of petroleum and coal: asphalt, paving and roofing material
355		Manufacture of rubber products not elsewhere classified: Footwear made of vulcanized or mouled rubber; industrial and mechanical rubber
356	3560	Manufacture of plastic products not elsewhere classified: kitchen and tableware; mats; containers; plastic footwear; insulation; furniture; bottles
36		Manufacture of Non-metallic Mineral Products, Except Products of Petroleum and coal
361	3610	Manufacture of pottery, china and earthenware: kitchen and tableware, plumbing fixtures, bathroom accessories; electrical supplies; art and ornamental articles; florist articles
362	3620	Manufacture of glass and glass products
369		Manufacture of other non-metallic mineral products
	3691	Manufacture of structural clay products: Bricks, tile, pipe,crucibles, architectural terracotta; chimney pipes; refractories

	3692	Manufacture of cement lime and plaster
	3693	Manufacture of non-metallic products not elsewhere classified: Concrete, gypsum and plasturer; cut stone products; aspestos products
37		Basic Metal industries
371	3710	Recycled iron
372	3720	Non-ferrous metal basic industries
38		Manufacture of Fabricated Metal Products, Machinery and Equipment
381		Manufacture of fabricated metal products, except machinery and equipment
	3811	Manufacture of cutlery, hard tools and general hardware
	3812	Manufacture of furniture and fixtures primarily of metal
	3813	Manufacture of sturctural metal products
	3819	Manufacture of fabricated metal products excent machinery and equipment not elsewhere classified: metal cans; apil, drums; wire and cable products; spring, bolts, nuts and washers
	3832	Radio assembly and communication equipment and apparatus

		3839	Manufacture of electric bulbs
	384		Manufacture of transport equipmtnt
		3841	Boat building and reparing
		3843	Motor vehicle assembly
		3844	Motor cycles and bicycle assembly
		3849	Manufacture of transport equipment not elswhere classified: Animal wagons, carts; push carts, wheelbarrows
39	390		Other manufacturing industries
		3901	Jewellery
		3902	Musical instruments
		3903	Sporting and athletics goods
		3909	Other: toys, articles not made of rubber

Major Division 4. Electricity, Gas, Water

41	410		Electricity, Gas and Steam
		4101	Hydro-electric plant
		4102	Gas manufacture and distribution
		4103	Geo-thermal plant
		4104	Diesel (oil) power plant
		4105	Transformer stations
		4106	Power transmission line
		4107	Other forms of generation not elsewhere classified

42 420 Water Works and Supply

4201 C Collection

4202 Purification

4202 Distribution: tank, pipeline

Major Division 5. Constraction

50 500 Construction

501 Building:

5011 Constructing

5012 Altering

5013 Demolishing

502 Highways and Railways

503 Harbours and marine construction

504 Hydro electric plants and irrigation

5041 Hydro electric plants

5042 Dams

5043 Drainage works

5044 Irrigation works

505 Communications

5051 Power lines

5052 Tlephone lines and microwave towers

5053 Pipelines

506 Recreational and other not elsewhere classified

5061 Golf courses

5062 Athletic fields and stadia

5063 Swimming pools

5064 Play grounds

5065 Car parks

507 Mining and pile driving

509 Other constraction not elsewhere classified

Major Division 6. Wholesale and Retail Trade,

Restaurants and Hotels

61 Wholesale Trade

610 Vacant wholesale plot

6100 Vacant wholesale premises

611 Wholesale Food stuffs

6111 Bakery products
6112 Meats
6113 Dairy products
6114 Fish and marine animals
6115 Vegetables

612 Wholesale footwear clothing

613 Wholesale footwear

614 Wholesale agents

615 Wholesale distributors, importers and exporters

616 Wholesale branch and sales office but not retail

617 Wholesale of hardware

618 Wholesale of chemical products: drugs, medicines

619 Wholesale trade not elsewhere classified

62 Retail Trade

620 Vacant Retail Plot

6200 Vacant Retail Premises

621 Food stores and tobacco products

6211 Bakery ppoducts
6212 Butcher shops
6213 Dairy product shops
6214 Fishmonger shops
6215 Greengrocers
6216 Grocers
6217 Supermarkets

	6218	Tobacconist
	6219	Food retail trade not elsewhere classified
622		Clothing stores
623		Footwear stores
624		Furniture stores
624		Hardware and software retail
	6241	Hardwared and building materials
	6242	Toy' shops
	6243	Appliances
	6244	Cameras
	6245	Sporting equipment
	6249	Other hardware and software retail not elsewhere classified
625		Sales of Books, music material and otherp published products
	6251	Book store; books, newspaper, magazines
	6252	Music store
626		Jewelle y and other related products
	6261	Jewellery
	6262	Tourist Curiors
	6263	Precious stones and gams
627		Animals, plant and related products
	6271	Pet shop
	6272	Florist
628		Office supplies, light equipment sales
	6281	Calculators
	6282	Typewriters
629		Other retail trade not elsewhere classified
63		Restaurants and Hotels
630		Vacant plot
	6300	Vacant premises

631		Restaurants
	6311	Cafes
	6312	Open air restaurants
	6313	Eating Kiosk with hot drinks services
632		Coffee, Tea shops
633		Take-away restaurants and food shops
634		Bar
	6341	Bear Hall
	6343	Night club
635		Hotels
636		Motels
637		Safari Lodge
638		Camps, Self-service Banda
639		Rooming houses
	6391	Guest houses
64		Sales Rooms and show rooms
641		Automobile showroom
642		Heavy Equipment Sales Room
643		Auction Rooms
649		Other Show Rooms
65		Petrol and Petroleum Products
650		Petrol station
651		Sale of Gas
66		Open markets
660		City markets
661		Barter markets

Major Division 7. Transport, Storage and Communication

71		Transport and storage
	71 1	Land Transportation
	7111	Railway Transport: station, locomotive sheds and repair shops
	7112	Urban, suburban and interurban passenger transport: bus terminals
	7113	Other passenger land transport: taxi ranks, rental cars
	7114	Freight Transport by Road
	7115	Pipeline Transport
	7116	Supporting serviees to land transport: Tool roads, bridges, tunnels, parking lots and structures
	712	Water transport
	7121	Ocean and coastal water transport: Harbours
	7122	Inland water transport: canals, ports, ferries
	7123	Supporting services to water transport: piers, docks, pilotage, lighthouses
	713	Air Transport
	7131	Air fields, Air strips, control towers
	7132	Air Terminals
	7133	Airplane Hangars
	7134	Supporting service to air transport: Radar stations, rental services, radio beacons
	719	Services allied to transport
	7191	Services incidental to transport: Forwarding, packing and crating arrangement of transport (travel agencies)

		7192	Storage and warehousing: For food, furniture and household goods, automobile, timber
72	720		Communication
	721		Radio
	722		Telephone
	723		Television
	724		Towers:
		7241	Microwave
		7242	Radio Transmitter
		7242	Television Mast
	725		Telephone exchange

Major Division 8. Financing, Insurance, Real Estate and Business Services

	800		Vacant plot
		8001	Vacant premises
81	810		Financial institutions
		8101	Monetary institution: Central Banks Commercial Bank
		8102	Other Financial institution: savings bank, Credit or Loan association, finance company
		8103	Financial services: Foreign exchange, lieencing, cheque cashing
82	820		Insurance
		8201	Motor insurance
		8202	Household insurance
		8202	Life insurance

83		Real Estate and Business Services
	831	Real Estate
	8311	Letting
	832	Business services except machinery and equipment rentals and leasing
	8321	Legal services: Advocates, barristors solicitors
	8322	Accounting, audting and book-keeping services
	8323	Data processing and tabulating services
	8324	Engineering, architectural and technical services
	8325	Advertising services
	8329	Business services except machinery and equipment, rental and leasing, not elsewhere classified
	833	Machinery and quppment rental and leasing

Major Division 9. Community, Social and Personal Services

	900	Vacant Buildings
91		Public Administration and Defence
	910	Government Administration: General administration, National Assembly Central administration
	911	East African Community Administration
	912	Municipal Administration
	913	County Council Administration
	914	Government Agencies
	915	Police: station, post
	916	Prisons
	917	Defence
	9171	Army

		9172	Air force
		9173	Navy
		9174	General Service Unit
		9175	National Youth Service
	918		Court House
92	920		Sanitary and similar services
		9201	Garbage and sewage disposal
		9202	Drainage
		9203	Disinfecting
93			Social and Community Services
	931		Education Services
		9311	Universities
		9312	Teacher Colleges, Polytechnics
		9313	Secondary school
		9314	Correspondence schools
		9315	Adult education
		9316	Driving schools
		9317	Primary schools
		9318	Elementary schools: Nursery, kindergaten
	932		Research and Scientific institutes
	933		Medical Health and Veterinary services
		9331	Doctor's surgery
		9332	Dentist's surgery
		9333	Other surgeries and clinics
		9334	Hospital (General)
		9335	Maternity
		9336	Mental Hospital
		9337	Health Centre: Dispensary
		9338	Veterinary services
		9339	Other medical and veterinary servcies not elsewhere classified

934		Welfare institutions
	9341	Red cross
	9342	Orphanage
935		Business, professional and Labour associations
	9351	Chamber of commerce
	9352	Kenya Farmers Association
	9353	Labour Unions
	9354	Professional Associations: medical engineering, architectural organisations
939		Other social and related community services
	9391	Protestant church
	9392	Roman Catholic church
	9393	Other Christian Denomination
	9394	Mosque
	9395	Temple
	9396	Synagogue
	9397	Other religious sects
	9398	Community Hall
	9399	Social and related Com unity services not elsewhere classified
94		Recreation and Cultural Services
941		Motion picture and other entertainment services
	9411	Motion picture production
	9412	Motion picture distribution and projection: cinema, drive-in-cinema
	9413	Radio and television broadcasting
	9414	Theatrical producers and entertainment servides: Theatre, opera house
	9415	Authors, music composers and artists

	9416	Entertainment Hall: Bowling Alley, Bingo, Dance, Ballet
	9417	Private club
	9418	Casino
942		Libraries and relat d services
	9421	Library
	9422	Museum
	9423	Information Centre
	9424	Gallery
943		Stadia and Playgrounds
	9431	Football stadium
	9432	Athletic stadium
	9433	Cricket Ground
	9434	Tennis Court
944		Racing Tracks
	9441	Horse race track
	9442	Motor race track
945		Parks
	9451	Urban or city park
	9452	Exhibition grounds
	9453	Aboreta
	9454	Zoo, snakes park
	9456	Toi lot
946		Water Amusement Areas
	9461	Swimming pools
	9462	Beaches
	9463	Boating areas
	9464	Dams and Fishing grounds
947		Courses
	9471	Golf course
	9472	Golf Driving Range

95			Personal and Household Services
	951		Repair services not elsewhere classified
		9511	Repair of footwear and other leather goods
		9512	Electrical repair shops
		9513	Repair of motor vehicles
		9514	Watch, clock and jewellery repair
		9515	Bicycle repair
		9516	Tinsmiths, blacksmiths and related repairs
		9519	Other repair shops not elsewhere classified
	952		Laundaries and related services
		9521	Dry cleaner
		9522	Carpets, rugs cleaning
	953		Domestick services
		9531	Maids, cooks, baby sitters
	959		Miscellaneous personal services
		9591	Barber and Beauty shop
		9592	Photographic studio
		9593	Gynasium, Slimming clinic
		9594	Hair stylist saloon
		9595	Massage Parlour, Sauna
		9596	Shoe shine
		9599	Personal services not elsewhere classified
96	960		International and other Extra-Territorial Bodies
		9601	United Nations
		9602	Embassies and High Commissions

4. CURRENT SITUATION[1)]

In this chapter the adequacy or inadequacy of reference maps and aerial photographs is dealt with. The current situation as it prevails both at the Department of Urban and Physical Planning, and Survey of Kenya is examined. Both departments fall under the Ministry of Lands and Settlements.

4.1 Department of Urban and Physical Planning:

4.1.1. Reference Maps: Experience has established that the topographic maps of scale 1:50000 are the most detailed and most useful for regional planning in Kenya. Thus for each of the provinces Western, Central, Nyanza, Coast, Rift Valley and Eastern this series is used with great advantage. The North-Eastern Province is mapped at 1:100000. The 1:50,000 ..x series gives settlement patterns whilst the 1:250,000 series gives infrastructural information. Services and the distribution of market centres, shhools, postal services, health and administrative facilities are shown inter alia.

For town planning practice, Nairobi, Mombasa, Nakuru and Kisumu have reliable topographic maps showing existing land uses and zones; but the maps are not up-to-date. For Nairobi the scales are 1:2,500 and 1:1,500 for its envirous. No reliable large scale base maps exist for smaller townships. Aerial photographic quickies have to be resorted to for such small centres.

There are no soil maps at scales below 1:10.000. Officers are compelled to go to the field and carry out novice-type soil surveys by eye with no proper drilling equipment.

Some up-to-date maps for Nairobi showing cadastral information for built-up areas exist.

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1) This information was obtained through a series of interviews conducted in the departments of physical planning and the Survey of Kenya.

The National Atlas of Kenya is one important source of reference that planners in Kenya readily resort to. It provides such information as soils, geology, population. This information is useful for land use and land utilization studies.

4.1.2 Air Photographs:

While planners have referred to air photos of smaller scales than 1:2,500 the most widely used is the so called "photo quicky" which is an enlargement of smaller scale photography. Although the 1:5,000 is not common it has reportedly been used.

The advantages thus far enjoyed by those who have used them include the following: the fact that they have all the topographic information including rivers, buildings, roads and footpaths. They give the exact picture of the locality at a particular time and are generally more up-to-date than reference maps.

Disadvantages also exist. Aerial photographs have no contours and therefore an overlay of only contours has to be supplied from the Survey of Kenya. They have no grid reference which makes it difficult to transfer information. Some of the air photos are very old and unreliable as an accurate record of certain development. Aerial photographs have been found to suffer from scale distortions which make map revision cumbersome for those not skilled in their use.

4.1.3 General Emergent Problems:

The problems experienced by planners in their practice were found to be as follows:

That the Physical Planning Departments priorities submitted to the Survey of Kenya take unduely long to be met. They may take upward of six months before anything is forth coming.

That the Town, Planning Act and Planning Legislation in general is weak as it has severally been overidden by Provincial Commissioners or other Ministries.

Photographic quickies are only good for smaller centres where accuracy is not critical. But for larger urban centres there is lack of adequate and accurate mapping. The problem thus is the irregularity or the overdueness of revision as the mapping for these urban areas might have been done many years past. The countour overlays show countours below sea level when laid over quickies.

Most photographs are now out-of-data. Maps similarly are out-of-date. In particular settlements, rivers and roads have been found to be inaccurate especially where new road construction has taken place since independence. These maps date back to 1953-66. Administrative boundaries and names are the only items that have kept pace with changes.

The North-Eatern Province is sparsely populated and less developed whilst other provinces are more densely populated. As such the current maps of 1:50,000 scale are not suitable for detailed planning of the more developed areas.

Undue resort has to be made to flying to the area under question if no information is recived from other departments and ministries. The Department of Forest and the Department of Mines and Geology in the Ministry of Natural Resources. The Ministry of Education, the Ministry Water Development and the Ministry of Agriculture have valuable planning information.

The Settlement Schemes offer a new problem in that maps are in the custody of field officers of the Department of Lands. As such they have not been properly incorporated in the Survey of Kenya records so as to be used for up-dating the current 1:50,000 series.

Problems converning existing data include: the duplication of data due to the difficulty experienced in securing it where such data has been compiled; the excuse of confidentiality which makes retrieval difficult; lack of inter-departmental and inter-ministerial liason;

a large number of officers going on leave towards the end of the year makes it difficult to get access to information as they leave a gap in the organization; and the reluctance in releasing information perhaps under the pretext of official Secrets Act - even infromation that should circulate among planning circles.

Factors affecting the delay of development plans were found to be as follows: there is a general lack of staff throughout the entire herarch of the planning agency. There is delay in communication between the Head office and the provincial offices, and Nairobi in general. In Nairobi, for example, air photographs are obtained in a matter of two days whilst it takes six months for planner at the province to get them. Government Land in townships is becoming scarcer. As such there is generally little concern in the development taking place. That is, legislation has sucumbed to political pressure on private land hence planning machinery cannot regulate the proper use of the land. Lack of subdivisional information due to the time lag in reporting such subdivisions to the Lands Office.

On the problem of setting up a plans record office or storage office, its administration will be difficult for lack of personnel sufficiently trained to keep the records up-todate. It was also reported that funds are not available for such an undertaking.

4.2. Survey of Kenya:

4.2.1 Reference Maps: The Survey of Kenya (SK) which is the technical agent of the Government of Kenya changed with mapping and execution of surveys has published a catalogue of all maps that they produce and keep. The maps include topographical maps, special maps, township maps and plans and cadastral maps. The catalogue ~~Appendix~~ - shows maps of Kenya depicting which areas have been mapped at what scale. It Appendix - also shows the price list for various maps and plans that may be purchased from the Survey of Kenya and the authorized agents both locally and abroad.

A reference map may take from three months up to two years to prepare

depending on area to be mapped, technique of production, available staff, urgency of the job, number of jobs undertaken, weather and other external factors.

The following were found to be the underlying delay factors at the office's mapping Section:

1. Since nearly base all maps in Kenya are prepared from aerial photographs adequate notice must be given to the SK to plan fresh flight coverages. So far they have not been receiving such adequate notice.
2. Poor weather condition hinder both the photography and any ground work required to control the photography.
3. Because of the general shortage of technical staff and the nature of the work taking a long time officers stay in the field for considerable periods of time.

Thus there is inevitable delay due to staff movement.

4. There is serious shortage of technically trained manpower. This is aggravated by the fact that those who are trained on the job have a tendency of seeking employment elsewhere, particularly in private firms where they are paid more. Thus any programmes geared to replenishing and generating manpower are frastrated.
5. The degree of detail of a particular township will have an impact on the time the mapping will take.
6. There is usually a time lag between the setting up of ground control in the field and the time the flight is undertaken and the mapping eventually done.
7. Priority changes due to pressures from other jobs may cause the delay.

It is hoped that the introduction of the orthophoto mapping equipment will remarkably reduce the time thus far spent on base map production.

4.2.2. Aerial Photographs:

Practically the whole of Kenya has been photographed from the air since 1947 at various scales, ranging from 1:80,000 covering the Northern areas to 1:10.000 covering some towns. The agencies that have done the

Preliminary work done using both satellite imagery and conventional aerial photography indicates that the available space and aerial photography provides the Central Bereau of Statistics with invaluable information required for field data collection operations.

Two land surveying satellites launched by the U.S. LANDSAT-I (formerly ERTS-I) and LANDSAT-2 are the sources of space photography. This type of photography is taken every eighteen days, and supplemented with aerial photography taken as often as desirable and economically feasible.

In Kenya several land cover changes have been observed on satellite imagery by comparing existing topo maps with up-to-date relief features as revealed by the satellite imagery at the same scale. Changes have in land use have also been noticed directly from the imagery by ground checking all most noticeable "scars" on the earth's surface. The changes have been most striking in places where major development project have been started and executed, for example irrigation schemes, land settlement example schemes, expansion of forested areas, and growth of urban areas. These changes have been related to Kenya's population census maps by overlaying census boundaries at scale 1:1,000,000 on a national mosaic of the same scale compiled from satellite imagery.

Observation made include the following:-

1. There is on the whole a close relationship between the administrative boundaries used during the last population census and ground features observed on the imagery.
2. This relationship is most significant in Western and Central parts of the country where most of the boundary lines follow natural features like rivers, forests, ridges and roads.
3. In a number of places, as revealed by the satellite imagery, changes in landcover have occurred on or around the boundary lines. These changes are now being studied with a view to adjusting the boundaries of enumeration areas into which the administrative zones of the country are sub-divided for purpose of census taking.

Overseas Surveys (DOS), Survey of Kenya, a Japanese Firm, Alexander Gibbs, Sugade Aerial Surveys, Geosurveys and Fjellanger Widerde. Maps - depict the extent of the aerial photo coverage. In particular Geosurveys can now thake aerial photographs to as large a scale as 1:3,500 which is very suitable for heavily developed areas such as central business districts of Townships.

The Nairobi area has received particular attention. In 1966 the coberage was flown for control mapping and x covered up to Kiambu. Ruiru and Athi River. In the following year 1967 the railway route was photographed from Athi River to Eldoret. In 1968 the entire city was flown as far as the old boundary extended and the area bounded by the new boundary was flown in 1970. Six years later 1976 another flight was imposed to be taken.

Cost and seasons of flying - the rate of hiring a an aircraft as at January 1976 was KSh. 2000/- per hour. The minimum utilizstion is two hours per day.

Three seasons are suitagle for aerial photography coverage in Kenya. These are first, that which runs from December to March and is the best time for photography. In June a short photography flight period is possible and in September similarly.

4.3 Remote Sensing in Kenya:

Work on the investigation into statistical application of "Remote Sensing" was initiated in the Central Beureau of Statistics in September 1974 as a result of an agreement between the Ministry of Finance and Planning and the United States Agency for International Development. A major objective of this agreement was to develop Kenya's institutional ability to utilize remote sensing technology, availabke else where, in the gathering of demographic and other related statistical data. Satellite imagery and the most up-to-date equipment to interpret the imagery have been made available for this exercise.

4. Aparat from making adjustment to the existing boundaries of the enumeration areas, the effects of changing land use and the accompanying movement of people in and out of such areas are also being studied.
5. Enumeration areas with straight lines boundaries which do not correspond to oberveable features on the ground are being re-identified with a view to establishing unambiguous boundaries, using satellite imagery in conjunction with aerial photographs and existing topographic maps.
6. The identification of unclear boundaries serves as an indicator on the bulk of work involuved in the proposed map revision to be undertaken prior the next census.
7. It is hoped that the available aerial photography will also assist in the selection of sample areas for the national sample survey and in obtaining information required to ascertain crop plantation and associated area measurements.

The imagery thus far used is available for general use at the Remote Sensing Census Laboratory, housed in the Survey of Kenya. High altitude aerial photography covering areas where noticeable changes in land-cover have taken place has been organized and will be undertaken soon. Ground details on temporal variations observed on satellite imagery are to be studied with the help of photography. Since the flight lines have been planned to include the study areas of Bureaus' agricultural and demographic surveys in Western Kenya, the photo-graphs should also benefit the mapping operations for theese surveys.

Meanwhile, the change detection exercise using satellite imagery continues and more field reconnaisanae exercises are expected in all other areas, where field data collection operations are currently being undertaken. Ultimately all statistical study areas are to be mapped and changes within them constantly monitored.

4.4 General Recommendations for solving the Problems are:

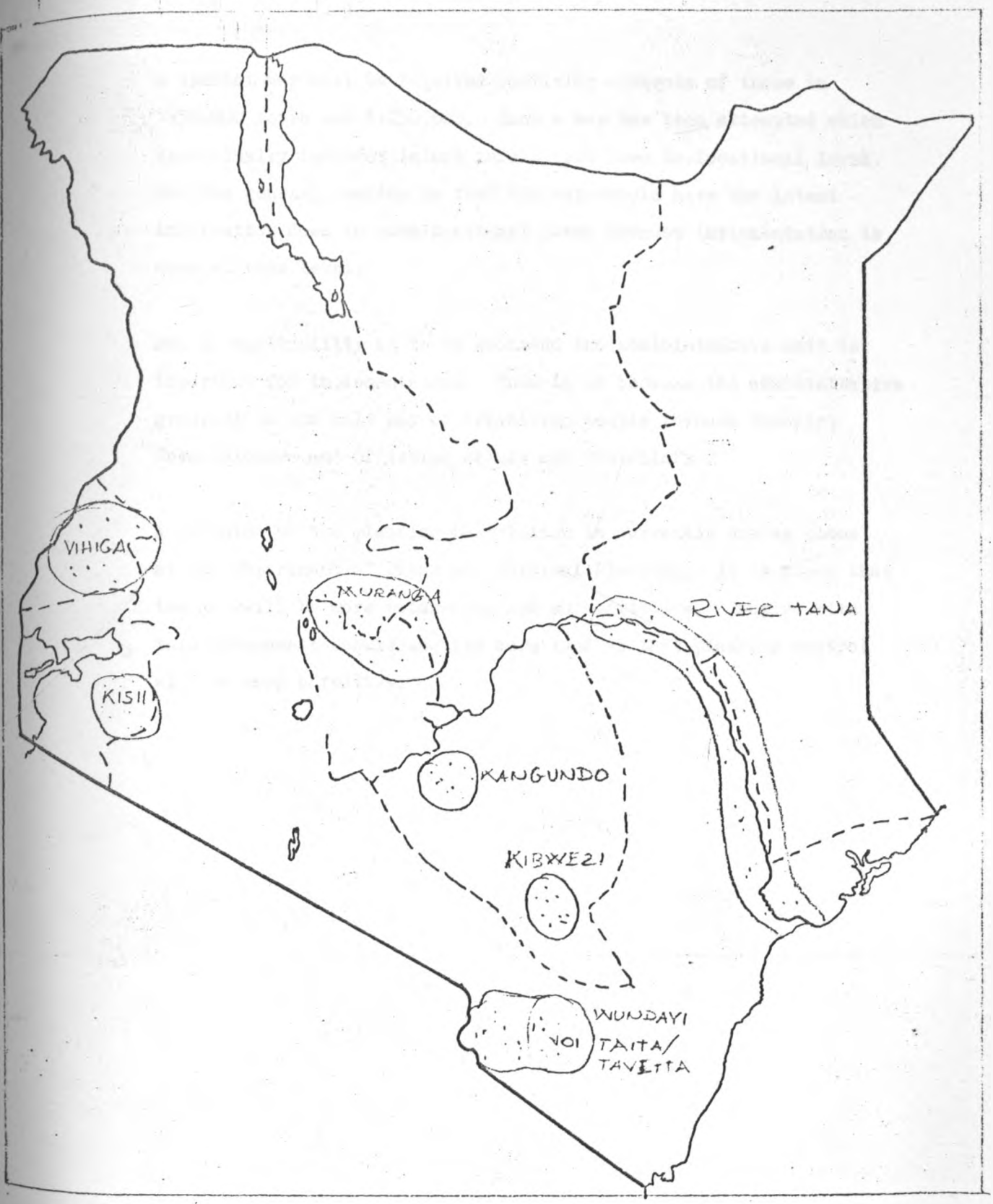
There should start close coordination between the Survey Office and

the Planning Office. Such coordination and dialogue should ab. be extended to other departments and offices holding information or data of planning interest.

As such a section should be set at the Survey Office to cater exclusively for the needs of the Planning Office to minimize problem related to base maps and photographs. This section should be changed with monitoring development especially on periurban land where uncontrolled development has grown alarmingly. This section will also carry out land use surveys of an anticipatory nature in advance of development. In other words, development should be anticipated rather than planners following events which hither to has been the case. Aerial photography should helpgreatly in forward planning for example, at transportation nodes and road intersections where development is likely to take place, areas of potential industrial growth for example Mumias, Webuye. Tourist potential areas should also be mapped.

Some agreed upon code for buildings and other man made features revealing conditions, of buildings and their function should be developed jointly to facilitate rapid land use mapping. This could be done by letter symbols or form of hatching preagreed upon. If the North-Eastern Province and other remote areas cannot be mapped economically at the scale of 1:50,000, then areas of potential development such as along the River Tana should receive attention. Those areas with high population densities should be mapped at larger scales say 1:25,000. These are areas such as Voi, Kibwezi, Wundanyi where so far no proper mapping at 1;50,000 occurs as previously they have disregardedly been classed under remote areas. Other effected areas to receive immediate attention should be Kisii, Murang'a, Vihiga, Kang'undo and Taita-Tavetta. See Map 4.1.

That National Land use studies should be carried out at District level and then to lead to National level. Thus the procedure would be working from the part to the whole. Thus for the district a



MAP 4.1 – AREAS RECOMMENDED FOR MAKING ATTENTION (KENYA) GSOA, 1976

a special map will be required combining elements of those in 1:50,000 scale and 1:250,000. Such a map has been attempted which specifically includes latest information down to locational level. But the general feeling is that the map should have the latest information down to sublocational level because implementation is done at this level.

And if equitability is to be achieved the administrative unit is important for implementation. This is so because the administrative grouping is the only way of organizing people through District Commissioners and Officers, chiefs and Sub-chiefs.

A revision of the planning Legislation is currently taking place at the Department of Urban and Physical Planning. It is hoped that the Act will be more embracing and authoritative. Coupled with this Government should acquire more land so that planning control will be more effective.

5 KENYA PATTERNS OF SETTLEMENT

The people of Kenya have organised their physical environment to meet their requirements for shelter, privacy and safety. They have sought to satisfy their social and economic needs and wants. Residential areas, social and service networks have emerged as a result of the exploitation of the natural resources in the localities to meet local and outside demand for neighbouring localities and for national development. From this organisation and the multitude of activities together with the factors influencing land use, as seen in the previous chapter, district settlement types have emerged. Through this study the author has established the following recognizable settlement types: rural proper, nomadic rural, large scale farmholdings, rural townships, rurban, urban shack and urban proper. Figure 5.1 shows this emergent concept.

5.1. Rural Proper.

By rural proper is meant the permanent non-migratory homestead as found in most of rural Kenya. This is where the population largely lives on produce from farms and derives incomes from the cash crops grown. Apart from growing crops a few heads of cattle are also kept for milk mainly. The families comprising the rural population build houses for themselves and do not pay rent as in urban areas. The rural population is the recepient of cash generated in urban areas. They receive it in form of remitances. This settlement type is characterized by dispersed or clustered homestead units. Over 65% of the rural population are settled here.* In each type may of climatic zone a typical homestead of a rural settlement type may be identified. These will be described below with respect to the climatic zone within which they fall.

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* Kenya's rural population is estimated as 90% of the total population (1969 census).

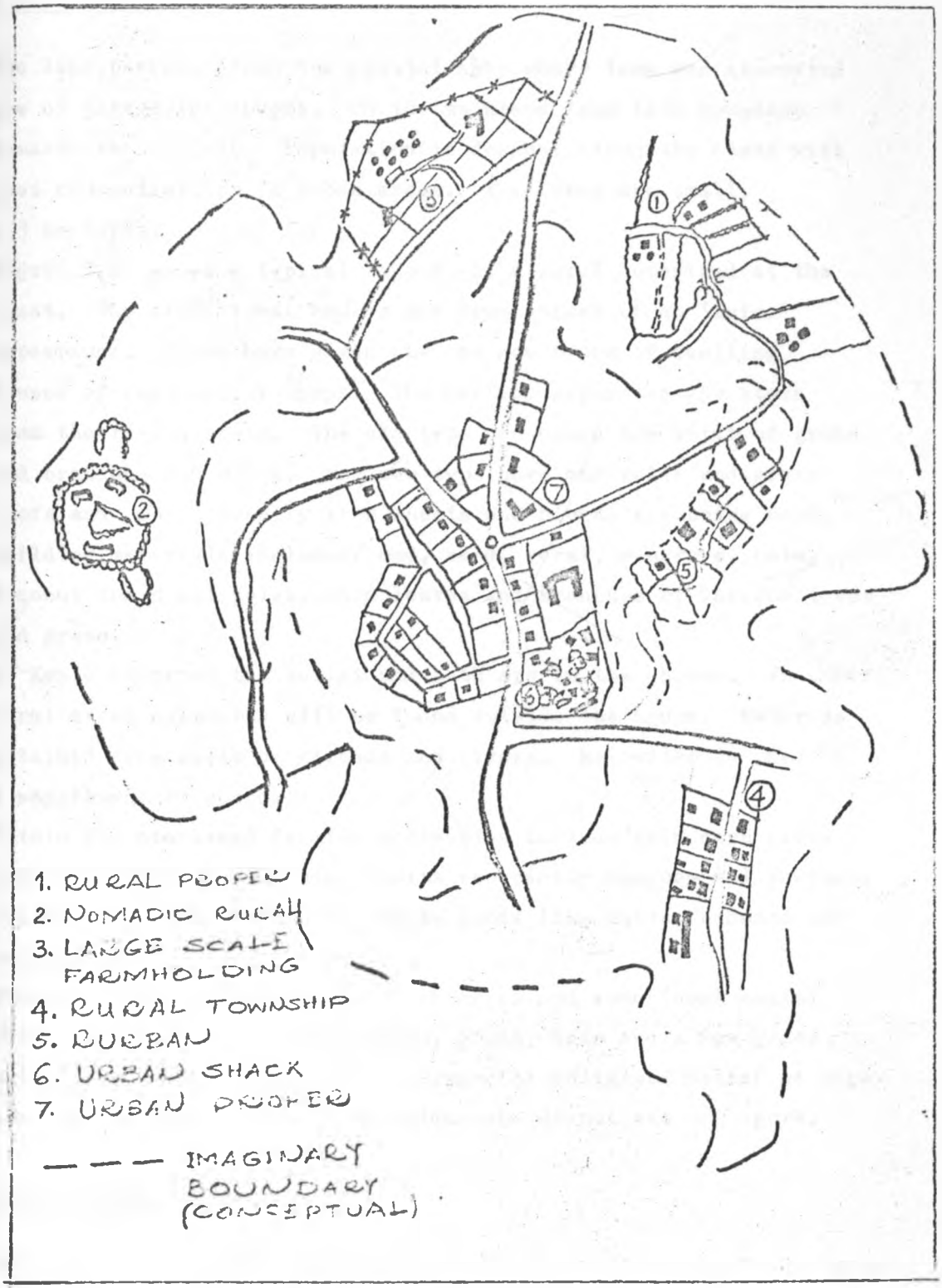

FIGURE 5.1 — SETTLEMENT PATTERNS CONCEPT
GSCA, 1976

5.1.1. Coast Zone

The land parcels along the coastal strip where land was alienated are of irregular shapes. On the mainland less land boundary demarcations exists. Population is densest along the coast with most concentrations in urban areas. The farms are small, 1-3 hectures.

Figure 5.2. shows a typical layout of a rural homestead at the coast. The traditional houses are dome shaped of an 'igloo' appearance. These have given way to new types of dwelling houses of rectangular shape. The ceiling separates the store from the living house. The old type of houses are built of grass and branches and poles. The new type have mad walls and grass roofs and more recently iron sheets and blocks are being used. Building materials include: mud, sand, coral, mangrove, palm, coconut and sisal poles, palm leaves and branches of various trees and grass.

In Kwale district the toilet and bath are in the house. In other rural areas a latrine will be found outside the house. Water is obtained from wells or streams and rivers. Rainwater is used as a supplementary source.

Within the homestead farming activities include main cash crops like coconuts, cashew nuts, fruits especially mangoes and pawpaws, cotton, rice and sisal; the staple foods like maize, bananas and cassava.

There is mostly mixed farming with crops and some local animal breeds such as zebu cattle, sheep, goats, hens and a few grade cattle fro milk productions. Because of religious belief no pigs are bred as most people are muslims who do not eat pork.

5.1.2 Savannah Zone

The rural settlement of Machakos and Kitui are found in this region. The districts are dry and hot hence the farms are small. No district fencing of parcels occurs. Figure 5.3. shows a typical homestead layout. In the remote areas of Kitui the houses are built of mud and poles and grass thatch. They are rectangular

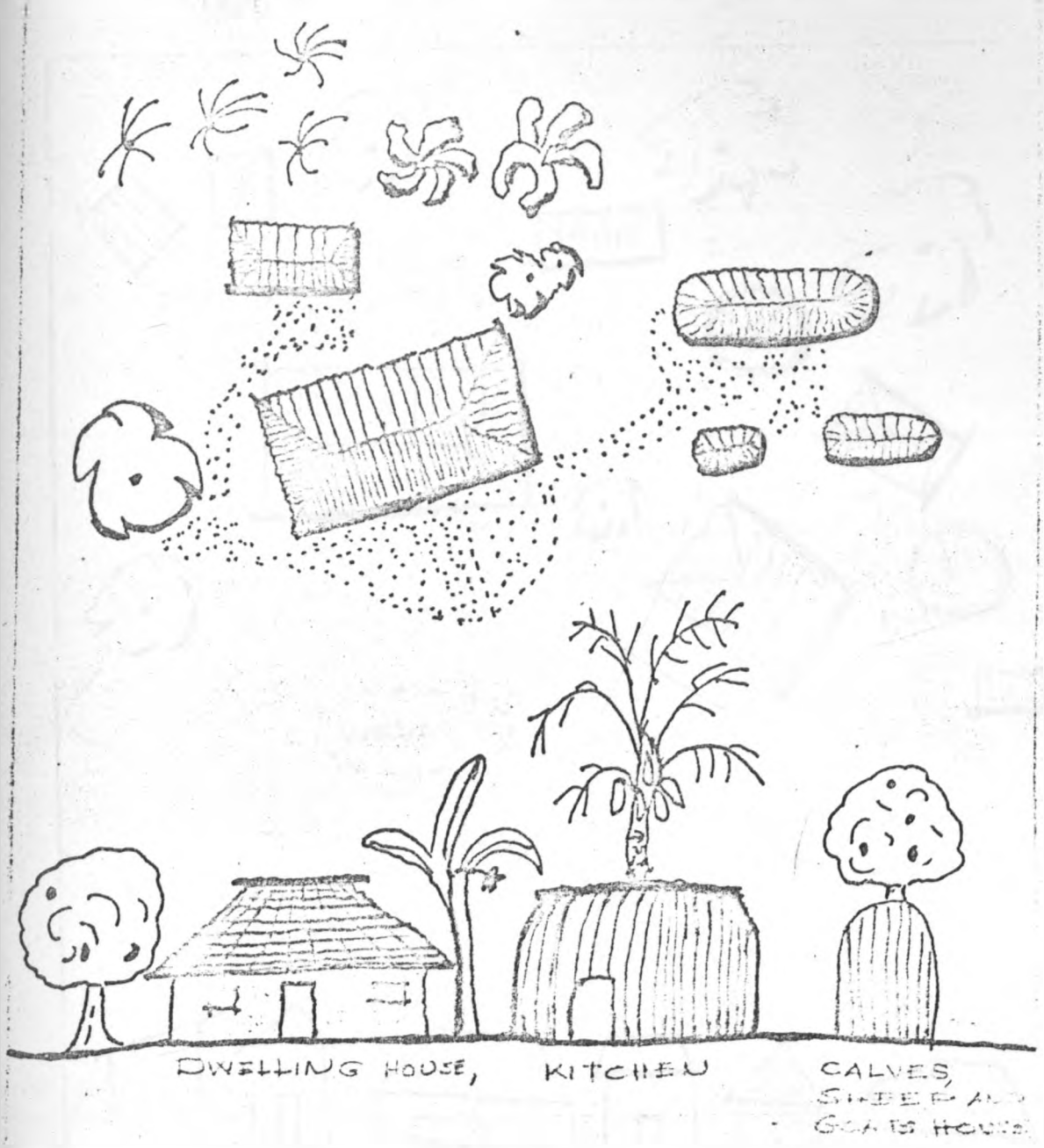

FIGURE 5.2~ SETTLEMENT PATTERN (COAST ZONE)
GSGA, 77.

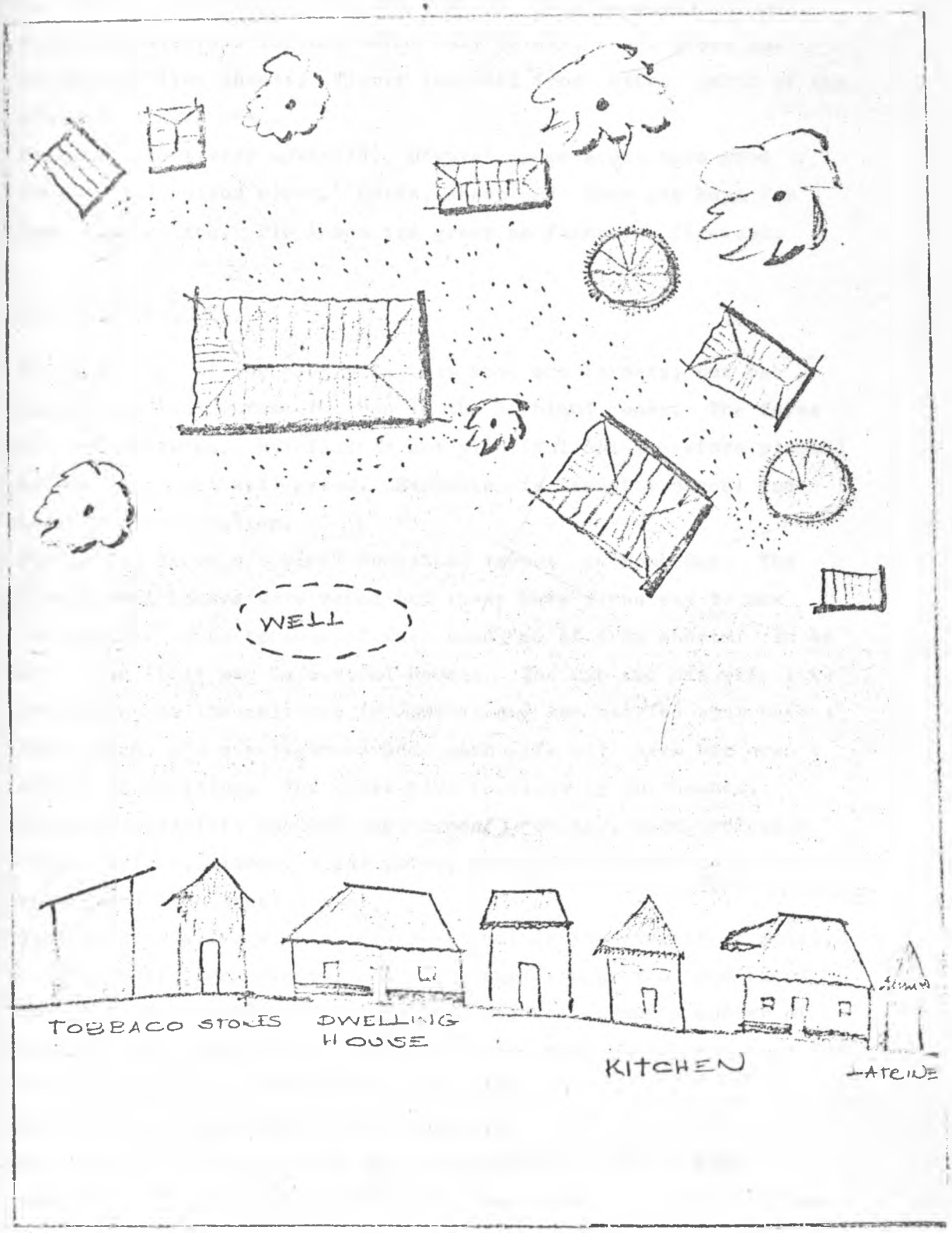

FIGURE 5.3 – SETTLEMENT PATTERN (SAVANNAH ZONE) GSOA, 1976

in shape. The more progressive farmers have permanent houses. Building materials include burnt clay bricks, sand, grass and corrugated iron sheets. Timber improted from other parts of the country is also used.

Farming is not very advanced. However, some areas have good tobacco and cotton crops. Goats, sheep and hens are kept for home consumption. Fig trees are grown on farms for firewood.

5.1.3. Lake Zone

The majority of the people in this zone are farmers, but the farming is less intensive than in the highland zones. The farms are 1-2 hectures. Rainfall is not plentiful and therefore planted hedges are not well grwon. Euphobia is used for parcel and homestead demardation.

Figure 5.4 shows a typical homestead layout in Homa Bay. The traditional houses were found but these have given way to new rectangular ones because of increased use of iron sheets. In an homestead there may be several houses. The man and his wife live in one house, the children in another and the married sons have a house each. In a polygamous home each wife will have her own house, in addition. The grave yard in close by the houses.

Building materials include mud, cement, cowdung, sand, volcanic stone, bricks, timber, sisal poles, grass, tin sheets and corrugated iron sheets.

Farming activities within this zone include the growing of maize, beans, coffee, groundnuts, cotton, sorgum, sugar cane and rice. They have some grade cattle for milk production and a number of indigiroous ones. Some sheep and goats and poulty are kept for home consumption. Few farmers keep pigs.

Latrines are found outside the houses.

From the lake and up to 10 km. inland there is little rain, increasing further inland. Thus the main source of water is the trapped rain water in paddles, and the rivers whose sources are the boundering highlands. Other reservoirs include iron sheet or concrete tanks for storing rain water.

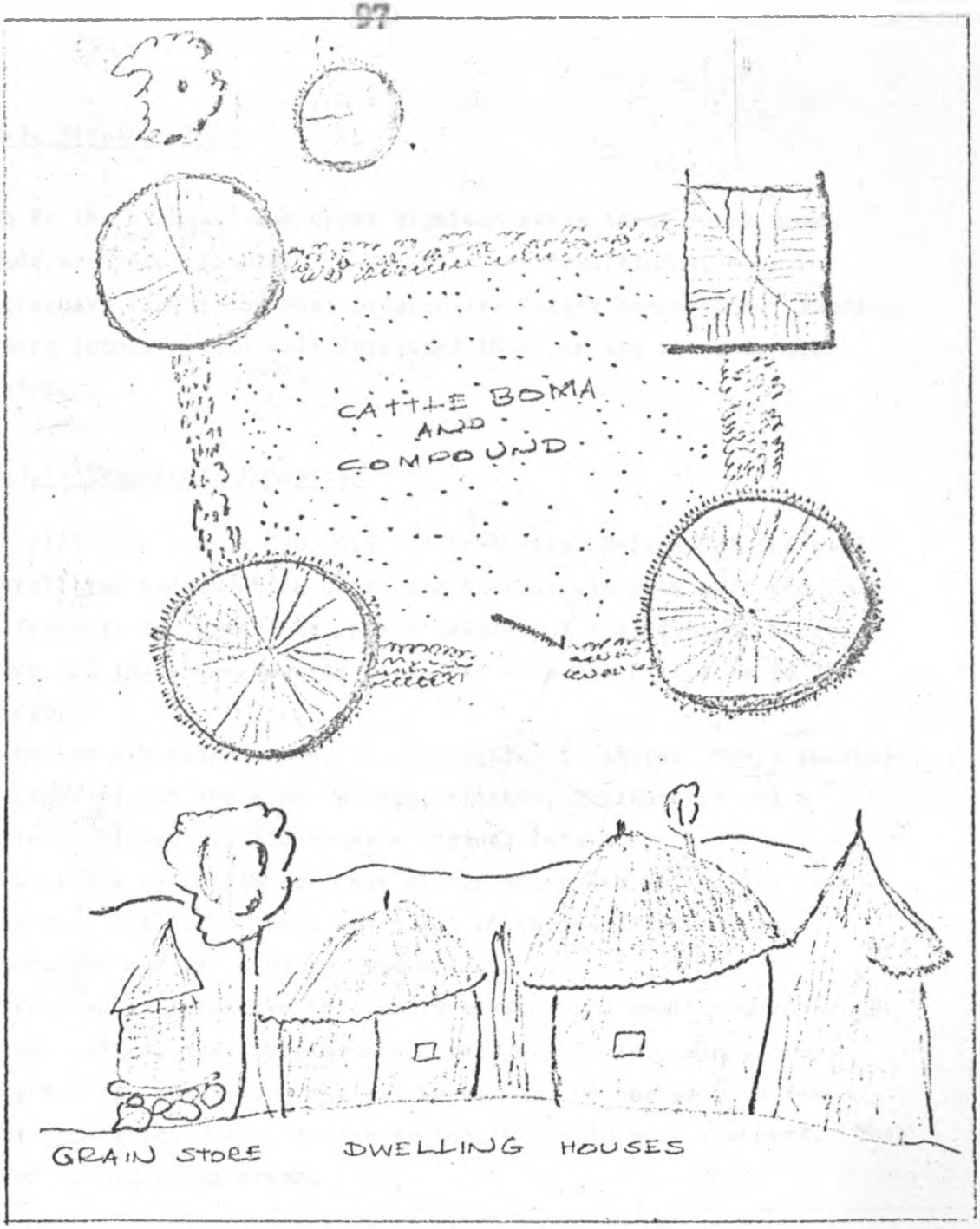

FIGURE 5.4 ~ SETTLEMENT PATTERN
(LAKE ZONE)

GSOA, 1976

5.1.4. Highland Zones

Both in the highland and upper highland zones three rural homesteads are recognizable. These are: the traditional, more progressive farmer and most progressive farmer homesteads. Farming is more intensive and well developed than in any zones in the country.

5.1.4.1. Tradtional Homestead

The plot size ranges from 0.5 - 4 hectures. Because of the good rainfall the hedges which demarcate the parcels grow well and are treamed to give thee entire settlement a strip appearance. Figure 5.5 (a) shows how the plots run from the hill tops to the valleys.

The houses are either round or rectangular in shape. Theyi include the parents; and the sons' houses, kitchen, grainstores and a latrine. Figure 5.5 (b) shows a typical layout.

The building materials are mud, wattle and grass as locally obtained. The grainstores are built of wooden stick and grass thatch. No mud is used for the walls.

The farming is intensive but the farm sizes are small. Cash crops include coffee, tea, pyrethrum and passion fruits. Other crops are potatoes, beans, vegetables, sugar can and bananas. A few heads of cattle, goats, and sheep together with hens are kept. They are of indigireous breed.

5.1.4.2. More Progressive Farmer's Homestead

The parcels are larger than those of the less progressive traditional farmer. They are 4-8 hectures in size.

The houses are rectangular in shape and larger thanthe previous category. The roofs are of corrugated iron sheets and the walls are semi permanent or permanent. Other house structures include improved kitchen, grainstores, latrine. Cow sheds for grade cattle and a reservoir tank for storing rain water for home cosumption and for the grade cattle are also present.

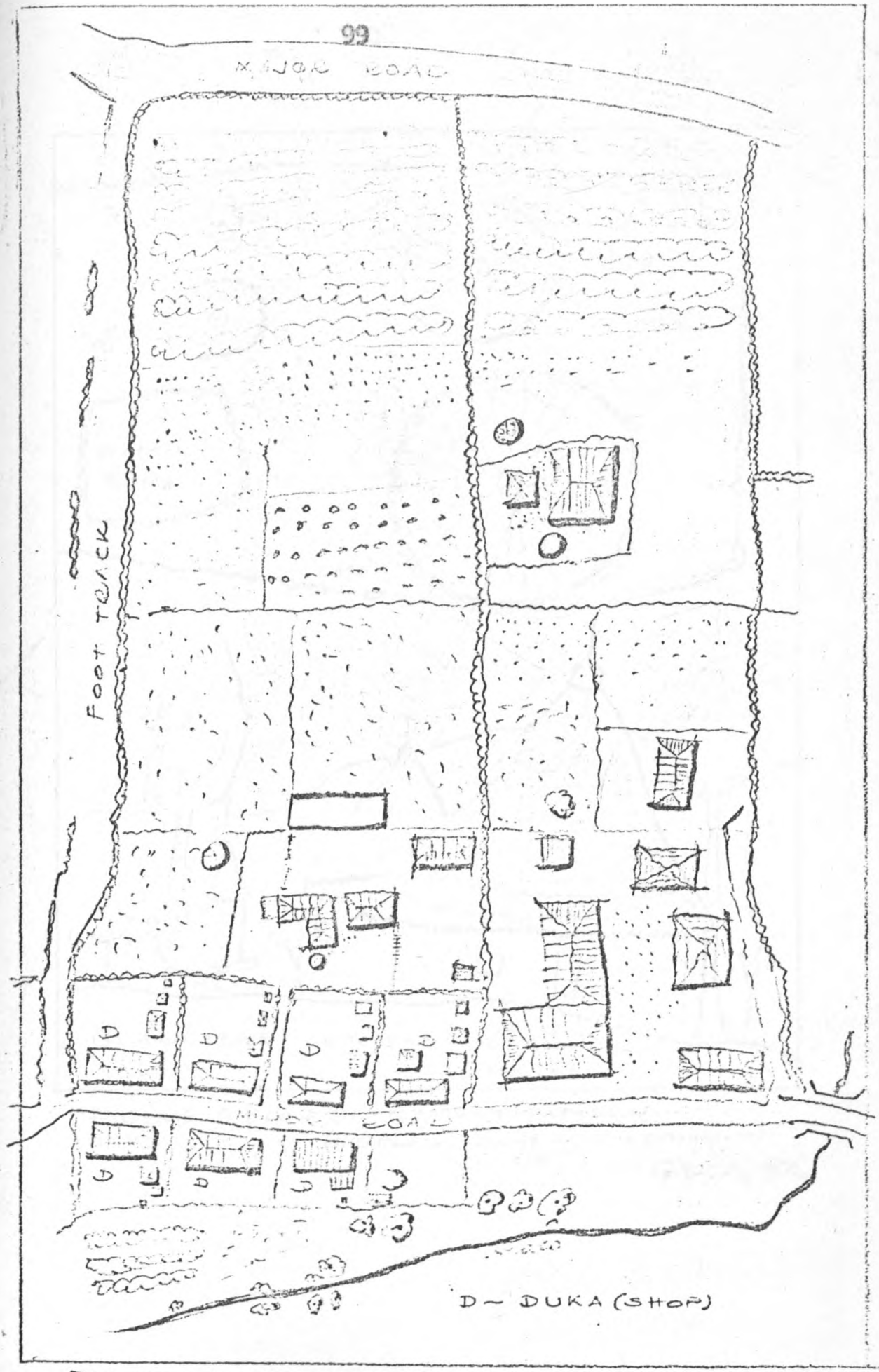

FIGURE 5·5(a)~ RURAL SETTLEMENT FARM STRIPS

G.SOA, 1976

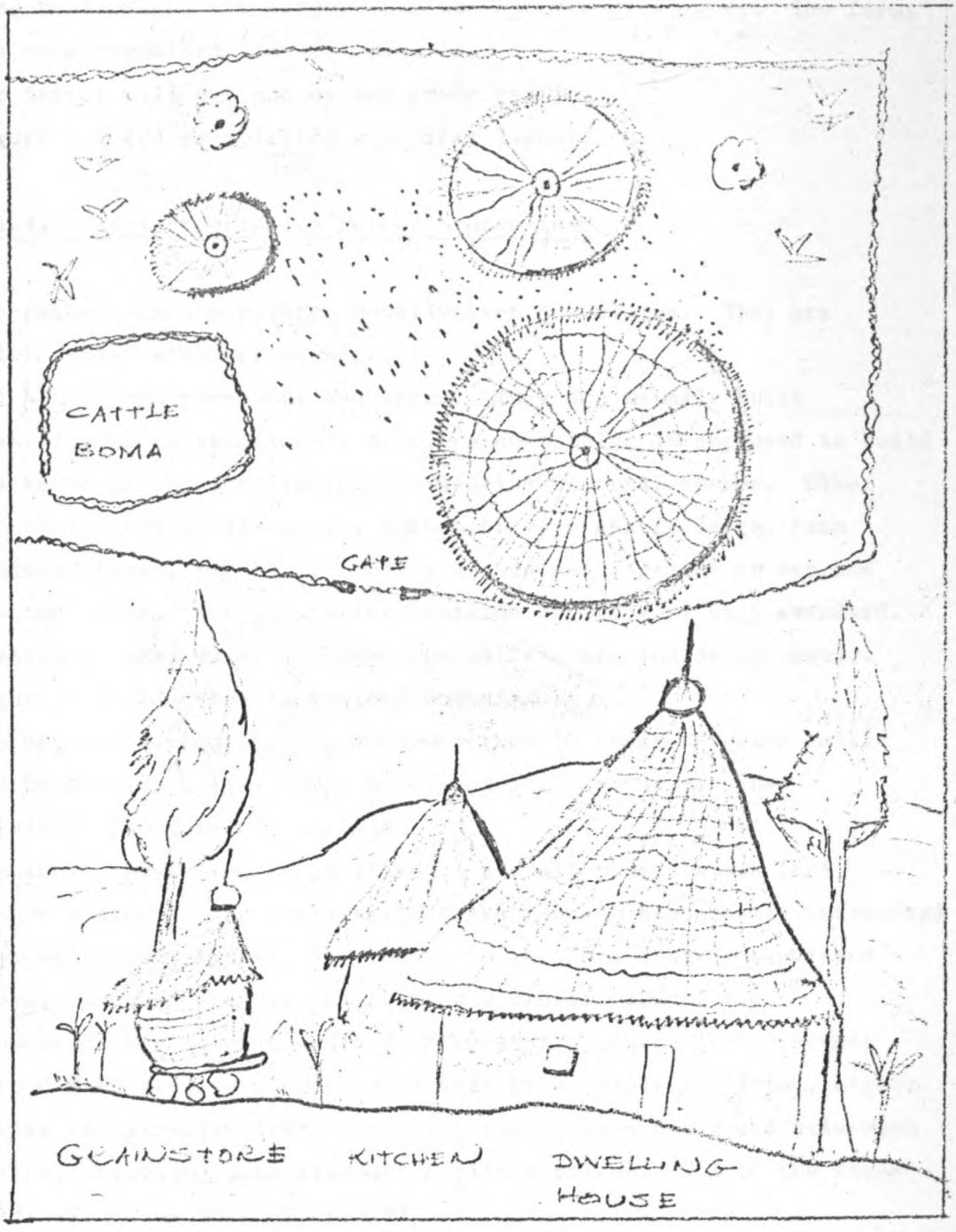

FIGURE 5.5(b) – SETTLEMENT PATTERN
(HIGHLAND ZONE – TRADITIONAL)
GSOA, 1976

Crop hectareages are larger than the previous category. The farms are more organised and well managed.
The farmer will own one or two grade cattle.
Figure 5.5 (c) exemplifies a typical layout.

5.1.4.3. Most Progressive Farmer's Homestead

The parcel sizes are large usually over 8 hectares. They are often fenced with barbed wire.
The houses are permanent and large. They are usually built according to an architect's plan. A contractor is employed to build the house unlike the previous categories of rural houses. Other structures are cattle sheds, timber or wire gauze, large, farm produce stores, pig pens, poultry houses and a garage or car and tractor shed. The lavatories outside are of very high standard. Sometimes where water is piped the toilets are inside the house.
Figure 5.5. (d) shows a typical homestead.
The crop hectarage is big and more than 10 heads of grade cattle may be kept. Poultry, pigs and sheep are also kept. They subsidize the farmer's income.
The above rural types of settlement are all based on kin land tenure systems. The small scale mixed farming has greatly influenced this settlement types. They occur in the more densely populated areas. Incomes are derived from cash crops. 12% of the households are considered to be progressive, where their incomes exceed £110 p.a., and have relatively high levels of living, higher access to infrastructure, including roads, mass media and extension advice, marketing schooling and health services. 20% of the households earn less than £20 p.a.**

** See ILO/UNDP report on Employment, incomes and Equality, Geneva 1972, p.74

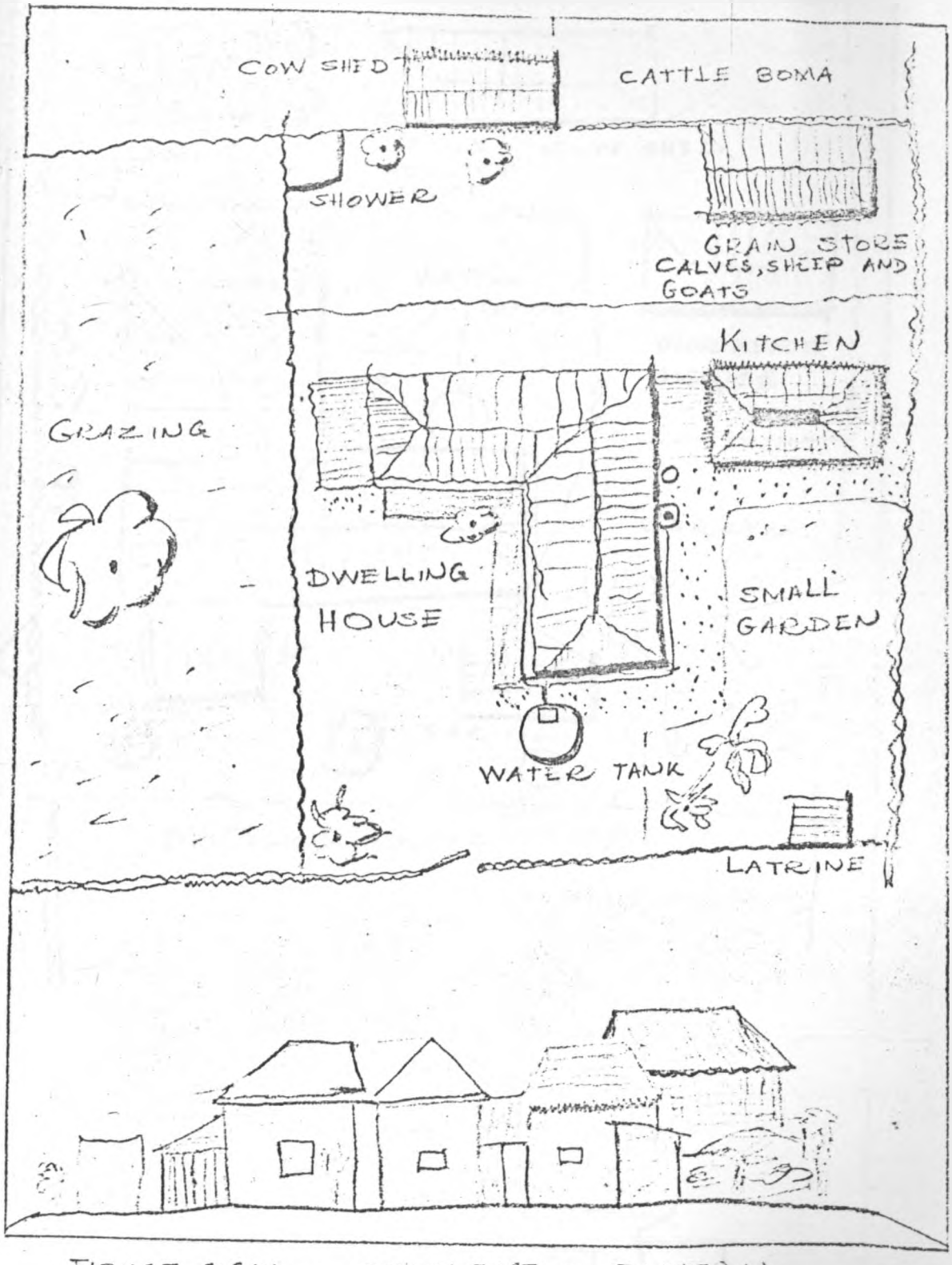

FIGURE 5.5(c) — SETTLEMENT PATTERN
(HIGHLAND ZONE — MORE PROGRESSIVE
FARMER)

GSOA, 1976

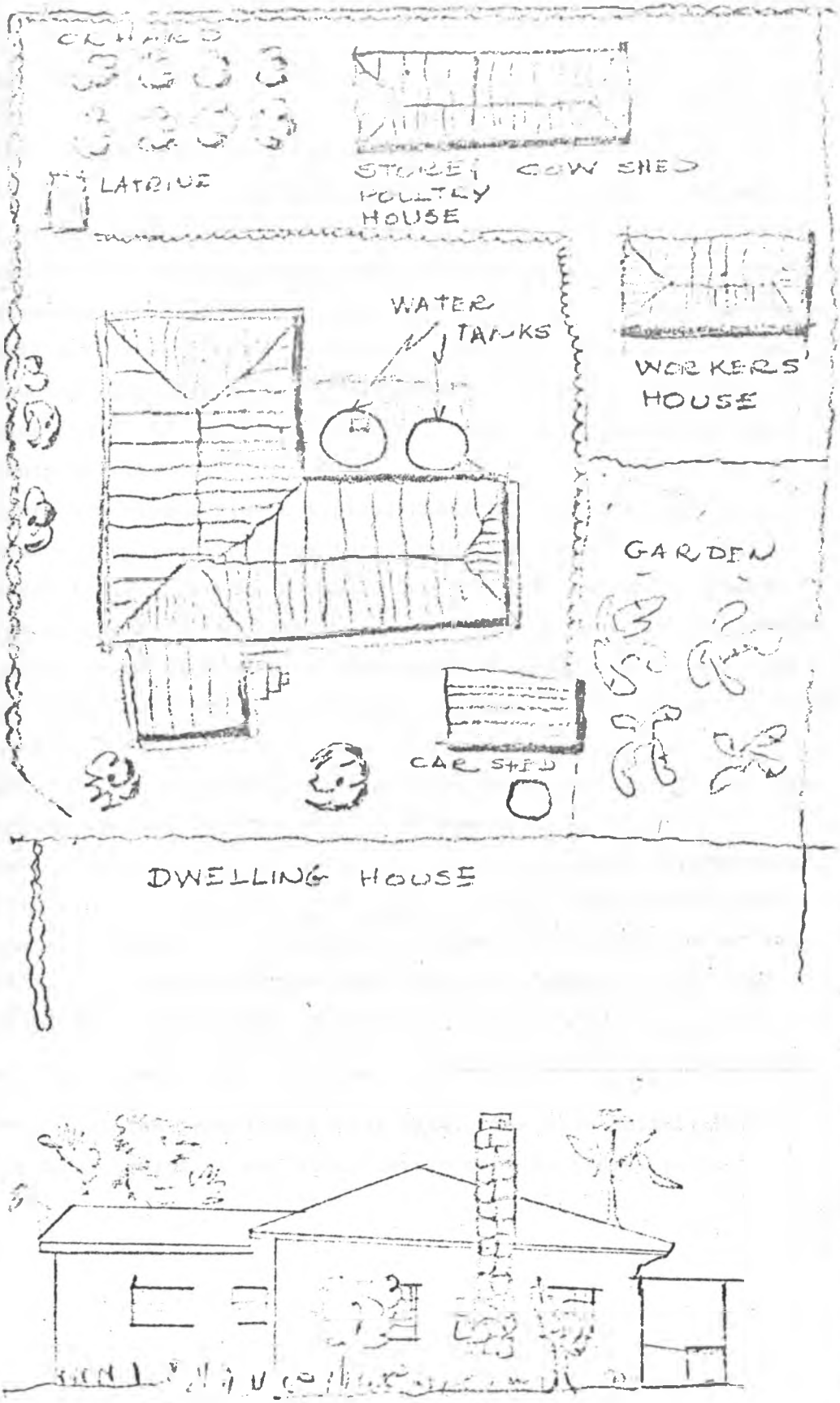

FIGURE 5(d) - SETTLEMENT PATTERN
MOST PROGRESSIVE FARMER
G.SOA, 1976

5.2. Nomadic Rural Settlements

These account for about 12% of the total rural population. *** The hub of their economic activities is livestock and most of their communities move from place to place in search of water, pature, salt licks and for control of livestock diseases. These movements are regulated by seasonal changes and rainfall patterns. Their settlements take the form of temporary camps and are constructed with livestock derived materials. These materials are: hides and skins, cowdung and urine, branches and twigs of the scanty vegetation.

Figure 5.6 exemplifies a typical Masai Manyatta (village). Because they require large territories for grazing this settlement type is very dispersed. The villages are very distant from each other with little communication by foot on earth tracks. A given large territory is used exclusively by a clan, age - set neighbourhood or any culturally recognized social collective group. In wetter regions of the nomadic patoral zone subsistence agriculture takes the form of growing vegetables and grains like sorghum. Because of the nature of land use no property demarcation is district except for the fence around the Manyatta. Infrastructure is at the very lowest level. Water is obtained from seasonal streams but an attempt to provide boreholes is ongoing. The improved roads are very far from the manyattas so are the schools and health facilities.

*** Calculated from 1969 census data. See also Mbithi, P.M. Rural Sociology and Rural Development in Kenya, p.19.

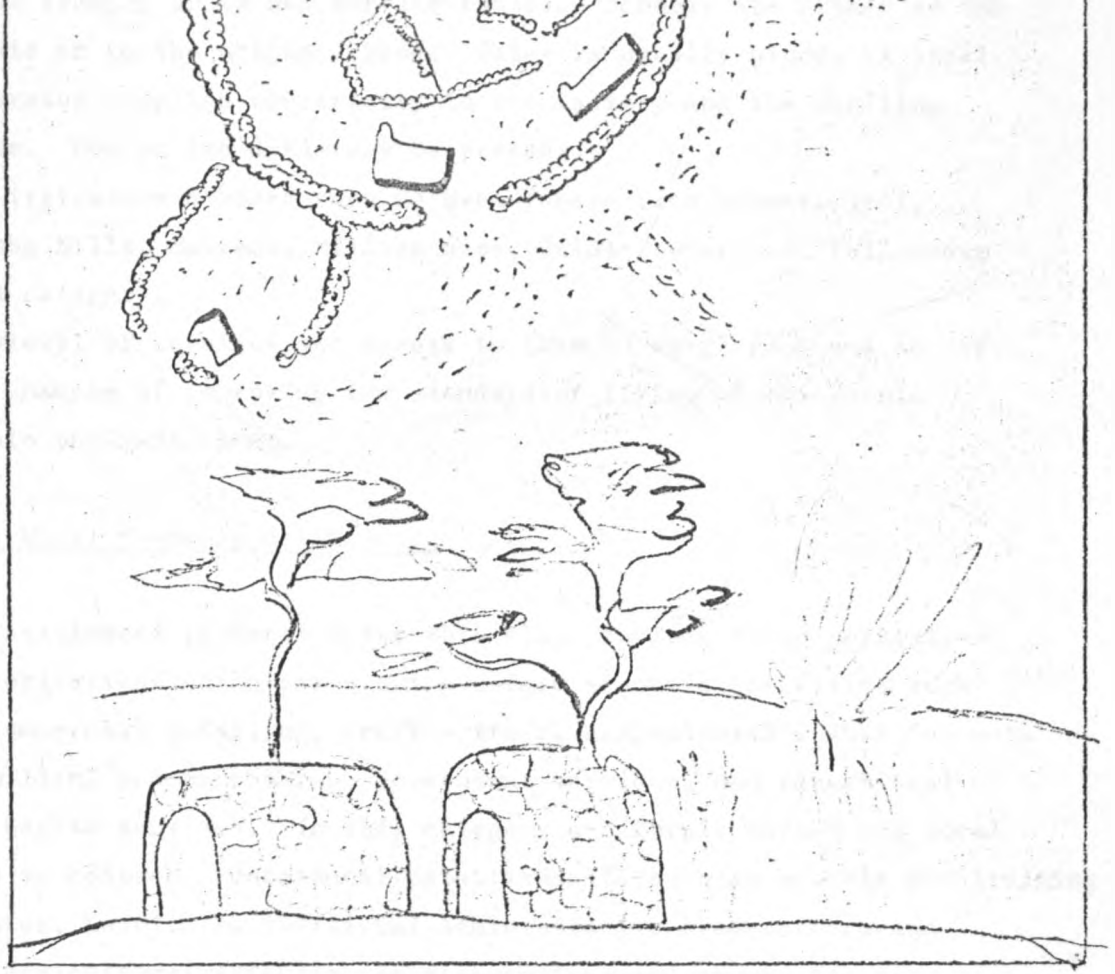

FIGURE 5.6 ~ SETTLEMENT PATTERN
(NOMADIC RURAL)
G.SOA, 1976

5.3 Large Scale Farmholdings

These holdings include coffee, tea, sisal, sugar, ranching estates, ride schemes and horiticultural farms. On the settlement the following are included: main owner or manger's homestead, factory, offices, and labour lives where the workers together with their families live. Figure 5.7 shows a typical farm layout. Access to services is very good. The estates are served with improved roads linking up to bus service routes. Schools are either on the estate or in the neighbourhood. Water is usually piped. A local generator supplies electricity to the factory and the dwelling units. One or two dukas may be present.

The irrigation schemes such as Mwea-Tabere rice scheme, Gedi, Shimba Hills, Makueni, Million acre, Galole Pekera all fall under this category.

The level of services and access to them is very good and so are the chances of improving the standard of living of the people within the settlement.

5.4. Rural Township Settlements

The settlement patterns under this class include those population concentrations which carry out non-farm economic activities such as commercial retailing, craft - trade, agricultural industries such as milling and processing, government services, and educational and health services. In this category are rural, market and local trading centres, educational establishments such as schools and training centres, hospitals, divisional administrative headquarters and and agricultural extension service centres and sugar, tea or coffee factories.

These settlement types occur within the rural areas. The layout may or may not be planned. Where planned the plots have been laid down by a surveyor. Licenses are possessed for carrying out various commercial activities. Health officers carry out inspections in these settlements.

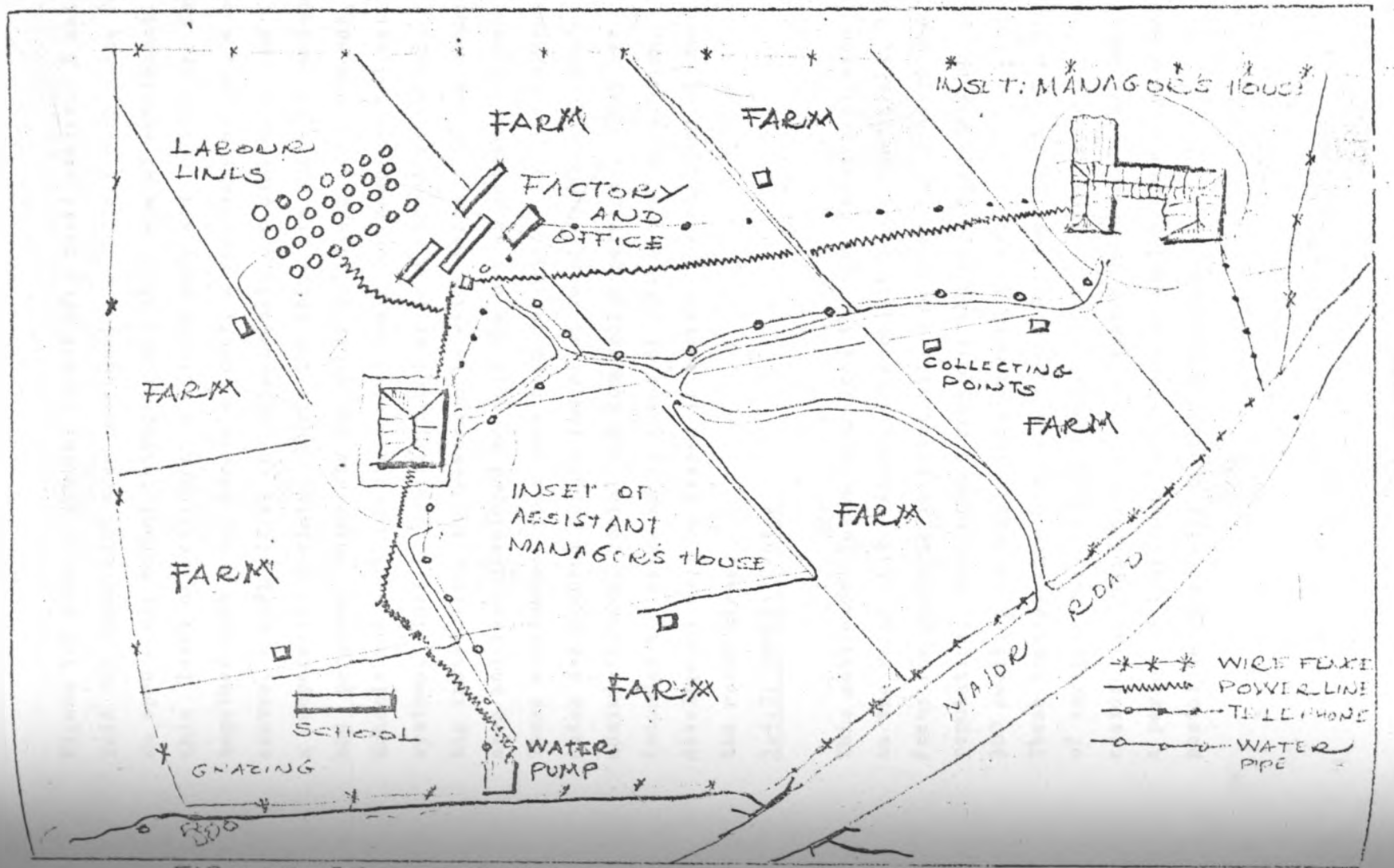

FIGURE 5.7— SETTLEMENT PATTERN [illegible]

5.4.1. Rural Centre

Figure 5.8 shows a typical layout of a rural centre. A well laid out commercial area surrounding a central open space for an open - air market charactdrizes this type of settlement. At this level of settlement a chief's camp and office are found together with a magistrate's court, a secondary school, a health centre, a post office and occasionally a social hall, and a cooperative society. While the shops are built of semi-permanent and permanent materials the other buildings are permanent. Schools and health centres have their own sewerage and water supply systems. This is usually piped or from stored rainwater. In big institutions the sewerage is water borne. In the commercial area and less developed schools the use of latrines is made. These settlement types have been designated for development to cater for a rural population of at least 40,000 - people with administrative, social and commercial services. They are intended to become small towns of 2000 - 5000 population. Their development will be geared to improve the standard of amenity in the rural areas.

5.4.2. Market Centre

This settlement has more or less the same commercial area layout as the rural centre above. Figure 5.9 shows the layout. It is the focus for periodic interactivities between the traders and the population. On a normal week day the population may be up to 300 swelling to triple this on market days.

These centres have been designated for development of a lower order of services for a rural population of at least 15,000. The residential population is anticipated to be less than 2000. Over a period of time such facilities as health, educational and postal services will be made available.

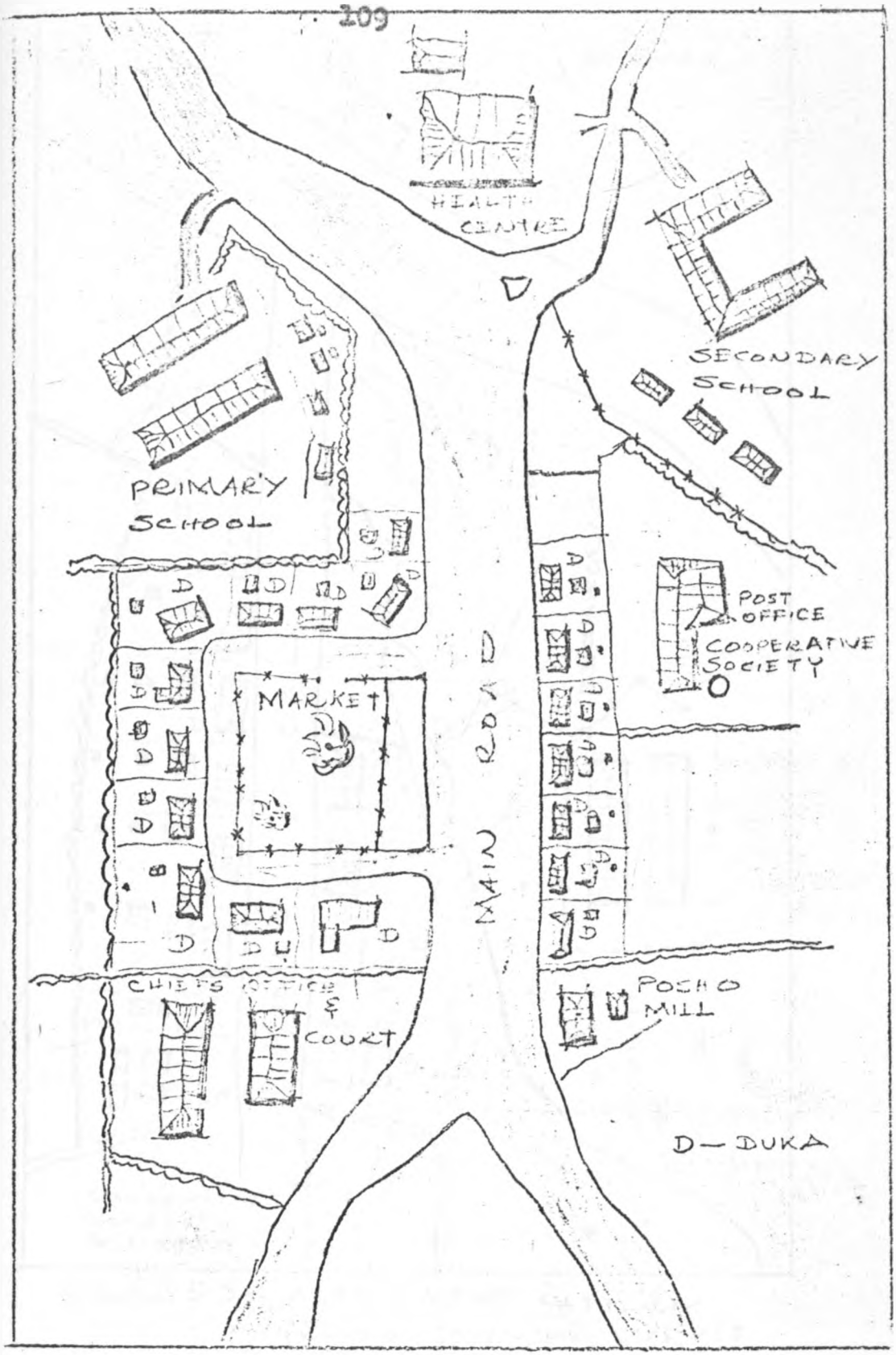

FIGURE 5·8 ~ SETTLEMENT PATTERN (RURAL TOWNSHIP, RURAL CENTRE)

G·S·O·A, 1976

DUKA
MAIN ROAD
CHURCH
&
PRIMARY
SCHOOL
GRAZING
BRICK WORKS
GYMKHANA
MAIN ROAD
POSHO MILL

5.4.3. Local Centre

These are most numerous and scattered all over the rural landscape. The resident population is of less than 200. They are the 'provision stores' for the local population. They meet the daily shopping needs of rural households. Figure 5.10 shows a typical layout. There may be only five shops, built of semi-permanent materials, in such a centre.

5.5. Rurban Settlements

This type of settlements occurs between the rural and urban settlement types. It is the transition between the two thus it is a rural - urban area. It combines characteristics of both urban and rural but there is no clear dividing line between the two. This settlement type is under constant change and develops most rapidly. Its characteristics are shown below and exemplified by Figure 5.11.

The farm owners sell small fractions of their farms to developers and retain part of it and continue to practice rural activities.

Transitional areas of this nature are interpenetrated by urban roads, tran sewers, water pipes electric power lines and telephones. Very few homesteads have connections.

The rural homesteads are the immediate hinterland for the urban area and thus speculators and private developers tend to acquire plots here.

Such plots may be left vacant and undeveloped for speculative reasons. If developed the main user is residential and the housed are built to very high standards.

This area forms the 'dormitory' for urban workers who cannot afford the high rents in the urban proper settlement.

The emergent layout is informal with concentrations on major access roads. Development is uncontrolled and does not comply with by laws.

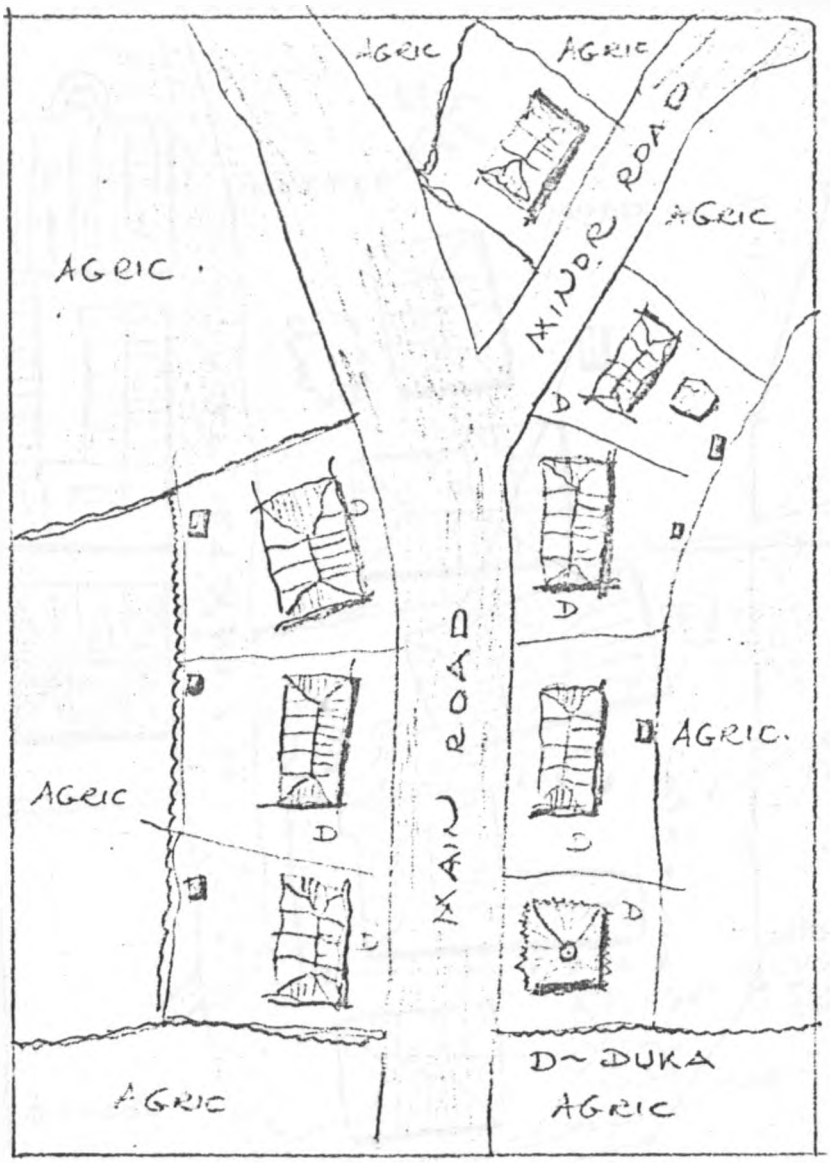

FIGURE 5.10~ SETTLEMENT PATTERN (RURAL TOWNSHIP, LOCAL CENTRE)

GSCA, 1976

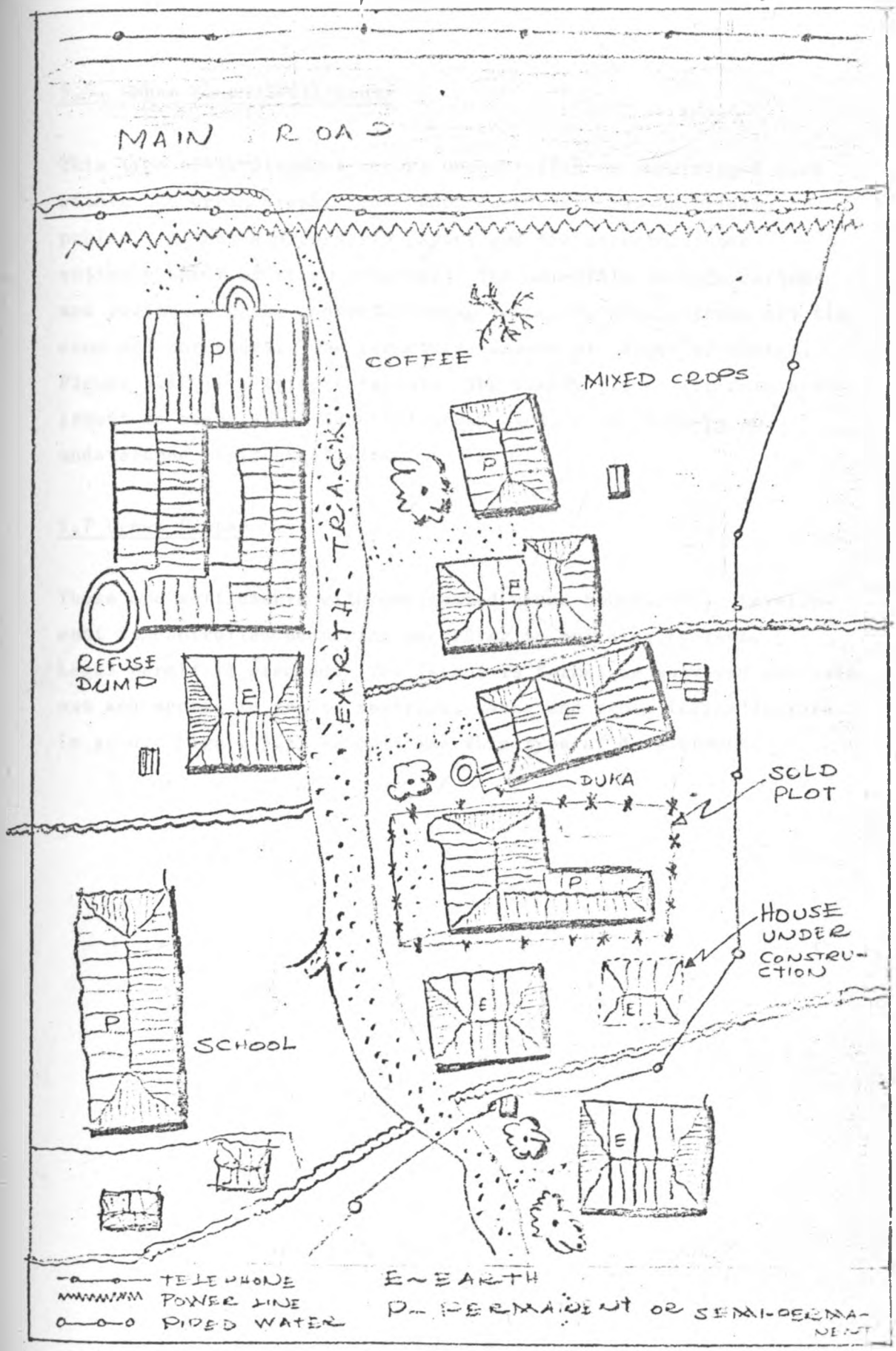

FIGURE 5.11~ SETTLEMENT PATTERN (RURAL) GSOA, 1976

5.6. Urban Shack Settlements

This type of development occurs uncontrolled on undeveloped land within the urban areas. The undeveloped land may be private or public. It has a disorderly layout and the structures are entirely built of scrap material: The materials include cartons and polythene bags, converted scrap vehicles, straightened out tin cans and cardboard. The structures assume all types of shapes. Figure 5.12 is a typical layout. The likely places for this settlement to occur are: derelict urban land, river valleys and undeveloped residential sites.

5.7 Urban Proper

These are settlements with designated urban boundaries. Development is controlled occurring according to building by-laws. Legal permit is granted. The layout is formal as surveyed and laid out and access to roads, sewerage, water and other infrastructure is good. Figure 5.13 exemplifies this type of development.

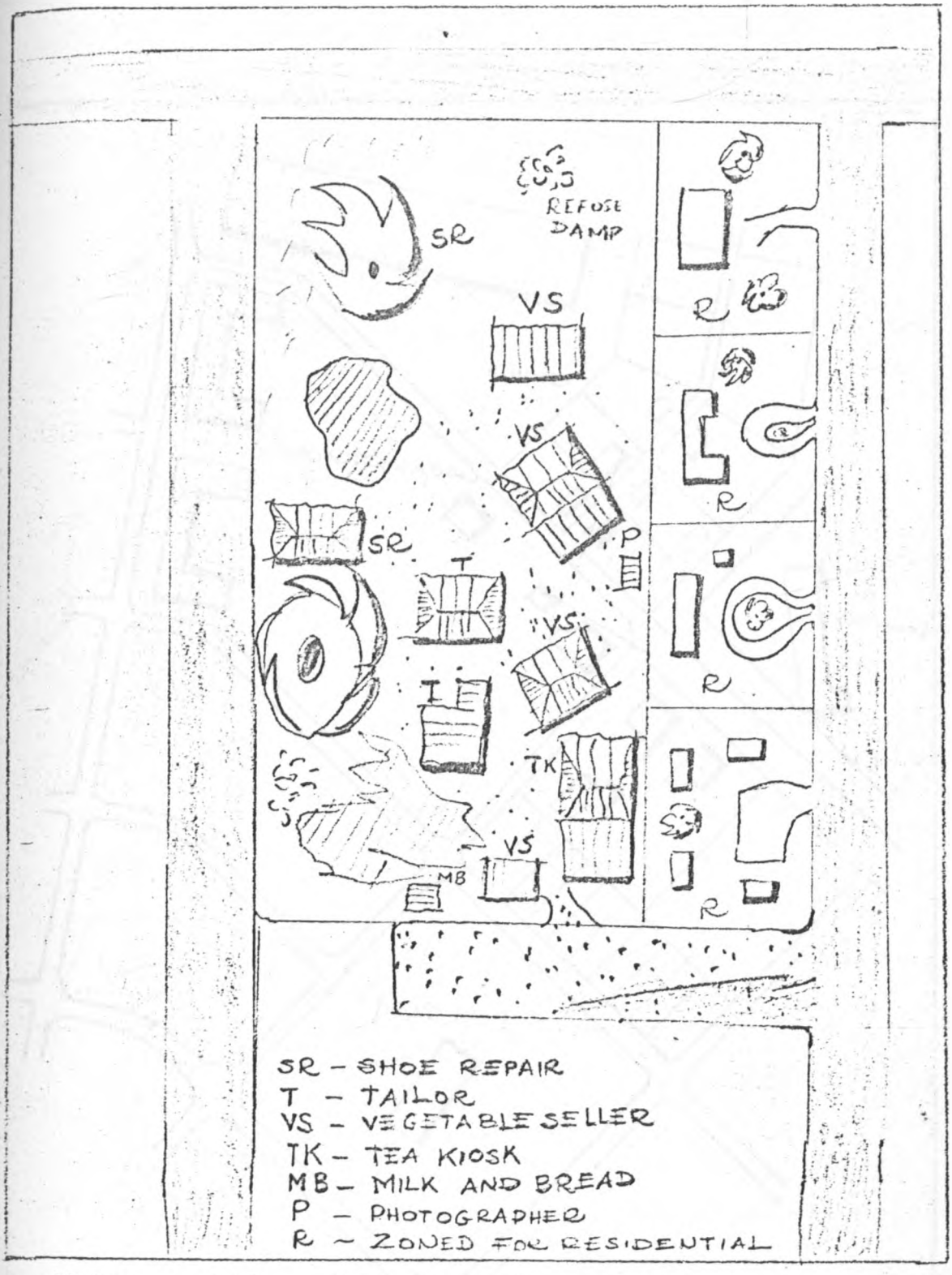

FIGURE 5:12 – SETTLEMENT PATTERN (URBAN SHACK)

G.Sc.A, 1976

FIGURE 5:13~ SETTLEMENT PATTERN
(URBAN PROPER LAYOUT)
GSOA, 1976

6. SURVEYS FOR SETTLEMENTS:

Of the seven settlement patterns recognized in Chapter 5, six of them are liable to rapid change and development. It is true also that these settlement types have been mapped least for planning purposes. At the same time these are the settlements likely to be invaded for development projects. Usually land use maps and data will have been prepared and collected for the Urban proper settlement type. Attention is here focused on the six type of settlements, namely: rural proper, nomadic rural, large scale farmholdings, rural townships, rurban and urban shack.

6.1 Surveys for rural Proper settlemt:

Experience has shown that for reference, the topographic series of 1:50,000 scale is the most useful. A base map will be prepared from this. The base map will doubtless require up-dating. Where aerial photographs exist they will be used for up-dating up to the time the air photos were taken. Further up-dating will be done by field work through light aircrafts. Direct observation from the aircraft and oblique photography will be combined.

From the topographic map settlement distribution will be obtained. Contours and topographic information will also be available. This series will also show boundaries for large scale farms, infrastructure such as roads, railroads, telephone lines, power lines, shops schools, health facilities and religious buildings.

Air photos will be useful in inserting such information as crop patterns, boundaries for small farms, new buildings and settlements, new road alignments, forests, dams and for assessing the population in the settlement.

For more detailed studies a field visit lasting one morning will suffice. A representative homestead will be studied in detail, a cross section of the settlemtnt will be sketched and a portion of

the settlement will mapped in plan. Such a representative survey is useful for Action Planning' as it is likely to be repetitive throughout the settlement . Figures 6.1,2, 6.2. and 6.3 show an example of this type of field survey. This survey was carried out from observations taken from a vantage point and by pacing through the settlement. No chaining or taping was necessary. This type of survey is the architect's impression of the settlement.

6.2. Survey for Nomadic rural Settlements:

This is the most difficult settlement to map and to keep up-to-date. This is so because of the temporary nature and the migratory form the settlement takes. This implies that any mapping done quickly turns out-of-date. Thus a quick survey method is required for this settlement type. The topographic map of 1:100,000 series is the only one available for these nomadic pastoral areas. Information on perennial rivers and improved roads and permanent settlements such as townships schools and game reserves and parks can be obtained from 1:100.000 series.

For up-dating and mapping of homesteads aerial photographs, and aerial surveys from light aircrafts will be resorted to. Information is also likely to be obtainable from the Ministry of Water Development who carry out surveys for water supplies in drought stricken areas. The Ministry of Education may also have information in connection to the distribution of schools. The Ministry of Health will have information related to health facilities. The Ministry of Natural Resources will have information related to forests, mines and geology. The Ministry of Tourism and Wildlife will have information on game reserves and parks, and tourist roads. In addition to this, any private firms engaged in mineral prospecting are likely to have mapped the areas of concern and their maps may prove valuable to the planner.

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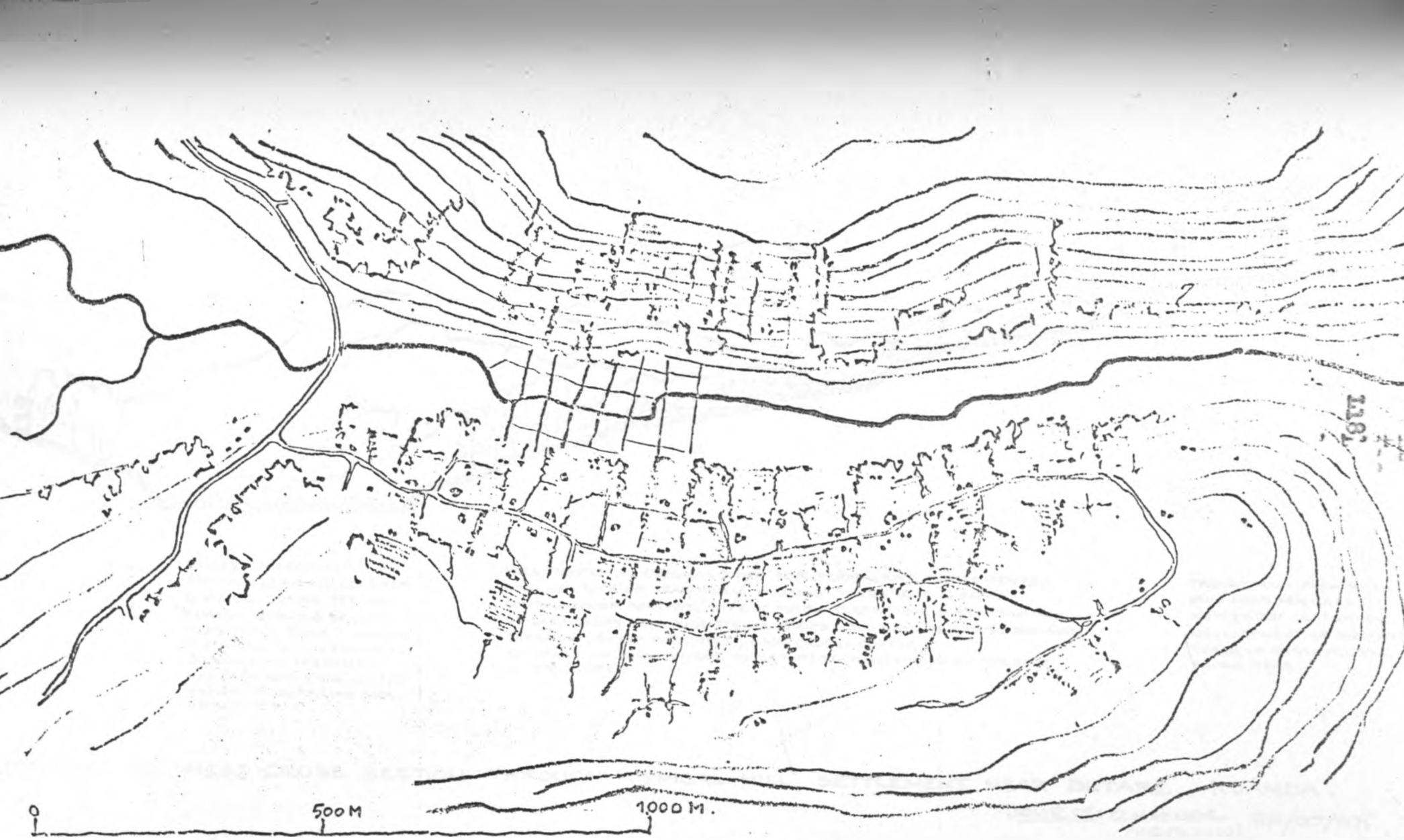
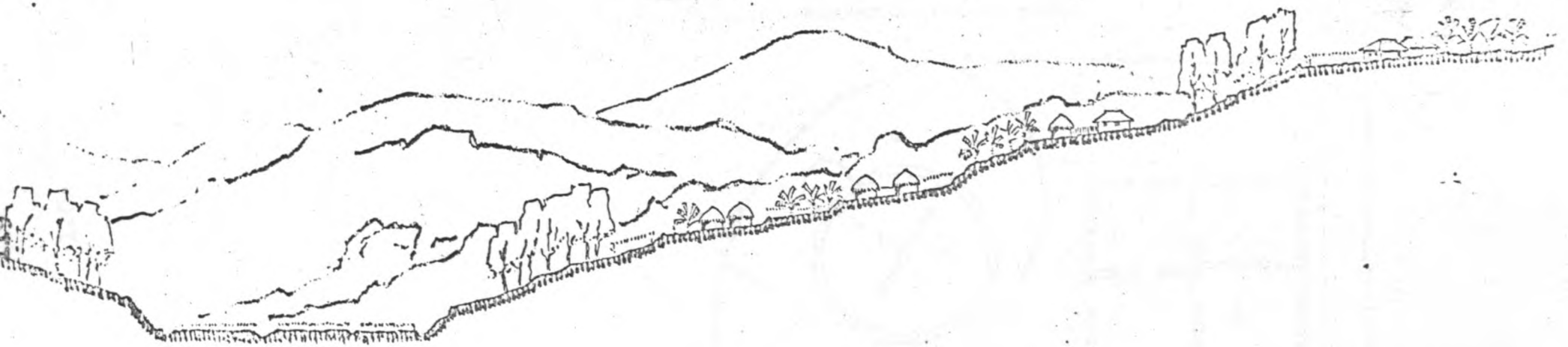
1) See paragraph 6.1



APPENDIX A, FIG 6.1 - TYPICAL HILL SETTLEMENT NEAR BUTARE, RUANDA. O.K./OCT/1975
SOURCE: O. KAZNER (HRDU)



VALLEY – MARSHLAND, PREVIOUSLY MAINLY USED FOR GRAZING DURING THE DRY SEASON, BURNING OF CLAY-TILES TAKEN PLACE SINCE THE BEGINNING OF THIS CENTURY, DRAINAGE OF THE VALLEYS HAS BEEN INITIATED, CULTIVATION OF CROPS LIKE RICE INTRODUCED.

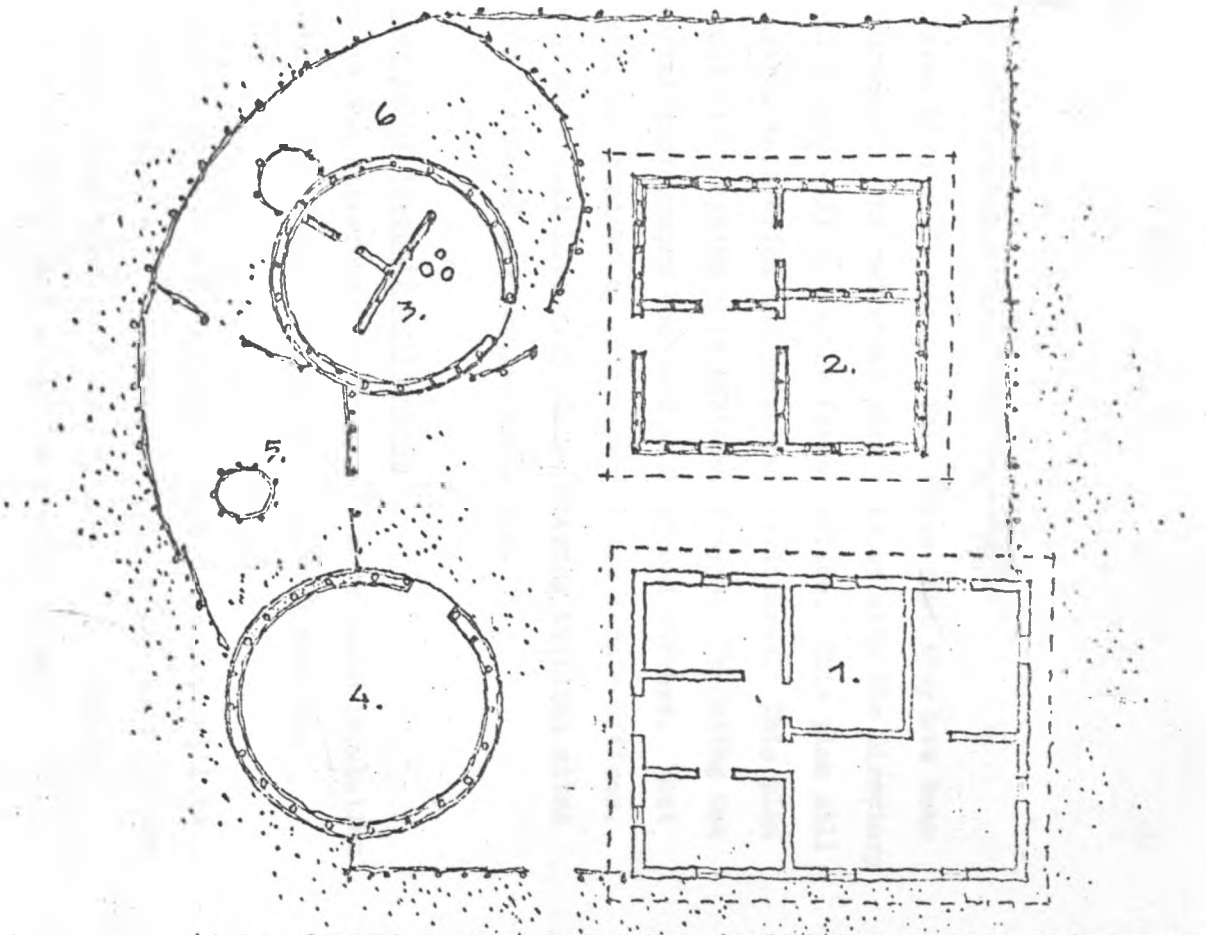
HILL SLOPES – ORIGINAL ZONE FOR PERMANENT SETTLEMENTS, ORIGINAL TYPE OF TRADITIONAL HOUSING FOUND IN THIS ZONE: COMPOUNDS OF 'RONDAVEL' TYPE OF HUTS. CULTIVATION IS A COMBINATION OF CASH CROPS AND SUBSISTENCE CROPS, SUBSISTENCE CROPS: BANANA, SORGHUM, SWEET POTATOES, CASH CROPS: COFFEE. EVIDENCE OF EROSION (DUE TO DEFORESTATION) FOUND AT THE FOOT OF THE SLOPES.

TABLELAND – PREVIOUSLY ONLY USED FOR GRAZING, NOW UNDER CULTIVATION. DEVELOPMENT OF MODIFIED TYPES OF RURAL HOUSING FOUND HERE.

FIG 62 CROSS SECTION THROUGH TYPICAL "HILL" SETTLEMENT NEAR BUTARE, RUANDA.

SOURCE: O. KAZNER (HRDU. UN) O.K./OCT./1975

ELEVATION FACING ROAD.



HOMESTEAD COMPRISING BOTH TRADITIONAL RURAL-- AND MODERN RURAL HOUSETYPES, OCCUPIED BY AN EXTENDED FAMILY. SIZE OF FARM : 1,5 HA. OWNER CONSIDERED RELATIVELY WEALTHY. PART OF THE FARM CULTIVATED BY SUBTENANTS.
STRUCTURE 1 AND 2 COVERED WITH BURNED ROOF CLAY TILES. STRUCTURE 1 ERECTED IN MUD BRICKS (PLASTERED) OTHER STRUCTURES ERECTED IN MUD-WATTLE.
5. PIGSTY.
6. CATTLE COMPOUND.
(PART OF HOMESTEAD REFERS TO J.H. DEMARAIS' STUDY ON HOUSING OF A RWANDESE HILL)

A. FIG 6.3 RURAL HOUSETYPES AT HILL SETTLEMENT NEAR BUTARE, RUANDA. O.K. INT
SOURCE: O, KAZNDE, HRDU)

6.3 Survey for Large Scale Farmholding Settlements:

Large scale farms have title deeds. This means that they have been cadastrally surveyed. The cadastral plan will be with the Directory of Surveys and a copy will be at the farms' office. This plan will show the cadastral boundaries and permanent structures. This plan will be the basis for mapping this settlement type. Up-dating can be done by aerial photographs combined with ground surveys. Most information will be obtained by interviews at the farm's offices. The farms architects will have site plans, showing building sites and layouts for drainaged and sewage facilities.

6.4 Surveys for rural township settlements:

At this point in the hierarchy of settlements more dense population clusters begin. Layout forms as shown in Chapter 5 show up.

Where plots have been laid out by survey methods the plan will be with the planning office and the survey office and the base map can be quickly compiled from this. If the scale is not suitable enlargement can be done by hand as the settlement is small.

Where large scale aerial photographs or enlargements are available they can be used directly as base maps for surveys on the ground. Use may also be made of oblique aerial photography. The photographs are taken by a camera held out through the window. Flying is done at approximately 500 m. This will result to large scale photography. In an aerial survey carried out by Bo Vaguby (2) photographs were taken for Elburgon (5000 population), Solai (2000 population) and Kabasi (500 population), The centres were rural, market and local respectively. A Nikon F 35 Camera was used. The Camera speeds ranged between 125 - 250 with F settings between 8 and 16.

The photographs were used for the determination of the number of

(2) The Survey was concerned with researching on infrastructure in Kenya Settlements, Department of Urban and Regional Planning University of Nairobi, 1974.

structures before a comprehensive Socio-economic survey was carried out. They were also used for the selection of a 10% stratified sample for the Socio-economic surveys. Population estimates for the date of the surveys were made.

The aircraft was hired at the rate of Ksh. 170.00 per hour. It took approximately one hour to cover the three settlemts as they were fairly close to each other. See Photo (i),(ii),(iii).

Interviews are carried out at this stage. Paragraph 6.7 shows the type of information that can be gathered during the field trip.

6.5 Surveys for Rurban Settlements:

Questionnaires (3) will be used to gather socio-economic data.

The Survey will be done by ground methods. It will be carried out to depict both controlled and uncontrolled development. Figure 6.4 shows the type of map resulting from the field survey. This type of settlement and that of urban shack will be the only ones requiring physical measurements on the ground. A linen tape combined with pacing are sufficient. In the survey carried out by the author (4) it was found that working in pairs is the most satisfactory way of executing the survey. One person will carry out the plotting and sketching while the other unencumbered will help with the measuring and information gathering. This type of survey is helpful for action planning for pilot area projects. The area shown in Figure 6.4 was representative and was surveyed for about four hours. The time spent in the field can be reduced by carrying out the interview and the physical survey simultaneously. Since the dimesions of the buildings will be given during the interview the physical survey need only show the layout with the nuber of the questionnaire shown on the building of homestead.

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(3) See paragraph 6.7

(4) Bukoba Urban Development Project 1975, carried out by the Urban and Regional Planning Department, University of Nairobi

OBLIQUE PHOTOGRAPHS:~ ELBURGON, RURAL CENTRE

SOURCE: BO VAGNBY, 1975. RESEARCH ON INFRASTRUCTURE IN KENYAN SETTLEMENTS.

OBLIQUE PHOTOS - SOLAI - MARKET CENTRE

SOURCE: BO VAGNBY, RESEARCH ON INFRASTRUCTURE IN KENYAN SETTLEMENTS.

OBLIQUE PHOTOS
KABASI ~ LOCAL
CENTRE
SOURCE: BOYAGNBY
RESEARCH ON INF-
RASTRUCTURE IN
KENYAN SETTLE
MENTS

6.6 Survey for Urban Shack Settlements:

Like Rurban settlement type, this pattern has an informal layout. Since it occurs on surveyed and laid out plots base maps can readily be obtained from original layout plans showing the street pattern and adjacent plots. Because of the temporary nature of the structures the survey need not be elaborate in terms of accuracy of measurement. Pacing out and sketching by eye is sufficient for planning purposes. Figure 6.5 shows a survey carried out for about half an hour covering an area of one hectare.

Other information to be collected during the survey should include: all the activities taking place on the settlement including social and economic; the type of building materials used, duration of the settlement; the origins of the settlements; incomes; reasons for settlers are widing to pay if accommodated in local authority market places; places of residence - on site or elsewhere; and information about regular customers - any customers on site may also be interviewed briefly.

The survey can then be plotted accurately using the data from the questionnaires.

6.7 Compilation technique -

6.7.1 Preparation of a base map:

Procedures for preparing the planning base map will vary from settlement to settlement according to the available reference maps and plans. The suggested outline below should be adapted to suit each particular situation.

STEP 1 - Determination of Area to be Surveyed:

The area to be surveyed will generally be the planning area. The factors which will go into consideration include, the planning period whether short -, medium or long - term; existing boundaries be they political, social or economic or even administrative; location of school attendance, watershed areas affecting the settlement water supply; limits of major drainage areas related to sanitation and storm

drainage systems, outlying the settlement boundaries; physical barriers such as takes, escarpments and rivers. Figure 6.4 illustrates a delineation of a settlement.

STEP 2 - Assembly of Control Map:

This is the stage when all available reference maps should be assembled and the selection of one consistant series of maps as a control of the development of new base is made. Factors governing the choice are: scale, accuracy, inclusiveness of coverage, street subdivisional data, and amount of detail to be plotted during and after the survey. The suitable scales should range between 1:1250 to 1:10,000.

STEP 3. Selection of Coverage of Individual Sheets:

The factors which need consideration will be firstly, whether a uniform grid system is employed. If the grid is employed then the individual sheets will be chosen by grid subdivisions. Secondly, the choice will be based on the recognition of boundaries such as words, residential neighbourhoods or physical features. Thirdly, the shape and size of the areas and their orientation to the north should be considered. Finally, the size of the sheets should be governed by the ease of handling both in the office and in the field. See figure 6.5.

STEP 4 - Preparation of the first base:

The first base, which shows only the road network, is prepared from the already assembled reference maps. This should be preferably drawn in pencil because of later corrections. See fig. 6.6

STEP 5 - Preparation of the second and third bases:

The second base is the first base plus subdivision lines. The third base is the second base plus structures. These can be obtained by adding the necessary information to prints obtained from the first base. Registry Index Maps will be used for property boundary data

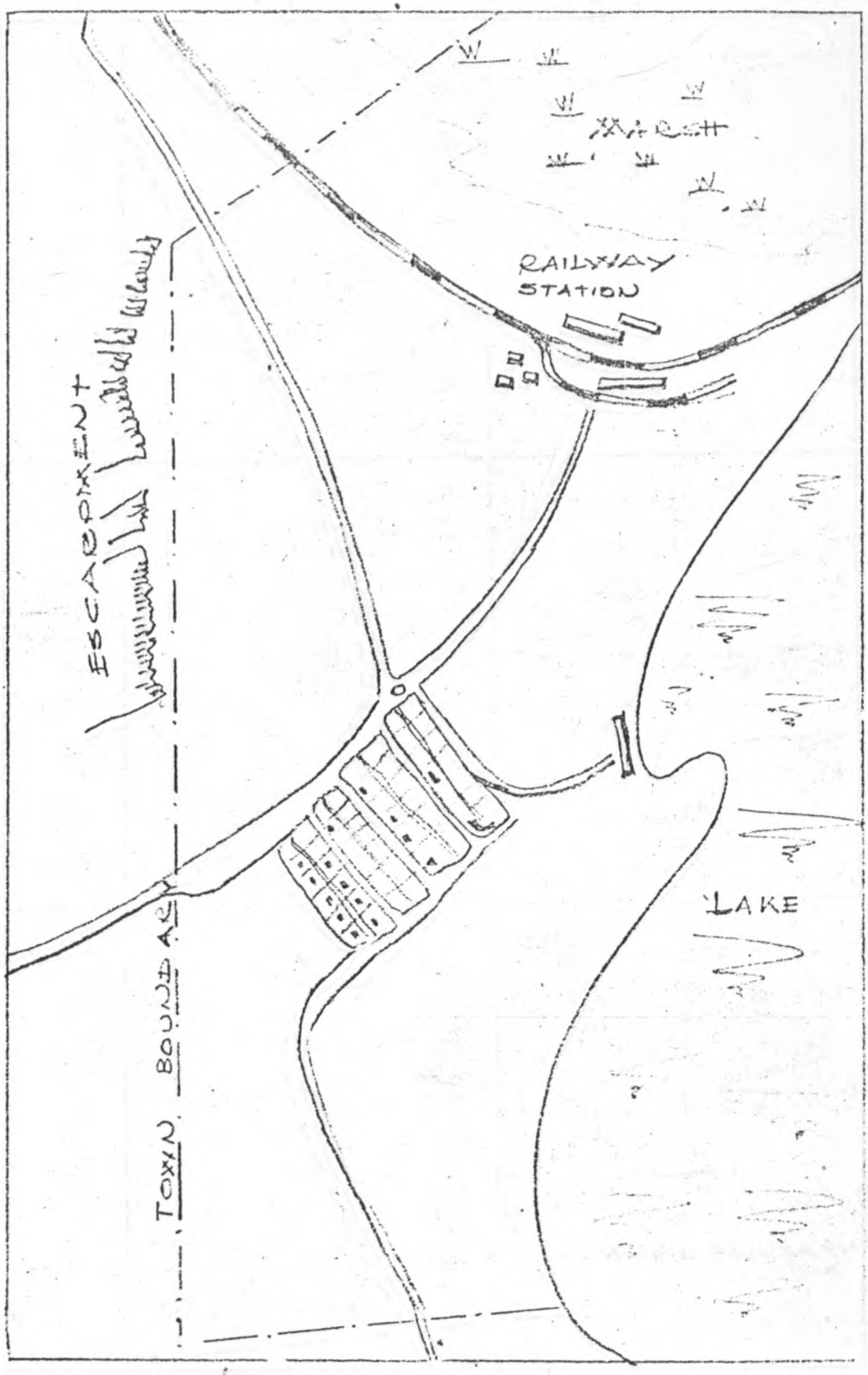


FIGURE 6.4 ~ DELINIATION OF SETTLEMENT
GSOA, 1976

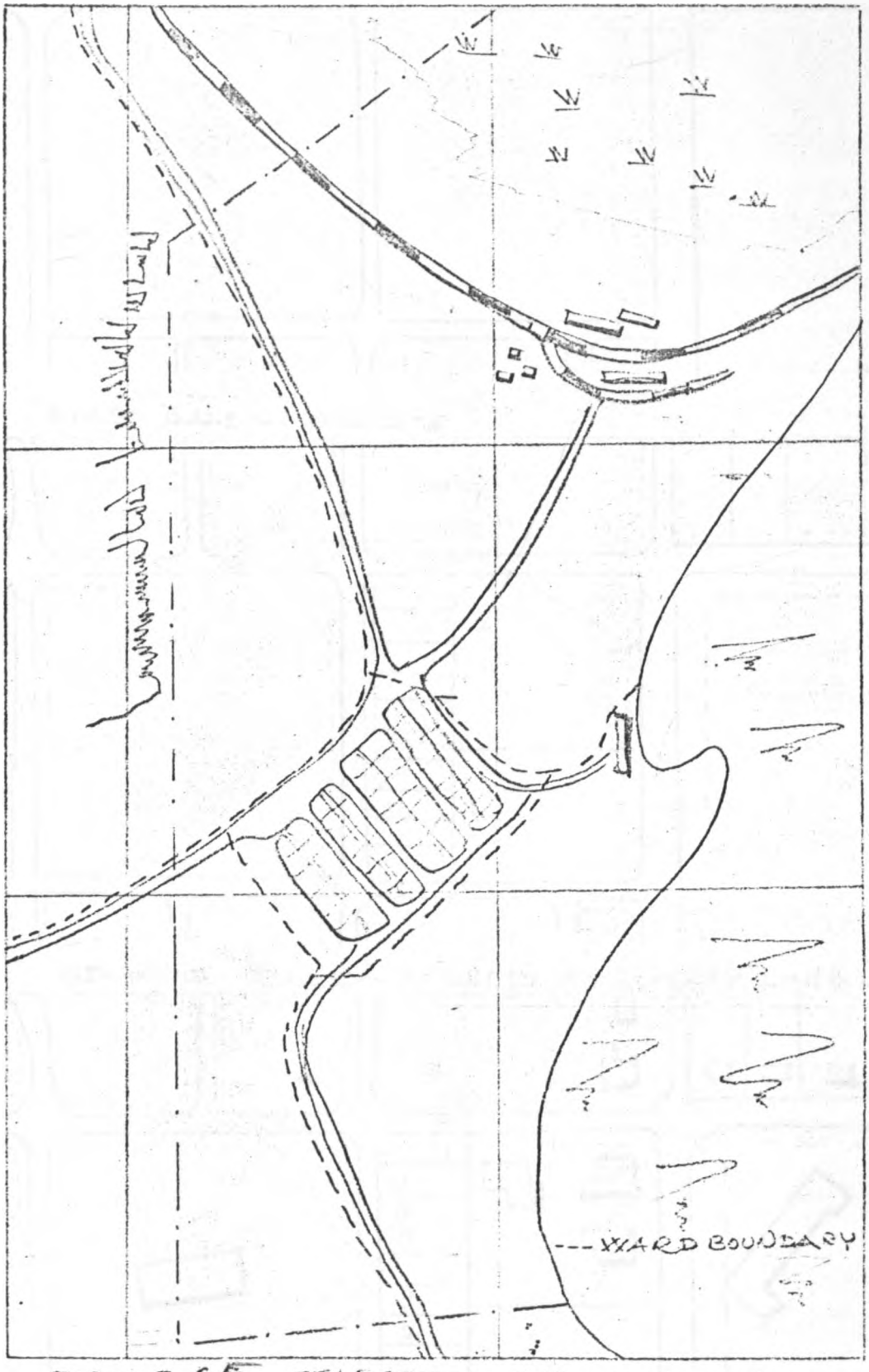
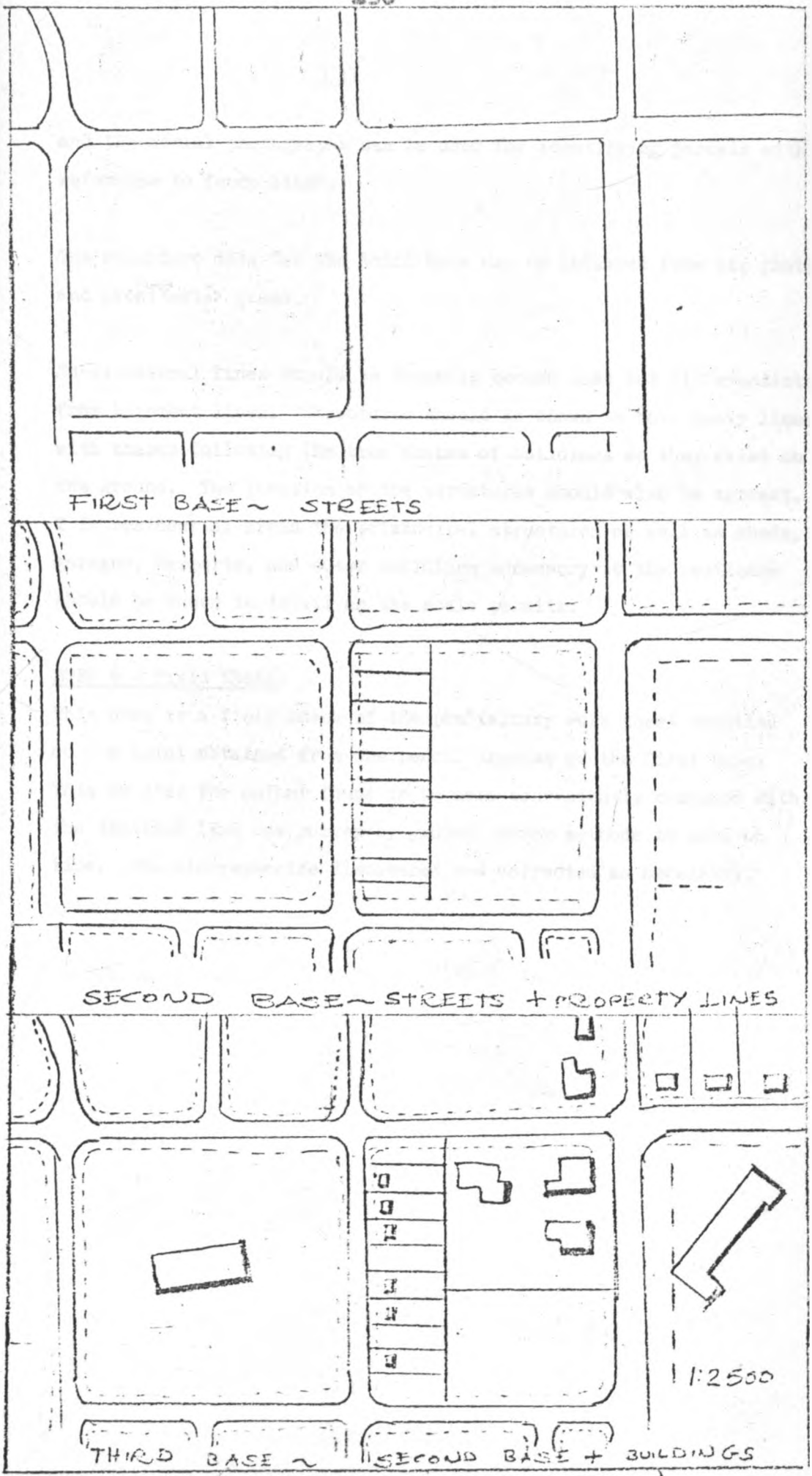


FIGURE 6.5 — SELECTION OF INDIVIDUAL SHEET COVERAGE

GSO.A, 97/


FIRST BASE ~ STREETS
SECOND BASE ~ STREETS + PROPERTY LINES
1:2500
THIRD BASE ~
SECOND BASE + BUILDINGS

and the aerial photographs can be used for identifying parcels with reference to fence lines.

The structure data for the third base can be obtained from air photos and architects' plans.

Subdivisional lines should be shown in broken line but differentiated from basement lines. Structures should be shown in bold heavy lines with shapes following the true shapes of buildings as they exist on the ground. The location of the structures should also be correct. In residential areas the principal structures as well as sheds, garages, carports, and outer buildings accessory to the residence should be shown in detail as the scale permits.

STEP 6 - Field Check:

This step is a field check of the preliminary work sheet compiled on the print obtained from the pencil drawing of the first base. This step the author found to be more conveniently combined with the detailed land use survey by ground survey methods to save on time. The discrepancies discovered are corrected as necessary.

6.8 The Use of Aerial Photographs:

It was quite clear from the interviews carried out in the Department of Urban and Physical Planning that aerial photographs as a source of data and information was underutilized. The reason for this was found to be lack of safficient skill by individual planners to work with aerial photographs. Secondly, it has not been fully realized that air photos, by virtue of the wealth of information stored, can actually facilitate the rapidily with which land use surveys for planing purposes are carried out.

It is true that the potential of air photographs as a source of data and information for planning is subject of debate. Their use is dictated mainly by their availability as well as the skill and experience of the user. His capability to interpret and extract the information required is important too.

It will be useful to quote the most recent application of air photos in Kenya to show their usefulness. Their use led to the ~~xxxx exp~~ Cave Exploration in April 1976. The exploration was carried out into the depths of an undotted series of lava tunnels and caves under Kenya's Chyulu Hills. The Survey lasted ten days. The tunnel was found to 11 Kilometre long lying at a depth of 470 metres below the earth's surface.

> ...entrances to the caves was first noted by the Cave Exporation Group's founder and chairman Jim Simons (geologist), through His study of aerial photographs. These fortuitous roof collapses are generally filled with large trees and the depressions show up as regularly orientated clumps in otherwise lightly bushed country.(5)

6.8.1. Advantages of Aerial Photographs:

Aerial photos are one of the true primary sources of planning information. Facts about the landscape are recorded directly from the ground. The physical features are pictured exactly as they appear

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(5) Daily Nation, May 20, 1976, p.11, published by Nation Newspapers Ltd..

during photography without any generatization.

Air surveys allows extensive areas to be recorded within a very short space of time. It therefore reduces the man-hours necessary for detailed field surveys. It, therefore, guarantees that over the entire are the record applies to virtually the same point in time.

Air surveys can record areas of land which may not be directly accessible from the ground. It can "see" into areas to which ground surveyors may be specificaly denied access. Information may be recorded which is not directly visible on the ground. Examples for this category are state houses, military camps and other protected areas; the routes of underground waterways such as pipelines or old streams and archeological remains.

In paricular land use information such as car park capacities, residential densities, extent of drainage caused by flooding are clearly registered on air photos.

6.8.2 Disadvantages of Aerial Photographs:

There are errors inherent in aerial photos caused by the camera, film processing and print reproduction. There are errors found in different photos such as tilt or trip, differences in scale between consecutive photographs caused during photographic flight coverage.

It is seldom easy to have ideal conditions for obtaining and preserving the original negatives. The transfer of the information contained in the original negatives to the map compilation can seldom be carried out with complete accuracy.

Because the surface of the earth is not level, flat or smooth, it always difficult to transfer data from aerial photographs without loss of accuracy. Because of the vast quantities of information contained in the photographs they are more difficult to interpret than maps.

6.8.3. Differences between air photos and maps:

The differences found to exist between air photos and maps are discuseed below. The reason for this is that in working with photos planners need to be aware of these ~~dfm~~ differences. They should know what to expect or ~~mx~~ not to expect from air photos. The fact that air photos have disadvantages does not necessarily mean that we have to jetison them. Ways must be constantly sought of overcoming these shortcomings so that their use may be more rewarding. Moreover, most base maps are nowadays prepared from air photos and maps have their own disadvantages too.

Maps are drawn on the basis of projections usually orthogonal whilst air photos, being a direct picture of the surface of the earth which lacks flatness, smoothness and level, are not - they reveal the true relief of the surface of the area of the earth.

Maps are highly generalized while photos record virtually every thing as seen from the air at the time of photography. Maps are complied over a long period of time up to their date of publication, while photos take a few hours to take and process.

Because maps are compiled from amany sources such as air photos, ground surveys and statistical information they have on them information which would otherwise be obscured on a photo. Underground passes, features obscured by tree cover, mine works fall under this category. Maps are planimetric i.e. two dimensional while photos are three dimensional thus yielding stereoscopic images. This is so because photos have information on height of relief.

Maps have contours, formlines, benchmarks, trigonometric points, orientation and grid coordinates which make measurements in map reading easy and while such information does not directly occur photos. Photos are taken either panchromatically (i.e. equal sensitivity to all colours) or orthochromatically (sensitive to part of the light spectrum) which a map will be drawn in monochrome

or with colour washes obtained otherwise than photographically.

Names, figures and numbers including boundaries appear on maps but these do not appear on photographs.

Scales on photographs are distorted due to tilts, relief differrences and quality of paper whilst maps are drawn with a uniform scale which is often shwown on the map.

6.8.4 Interpretation of Aerial Photographs for Kenya Settlements:
Photo interpretation is the art and skill of identifying visible details from their images on a photographic print.

6.8.4.1 Qualities to be Studied:
It has been seen in the analysis of past studies( ) that interpretation requires studying three things mainly Tone, light and shadow, shape and size.

Tone: This is depends on the amount of light reflected from an object. If a large amount of light is reflected the result is a white appearance, whilst no light results in a black object. Between the two extremes are all shadows of gray. Due to the good sunshine in Kenya those two extremes are well distinguished. Buildings, roads, clear water surfaces and sand and gravel quarries appear while. Sewage oxidation ponds and vegetation cover appear black and fairly dark respectively. The amount of light reflected depends in turn, on texture. Smooth surfaces such as body of water will generally be white unless the light is relflected away from the camera.

Light and Shadow: Tall buildings in built-up areas cast the most shadow on a photo print: In law rise areas and especially in rural areas the problem of shadows is minimal. Whan studying photos they should face the source of light and have the shadows on the print fall toward oneself. This will put the light in the same position the sun was in when the picture was taken. The prints should be rotated to arrive at the required position. In this respect care must be exercised in differentiating holes from hills. Although the object may have a tone similar to the surroundings its shadow will always be quite dark.

Shape and Size:

Man made features are usually bounded bounded by straight lines often smooth curved whilst natural features usually have irregular edges. The scale of the prints will determine the size of objects. Therefore, it is important to keep in mind the relative size of objects. What appears as a dot on a small scale may actually be a building on a large scale. This is particularly important in small scale photography taken for rural areas. Large built-up areas are generally taken at larger scales and the problem of size is minimized.

6.8.4.2. Identification:

Relief:

It is not possible to measure relief from one photograph alone, but much information can be obtained.

Relief can, however, be inferred by studying other details. For example, shadows cast by hills, cliffs, banks and so on. The path of streams, rivers and lakes tell about the depressions and valleys The ridge lines tell about the ridges. Cut or fills in roads and railroads and railroads indicate the ridges. Cut or fills in roads slopes. The shape of cultivated fields in rural areas is particularly significant as they tend to run from hilltops to valley bottoms. Cultivation habits and crop patterns are typical of rural settlements. Tea, coffee, pyrethrum are grown on slopes whilst arrow roots and yams occur in the valleys. Grazing lands are either near swamps or on hilltops. The location of houses and their orientation also tell alot about relief. Contour cultivation, another man-made feature reveals the sloping change on the landscape. Roads run along the ridges and follow contours generally. This is especially true where topography is difficult. See photo 6.1.

Streams and rivers:

Small streams may appear as a white or black line. They may be hidden by trees or underbrush along the side. They are usually highly

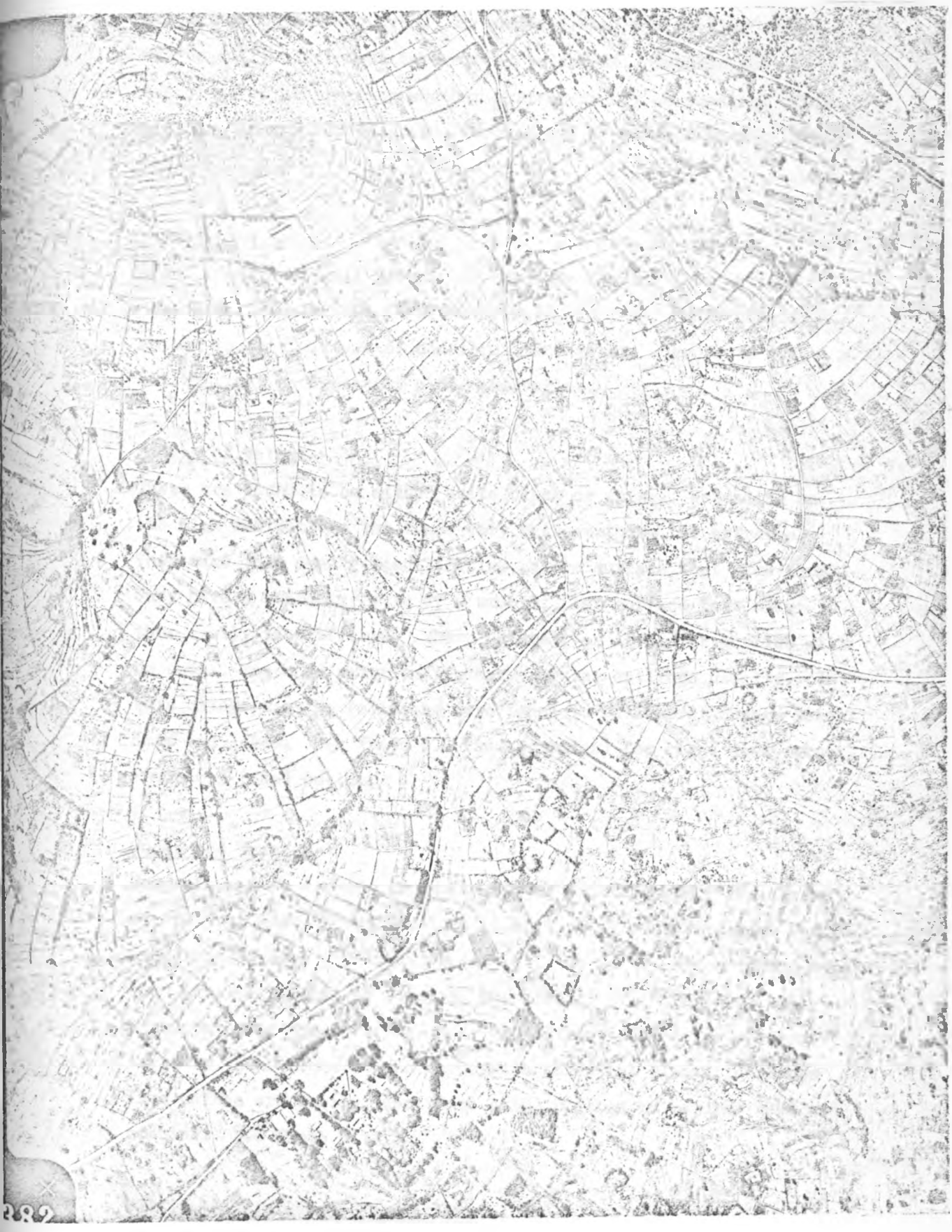

PHOTO 6.1: Relief
Source: Survey of Kenya.

irregular in their courses. In wooded areas, the smaller stream may be difficult (amost impossible) to defect. Caution must be exercised in determining whether a river is dry or running. This problem, if any doubts arise, is overcome by a field check. Study photo 6.2.

Marshes and Swamps:

Often there are small streams or channels flowing through them. Sometimes there are small areas of water in them. They usually appear to be a mixture of underbrush and water. See Photo 6.1, bottom right hand corner, along the valley.

Bodies of Water:

These are found to be either quite black or white. Depending on the high reflections the tones vary between these two extremes. They make them easily identifiable. Where surface that make them They have a characteristic of a smooth, flat surface that make them easily identifiable. Where natural, an irregular outline will be seen. Man made water bodies have regular outlines usually. In this categories the following were found to fall were: Sewage ponds, dams and lakes. See Photo 6.2 (sewage ponds) top right hand corner, Photo 6.3 (dam) bottom.

Woods and Brushes-

Woods appear as darker, irregular shapes on the photo. The season of the year must be constantly kept in mind when studying the woods. Evergreen forests will show as dark all the time. Brush has an appearance similar to that of forests, but a study of the shadows will show that they are shorter. Most brush areas have a few scattered trees in them. Orchards and farms with perennial plantation crops like coffee are easily identified being platted in regular rows and spacing. See Photo 6.1

Cultivated Fields and Plantations:

Fields that are under cultivation stand out from other areas. They usually have a tone darker or lighter than the surroundings. The

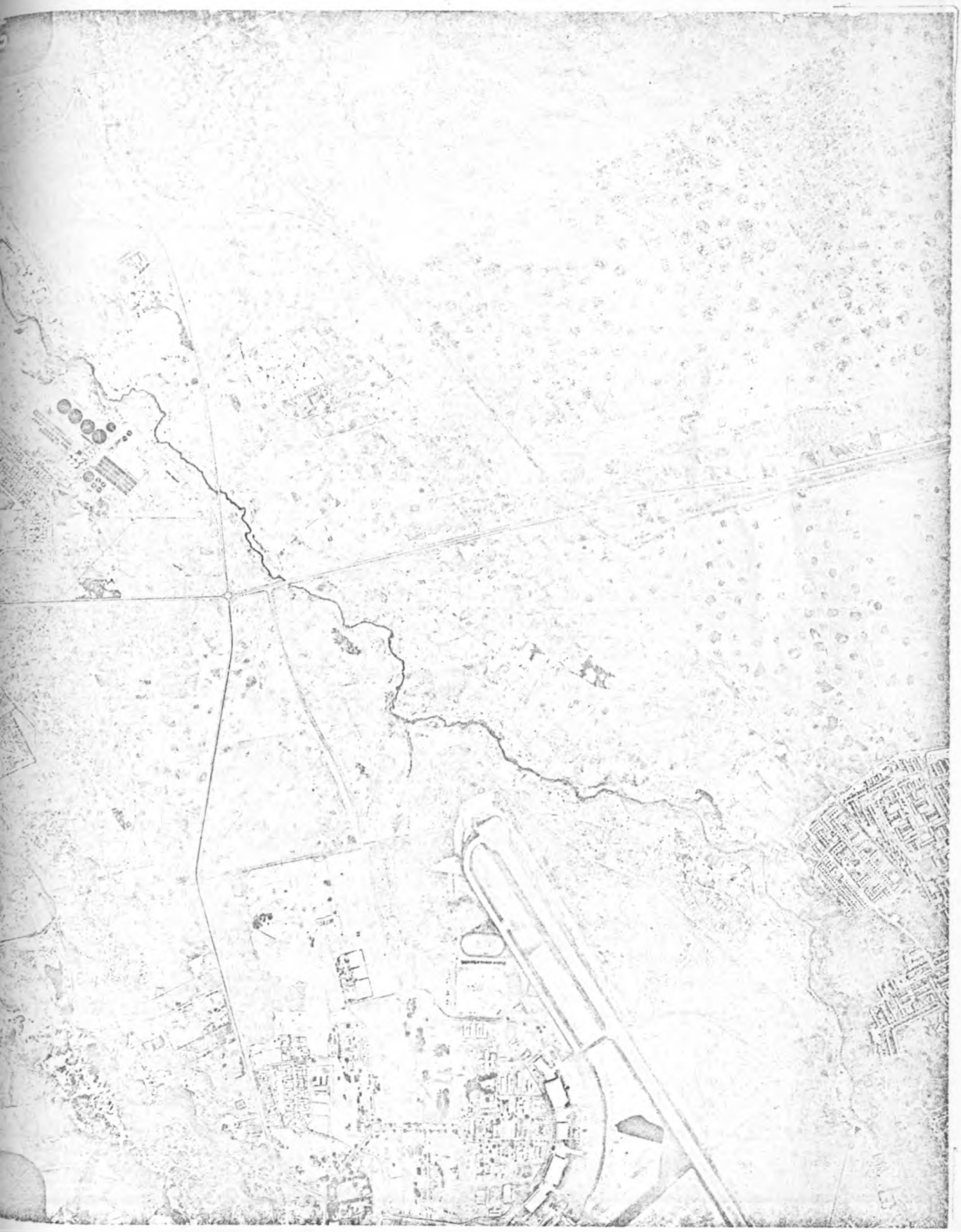

PHOTO 6.2: Streams and rivers
Source: Survey of Kenya.

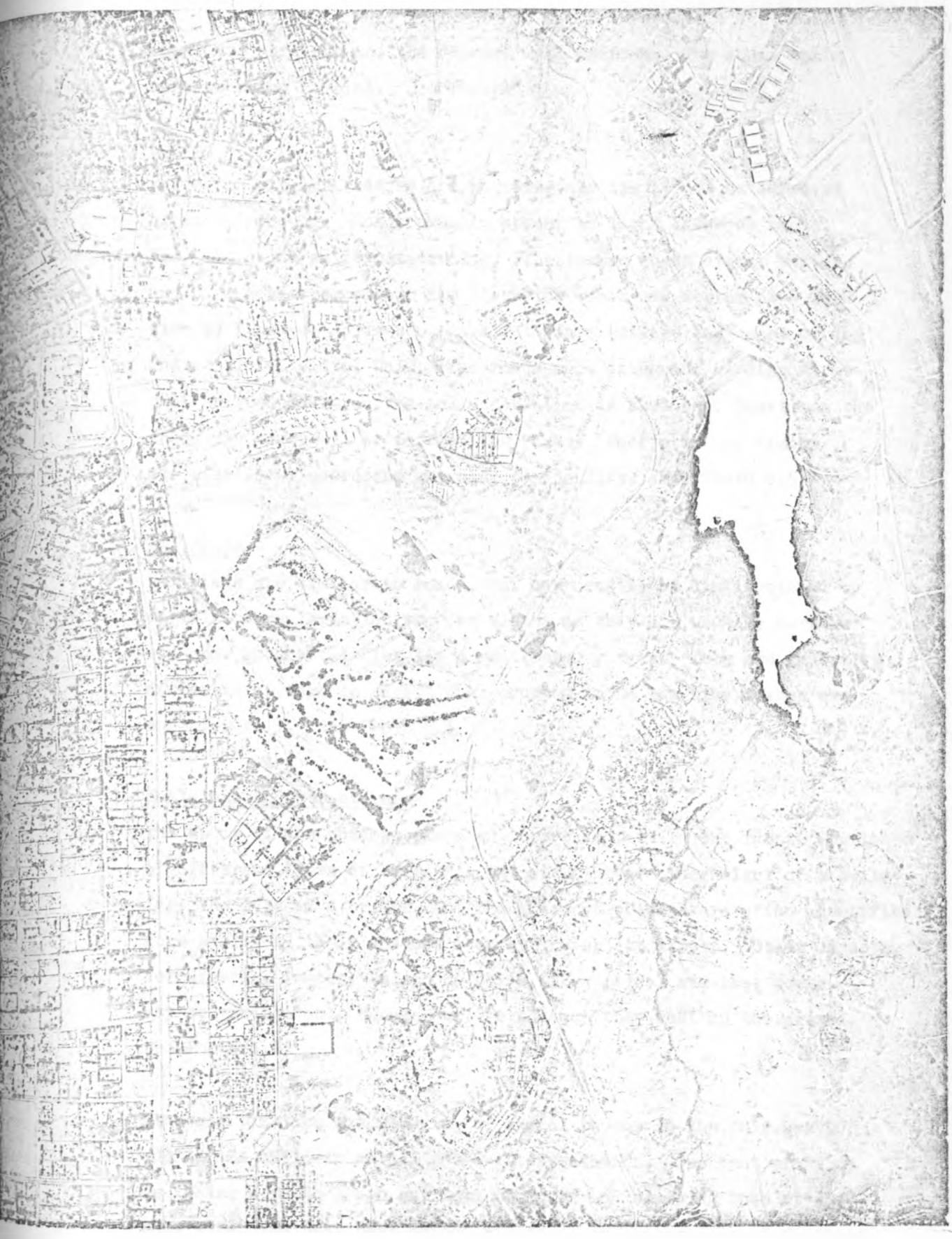

PHOTO 6.3: Bodies of water
Source: Survey of Kenya.

edges are straight and the corners well defined. The scale again must be borne in mind. See Photo 6.4

Roads:

Roads for mapping reasons and purposes are identified as improved or unimproved. Roads usually appear as light lines or bands. They are quite quite outstanding. The termac roads appear whiter and have a sharper edge. The black-top roads may appear as a dark line. Improved roads show straight lines between long easy curves and a regular width. Unimproved roads show irregular winding stretches between sharp curves and a naviation in widths. Sometimes the trees may cover all or part of the roads. Footpaths and tracks are usually crisscrossed and easy to identify. See Photo 6.5

Railroads -

Railroads are similar to roads, but can usually be distinguished by certain characteristics such as widths as they are usually narrower and show much straighter lin s and longer curves. They are generally darker in appearance except when crushed stone was used for fill. See Photo 6.3

Buildings and Structures -

The study of the shadows plays an important part in the identification of different types of buildings and structures. The height of a building, the type of a bridge, and the shape of objects are often identified more easily by their shadows than by the object itself. Other objects, for example, fences, telephone poles, flag poles, and lamp posts, may be visible only because of the shadows they cast on the ground. See Photo 6.6

Constant practice and studying of aerial photos is the only way to add to the skill in aerial photo-interpretation. The best practice is taking a photo graph out into the area and studying both at the same time. The next best method is to study photographs of familiar areas. The following points are noteworthy.

PHOTO 6.4: Cultivated fields and Plantatations
Source: Survey of Kenya.

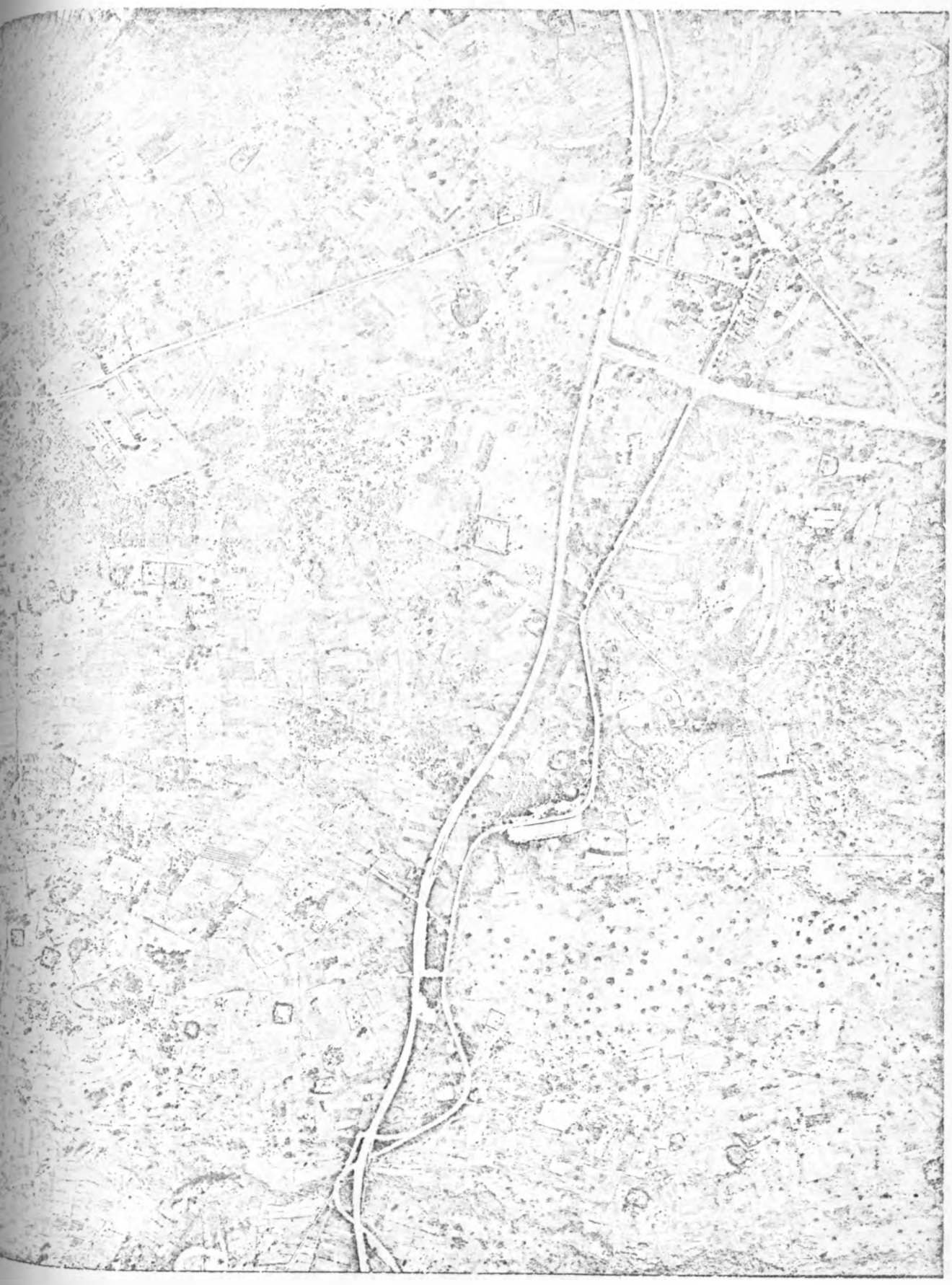

PHOTO 6.5: Roads
Source: Survey of Kenya

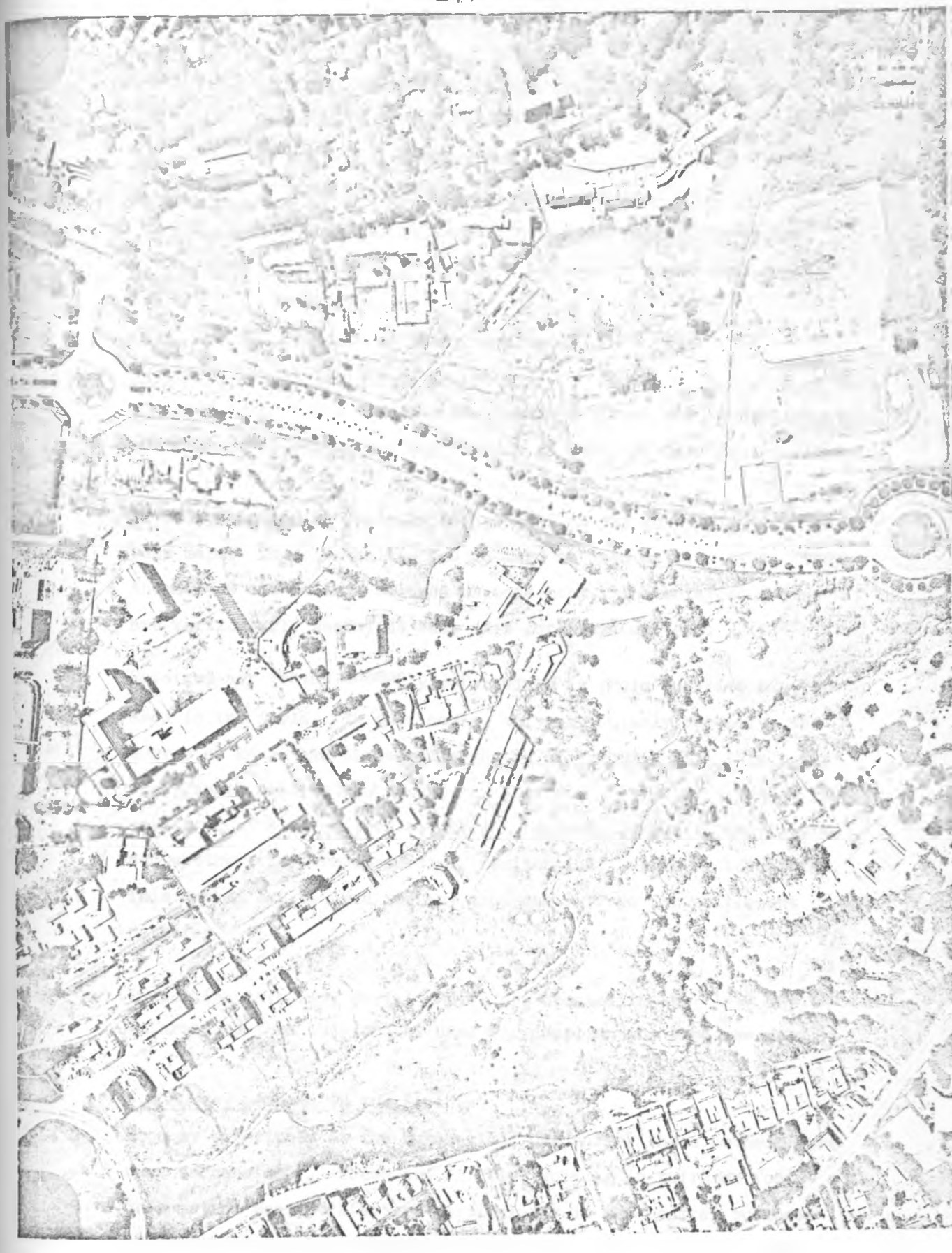

PHOTO 6.6: Buildings and structures
Source: Survey of Kenya.

The direction from which the light falls on the photograph.

The scale of the print

Use a stereoscope whenever possible

Boundaries of natural areas are usually irregular.

Boundaries of man-made objects or areas are usually straight.

Practice at every opportunity.

6.8.5 Summary of the use of Air Photos:

It is evident by now that air photos are employed with advantage at every stage of survey and compilation of land use data for settlements.

Firstly, the aerial photographs are used in the preparation of the base maps. They themselves can in turn be used as base maps. ~~They~~ themselves can in turn be used as base maps. The enlarged photos are particularly useful as base maps for field surveys.

Enlarged air photos commonly referred to as photo quickies can be used in the field. In most cases, and particularly recently, the survey of Kenya has large scale photos of 1:2500. With this print the planner goes out to the actual area and physically notes on the positive. The structures are shown and their purpose, their state, and whether they are commercial, residential, public or industrial. This method can be used for any land use surveys for settlement patterns.

In working this way, aerial photos are updated in the field and the information thus obtained is used for compling the land use map.

6.9 Survey methods in the Field -

From my experience at the Bukoba land use survey three methods were used successfully. These are firstly, working in pairs on foot - this method was satisfactory particularly in the central business district and in the residential areas where plot use and in the structure of dwelling units were important. Secondly, driving in a car - this was particularly suitable around areas at the central

business district and elong major roads where representative land-use patterns were the main objectives. Thirdly, from elevated points this is applicable to the situation where aerial photographs are present and roadside land uses of the settlement, and particularly updating of such uses as agricultural where accuracy is not critical. These procedures will be dealt with in detail below. Pilot area studies which are carried out in similar manner as the first one but entail measurements will also be discussed.

6.9.1 Surveys On Foot -

Most surveys can probably best be done by people working in pairs, one would be charged with recording information on the map, while the other unencumbered and free to prowl round and tell the first what he discovers.

Obviously, there are advantages in collecting survey information on all subjects during one visit but there are disadvantages too. Much of the information to be obtained from inspection needs the exercise of judgment and discretion if it is to be recorded correctly, and it is difficult to consider a number of diverse subjects on a single occasion. There is, also, a certain rythm about such work; a land use survey can sometimes proceed at considerable speed, and the sudden intrusion of difficult problems relating to ather subjects would reduce this. Further, in particular in unfavourable weather conditions it is extremely difficult to record a large volume of information on a map in the field sufficiently clearly for it to be able to be plotted afterwards with certainty. Thus just as, "one subject one map" is a sound rule for survey, and what is lost presentaion, "one subject one visit" is a sound rule for survey, and what is lost perhaps in expenditure of footwear is likely to be more than compensated in the reults acieved to follow when the work is analysed in the office.

It will be rewarding to work in some orderly fashion of covering the settlement in some predentermined division such as block by block.

At any rate the boundaries should be clearly borne in mind be they road, river or some definite demarcating feature. An haphazard s sp-rawl around the city randomly picking uses is not rewarding.

Everything that needs recording must be recorded and memory should not be relied upon. This usually is one of the greatest temptaions on such surveys. This survey gives the planner to also record such activities as share the intended use of the plot. For example such side activities as sale of produce, repair wark, services like shoe shining or newspaper sales.

This also serves as the time to appraise vacant land as far as the topographic, physiographic and unlicensed use aspects go. Any services adjacent to such land such as railway, road, telephone and electricity and water should be noted. See Fig.

6.9.2. Windscreen Surveys -

As a prerequisite to the success of this is the preparation of a base map and a simple clear and easily read key of symbols and notations as outlined in the manual.

As noted above this technique in residential areas and areas of scattered development. The surveyor in the passenger seat carries the map filled or clipped on the board (it is necessary that the map be of a reasonable size to avoid encumberances and inconvenience in handling it during the survey), marks it and observes the land on his side, while the river observes on the other side and supplies the information at intervals, such as "All houses this side: solidly built up". Whenever anything requiring detailed scruting appears, the car must, of necessity he stopped. As density and diversity of use increase it will become necessary to stop more and more frequently and to make sallies from the car for purposes of detailed investigation until eventually the stage is reached at which the pattern of development becomes so complicated and perhaps traffic congested that the car ceases to be useful, and the work continues on foot.

Specialization in mapping may also be excercised. If for instance vehicle such as a land Rover is used the driver who should, necessary be planner should sit with reader or booker seated the passenger seat. These two could record at the same time road side activities of an economic nature and other social characteristics of the area which while two recorders or surveyors on the back seats concentrate on land use surveys on their own one for each side. We found this method to be extremely powerful in our Bukoba Survey (1975).

By employing methods one and two, namely foot and car surveys it is possible for four people to cover a town of normal structure with a population of 14000 in four working days (BUKOBA LAND USE SURVEY 1975).

Other consideration on the use of car are that the speed must be slow enough to allow writing and correct observation. The surveyors must be seated in such away as to constantly be able to look outside without turning badly , but taking just a glance and recording. The car must be comfortable if long hours are to be spent working in this position.

It should be noted that in all these methods written notes and inset sketches should be used fairly liberally to clarify complicated points. See Figure

6.9.3 Survey From Elevated point:

Not all town have hills, scarps and tall buildings. But where there these occur the planner has an advantage of having what approximates a birds-eye-view of the settlement pattern. Here the planner views the town in total or at least the section he is able to sight will have all land uses before him as the situation exists at the material time. With the aid of the aerial photographs and especially the enlargeed type (1:2500) the planner is rapidly capable of updating the aerial photo if it is not and in turn able to update the base map thus far compiled in the office.

Noteworthy points are that the weather must be clear without fog or mist. Obviously this method is not suitable in rainy seasons. When there is shimmer from the hot sun and sharp bright refledtions from water, sand, corrugated iron roofs the view may be obstructed andtimes of the day therefore, must be well chosen to avoid these problems.

Care must be taken in overgeneralization. This is important especially in fringe areas of the urban settlement where agricultural land uses without easily discernable boundaries exist. Use should be made of outstanding features such as monuments, distances and legths which are important if the areas are required.

Sketches of suitable cross-section representative of the larger area can be made from such elevated points. Landscape photography may be taken from here at an advantage to help later land -use analyses. See Figure

6.9.4 Use of Questionnaires for Land Use Data:

The aim of the questionnaires is to secure information that is reaily available by direct observation. The information includes the survey of structures, utilities and services; survey of households, socio-economic status; and survey of industrial utilities and services.

The questionnaire outlines given below can be adopted and modified to suit the conditions of the settlement under survey. Boxes will be inserted with sufficient number of columns to accommodate anticipated responses. The alternative answers should be identiffied uniquely by a number.

The Interviewer:

The interviewer should be courteous to all the interviewed persons regardless of their background, status and education. The aim of the survey should be stated clearly and firmly at the very beginning. It should be emphasized that the information will be kept secret, and no information concerning persons will be processed or treated in a way where it can be used against any individual, as well as none of the information will be used for income tax purposes.

Experience has shown that people are more willing to give information on their expenditures i.e. outgoings than they are to reveal their incomes and the sources of their incomes.(6)

Further it has been found out that it is good strategy to start a conversation that will lead towards extraction of information. In otherwords the interviewer should not be interested only in getting the questionnaire filled. The quality of the responses and their trustworthiness will depend on the intimacy shown to the interviewed

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(6) Housing Survey Kariobangi, M.A. (Planning) year 1 Department of Urban and Regional Planning, University of Nairobi (1975).

persons. The interviewer should be intrested in the persons he is interviewing. Questions about income should be asked after some intimacy has been gained, so that the interviewed person is not offended or embarassed. If the answer to a question is nil the columns should be filled with a 0 in order to secure proper processing of the data. The columns should be filled up correctly and legibly.

Survey of structures, utilities and Services:

A structure means any type of building such as a stone house, a timber house or shanty. There can live more than one family in a structure and workshops and dukas may be found within a structure.

Utilities means the public services one finds in house such as water supply, electricity and telephone.

Services means the service which is provided the individual by private or public orgainzations for example bus service, taxi service or if there are people catering for ones daily needs in the neighbourhood (markets).

Most people are used to imperial scale. It is therefore advisable to ask the questions in feet and converted later into metres by dividing by 3. The area in square feet is divided by 10 to get the approximate area in square metres.

Plinth area is the actually built-up area of a house. A dwelling unit can consist of one or more rooms. If duka is immediately outside the house, but clearly belonging to the house, then this should be stressed. A household is defined as a group of people sharing food from the same pot or sharing the same table or sharing the same meal.

A habituble room is a room used or intended to be used for the purpose of working, living or sleeping, other than a kitchen or a laundry room for the dwelling to which it is attached. It is a room which is in a

good structural condition, properly maintained and conforming to minimum standards.

Ventilation is adequate when the window area is more than 1/10 of the floor area and when there is cross ventilation, i.e. window(s) in opposite walls or door(s) in one wall and window(s) in the opposite wall.

Survey of Households.Socio-economic Status:

The information for this questionnaire should preferably be obtained from the head of the household or a senior member of the household. Such a person will usually be able to provide information regarding all members of the household.

The households living in the structures surveyed should be interviewed. But coordination amongst the interviewers must be maintained.

A family is self-reliant in food crops when they grow sufficient crops to maintain themselves. Building tenure are the terms for renting the dwelling.

Survey of industrial Utilities and Services:

This questionnare is straightforward once the definitions used in the preceeding questionnairres is understood.

A Survey of industrial utilites and Services:

1. Survey district number (the name of the road/street/area should be written).
2. Industrial serial number.
3. Name of industry.
4. Type of industry.
5. Scale of industry: large scale, medium scale, small scale, cottage industry, other (specify).
6. Location of industry: industrial area, residential area, central area.
7. Size of plot (acres).
8. Size of plot (hectares).

9. Built up area/plinth are (approximately) square metres.
10. Built up area/plinth are (approximately) square feet.
11. Total floor area (approx.) square feet.
12. Total floor area (approx.) square metres.
13. Year of establishment.
14. Total number of employees.

Description	Permanent	Casual
Administrative	--	--
Technical	..	..
Skilled	..	..
Semi-skilled	..	..
Unskilled	..	..

15. Source of water: own borehole, public borehole, pipe borne water supplied by municipal authorities, other spcify.
16. How much water do you consume per month (gallons).
17 How much water do you consume per month (litres).
18. How much do you pay for water per month (shs).
19. Have you ever had to stop work due to inadequate supply of water? Yes, no.
20. Electricity supply: no supply, supplied by East African Power and Lighting, private generator, other (specify).
21. How much electricity do you use per month? (KW).
22. How much dd you pay for electricity per month? (shs).
23. What type of drainage do you have? open surface drain, covered surface drain, underground, none.
24. How is surface run off (water rain) disposed of? constructed open drain, underground, constructed covered drain, none.
25. How do you dispose of domestic sewage? Water closet system, bucket collection, pit latrine, septic tank, conservancy tank, backyard or compound used, other (specify).
26. Do you have a separate system for industrial waste water? Yes, No.
27. If your sewarage system is connected to the municipa system, how much do you pay in monthly charges?

28. How do you dispose of refuse? bury it at own plot/compound, dump it in a pit nearby, dump it at communal pit, dump it in container at central place, use refuse bins collected by local authority door to door.
29. If refuse (bins) is (are) collected by local authority, then how often? less than once a week, once a week, twice a week, daily.
30. How much do you pay/spend for disposing of refuse (shs per month).
31. Have you invested in special sewage treatment for your industry? If yes, when? (year).
32. What was the capital investment? (£'s).
33. What are the annual maintenance costs? (shs).
34. What were the total costs of the plant? (£'s).
35. Have you invested in any water provision system for your industry? If yes, when? (year).
36. What was the capital investment? (£'s).
37. What are the annual maintenance costs? (shs).
38. What were the total costs of the plant? (£'s).
39. What are the annual maintenance costs for your water system? (if no special investment).
40. What are the annual maintenance costs for your electricity system? (if no special investment) Shs.
41. What are the annual maintenance costs for your sewage system? (if no special investment).
42. What are your annual street charges? (Shs).
43. Do you have a telephone in the building? Yes, no.
44. How large quantities of effluent does the industry produce per month/year?
45. How large quantities of refuse does the industry produce per month/year?
46. How large quantities of waste water (ile. for cooking/cleaning) does the industry produce per month/year? (7)

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(7) The questionnaires have been adopted from those used for the research on infrastructure in Kenya Settlement, Elburgon/Kabazi Surveys; Bo Vagnby (1975) Department of Urban & Regional Planning University of Nairobi.

A SURVEY OF STRUCTURES, UTILITIES AND SERVICES:

1. Survey district name.
2. Building serial number.
3. Use of building: residential, residential cum commercial, residential cum industrial, residential cum institutional.
4. Type of structure - controlled development: detached, semi-detached, terraced, maisonette, flat, lodging house.
5. Type of structure - uncontrolled development: rural proper, nomadic rural, large scale farmholding, rural township, rurban, urban shack, urban proper.
6. Number of storeys.
7. Width of plot: write in feet: (The question should be asked in feet, then converted to metres by dividing by 3).
8. Length of plot: write in feet: (metres)
9. Size of plot in sq. metres.
10. Plinth area in sq. feet: write in sq. feet (convert to sq. m. by dividing the sq. feet by ten).
11. Total floor area: (Plinth area multiplied by no. of storeys).
12. Number of dwelling units in structure.
13. Number of shops/duka:
14. Number of workshops in structure (or immediately outside).
16. Type of workshop.
17. Number of industries in structure (or immediately outside)
18. Type of industry.
19. Proportion of structure occupied by other than residential use (percentage).
20. Number of households living in structure.
21. Number of habitalile rooms in structure.
22. Number of people liming in structure.
23. Type of floor: earth, rough concrete, smooth concrete, timber, tile linol other(specify).
24. Type of walls: cardboard/flattened tin, mud and wattle, mud bricks, stone, concrete blocks, stone, timber, baboo/sisal, hatched.
25. Type of roof: thatched, cardboard, flattened,tin (scrap),

corrugated iron sheets (mabati), asbestos, tiles, concrete (flat), other (specify).

26. Type of ceiling: fibre board, mats or cloth, other (specify).
27. Wall finish: unplastered unpainted, unplastered painted, plastered painted, plastered unpainted.
28. Foundation: concrete, stone, brick, other (specify).
29. Ventilation: adequate, small windows, no windows.
30. Wind penetration of walls: low medium, high.
31. Water penetration of walls: low, medium, high.
32. Kitchen facilities: separate but shared, separate but private, inside the building but shared, inside the building but private, no kitchen facilities.
33. Bathroom facilities: separate bathroom, separate bathroom for the house, bathroom(s) shared with others, backyard or compound used for bath, other (specify), no bathroom facilities.
34. Toilet facilities as found in/out of the building: water closet private inside, water closet private outside, water closet shared inside, latrine private inside, latrine private outside, latrine shared inside, latrine shared outside, bucket latrine private inside, bucket latrine private outside, bucket latrine shared inside, bucket latrine shared outside.
35. If you have bucket latrine, how often is it empied? daily, twice a week, weekly every other week, monthly.
36. How do you dispose of domestic sewage? Water closet system, bucket collection, pit latrine, septic tank, conservancy tank, backyard or compound used, other (specify).
37. Do you use human waste as manure? Yes, no.
38. How do you dispose of refuse? bury it on your own plot/compound, dump it in a pit nearby, dump it in a communnal pit, dump it in a container at a central place, use refuse bins collected by local authority door to door, burning, combination of burning and other.
39. If refuse bins are collected by local authority, then how often? less often than once a week, once a week, twice a week, daily.

40. State of building: habitable, maintanined, habitable but not maintained, not habitable.
41. Extention or rebuilding of structure: once, twice, more than twice, rebuilt.
42. Age of building in years.
43. Assessment of the structure: very good, good, fair, poor.
44. Who built the house? (financing of the house): owner himself, government, institution, building company, cooperative.
45. Who did the construction? owner, contractor, owner and contractor.
46. Cost of building if known (in shillings).
47. If you have a latrine on the plot, how much did it cost to construct? (in shillings).
49. Source of water: stream or river, well, own barehole, public barehole, pipe borne water on own plot/compound, pipe borne water in house, pipe borne water from nearly street, pipe borne water from street in another neighbourhood, bought from a seller.
50. Distance to water source (if one has to walk): 0-250m, 25--500m, 500-1000m, more than 1000 m.
51. Time taken to fetch water (both ways including waiting time): less than 15 minutes, 15-30 mins, 30-45 mins, 45-60 mins, more than 60 mins.
52. If water is brought to the house, whc does it? head of the family, the wife, the children, the servant, a street seller, other person living in the house.
53. At what time of the day does it take you longest to fetch water? 6-8 am., 8-10 a.m., 10-12 am., 12-2 p.m., 2-4 p.m., 4-6 p.m., 6.00 p.m. - 6.00 am.
54. If you use water from a well, do you boil it before drinking? Yes, no.
55. Has your well been inspected by a health inspector? Yes, no.
56. If you have a well and a latrine on your plot, what is the distance between them? (feet).
57. If you use water from a well, has the well caused any adcident such as drowning of children? Yes, no.
58. How many debes of water do you use a day?

59. What is the cost of one debe of water? (cents)
60. How much water do you use per month? (gallons)
61. How much do you pay in flat rate per month for water? (Shs)
62. How much do you pay for refuse collection per month? (shs.)
63. What type of drain age do you have? open surface [redacted] dadrain, underground, none.
64. Electricity supply: no supply, supplied by East African Power & Lighting (EAPL) from hydropower, EAPL (diesel station), cooperative aor communal generator, private generator, electricity supply not utilised (by voluntary choice), other form of power (specify).
66. Cost of electricity per month? (Shs)
67. Cooking fuel: firewood, charcoal, coal, kerosene, gas, electricity, other (specify).
68. Total cost of fuel per month (Shs).
69. Do you have access to telephone? In the house, in the neighborhood (private), in the neighbourhood (public call box), outside neighbourhood (public call box).
70. Condition of nearest road: motorable track, murram, tarmac.
71. Distance to nearest road in feet.
72. Distance to nearest market: in the neighbourhood, 0.25-0.5 miles, 0.5-0.75 miles, 0.75- 1 miles, more than 1 mile.
73. Condition of immediate environment: little open space uncared for, little open space cared for, extensive open space uncared for, extensive open space cared for, no openspace.
74. Grain storage: none, in the house, outside the house.
75. What do you pay in street charges per month (shs)
76. Interviewers impression about the interviewed person: honest, dishonest, suspicious, eomprehensive (understanding), confused.

A SURVEY OF THE HOUSEHOLD SOCIO-ECONOMIC STATUS:

1. Survey district number or name.
2. Building serial number.
3. Houseld number.
4. How many members are there in your household in this houses?
5. How many members of your household live outside (the state survey area?).
6. Where? (the possible choices should be listed before hand).
7. How frequently do you visithem? once a year, twice a year, quarterly monthly.
8. How long do you stay with them? less than a week, 1-2 weeks, 2-4 weeks, more than 4 weeks.
9. How frequently do they visit you? once a year, twice a year, quarterly monthly.
10. How long do they usually stay with weeks, more than 4 weeks.
11. How long have you been staying in (the state survey area): less than 6 months, 6-12 months, 1-2 years, 2-5 years, 5-10 years, more than 10 years.
12. Are you planning to more out of (state the survey area)? Yes, no.
13. Are you planning to bring the other member(s) of your household to (state survey area)? Yes, no.
14. Are you on the waiting list to any type of housing? Government housing, housing Company, cooperative, other (specify).
15. Have you applied for allocation of a plot in a settlement scheme? Yes, no.
16. If yes, where? Western Province, Nyanza Province, Central Province, Nairobi Province, Rift Valley?
17. Where were you living before you moved to (state the survey area list the likely places of oringin)?
18. How long have you stayed in this house? Less than 6 months, 6-12 months, 1-2 years, 2-5 years, 5-10 years, more than 10 yrs.
19. Do you own land (shamba) elsewhere? If yes where? Provinces - Western, Nyanza, Central, Eastern, Coast, Nairobi, Rift Valley,

North Eastern, Outside Kenya.

21. Do you grow any subsistence crops on this plat? (e.g. bananas, beans, maize, vegetables)? Yes, but not self-reliant in food crops, yes, self-reliant in food crops, no
22. If you are self-reliant in food crops, then which crops? bananas, beans, maize, vegetables, sweet potatoes, beans and maize, maize and vegetables, beans and vegetables. Maize and sweet potatoes.
23. Do you keep any domestic animal(s) on the plot? Yes, no. If yes, specify: number of cows, goats, sheep, pulty, other (specify).
24. Are any surplus crops produced on the shamba sold? Yes, no: if yes, state which produce and where it is sold.
25. Land tenure for building owners: own, formal lease - private land, formal lease - public land, informal lease, uncontrolled.
26. Annual rent of land if known (shs)
27. Initial cost of land if known (shs).
28. Monthly mortgage payment or repayment for house? (shs).
29. If you are a tenant, what is the type of building tenure? Own, free-relative of owner, free-works for owner, free-guest/care taker, partial rent - relative/friend, partial rent-employer pays part, full rent.
30. If you are a tenant state the monthly rent paid for the house? (shs).
31. What do you estimate the value of the plot/shamba to be (including buildings) if it should be compensated in case of urban expansion? (shs).
32. Do you remit (send) money to your relatives? Yes, no.
33. If yes, how much per month? (shs)
34. Do you receive any money from relatives? Yes, no.
35. If yes, approximately how much? (shs).
36. If you own land/shamba elsewhere, what is your monthly income from this? (shs).
37. If you have any income from sale of crops from your plot/shamba here, how much is this per month? (shs).
38. If you have any income from sale of poultry (or poulty products e.g. eggs) from your plot/shamba here, how much is this per month?

39. If the area where you are living was to be improved, (that is, provision of water, better roads, upgrading of the environment) would you be willing to participate in the work on harambee basis? yes, no.
40. If yes, under which conditions? Against payment, free of charge.
41. If y such work were to be carried out, how many members do you think there should be in a working team?
42. What skills would you provide? (list of appropriate skills e.g. masonary, plumbing, carpentry).
43. Which skills would you be willing to learn? (list of appropriate skills).
44. If you are living in a house which is considered illegal (shack house), would you be willing to improve it if you could get some sort of guarantee that you would be allowed to stay on in the house? Yes, no.
45. If yes, what sort of improvements would you make? repair the roof, repair the walls, improve the general appearance of the house, put a fence around the plot, other (specify).
46. If the following services were to be offered, which ones would you like to have?

(a) Health centre
(b) Dispensary
(c) Hospital
(d) Nursery School
(e) Primary School
(f) Secondary School
(g) Water
(h) Sewage
(i) Electricity
(j) Drainage
(k) post office
(l) police station
(m) street lighting
(n) better road surfaces
(o) bank
(p) public transport
(q) church/mosque.

47. If you should give first priority to the following, which one would you choose? Health facilitie, shools and educational facilities, public utilities (that is, water, sewage, drainage) better security (that is, police, streeet lighting), public transport, banking facilities, post office, better roads, places of worship.

48. If you would give second priority to the above mentioned facilities (No. 47) which one would you choose?

49. Interviewers impression about the interviewed person: honest, dishonest, suspicious, comprehensive (understanding), confused.

50. Respondent: Head, wifes first son, second son, first daughter, second daughter, parent.

51. Relationship to the head oft the household: Head, wife, child, brother, sister, cousin, parent, servant, other (specify).

52. Age in years.

53. Sex: male, female.

54. Marital status: married, unmarried, widow, widower, divorced/ separated.

55. Level of education: Nursery, primary, secondary, university, vocational, higher (other than University but not vocational).

56. Occupational status: self-employed, employed, unemployed, un-employed, unemployed but actively looking for a job, casual laborer/employee.

57. Type of occupation: Agriculture; extractive industry (mining, quarrying, etc.), manufacturing industry: name of industry; service industry: state activity; Government/parastatal (administration); private instititution; Domestic work (servant, cook, Hayah, etc.); small scale industry (woodwork); small scale industry (metalwork); other (specify).

58. Location of place of work: on same place where you are living, within dwelling group, within residential area within neighborhood, other neighbourhood (not industrial area), industrial area, outside survey area.

59. How long do you normally take to reach your place of work? less than 15 mins. 15-20 mins., 30-45 mins., 45-60 mins., more than 60 mins.

60. How do you get to your place of work? On foot, on bicycle, by matatu, private car, by bus, other (specify).

61. What is your place of birth? (list of likely places will be made depending on the survey area).

62. Ethnic origin: which tribe do you belong to? Such as Kikuyu, Luhya, Luo, Kisii, Kalenjin, (including Kipsigis, Nandi, Elgeyo,

tugen,) Mhindi, Mzungu, other

63. Which religion do you belong to? Christian, muslim, Ismaili, Hindu, other

64. What is your total monthly expenditure? (shs).

65 What is your income per month?* (shs)

66. Do you have any other source of income? Business, construction, transport, private employment, from relatives, other (specify).

67. If yes, state monthly amount. (shs).

68. Do you own a car? If yes, which type? Saloon car, van, lorry, bus taxi, other (specify).

69. Interviewers impression about interviewed person: honest, dishonest, suspicious, comprehensive (understanding), confused.

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* Experience has shown that expenditure is usually given to be more than income. Therefore this question (64) should be asked before 65.

6.10 Land Use data Presentation:

As new techniques are developed for classification, data acquisition, processing and storage, so new ways must be developed for present the data so acquired. Land use data may be stored on punched cards as well as on maps depending on the method of survey seen above. Two basic forms of representation are commonly used - Statistical and map apresentations. Data stoned on punched cards renderd itself to statistical presentation. In this presentaiton an individual use percentage of the total area under survey is tabulated. The results may be shown on tabular form as well as diagramatically using pie charts for example. Where equipment for autbmated cartography are available the data can be translated from the computer storage and plotted graphically on a map. This method speeds up the mapping stage considerably.

Where data from the field has been gathered on a map the technique of presentation will be in map form. This technique aids in understanding how the entire urban or settlement land is utilized. The distribution is perceived visually. This is of considerable help to the planner. Each use may be the subject of one map or all uses may be shown on the same map. Where each use is drawn separately it is better done on transparency so that for comparison two or more may be overlaid. The choice of colour will be decided by the planning agency. Where possible the colours should be standardized so as to avoid confusion.

6.11 Land use Data Up-dating:

Acquiring and presenting land use data can take considerable effort, energy time and funds especially if it is undertaken haphazardly. Every effort should therefore, be made to maintain the information and data thus acquired so pains-takingly. This data should be kept as up-to-date as possible so as to avoid repeating the field work over and over again. This is the secret of cutting down the cost and the time spent. The method used for up-dating data stored on punch cards will, necessarily, be different from the one where the map is the medium of storage.

The larger the urban centre or the settlement the harder it will be to keep the data up-to-date. But the size should not be a hinderance or an excuse for not attempting to keep the data up-to-date. If the necessary arrangements are made it should be fairly easy to carry out. Where inspections are carried out or some city wide census taking or collection of rates such as water rates required data may be collected at the same time and the updating for punch cards is merely to up data the particular card affected by the change.

Where maps are the medium for storage and presentation of data a different method will be followed. First the base maps must constantly be kept up-to-date. Because of the time and money involved in preparing the base maps, it is only logical that a systematic procedure be established for keeping them up-to-date.

The problem really lies with keeping abreast with changes as they come. A distinction will also have to be made between those items that change rapidly and those that are not prone to change rapidly. Thus it would be worth the hile of a planning office to have some one whose task it is to knote these changes. These changes or additions can then be plotted on special "correction prints" as they are formally approved. In the case of new structures or converted buildings, in cities, towns or countries where building by-laws are in effect, it is possible to keep an up-to-date plot of these changes through the building inspector who would monitor the changes. Such an officer will be provided with a copy of the print as outlined above (the Base C) showing the structures and instructing him on how to show the additions and mark the changes. Where development is rapid especially in areas extending beyond the boundaries of the planning area field checks are the answer. By consolidating these correction sheets and maintaining them on an annual or biannually as the agency may choose it is possible to develop comparative data at regular intervals on rates of change, directions of growth and the locations of conversion activity.

Regardless of what precautions are taken to keep a survey up-to-date, and no matter how carefully this has been done, it cannot be relied upon endlessly. In a situation where undeveloped areas are developed uncontrolled and such changes go undetected it is important that the three phases described above for the compilation of a land use map be used to effect up-dating. Changes in classification may render a land use map out-of-date, hence the classifaction changes should keep abreast with changes in land use. Changes in technology such as changes in survey methods and analytical tools will necessitate keeping land use data in line with such changes.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

7.1 Summary

The problem this study was addressed to may be stated as: How to prepare an up-to-date land use map and obtain quantitative as well as qualitative data and information for developing settlement areas at rapidly reasonable time and cost.

In order to arrive at the workable solution sought it was necessary to analyse critically the studies hitherto made on land use surveys and mapping. It was alsc important that the mapping and planning agencies in Kenya be examined in the light of what is available for the planner who embarks on land use survey. The analysis of the land uses and emergent settlement patterns was also carried out so that a meaningful land use classification could be evolved. This was done for both urban and rural uses.

The findings were: Firstly, there exist managements problems. These were found to be:

> The acute lack of dialogue and coordination between the planning agency and those ministries and departments that hold planning information and data. This leads to the acute inaccessibility to land use data throughout the country and hence a duplication of effort in its collection.
>
> There is a general staff shortage in the planning and mapping agencies and in particular technical staff. This is the main contribution factor to the delays prevelant in surveying and planning agencies for the execution of mapping and land use Surveys.

The problem of delay is further aggravated by the underutilization of aerial photographs due to lack of experience and skill in working with photographs by individual planners.

The reference maps were found to be extremely out-of-date. Appendix 3.6.1 indicated that reference maps were out-of-date by eight years and aerial photographs were less out-od-date that maps. Whilst recent photography (1975) was available for some parts, no revision of maps had hitherto been undertaken. Further, the current map scales are unsuitable especially for places of dense development.

7.2 Conclusions -

Based on the study the author was led to conclude that there exist a quick method of data and information gathering for rapidly growing or developing areas. This method is the judicious combination of reference maps, aerial photographs and field surveys. The rapidly with which this compilation can be done in depends on the following: Availability of the most recent reference maps, plans and air photos. It also depends on the experience and skill of the planner working with His willingness to use them if available. The availability of a comprehensive land use classification.

Despite technological advancement over recent years, the more detailed land use maps still require some direct field work to produce part, at any rate, of the required data. It is the authors opinion that aerial photographs can be used for most physical surveys whilst field work should be for social and economic surveys.

7.3 Recommendations:

It is recommended that: A comprehensive national land use survey be carried out before the next development plan period (1978-82). This is should be done fore the most developed areas - i.e. all of Kenya except the semi-desert. Land uses for the arid zone would be a long term objective. This is necessary because of the next step namely comprehensive resource survey. A national resource survey is essential for the for the formulation of realistic comprehensive national regional and local development plans.

In urban areas standard interview schedules be formulated to be given out to urban dwellers and returned to local authorities annually or biannually giving relevant land use information. The length of time will depend on the particular centre in question, and its financial resources.

Aerial photographic coverage be done annually for urban centres and biannually for rural areas. This is necessary if planners are keep pace with development instead of following it.

Arising from this section in the survey department which has been set be charged with land use mapping relevant to town planning. Close coordination between this section and the Department of urban and physical planning be maintained. Further application of remote sensing now available in Kenya be made for natural resource surveys.

As a partial solution to the population from rural areas. Offices for Land use data be opened Rural Centre level and school leaves be employed to help carry out the comprehensive national land use survey.

Appendix 3.6.1 - Land Use Code*

Note: As far as possible the following land use coding is in accordance with the International standard Industrial Classification of economic activities. Since not all land uses are related to economic activities however, new classifications for land uses such as residential (0) and public open space (5) have had to be created resulting in the code 5, constructions, to code 4 electric, gas and water. Where the ISIC classification is not suitable for using as a land use code and it would be more appropriate for planning purpose to include a certin group of activity in a different category, the ISIC classification system has been modified. Thus, for example, hotel, rooming houses and camps have been included in Residential (0) instead of in Wholesale and Retail Trade (6).

Although the first and second digit of the Land Use Code follows the ISIC fairly closely, the third digit represents a classification worked out to suit land use planning purpoes primarily and bears little coresspondance with the ISIC system. Other modifications of ISIC have been made to accommodate activities peculiar of Kenya.

0	RESIDENTIAL
00	Unoccupied Residential
000	Vacant residential plot
001	Vacant single family hose
002	Vacant two family hose
003	Vacant apartment house, sute, or hotel
004	Other vacant residential premises
005	Residential primises under construction
010	Single family hose
020	Two family dwelling
030	Apartment with self-contained toilet and cooking facilities but communal entrance and plot.
040	Row House or maisonette with self-contained toilet and cooking facilites with separate entrance to outdoors.
041	As above on Communal plot.
042	As above on separate plot.
050	Special Residences
051	State Houses
052	Embassy Residences
060	Squatter Dwelling
070	Communal dwellings
071	Hotel, Motel, Safari Lodge, Self-service Banda
072	Institutional dwelling, e.g. Dormitory, Hostel, Hall

*Prepared by Jim Eastwell, Department of Urban

of residential.

073 Boarding House, Rooming House

080 Other residential

1 AGRICULTURAL LAND

*?? Unregistered Trustland

110 Ranch (Registered holding 10.0 hectares or greater used exclusively for animal grazing).

120 Forest Reserve

130 Plantation (Registered holding used exclusively for growing a single industrial crop)

140 Large Scale Farm (Registered holding 10.0 hectares or greater used for arable or mixed farming)

150 Small Scale Farm (Registered holding less than 10.0 hectares)

160 Co-operative Farm registered as such

170 Intensive agricultural operation e.g. Feedlot, mushroom farm breeder houses etc.

180 Game Reserve, National Park

190 Wasteland, water areas Lakes, reser

191 Lakes, reservoirs

192 Rivers

193 Unused Government Land

2 PRIMARY EXTRACTIVIE INDUSTRY

210 Mines (coal, ligunite etc.)

220 Oilwells, natural gas wells

230 Metalic ore extraction

240 Non-metallic material extraction

241 Stone and gravel quarries, sand pits, murram pits road stone and building stone

242 Industrial minerals (fluorspar, diatomite etc)

243 Precious stones

250 Other Mining.

3 MANUFACTURING

31 Agricultural Crops (Primary Processing)

310 Coffee Factory

311 Tea Factory
312 Sisal Processing
313 Pyrethrum Processing
314 Grain Milling, Posho milling
315 Oil Milling
316 Cotton Ginning
317 Dairy Processing
318 Abbatoirs, Meat Packing
319 Fish packing plants
32 Textiles, Leather
320 Manufacture cotton cloth
321 Manufacture woollen cloth
322 Manufacture sisal cloth
323 Other ~~textiles~~ textiles
324 Garment manufacture
325 Footwear manufacture
326 Manufacture other leather goods
327 Leather tanning and processing
33 Wood and Wood Products
330 Sawmills
331 Wood carving
332 Funiture manufacture
333 Other wood products manufactures (except
34 Paper bases Industries
341 Pulp and paper mill
342 Printing and publishing
35 Petroleum and Chemical Industries
351 Manufacture industrial chemicals
352 Other chemical production
353 Petroleum refineries
354 Miscellaneous products of petrol, coal
355 Rubber prodcts
356 Plastics
36 Non-metallic mineral industries

361	Pottery, chinaware
362	Glass and glass products
363	Cement manufacture
364	Others
37	Basic metal industries
371	Iron and steel basic industries
372	Non-ferrous metal basic industries
38	Manufacture of metal goods
381	Manufacture of metal products except machinery
382	Manufacture of all machinery except electrical
383	Manufacture electrical machinery
384	Manufacture scientific equipment.
385	Manufacture of transportaion equipment
39	Other manufacturing & industrial uses
390	Fruit vegetable canning and bottling
391	Breweries, soft drinks
392	Other manufacturing

4	UTILITIES, Construction, Warehousing, Storage, Services
	Industry
41	Electricity Generation
411	Hydro-electric plant
412	Geo-therm plant
413	Coal-fired plant
414	Oil-fired plant
415	Nuclear plant
416	Other forms of generations
417	Transformer staions etc.
418	Power line R.O.W.
42	Water Supply and Sewage Disposal
421	Water treatment and pumping plant
422	Water pipe line R.O.W. Water storage tank
423	Sewage Disposal Plant
424	Garbage dump, Sanitary landfill
43	Warehousing & Parking Structures

430 Vacant Warehouse
431 Food Warehouse
432 Beer of liquor Warehouse
433 Other Warehouses
434 Parking Structure Silopar
45 Service Industry
451 Automobile Sevicing
452 Panel Boating & spraying
453 Appliance Repair
454 Shoe Repair
455 Bicycle Repari
456 Other repairing & service industry

5 PUBIC OPEN SPACE
51 SPECTATOR SPORT AND ENTERTAINMENT AREAS
511 Football Satium, Cricket Group, Athletic Stadimum
512 Horse Race Track
513 Motor Race Track
514 Drive-in Cinema
515 Exhibition Grounds
516 Amusement Park, Exhibition Grounds
52 PARTICIPANT SPORTS AREAS
521 playing Field
522 Swimming Pool
523 Tennis Court etc.
524 Golf Course
525 Golf Driveng Range
53 OTHER PUBLIC OPEN SPACE
531 Urbsn Public Park
532 Arboretum
533 Zoo, Snake Park
534 Tot lot
535 Cemetery
536 Beach

6 RETAIL USES

600 Vacant Retail Plot

601 Vacant Retail Premises

610 Food Stores

611 Baker

612 Butcher

613 Dairy

614 Fishmonger

615 Greengrocer

616 Grocer

617 Supermarket, mixed food retail

62 Other Retail Stores and Dukas

620 Clothing Stores

621 Footwear Stores

622 Furniture Storey

623 Hardware, Toys, Appliances, cameras, sporting goods

624 Bookstote, Music Store, Tobacconist

625 Jewellery, Tourist Curios

626 Pet Shop, Florist,

627 Office Supplies, Light Equipment Sales

628 Variety store, Department Store

629 Other Stores

63 Eating and Drinking Places

631 Restaurant

632 Bar, Beer Hall, Night Club

633 Coffee Shop Tea Kiosk

634 Driven in restaurant, Take Cut Restaurant: Dairy Bar.

64 Sales Rooms and Show Rooms

641 Automobile Showroom

642 Heavy Equipment Sales Room

643 Auction Rooms

644 Other Show Rooms

650 Petrol Stations

660 Open Markets, Barter Markets

7 TRANSPORTATION AND COMMUNICATION

71 Land Transportation

711 Railway Station R.O.W.

712 Railway Station

713 Railway Locomotive Sheds Repair Shops

714 Streets and Roads

715 Bus, Truck terminal

716 Taxi Stand

72 Water Transportation

721 Canals

722 Harbour Facilities

73 Air Transportation

731 Air fields, Control Towers

732 Air Terminals

733 Airplane Hangars

74 Radio, Telephone, Television

741 Microwave Tower, Radio Transmitter

742 Telephone Exchange

8 OFFICES AND PERSONAL SERVICES

800 Vacant Office Plot

801 Vacant Office Premises

81 Financial Offices

811 Bank

812 Laon Office Finance Company

813 Collection Agency

814 Stockbrokers Office

82 Other Offices (except Govt. Offices 910)
821 Insurance
822 Real Estate
823 Travel Agents, Shipping Agents, Ticket Offices
824 Detective Agency, Security Company
825 Commercial Schools (driving, secretarial, dancing, music etc)
826 Betting Shops
827 Auto Rental Agency
828 Other Offices
830 Embassy, High Commission Offices

84 Office Services
841 Stenographic Services
842 Blueprinting, Photo copying, Mimeographing
843 Office equipment Servicing
850 Indoor recreation and entertainment
851 Cinema, Theatre
852 Bowling Alley, Bingo Hall, Dance Hall
853 Private Club
854 Casino
860 Medical and Professional Services
861 Doctors Surgery
862 Dentist's Surgery
863 Optometrist
864 Vetenary Surgeon
865 Chiropodist
866 Lawyer
867 Architect, Town Planner (Private), Engineer
868 Accountant
869 Other Professional Consultants
870 Personal Services
871 Barber, Beauty Shop

872 Massage Parlour, Sauna
873

873 Gynasium Slimming Clinic

880 Other Services

881 Research Laboratory

882 Photographic Studio, Artists Studio

883 Broadcast Studio, Sound Recording Studio
Film Studio

884 Animal Kennels

885 Miscellanious Services

9 PUBLIC AND QUASI PUBLIC BUILDINGS

900 Vacant Public Buildings

910 Government Administration (General)

911 Legislative Assembly

912 Central Government Administration

913 East African Community Administration

914 Municipal Administration

915 County Council Administration

920 Government Agencies

921 Post Office

922 Police Station, Police Post

923 Court House

924 Prison

930 Education

931 Universities

932 Teacher Colleges, Polytechnics etc

933 Secondary Schools

934 Primary Schools

935 Nursery Schools

940 Health

941 General Hospital

942 Maternity Hospital

943 Mental Hospital

944 Health Centre

945 Dispensary

950 Military and Quasi Military Establishments

951 Kenya Army

952 Kenya Airforce

953 Kenya Navy

954 G.S.U.

955 N.Y.S.

960 Religious Establishments

961 Protestant Church

962 Roman Catholic Church

963 Other Christian Denominations

964 Mosque

965 Temple Hindu religion

966 Temple Buddhist

967 Synagogue

968 Other religious sects

969 Church Hall, Community Hall

970 National Monuments

971 Fort Jesus

972 Gede National Ruins

APPENDIX 4.1

PROJECT	LEVEL OF CENTRE	PROVINCE & DISTRICTS	APPROVED DEV. PLANS	AIR PHOTOS AVAIABLE	MAPS AVAIABLE
BUNGOMA	URBAN CENTRE.	WESTERN BUNGOMA	No. 6 126/61/3	1974	1974 - 1:10000 1:5000 1:2500
ELDORET	PRINCIPAL TOWN	RIFT VALLEY UASIN GISHU	No. 80 17/70/1	1973/03	1:50
GARISSA	URBAN CENTRE	NORTH EASTERN GARISSA	No. 2 326/69/3	1967/42 1973/60	1967 - 1:25 BEING MAPPED
KAKAMEGA	PRINCIPAL TOWN	WESTERN KAKAMEGA	No. 72 63/70/1	1966/22 1969/26 PARTLY	1968 - 1:5000 INACCURATE
✓KIAMBU	URBAN CENTRE	CENTRAL KIAMBU	No. 26 40/71/1	1966/1 REGION 1971/36 ✓	1966 - 1:5000
KISII	URBAN CENTRE	NYANZA KISII	No. 51 37/71/1	1969/65	1967 - 1:5000
KISUMU	PRINCIPAL TOWN	NYANZ KISUMU	No. 9/72/2	1972/45 REGION 1974/01	1970 - 1:5000 BEING MAPPED
KITALE	PRINCIPAL TOWN	RIFT VALLEY TRANS N	No. 91 10/72/7	1966/21 1974	1974 - 1:10.000
KITUI	URBAN CENTRE.	EASTERN KITUI	No. 35 29/66/1	1970/63 NORTH 1972/46 SOUTH	1972 - 1:2500
LIMURU	URBAN CENTRE	CENTRAL KIAMBU	No. 13 44/66/1	1969/30	1969 - 1:2500 INACCURATE
MALINDI	URBAN CENTRE	COAST KILIFI	No. 55/67/3	1969/43 1974	1974 - 1:2500
MERU	PRINCIPAL TOWN	EASTERN MERU	No. 27 167/68/2	1967/25	1967 - 1:5000 INACCURATE
MOMBASA	PRINCIPAL TOWN	COAST MOMBASA		1969/12 1:31000	1969 - 1:2500 BEING MAPPED

CHUKA	URBAN CENTRE	EASTERN MERU	NO 1. 350/69/1	1969
ELBURGON	RURAL CENTRE		"	1964
KILIFI	URBAN CENTRE	COAST KILIFI	NO 7 134/65/1	1961
LAMU	URBAN CENTRE	COAST LAMU		1960
LONDIANI	URBAN CENTRE	RIFT VALLEY KERICHO	NO 20 44/65/2	1970
MOLO	URBAN CENTRE	RIFT VALLEY NAKURU	NO 33 52/64/2	1962
NJORO	URBAN CENTRE	RIFT VALLEY NAKURU	No 25/63/1	NONE
NKUBU	URBAN CENTRE	EASTERN MERU	NO 1 349/69/1	1969
RUNYENJES	URBAN CENTRE	EASTERN EMBU	NO 1 354/69/1	1969
SOTIK	URBAN CENTRE	RIFT VALLEY KERICHO		1970
KWALE	URBAN CENTRE	COAST KWALE	NO 9 140/6/67/1A	1969
MAJENGO	URBAN CENTRE	WESTERN KAKAMEGA		1965
MARAGUA	URBAN CENTRE	CENTRAL MURANGA		1971
NANDI HILLS	URBAN CENTRE	RIFT VALLEY NANDI	106/65/1	1972
SAGANA	URBAN CENTRE	CENTRAL KIRINYAGA	No 5 222/71/1	1970
TALA	URBAN CENTRE			1971
[illegible]	URBAN CENTRE	RIFT VALLEY KAJIADO	NO 12 164/70/1	NONE

MARALAL	URBAN CENTRE	RIFT VALLEY SAMBURU	NO 5 205/72/2A	1970	1:5000 INACCURATE
MARIAKANI	URBAN CENTRE	COAST KILIFI	140/7/67/1	1967	
MARSABIT	URBAN CENTRE	EASTERN MARSABIT	NO 7 276/69/1	NONE	
MIGORI	URBAN CENTRE	NYANZA SOUTH NYANZA	NO 7 133/67/2	1975	1:2500 INACCURATE
NAROK	URBAN CENTRE	RIFT VALLEY NAROK	NO 163/66/1	1967	
SIAYA	URBAN CENTRE	NYANZA SIAYA	NO 6 NB/71/1	1975	NO - 1:2500 INACCURATE
BUTERE	URBAN CENTRE	WESTERN KAKAMEGA	NO 95/70/1	1966	
GILGIL	RURAL CENTRE	RIFT VALLEY NAKURU		NONE	
KAIMOSI	URBAN CENTRE	WESTERN KAKAMEGA		1974	BEING MAPPED
KAJIADO	URBAN CENTRE	RIFT VALLEY KAJIADO	NO 9 166/71/1	1970	1:2500 INACCURATE
KANGUNDO	URBAN CENTRE	EASTERN MACHACOS	301/69/1	1971	1:2500 INACCURATE
KHAYEGA	URBAN CENTRE	WESTERN KAKAMEGA		1975	1:2500 INACCURATE
KIMILILI	URBAN CENTRE	WESTERN BUNGOMA	NO 9 65/66/1	1971	1:2500 NOW
KIPKELION(I	RURAL CENTRE	RIFT VALLEY KERICHO	NO 31 45/70/1	1970	1:2500 INACCURATE

MARALAL	URBAN CENTRE	RIFT VALLEY SAMBURU	NO 5 308/72/2A	1970	1:5000 INACCURATE
MARIAKANI	URBAN CENTRE	COAST KILIFI	140/7/67/1	1967	
MARSABIT	URBAN CENTRE	EASTERN MARSABIT	NO 7 276/69/1	NONE	
MIGORI	URBAN CENTRE	NYANZA SOUTH NYANZA	NO 7 133/67/2	1975	1:2500 INACCURATE
NAROK	URBAN CENTRE	RIFT VALLEY NAROK	NO 163/66/1	1967	
SIAYA	URBAN CENTRE	NYANZA SIAYA	NO 6 NB/71/1	1975	1970 - 1:2500 INACCURATE
FUTERE	URBAN CENTRE	WESTERN KAKAMEGA	NO 95/70/1	1966	
GILGIL	RURAL CENTRE	RIFT VALLEY NAKURU		NONE	
KAIMOSI	URBAN CENTRE	WESTERN KAKAMEGA		1974	BEING MAPPED
KAJIADO	URBAN CENTRE	RIFT VALLEY KAJIADO	NO 9 166/71/1	1970	1:2500 INACCURATE
KANGUNDO	URBAN CENTRE	EASTERN MACHACOS	301/69/1	1971	1:2500 INACCURATE
KHAYEGA	URBAN CENTRE	WESTERN KAKAMEGA		1975	1:2500 INACCURATE
KIMILILI	URBAN CENTRE	WESTERN BUNGOMA	NO 9 65/66/1	1971	1:2500 NOW
KIPKELION	RURAL CENTRE	RIFT VALLEY KERICHO	NO 31 45/70/1	1970	1:2500 INACCURATE

MUHORONI	URBAN CENTRE			1973/61	1963 — 1:2500
MURANGA	URBAN CENTRE	CENTRAL MURANGA	No. 61 27/170/1	1973/22 1975	1:5000 BEING MAPPED
NAIVASHA	URBAN CENTRE	RIFT VALLEY NAKURU	No. 41 17/68/2	1967/21 1972/21	1974 — 1:10,000
NAKURU	PRINCIPAL TOWN	RIFT VALLEY NAKURU	No. 106 7/68/6	1975/01	1970 — 1:5000
NYAHURURU	URBAN CENTRE	CENTRAL NYANDARUA	No. 31 2/66/2	1966/26 1971/53 PARTLY	
NYERI	PRINCIPAL TOWN	CENTRAL NYERI	No. 56 6/68/3	1973/04	1961 — 1:2500 BEING MAPPED
OL-KALOU	URBAN CENTRE	CENTRAL NYANDARUA	No. 6 160/70/1	1967/40 PARTLY 1974	1974 — 1:10000
RUIRU	URBAN CENTRE	CENTRAL KIAMBU	No. 53/73/1	1969/67	1969 — 1:2500 INACCURATE
WAJIR	URBAN CENTRE	NORTH EASTERN WAJIR	No. 2 290/71/1	1970/76	1970 — 1:2500 INACCURATE
GITHUNGURI	URBAN CENTRE	CENTRAL KIAMBU	No 1 331/66/1	1970	1:2500 INACCURATE
KAPENGURIA	URBAN CENTRE	RIFT VALLEY WEST POKOT	No 2 130/69/1	1972	1:2500
KINANGO	URBAN CENTRE	COAST KWALE		1967	1969 — 1:2500 INACCURATE
LUANDA-MASI	URBAN CENTRE	WESTERN KAKAMEGA	W444/74/1	1970 LUANDA 1974 MASENO	1:2500 INACCURATE

BUSIA	URBAN CENTRE	WESTERN BUSIA	No. 62/65/1	1973/33 PARTLY	1973 — 1:2500
HOMA BAY	URBAN CENTRE	NYANZA SOUTH NYANZA	No. 27 162/66/1	1970/43	1:2500 INCOMPLETE
ISIOLO	URBAN CENTRE	EASTERN ISIOLO	No. 12 117/66/2	1975/106	1968 — 1:2500 BEING MAPPED
KAPSABET	URBAN CENTRE	RIFT VALLEY NANDI	No. 11 126/65/1	1972/17	
KERICHO	URBAN CENTRE	RIFT VALLEY KERICHO	No. 40 22/65/3	1968/15	1965 — 1:2500
KERUGOYA	URBAN CENTRE	CENTRAL KIRINYAGA	No. 4. 172/70/1	1965/25 1975	1965 — 1:2500 BEING MAPPED
NANYUKI	URBAN CENTRE	RIFT VALLEY LAIKIPIA	No. 52 54/66/2	1965/6 ROAD ONLY	
VOI	URBAN CENTRE	COAST TAITA	No. 22 TTA/P/69/64	1967/35	
ELIAMA RAVINE	URBAN CENTRE	RIFT VALLEY BARINGO	No. 10 1956	1971/50	— 1:2500
WUNLANYI	URBAN CENTRE	COAST TAITA	No. 2 TTA/P/69/66	1970/14	—

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SEWERAGE PROGRAMME - PLAN INFORMATION

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GLOSSARY

data - facts in their raw state, such as number of bakeries in a town, areas of recreational spaces

Information - Processed data available for usage, such as population structure of town

land use - the use to which a parcel or plot of land is put, unit for unit.

land use classification - categorization of land according to functional activities and utilization

land use coding - systematic means of recording land uses by indexes in line with a predetermined puppose such as industrial activity or economic activity

vertical air photos - taken by use of aircraft whose tilt angle is very nearly zero

oblique photos - photos taken by use of aircraft whose tilt angle is very large i.e. more than 3° to the vertical. The tilt may be cause by the aircraft or the photographer.

BIBLIOGRAPHY

1. Photogrammetria. Elsevier publishing company, Amsterdam: 1965/66 pp. 66-82; 1967 pp. 144-149, 153-159, 101-110 1971 pp. 71-92

2. Photogrammetric Engineering, Elsevier Publishing Company, Amsterdam: 1959 pp. 44-49, 523-533; 1963 pp. 146-148, 681-684; 1964 pp. 124-129; 984-990; 1970 pp. 449-459; 1965 pp. 294-307; 1971 pp.365-372, 379-388.

3. Morris Ml Thompson, Manual of Photogrammetry vol. 1 and 2 3rd Edition, American Society of Photogrammetry, 1966.

4. Francis H. Moffit, Photogrammetry, 2nd Edition, International Textbook Company, Pennsylvannia, 1967

5. Abrams, T, Essetintials of Aerial Surveying and Photo Interpretation. McGrain-Hill Book Company.

6. Abercrombie P., Town and Country Planning 3rd Edition, London, Oxford University Press, 1961.

7. Adams W.R. Modern Town and Country Planning. J. & A. Churchill 1952.

8. Keeble, L., Principles and practice of town and country planning, 4th Edition, Walker & Co. 1969.

9. Goodman, W.I. & Freund, E.C., Principles and Practice of Urban of Planning, Institute for training in municipal Administration, 4th Ed. 1968

10. Chapin, F.S., Urban land use Planning, 2nd Ed. 1972, University of Illinois Press.

11. Odingo, R.S. The Kenya Highlands, Land use and Agricultural Development. East African Publishing House, 1971

12. Andersen, K.B., African Traditional architecture; a study of the housing and settlement patterns of rural Kenya,School of

13. Haugum, K, A Survey of Building in rural Areas of Kenya, Embu Institute of Agriculture, 1972

14. Hooper, C., Design for climate, Guidelines for the design of low cost houses for the climates of Kenya. Housing research and Development, University of Nairobi, 1975

Bibliography (Cont'd):

15. National Atlas of Kenya, 3rd Edition 1970, Survey of Kenya

16. United Nations, Index to the International Standard Industrial Classification of AIL Economic Activities, Series M. No. 4,