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S. H. Jiwani.

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AGRICULTURAL DEVELOPMENT PLANNING AND PHYSICAL
ENVIRONMENTAL DATA IN UGANDA

Note: Rural Development Research papers are written as a basis for discussion in the Makerere Rural Development Research Seminar. They are not publications and are subject to revision.

The Purpose of this paper is to attempt to describe and analyse the present environmental data in Uganda. For Agricultural development planning the need for environmental knowledge, is of prime necessity. Failure to consider this aspect has lead to drastic failures of several major projects in East Africa. The paper reviews the existing knowledge available for agricultural planning, with particular reference to Uganda.

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INTRODUCTION:

Uganda lies astride the Equator on the East African Plateau, most of the land being between 2,000 to 5,000 ft. above sea level. The total area enclosed within the borders of Uganda is 91,134 sq. miles consisting of 74,748 sq. miles of land and 16,386 sq. miles of Lake Victoria, 43% of the total area of the lake.

/respective
rift system
along which
more recent/

Geologically, Uganda consists of a plain 300 to 400 miles wide confined between the eastern and western rift systems which traverse East Africa from North to South. The southern part of the plain is in the form of a shallow basin, which contains Lake Victoria and its surrounding water-sheds. North of the Lake Victoria basin a similar basin contains the Kyoga complex of lakes. To the east and west the plain rises towards the edges of the volcanic activity has produced mountain features of which Mt. Elgon to the East and the Rwenzori Mts in the south-west are the greatest. The Acholi Plain, in the Eastern Region is flat, while West of the Acholi Plain, the country drops into the Western Rift Valley containing lake Albert and the Albert Nile.

With high mountain masses, extensive lake systems and considerable rainfall - Uganda has a varied topography and is well favoured with sources of water. Practically the whole of the country lies within the Lake Victoria/Nile River drainage system. Lake Victoria is an enormous reservoir and together with the Nile itself, the Kyoga complex, Lakes Albert, Edward and George, the Koki lakes and the lakes of Kigezi are all potential sources of supply for water, as well as several perennial rivers.

Practically all farming in Uganda is at present dependent solely on rainfall and over large areas farming patterns are predominantly affected by the pattern of rainfall. Efforts to develop agriculture are likely to be successful if the natural environment is suitable. This means that farming must be properly adjusted to ecological conditions - the characteristics of soils and climate, including the range of temperature and rainfall, and the pattern and reliability of the rainfall. Agricultural research and experimentation should be adapted to the physical variations in natural conditions.

There is no doubt that over time much information on Uganda's natural environment - soils, climate, vegetation, water-resources, topography, etc., has been collected and used for development programmes. It is important that no development programme may be launched without a knowledge of the relevant natural conditions. Unfortunately there have been and continue to be quite a few cases where success has been prejudiced by a failure to keep this in mind. The well known "ground-nut scheme" in Tanzania failed in part owing to inadequate knowledge of soils and rainfall. Even in recent years important schemes have been launched with little more information.¹ The impatience to begin projects, often politically inspired, and the failure of those who finance them to understand the importance of adequate data on soils, climate, and similar factors have contributed to the recurrence of such cases. In Kenya the small irrigation schemes had also suffered to some extent from the failure to gather in advance all the relevant information. The Mwea-Tebere scheme, dictated by the availability of people from prison labour camps to do the necessary work. The soil in the area posed difficult and unresolved problems of irrigation - though the mistake was corrected before the project produced a serious misinvestment. The Perkerra basin irrigation scheme was over hasty. The employment of inappropriate irrigation duty on a type of soil which proved difficult to drain produced a heavy infestation of nut grass (*Cyperus rotundus*) which made a little over a fifth of the area useless. There are many cases where attempts to modernize agriculture, involving heavy expenditures, are being started with little or no prior study of important variations in soils and micro-climate which may significantly affect the outcome. In a number of cases, insufficient knowledge of significant local variations in the amount and pattern of rainfall have produced generalized recommendations on sowing dates, etc. with the risk of generating lack of confidence in the agricultural extension service.

In Kenya the failure of attempts to deal with the problems of some of the drier areas can be explained by the lack of information on the relationship of the population and its livestock to its natural environment. In Baringo District, for example, there was reason to believe that the constant difficulty with attempts to control grazing and livestock numbers stemmed basically from over

population and the inability of the grazing areas to support the minimum livestock numbers the people needed for their livelihood. The information that was available, however, could not be clearly related to defined ecological areas.

II CLIMATIC DATA:

Plant population in any area is the expression of the environment. A particular plant specie may exist there because of climate - temperature, rainfall, humidity, sunshine, soil depth etc. The ultimate success of most crop introductions depends upon a more complete understanding of plant's relationship with the environment. E.W. Russell² maintains that low yields in equatorial and tropical regions are low not mainly because of lack of plant nutrients in soils but because of lack of understanding of the inter-action of climate with crop growth. Understanding the climate is difficult without reliable climatic data.

The measurement of climate in Uganda is primarily the responsibility of the East African Meteorological Department (E.A.M.D.). The activities of this Department, apart from aviation forecasting, are in collecting data of specific use to agricultural meteorologists through the cooperative efforts of Agricultural Research Stations, and Farm Institutes (see Map 1 ~~and Table 1~~ for the coverage of E.A.M.D. "Penman" stations in Uganda).

A full range of agriculturally and Hydrologically important meteorological observations in areas of potential development projects have been taken by the staff of the Water Development Department, Uganda (previously the Hydrological Survey Department, before 1956), and the Agricultural Department in cooperation with the Cotton Research Station, Namulonge³ (see map 2 for the hydro-meteorological stations in Uganda).

Coverage of climatic data is better than in many African Countries, with one first grade* and twelve second grade stations having reliable rainfall records extending over thirty years, and as many as three hundred and ninety ordinary rainfall, 'Agpo-meteorological Station'.

* Grades of stations are not related to the number of recording instruments but to the frequency of record taking. /4

The hydro-meteorological stations shown on the map are owned and controlled by many different organizations. Some of the stations have been only recently opened; the commencement of data collection did not begin before 1959 and the data are not of long enough duration to be very useful for development. However, the quantity of the primary data collected and recorded is as good as any.

A station has recently been expanded at Kibanda and a further station will shortly be opened at Kassolwe in Busoga District. There are some gaps in the coverage and it is hoped that the sites at Serere, Bugusege, Busia, Kabale and Arua can be up-graded. A new site should be established in Mubende and in Northern Karamoja

For accurate planning, rainfall data should be available extending over thirty years, and for evaporation and temperatures data extending over at least ten years should be available. Long and reliable records are particularly important for information on distribution, frequency, intensity and reliability of the climate of an area. Worthington (1946)⁴ stated that rainfall stations should be at five mile intervals throughout Uganda in densely populated areas and ten miles apart in more sparsely populated areas. Woodhead (1966?), on the other hand, stated that a good station can cover about four hundred miles (20x20 miles), provided there is no variation in topography. It is emphasized that a long run of records and detailed consideration of the characteristics of the crops to be grown is necessary for a final assessment of agricultural potential.

The number of stations would have to be doubled to meet Worthington's statement on the required density of stations. Supervision and frequency of recording would also have to be strengthened. "The Ten Commandments for Meteorological Observers", circulated from Namulonge, in May 1966, by D.A. Rijks should be strictly observed by each station. It is very difficult to check whether enumerators have been putting down correct recordings at given times especially in remote areas. It could be investigated if in future more stations could be sited near police stations, post-offices, air-fields etc., and if their cooperation could be obtained, voluntarily or otherwise, in supervising enumerators or helping as recorders.

Namulonge⁵ has developed a method for calculating confidence limits of expected rainfall. A computer programme is being initiated to calculate these limits for a selected number of stations. The cost of using a computer in this way is about 10/- per station, per year of data. Instead of publishing raw figures of climate, it may be more useful for different purposes to have records published in the form of confidence limits, charts, graphs etc. so as to give a clear picture of climate on a glance. It should be investigated whether more use could be made of computers produce and assess climatic records not only for Uganda but for East Africa as a whole.

At present the main factor inhibiting the expansion of the E.A.M.D. is finance. In future if more finance is available a finer network of stations with more useable data would be available from the Department. It is worthy of note that facilities now exist in East Africa for the training of enumerators and Meteorologists of all grades - which very few countries in Africa have. A Chair of Meteorology was created at the University College, Nairobi, by the World Meteorological Organization for professional Meteorological class I training. Manpower, therefore, need not be a limiting factor compared to the awareness of the importance of improved standards of climate data for agricultural planning purposes.

III Irrigation and Water Development Surveys:

An economist and an engineer working for Sir William Halcrow and Partners⁶ carried out a feasibility survey of irrigation in Uganda in 1964 with three main objectives:

- (1) "To carry out a feasibility survey of the irrigation potential in Uganda with reference to areas where soil and water conditions are favourable for irrigation and where irrigated agriculture is likely to prove economical bearing in mind world and internal market prospects";
- (2) "To recommend areas for the establishment of five or more pilot irrigation schemes, each of approximately one thousand acres".
- (3) "To give general details of the engineering requirements etc. and various cropping patterns and sizes of holdings on which the irrigation layout and farming economy could be based".

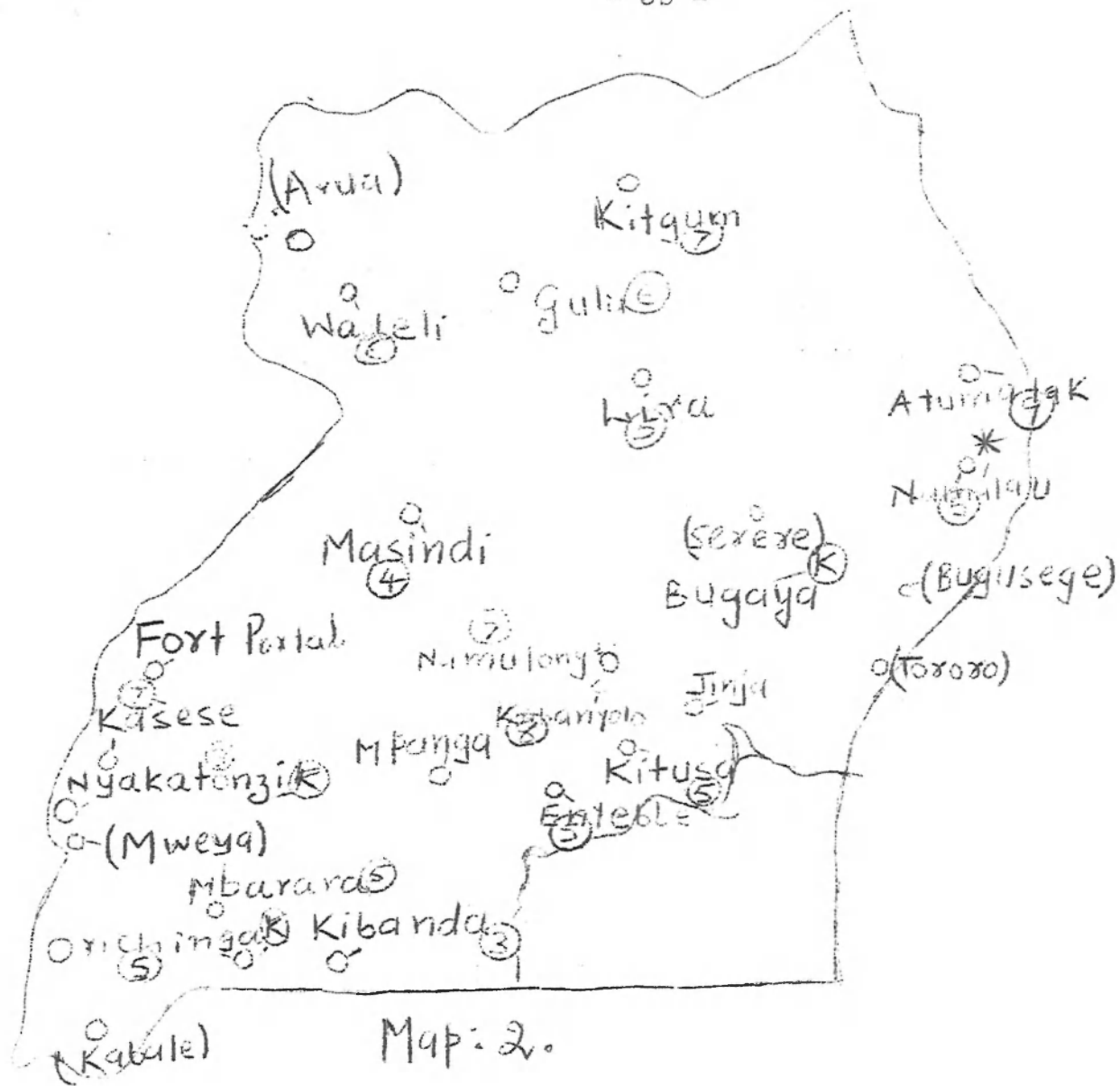


Map 1. Coverage of E.A.M.D., Main fully equipped stations in Uganda. (with number of years of records available - indicated in the brackets).

Key:

- 7 First grade - 24 hours observation:
- 60 Second grade 18 hours observation
- 8 Second grade 12 hours observation
- / / / 2 hours observation
- * Second grade hours of observation not available

Source: Annual Reports and Met. Office, Kampala.



Coverage of Hydro-Meteorological Stations in Uganda. Stations not yet fully instrumented are indicated in brackets.

Key:

- * Observatory trouble.
- (K) Closed down
- (1) No of years of records

The results of the survey were reported. It was found out that:

- (a) irrigation is feasible in many areas in Uganda;
- (b) water is available and can readily be applied over wide areas where soils and climatic conditions indicate good agricultural potential;
- (c) potential irrigation land in Uganda was estimated at nearly half a million acres, i.e. with suitable soils, reasonable accessibility to sources of water but with crop moisture deficits;
- (d) in much of Uganda, a deficiency in the moisture available at critical periods for plant growth is a major factor inhibiting farm investment and agricultural development;
- (e) under irrigation, crop yields can be greatly improved and thus there is every prospect of the cost of irrigation being more than offset by the value of the extra product even though Government is unlikely to realize a direct recovery of its outlays;
- (f) valuable experience has been gained in irrigation trials in the Western Region, that there is urgent need for further trials in other areas.

Establishment of four Pilot Irrigation Projects was recommended in the Report. In order to cover the wide range of possible types of development, the following pilot projects were recommended:

- (i) Okokoria - A typical settled area
- (ii) Atera - An occupied area suitable for surface irrigation.
- (iii) Labori - A group farm
- (iv) Omunyal - A typical swamp valley

The capital cost of this immediate programme was estimated to be U£170,000 of which some U£60,000 would represent machinery and equipment.

It was also recommended that soil surveys should be carried out and that the amplification and extension of hydrological and meteorological data be carried out.

The first survey in Uganda of the possibilities of swamp reclamation and irrigation was carried out in 1954 by Sir Alexander Gibb and Partners. This investigation was confined to selected localities. This report was published in 1955, which included recommendations for the development of some 110,000 acres of land under irrigation and a further 225,000 acres of Swamp reclamation. Some swamp reclamation work was started in Kigezi district, and one of their recommendations for irrigation has been implemented in the Mubuku Pilot Irrigation Project in Toro.

In the Nyakabouzi Pilot Irrigation scheme, a furrow was constructed from the Kanyampara River to carry water from the foot hills of the Ruwenzori Mountains into the plains, north of Lake Edward. This water was basically for the cotton growers who had settled temporarily in the area. It also became the irrigation supply to the Nyakabouzi Pilot Irrigation scheme which was established in 1958. Irrigation trials on 10 acres began in 1958, 1959 and were continued until 1962.

Between 1956 and 1959 Messrs. Muljibhai Madhvani carried out trials with irrigation on their sugar estates at Kakira (South Busoga) some 50 acres of land was irrigated. This was extended over most of the sugar estate recently.

In 1959 a 10 acre irrigation plot was opened in the Orichinga Valley in Ankole (Isingiro District). But the future potential for development of this valley is limited by land availability. In 1960, a five acre pilot project for irrigation research in the Namalu settlement area (Karamoja) was established. A detailed survey of 650 acres was carried out for general settlement. Little has been achieved out by 1964 a few rows of coffee were being irrigated periodically.

The Mubuku Project in 1961, consisting of a five-acre experimental plot was provided with water from the Sebwe River. This experiment is still operating and has provided valuable information. Further north a pilot project of a thousand acres drawing irrigation water from the Mubuku has now started as a UN Special Fund Operation under FAO and UDC direction. The full development of this project is planned to cover some 12,000 acres with cotton as a principal crop.

Thus in the past ten to fifteen years important experience and knowledge has been acquired. But the experience is not adequate to predict the potential benefits from irrigation in Eastern and Northern Regions, as there are important differences between these and Western Regions. More projects should be tried in the Eastern region to find out the feasibility of irrigation in the region (see Appendix C for a summary of Irrigable Areas in Uganda).

Most of the crops which are at present grown in Uganda could be grown at higher levels of productivity under irrigation. This has been demonstrated in Western Region and whilst the physical conditions differ in other parts of the country, there is reason to suppose that with a more clearly defined dry season, slightly higher temperatures and greater evaporation further north, existing crops would benefit to a greater degree from irrigation.

In most of the areas - considered for irrigation, cotton is the major cash crop, but an extension of the cropping seasons with irrigation would enable other crops such as ground nuts and onions to be produced as cash crops. In the cropping systems considered (except in the case of sugar cane) food crops appropriate to particular localities in rotation with the cash crops have been included.

IV Soils, Vegetation and Land Use

1. Land-use Planning:

Land use planning may be defined as the planning of land and water resources aiming at helping the farmer to produce more food and more money from his land, at the same time maintaining and, possibly, improving the lands' fertility. It is becoming particularly important in developing countries where uses of resources become more competitive and also where there is the possibility of attracting larger sums of money from outside sources for suitable agricultural development. The aim of extending and improving the exploitation of land resources by raising output can be rapidly attained by greater effort on the planning of development. An attempt should not be made to develop land without first assessing resources or else the failure of the project or impoverishment of natural resources may result. So the problem is how one sets about deciding

whereabouts in a large area of a country the natural conditions as climate, soils, vegetation, most favourable for an intensification of the existing agriculture or for introduction of new systems⁷.

For planned development of an extensive area the following sequence of surveys and mapping could be carried out.

- (i) Topographic mapping with general coverage on scales of 1:500,000, 1:125,000, 1:50,000 and in some special areas at 1:25,000, 1:5,000 or 1:2,500. Topographic mapping covers Uganda fairly well at the above scales.
- (ii) The second phase consists of reconnaissance surveys, mapping at 1:500,000 and 1:250,000 scales. The duration of this type of survey depends upon the area and the details to be covered. Aerial photographs can be useful. The potential land use of each land system is assessed in broad terms such as "suitability for cultivation, for grazing, for irrigation etc".
- (iii) Detailed reconnaissance surveys; these are based on the Reconnaissance Surveys, the more promising areas being surveyed further for details. Land is classified according to soil characteristics, climate, vegetation etc.
- (iv) Development and Implementation: other factors economic, social, political may have to be considered in making plans for specific areas. Uses may be found by the planning authority for detailed mapping from 1:10,000 to 1:5,000 and even to 1" to 200 ft.

To assess the value of surveys undertaken by land planning officers in terms of subsequent actual development is rather difficult.

2. Soil Surveys and Available Knowledge on Soils in Uganda

The reconnaissance soil and land use surveys of Uganda are systematic surveys of the whole of Uganda which were initiated in 1956, as a result of the recommendations of the Agricultural Productivity Committee (1954), within the five-Year (1956-1960) Capital Development Plan. The purposes of the surveys were to identify the difficult soils of the

districts and to record their distribution on maps, with the object of assessing their present and potential productivity. Field mapping was conducted on a scale of 1:250,000. To achieve the required rate of mapping it was necessary to confine most activities to road traverses rather than employ the more time consuming method of grid traverses. Details of profile morphology and soil distribution were obtained by digging soil inspection pits and augering. Use was also made of any available section that could be examined in road cuttings murrum pits or natural exposures in river channels etc. Information was thus collected about conditions of both topsoil and subsoil and of their relationship to the underlying rock. The map depicts soil units of different kinds, ranging from approximate series to cayenas and complexes - but in a wider sense they are all natural land units and can be used as guides to the assessment of soil productivity and land use. However for agricultural planning purpose, additional fertilizer, crop rotation trials are required before the information can be considered adequately.

Base maps used for the survey were the 1:250,000 district sheets. After plotting the field data interpolation was aided by the use of air photographs and print lay downs. Air photographs enabled a much quicker rate of mapping to be achieved and a more accurate delineation of certain boundaries than would have been possible by field methods alone. To produce maps on this scale smaller areas of localized soil types had to be ignored. Black and white maps were initially prepared to be followed by coloured maps. The soil maps are able to serve as a basis for present and potential landuse planning and agricultural development in Uganda.

A series of Research memoirs⁸⁻¹² published the results of the soil surveys carried out under the Department of Agriculture mainly by Radwinski and Harrop (1960) and Ollier and J.G. Wilson (1959). The soils of Karamoja District, of the same area.

Before this soil survey, very little information was available on the subject. The only important work done was on the nineteen soil surveys done in small agricultural areas in Uganda.¹³ Typical agricultural communities were selected from the whole country with a view to finding out the extent of soil deterioration. The report was not detailed

enough to give information on average conditions of Mutala in each district, but it was for a long time an important document for agricultural planning (see Appendix A for total fertilizer utilized in Uganda).

Soil maps have been published on a scale of 1:250,000. Except for Masindi, Mbale and Jinja areas, the whole of Uganda is mapped. At present, work is being done on the Masindi soils map in the same series. The soil map of Uganda in the Uganda Atlas was also compiled from the reconnaissance Survey according to classification devised for the 1:5,000,000 soils map of Africa by D'Hoore (1961). Mapping units were distinguished in the field by their morphological characteristics, i.e. colour, texture, parent material and depth.

3. Ecological Surveys:

Land use planning becomes risky without knowledge on vegetation and ecological conditions. It is by studying different crops in the various regions that policies more intensive systems of agriculture can be drawn up. Detailed planning of more intensive systems of agriculture will have to await for more detailed land use surveys. Without ecological surveys it becomes more difficult to interpret the agricultural potential of any area. Ecology can be defined as the study of organisms and their environment. It is inter-disciplinary in nature. Essentially it is concerned with populations of organisms and the processes which make for their stability, increase, decrease, or replacement by other populations. Ecological surveys have a broad basis. They provide information for a wide variety of applications but are especially valuable in fields concerned with the management of populations. The value of ecological surveys can best be appreciated from examples of their use in various fields. They have been of value in delineating areas where research or development is unlikely to be profitable and for channelling limited funds for research and development to the best areas. The fields of range management, forestry, conservation, and water-shed management are all examples of applied ecology.

II. The cost of modern land surveys can be reduced greatly by interpreting from aerial photographs. This involves the establishment of a correlation between patterns on the

aerial photographs and ground features. As the patterns on aerial photographs are dependent on the integration of all kind features (geology, topography, soils, vegetation, drainage pattern etc.). They can be properly understood only in terms of all these factors.

The main work dealing with the vegetation of Uganda is the Grass Communities and Mountain Vegetation of Uganda by Snowden (1953). In all, 36 types are distinguished. Their dominant species, physiognomy and environments are discussed. The distributions of 28 of these thpes are shown on 9 maps at a scale of 1:2 million.

The other map showing the distribution of plant communities in Uganda is Shantz (1923) Vegetation map of Africa. Scale: (1:10 million). The map is essentially a compilation of previous data revised according to his observation on a journey from Cape Town to Cairo. His classification is useful and his conclusions on the land use potential of each of the types are pertinent, but the actual delimitation of the types on the map is inaccurate.

The A.E.T.F.A.T. Vegetation map of Africa south of the tropics of Cancer¹⁵ is another compilation but it is based on rather more data than the previous one. The map is on the same scale as Shantz and may be regarded as a revision of it. The only value of this map is for making broad comparisons between the vegetation of the differnt parts of Africa.

The main source of information on vegetation of Uganda is available from the ecological survey carried out in Uganda from 1959 to 1962 by the Uganda Department of Agriculture. It was designed as an aid to the development of Uganda's Agriculture. Detailed accounts of the surveys of different parts of the country have been published in the Research Memoirs series 2 (vegetation)¹⁶⁻²² and other works cited in bibliography of this paper. Several maps are also available - which are compiled from the survey and from the imformation available from the Annual Reports of the Department of Agriculture, 1955 to 1961; i.e. The Systems of Agriculture practised in Uganda (Parsons 1960), A subsistence crop Geography of Uganda, (McMaster 1962), and the map showing Forest Reserves in the Atlas of Uganda. Prior to this survey there was very little written on the topic - except by A.S. Thomas (1943), who covered soil, climate, topography and ethnography as well as the vegetation

of each district.²³

Owing to the meagre records of rainfall in Karamoja district, a probable Rainfall map has been drawn up by J.G. Wilson based on the existing vegetation cover.

The objects and applications of the Ecological surveys are several:

- (a) It surveys the existing botanical resources.
- (b) It assesses in general the agricultural and pastoral potential which is dependent on the physiological environment.
- (c) The survey could be used as a yard-stick for the measurement and evaluation of future changes in the vegetation of Uganda.
- (d) It could also be used as basis for future Agro-ecological research and as a background for work on related biological phenomena, e.g. work on the distribution of insect pests and disease vectors.
- (e) It could provide the framework for the future collection and correlation of agricultural, demographic and social data.

The field work was carried out in stages from June 1957 to November, 1959. Observations were made on both sides of traverse lines which were routed along roads, motorable tracks and footpaths. The distances between apparent changes in the vegetation were noted, together with details of the salient features of the plant communities: species present, their cover abundance, physiognomy (with height and percentage aerial cover of the different strata), soil type, topography and drainage conditions. Notes were made of any features thought to bear on successional relationships and some stands were visited at different times of the year to assess seasonal variations. Observations were also made of the present land use and the density of cultivation.

TABLE III Traverse Density: Vegetation Survey of Uganda

Region	Length of Traverse (miles)	Mapped area (Sq. miles)	Area/Mile of Traverse 1 sq. miles
Eastern Province	2,550	11,000	4.3
Buganda	2,544	16,247	6.3
Northern Province (Excluding Karamoja)	2,228	20,638	9.3
Western Province	2,818	15,895	5.6
TOTAL	10,140	63,780	6.3

Mapping:

The communities distinguished in each area were plotted according to the traverse data on a transparent overlay over a 1:250,000 base map. This resulted in a skeleton map showing the distribution of plant communities close to the traverse lines, with blank spaces between traverse lines. More precise delineation of the boundaries and data on the distributions of communities between traverse lines were obtained by air photo interpretation and reference to physical details on the base map.

Two types of air-photo were used 1:30,000 verticals and 1:125,000 print lay-downs (rough mosaics prepared from the 1:30,000 verticals). The original vegetation maps were drawn on the scale 1:250,000. A preliminary edition was produced in blank and white on the scale 1:500,000 (8 miles to an inch). A second edition was produced shortly afterwards, colour print over the new 1:250,000 standard.

Vegetation Maps:

(a) There are as follows:

1:500,000: Uganda vegetation. A wall map in four sections; published in 1964; multi-coloured; size 47x50 ins.

1:250,000: Uganda vegetation series: Multi-coloured maps showing **Vegetation Communities** size 26x17½ ins
 Maps have been published for Mbarara, Masaka and Kampala. The rest are to appear shortly.

(b) Land use map:

1:1,000,000 (16 miles to 1.014") published in the book The Vegetation of Uganda by Langdale-Brown, Osmaston and Wilson. This map attempts to show the type of land use practised in different areas at the time of the survey and by inference it indicates the abundance or sparsity of the vegetation. It can be used to compare land usage with the distribution of the vegetation types and so to gauge the present productivity of areas of the different vegetation types.

(c) Ecological Zones Map:

Scale, 1:1,500,000. The map divides the country into 21 ecological zones. It is one of five maps which accompany the book The Vegetation of Uganda.

(d) Range Resources Map:

Another map accompanying the book mentioned above, it is based on the 1961 stock census. It indicates the distribution of livestock throughout the country. There are no reliable figures for the populations of the different wild animals; the main occurrences of the various game animals are therefore indicated by name.

Both the domestic and the game animals of Uganda are dependent on unimproved range land grazing. The semi-natural communities that make up this resource are therefore of considerable economic importance and since the distribution of domestic livestock, game and range types are inter related they are shown together on a single map*

(e) Cultivation Density

On a scale of 1:500,000; surveyed and compiled by Langdale-Brown and drawn by the Lands and Surveys Department. The map distinguished three types of cultivation density

- (i) Heavy, in which more than $\frac{1}{3}$ of the area is cultivated.
- (ii) Light cultivation - up to $\frac{1}{3}$ cultivated.
- (iii) Virtually no cultivation.

The proportion of land under cultivation varies from place to place. There is very little unmanaged land in areas shown as

* This list of maps is by no means complete. All of the maps in references 9-12, 16-24, 24, are not (i.e. see Appendix c) included here.

"heavy" cultivation. Any major increase in crop production in these areas would therefore require an intensification of the farming. On the other hand, the mapping suggests, there is sufficient unused land in the lightly cultivated area ~~area~~ under the established systems of land rotation. It should be noted that the proportion of cultivable land is lower in the latter areas chiefly owing to lower, more intense and more erratic rainfall, and soils of low water-holding capacity.

The maps are in demand not only by agricultural extension and teaching staff but also by private companies concerned with water, electricity, banks, land agents and cooperative organisations, and for purposes of local Government and general education and research. Policies for increased food production, soil conservation, movement of population, diversification of crops or opening up new grazing grounds may call environmental maps. Again, for the rational use of fertilizers and for the introduction of new crops, uses of environmental maps and especially of soil maps are necessary.

In developing countries the soil surveyor should lead, instead of follow after, when major readjustments of land use have become urgent.³⁷

V Conclusions:

A long run of adequate and reliable records (in detail) of physical environmental data should be made available before initiating expensive projects for agricultural development.

The coverage of environmental data in Uganda is better than in many other African countries. Recently, more new climatic stations have been built. The recording of Hydro-Meteorological data, which has commenced recently, will be of great value for future development. There are some gaps in the coverage which can be filled by upgrading present sites. The number of stations should be increased to meet Worthington's statement on the required density of stations. Supervision and frequency of recording should also be strengthened. Alternative ways of supervising enumerators, especially in the remote areas, should be investigated - as discussed under Section II of this paper.

Important experience and knowledge has been acquired in potential irrigation areas, especially in Western Uganda. Little has been done in other areas. Priority should be given to the Eastern region to find out the feasibility of irrigation in that region.

A SUMMARY

THE UNIVERSITY OF CALIFORNIA, BERKELEY

A research laboratory, adequately staffed and equipped to look into the basic problems of the factors in the natural environment that influence agricultural production may be established. This could help a great deal in assessing various projects within the framework of future development plans.

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APPENDIX A

Total Fertilizer Utilized in Uganda, 1967*

Fertilizer	Metric tons
Sulphate of Ammonia:	4900
Nitrogen:	3000
Phosphate	1000
Potash	1500
Others	6700
Super Phosphate **	3000
Exports	
(1967) Phosphates	16,900

It is difficult to say how much fertilizer is used in Uganda. But rough figures can be obtained from the export and import figures as well as figures from the firms distributing fertilizers in Uganda.

The Agriculture Department, has not yet decided exactly on the use of fertilizers to be recommended to the peasant farms in Uganda. Various trials are being carried and throughout Uganda and possibly by 1969, some firm recommendations for peasant farmers will be available. From the above figures, it appears that very little fertilizer is being used in Uganda.

* Based on Import Figures.

** Home product consumed mainly on estates source:
verbal communication, Mr. Foster, Kawanda Research Station,
Department of Agriculture, Uganda.

APPENDIX B

Summary of Gross Irrigable Areas in Uganda

District	Crop areas (acres)				Vegetation
	Rice	Cotton	Sugar	Horticulture	
Ankole	2,250	-	12,000	50	Imperata and Themeda Savanna
Kigezi				500	Swamps and Swamp Forests
Toro		5,990		710	Imperata and Themeda Savanna
Bugushu	1,550	17,610		50	Compound leaf tree Savanna
Bukedi	4,840			500	Echinochloa Aquatic Grassland
Busoga			26,800		Cyperus Papyrus Swamp.
Teso	11,000			200	Echinochloa Aquatic Grassland
Acholi	540			380	Compound-leaf tree Savanna
Lango	9,950			200	Aquatic Grassland and Grass Savanna
West Nile	9,500		11,000	200	Mostly Aquatic Grassland
Mengo	3,460			200	Various
TOTAL	33,590	23,600	49,800	3,240	

Total Irrigable Area = 110,230 or 172 Sq. Miles

Source:

Gibb, Sir Alexander and Partners: Water Resources Survey of Uganda, 1954 - 55, Applied to Irrigation and Swamp Reclamation.

APPENDIX C

A list of climatic maps and figures²²

In the system of Agriculture Practised in Uganda six maps appear. They are Annual Rainfall of Uganda (scale 1:2 m); Rainy Days, average of 10 years (scale 1:2m); Relative Humidity at 12 G.M.T, Annual Mean of 1957; Map of Annual Average Temperature, 1957; Map of Maximum Temperature 1957; and Degree of Wetness during three driest months.

Accompanied by the maps are also Figures for

- (i) Rainfall patterns,
- (ii) Teso-Uganda, Average annual Rainfall and
- (iii) Teso district average rainfall from January to December.

R E F E R E N C E S

1. John C. de wilde, et al., (1967), Experiences with Agricultural Development in Tropical Africa, Vol.I.
2. Russell, E.W. (1967), The climate and crop yields in the Tropics, Empire Cotton Growing Review 44.
3. Rijks, D.A. and Owen, W.G. (1965), Hydro-Meteorological Records from Areas of Potential Agricultural Development in Uganda, Ministry of Mineral and Water Resources, Uganda.
4. Worthington, E.B. (1946), A Development Plan for Uganda, p.15.
5. Third Specialist Meeting in Applied Meteorology, November, 1965, Muguga; The use of machine methods for the processing of storage of Meteorological Data (mimeo)
6. Sir William Halcrow and Partners (1964), Report on the Feasibility of Irrigation in Uganda, Ministry of Overseas Development, United Kingdom.
7. Department of Technical Co-operation, 1962, Report of a Technical Conference of Directors of Agriculture and Senior Officers in Overseas Departments of Agriculture and Agricultural Institutions, held at Wye College, Kent, Misc. No.2.
8. Radwanski, S.A. (1959), A Reconnaissance Survey of the Soils of the Northern Province, (Excluding Karamoja) Uganda Department of Agriculture, Research Memoirs, series 1 No.3.
9. Radwinski, S.A. (1960), A Reconnaissance Survey of the Soils and Land use of Buganda, Uganda Department of Agriculture, Research Memoirs Series 1, No.4.
10. Harrop, J.F. (1960) A Reconnaissance Survey of the Soils of the Western Province of Uganda, Uganda Department of Agriculture, Research Memoirs, Series 1 No.6.
11. Ollier, C.D. and Harrop J.F. (1959), A Reconnaissance Survey of the Soils of the Eastern Province of Uganda, Uganda Department of Agriculture Research Memoirs Series 1, No.2.
12. Wilson, J.G. (1959), The Soils of Karamoja District, Northern Province of Uganda, Uganda Department of Agriculture, Research Memoirs, series 1 No.5.
13. Tothill, J.D. (1938), A Report on the 19 Surveys done in small Agricultural Areas in Uganda. Uganda Department of Agriculture.
14. Shantz, H.L. and Marbut, C.F. (1923), The Vegetation and Soils of Africa, American Geographical Society, Ref. Series 13

15. Auberville, A., et al, (1958), Vegetation Map of Africa South of the Tropic of Cancer. Oxford University Press.
16. Langdale-Brown, I. (1957), An Ecological Survey of the Vegetation of the North Mengo Low lands, Uganda; Ph.D. Thesis, University of St. Andrews.
17. (1959 a), The Vegetation of the Eastern Province of Uganda, Uganda Department of Agriculture Research Memoirs Series 2 No.1.
18. (1959 b), The Vegetation of Buganda, Uganda Department of Agriculture, Research Memoirs, Series 2, No.2.
19. (1960 a), The Vegetation of the West Nile, Acholi and Lango Districts of the Northern Province of Uganda, Uganda Department of Agriculture, Research Memoirs, Series 2 No.2.
20. (1960 b), The Vegetation of the Western Province of Uganda, Uganda Research Memoirs, Series 2 No.4.
21. (1960), The Vegetation of Uganda, Uganda Research Memoirs, Series 2, No.6.
22. Parson, D.J. (1960), The Systems of Agriculture practised in Uganda, Department of Agriculture, Series 3.
23. Thomas, A.S. (1943), The Vegetation of the Karamoja District, Uganda Journal of Ecology, 31, 149-177.
24. Milne, G. (1940), Some Aspects of Modern Practice in Soil Survey. East African Agricultural Journal May 1940.

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