

MINISTRY OF OVERSEAS DEVELOPMENT



ASSISTANCE TO DEVELOPING COUNTRIES: PLANNING THE USE OF LAND RESOURCES

A guide to the work of the Land Resources Division
of the Directorate of Overseas Surveys

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THE LAND RESOURCES DIVISION
OF THE
DIRECTORATE OF OVERSEAS SURVEYS



The Directorate of Overseas Surveys, part of the Ministry of Overseas Development, assists developing countries in the fields of land survey, air photography, mapping and the investigation of land resources.

The Land Resources Division assesses land resources, and makes recommendations on the use of these resources for the development of agriculture, livestock husbandry and forestry; it also gives advice on related subjects to overseas governments and organisations, makes scientific personnel available for appointment abroad and provides lectures and training courses in the basic techniques of resource appraisal.

The Division endeavours to work in close co-operation with government departments, research institutes, universities and international organisations concerned with land resource assessment and development planning.

This leaflet describes the aims and work of the Land Resources Division.

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PLANNING THE USE OF LAND RESOURCES

In most developing countries there is an urgent need to extend and improve the exploitation of land resources: that is, to obtain the maximum output of crops, livestock and timber and at the same time to ensure that the productive capacity of the land is augmented rather than depleted. This objective can be rapidly attained only by a concentration of effort on the planning of development and on the implementation of the plans.

Resource Assessment and Development Planning

To attempt to develop land without first assessing resources and planning their development is to invite economic failure and permanent impoverishment of natural resources. Before development begins, therefore, the nature of the resources should be carefully studied and an assessment made of the suitability of the land for various kinds of use, for example forestry, grazing, watershed protection, and irrigated or unirrigated arable farming. Finally when economic and social factors have been considered, detailed plans can be made for the most advantageous use of the available resources.

The Phases of Assessment and Development

The processes involved are shown in the table below, where for the sake of simplicity a totally unsurveyed country is considered: in the table all the work necessary to assess and develop resources is mentioned; in practice of course, when an assessment/development project is started, it is usually found that certain aspects of the country's resources have already been studied and documented.

It will be seen that between the initial mapping of a territory and the actual development of selected areas there are three main phases of investigation: reconnaissance resource assessment of the whole region, intensive resource assessment of more promising areas and development studies, the successive phases being associated with progressively more detailed investigations, smaller areas and larger scale mapping.

PHASES IN THE PLANNED DEVELOPMENT OF AN EXTENSIVE UNSURVEYED REGION

(It is assumed that the region is a large one, 50,000 to 300,000 square miles, and that no accurate maps of the area have previously been made.)

Phase	Process	Typical Mapping Scale
1. Topographic mapping	Ground survey, aerial photography, mapping. The aerial photographs are also used in Phase 2.	1:500,000, 1:250,000 1:250,000, 1: 50,000 Special areas at 1:25,000, 1:10,000 1: 5,000, 1: 2,500
2. Reconnaissance land resource assessment (This type of assessment usually lasts one or more years; occasionally a 'rapid reconnaissance', lasting a few months only, may be made.)	(a) The characteristics of the landscape which affect potential land use are described in an integrated survey by scientists trained in geology, geomorphology, hydrology, climatology, soil science, ecology, forestry, agriculture, livestock husbandry. (b) Aerial photographs are interpreted-patterns representing rock structure, drainage, change of slope, soils and vegetation are plotted. (c) The interpretation is checked and amplified in a ground survey. (d) Units of landscape, called land systems, each having a characteristic pattern of relief, soil and vegetation, are described in detail. Boundaries between land systems are mapped. Soil associations are described. (e) The potential land use of each land system is assessed in broad terms such as "suitable for cultivation"; "suitable for grazing". (f) Development possibilities are discussed and recommendations made for further study of promising areas, including experiments.	1:500,000 1:250,000

Phase	Process	Typical Mapping Scale
3. Intensive land resource assessment	<p>(a) For the most promising land systems, indicated in Phase 2, details are now mapped, and this makes it possible to map land capability, which is a detailed classification of land according to potential land use as determined by soil characteristics, slope, climate and vegetation. Soil series are described. For forests, the potential yield of timber is assessed.</p> <p>(b) The areas most suitable for development are selected and a report is made on development possibilities. Experimentation in some areas may be recommended.</p>	1:50,000 and occasionally at 1:25,000
4. Development study	<p>(a) Social and economic factors are considered and areas are chosen for development.</p> <p>(b) Plans are made for the development of specific areas, and usually for a specific kind of land use. The plans include the location of irrigation networks, farm boundaries, roads etc. and the establishment of processing and marketing facilities.</p>	1:10,000 1: 5,000
5. Development	Implementation of 4. Usually supervised by the Government concerned.	

LAND RESOURCE ASSESSMENT

IMPORTANT CONCEPTS AND TECHNIQUES

The effectiveness and speed of resource assessment has increased rapidly during the last two decades, thanks notably to the increased use of air-photo interpretation, the emergence of the concept of the integrated survey and the introduction of the land system as a unit of landscape analysis. Land classification is a long established concept not peculiar to land resource assessments, but essential to their success, since sound decisions on development depend on accuracy of classification.

Air-Photo Interpretation

Aerial photographs, especially when viewed stereoscopically, reveal patterns in the landscape which are usually closely related to the pattern of land classification which will eventually be derived from the survey. This is because the patterns represent combinations of landscape features - relief, rock type, soils, vegetation, crops - which are themselves determinants or indicators of potential land use.

Surveys therefore begin with photo interpretation in which the main components of the landscape are mapped. In the field the preliminary interpretation is checked and amplified by the ground survey. On the return of the field team to the laboratory more refined interpretation of the photos is conducted on the basis of the detailed information gained during field work.

There is an increasing interest in the use of colour and other special types of photography to improve the accuracy and speed of interpretation.

The Integrated Survey

In the past, many scientific surveys of tropical countries were made by geologists, soil scientists, botanists and others - as unrelated enterprises for special purposes. Such surveys did not promote well balanced consideration of development possibilities.

In an integrated survey, now generally considered essential for a balanced appraisal of land resources, scientists of the relevant disciplines collaborate with the object of recording knowledge about resources which will contribute to the classification of the territory in terms of potential land use. Their efforts are channelled towards a practical end and are made more effective by mutual help.

An integrated survey includes studies of:

- General geological structure
- Geomorphology (landforms)
- Water resources
- Climate
- Soils
- Vegetation, including forests and pastures
- Existing land use.

The Land System

The land system is the major unit in a form of landscape analysis devised in Australia for resource assessment and since used by the Land Resources Division in Africa and the Pacific.

The object of the analysis is to divide the region under survey into landscape units which can be detected on aerial photographs and located in ground surveys. These units - the land systems - have characteristic patterns of relief, soils and vegetation which can be translated into terms of potential land use.

Two examples of such systems might be:

- (1) a plateau intersected by shallow stream courses and supporting savannah grassland with intermittent trees;
- (2) a sharply dissected mountain area with steep sided, forested valleys and bare mountain tops.

The recurrent units of landscape within each system, e. g. valley bottoms and mountain tops, are known as land facets.

At the end of a reconnaissance resource assessment the land systems with the highest levels of potential land use are selected for further study, i. e. intensive assessments. In the intensive assessments details of the land facets are mapped.

Land Classification

Two types of classification are commonly used in resource assessment.

A reconnaissance assessment culminates in a broad classification of land systems according to potential land use, i. e. each land system is graded as 'suitable for cultivation', 'suitable for grazing', etc.

An intensive assessment culminates in a land capability classification. This is a detailed classification of land according to potential use as determined by soil characteristics, drainage, slope, vegetation and climate. An accurate land capability map can be produced after mapping small units of landscape, usually land facets.

DEVELOPMENT STUDIES

Once land capability has been determined and recommendations made for future land use of selected areas the next step is to plan the actual use of the land with exact allocation of boundaries between different types of land use. In many cases a detailed and very accurate soil survey and a similarly detailed land capability study is needed before planning begins, that is to say, some of the work of the previous two stages is supplemented by additional studies. Physical, chemical and agronomic characteristics of the soils may be described. Mapping is at large scales: typically 1:5,000 or 1:10,000. Planning, in close co-operation with the government concerned, includes decisions on land tenure, farm boundaries, irrigation networks, services such as roads and water supplies, economic forecasts and provision for processing and marketing.

Development plans can be extremely specialised, particularly when a single plantation crop is considered. In forestry the development plan is known as the 'working plan'.

THE LAND RESOURCES DIVISION

This Division of the Directorate of Overseas Surveys has expanded in recent years in response to increasing requests from overseas governments, mainly in the tropics, for scientific investigations of land resources and development possibilities. The Division has a team of scientists trained in all the relevant disciplines: geology, geomorphology, climatology, soil science, hydrology, irrigation engineering, ecology, forestry, agriculture, livestock husbandry, agricultural economics. Cartographic services are supplied by other Divisions of the Directorate of Overseas Surveys.

Scientists covering several subjects normally work together on integrated resource assessments or development studies so that all the relevant aspects of the environment are investigated. At the same time the Division's procedures ensure that the investigations are constantly orientated towards the main objective - effective use and development of natural resources.

The Work of the Land Resources Division

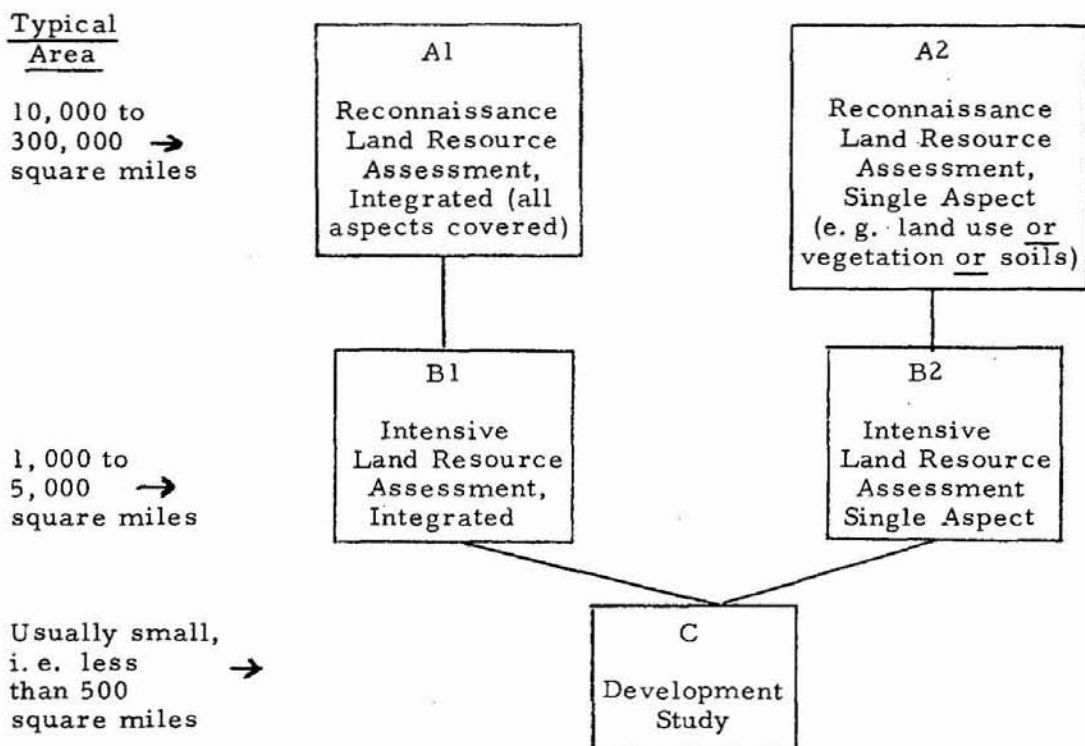
The Division undertakes a wide range of projects of which extreme examples would be reconnaissance resource assessment of a region covering a hundred thousand square miles and a development study of an irrigated area of a few thousand acres.

The main categories of project undertaken by the Division are described below and for each category examples are given of recently completed or current projects; the list is not exhaustive.

The Division prefers to work on integrated assessments covering all aspects of land resources. Nevertheless it frequently conducts assessments of single aspects of land resources, such as land use or forests or vegetation or soils, in response to requests from governments who require these surveys to be made for special purposes.

Some projects cover more than one phase of assessment.

Main Types of Project Undertaken by the Land Resources Division



A1. Reconnaissance Resource Assessment (Integrated)

This is an integrated resource survey culminating in an assessment of potential land use. The resources (including actual land use) are systematically described during a survey which may last several years depending on the area covered. Landscape analysis is used to divide the region into land systems each of which has a consistent pattern of topography, soils and vegetation. Soil associations are described. The land systems are classified according to potential land use into categories such as "suitable for grazing", "suitable for agriculture" or "to be conserved for watershed protection".

The map scales normally used vary from 1:500,000 to 1:125,000.

- (1) Land Resources of E. Bechuanaland 1963. Area 40 000 sq. miles; map scale 1:500 000.
- (2) Land Resources of S. Sardauna and S. Adamawa, N. Nigeria, 1966. Area 23 000 sq. miles; map scale 1:500 000.
- (3) Land Resources of Lesotho, 1966. Area 12 000 sq. miles; map scale 1:250 000.

- (4) Malawi Agro-Ecological Survey (Southern Region) Stage I. In progress; area 12 000 sq. miles; map scale 1:500 000. Stage II is an intensive assessment of selected areas.
- (5) North East Nigeria Project. In progress; area 60 000 sq. miles; map scale 1:500 000.
- (6) British Solomon Islands Land Capability Appraisal. In progress.
- (7) East Nigeria. Soil and Land Capability Survey of the Cross River Area, Stage I. In progress; area 14 500 sq. miles; map scale 1:200 000. Stage II is an intensive assessment.

A2. Reconnaissance Resource Assessment (Single Aspect)

This type of project represents a portion of an integrated Reconnaissance Resource Assessment and is a survey of a single land resource characteristic. The results may be combined with existing data to give an assessment of potential land use or they may be used for some other specific purpose, for example to indicate where a particular type of land use is feasible when for one reason or another no other type is to be considered.

- (1) Malawi Land Use Survey. In progress; 36 000 sq. miles; related to map scales of 1:50 000 and 1:250 000.
- (2) Botswana Northern Statelands Potential Land Use Survey (vegetation survey leading to assessment of livestock grazing possibilities); 1967; area 25 000 sq. miles; map scale 1:660 000.
- (3) Botswana Reconnaissance of Irrigation Potential, Stage I. In progress; map scale 1:250 000. Stage II will be an intensive resource assessment of selected areas.

B1. Intensive Resource Assessment (Integrated)

This is a detailed integrated study of an area selected for its relatively high land use potential; it culminates in a land capability assessment. The study usually includes description of the soil series and accurate mapping of the land facets which make up a land system. The mapping of these units makes it possible to make a detailed map of land capability. Mapping is at 1:25 000 to 1:100 000 and is normally at 1:50 000.

An intensive resource assessment can be used to show how much land is available for each possible type of development and to form the basis for economic calculations which assist decisions on the location of development areas.

Examples

- (1) Malawi Agro-Ecological Survey Stage II. Land systems of the Lower River Region. The land systems selected at Stage I for further study have been subjected to detailed land capability studies. Map scale 1:50 000.

- (2) Fiji Land Capability Survey. In progress;
map scale 1:50 000.

B2. Intensive Resource Assessment (Single Aspect)

Each project in this group represents a portion of an Intensive Resource Assessment and deals principally with a single aspect of the environment. It will normally be intended to contribute, along with other data, to a land capability assessment, or to a specialised suitability assessment in relation to a specific form of exploitation. There are also special cases where a single resource such as a forest can be exploited immediately.

- Examples
- (1) New Hebrides Geomorphological Analysis. Detailed mapping of landform units which will eventually assist soil mapping and land capability mapping. In progress; map scale 1:50 000.
 - (2) Fiji Forest Survey. In progress; map scale 1:50 000.
 - (3) Kenya Ecological Survey of the S. W. Highlands. A vegetation survey. The results are being published at a scale of 1:250 000 based on field mapping at 1:50 000.
 - (4) New Hebrides Forest Survey. Map scale 1:50 000.

C. Development Study

At this stage land capability assessments have been made, economic and social factors have been considered and a detailed study has to be made in preparation for development. In the tropics this type of development is frequently in connection with the cultivation of arable crops on relatively good soils. Large scale maps are made on which boundaries of soil types or other appropriate resource characteristics are shown. Maps showing farm boundaries, suggested location of roads and houses and water supplies may be included. Where the studies are concerned with soil conservation it will also be usual to map areas suitable for various types of cultivation, grazing control and land reservation.

The equivalent study in forestry results in a "working plan" in which details of exploitation for sustained yield are laid down. So far, no such working plans for forest areas have been prepared by the Land Resources Division.

- Examples
- (1) Development of the Lower Mgeta River Area of Tanzania. Completed 1966; area 190 sq. miles; mapping scales 1:50 000, 1:25 000 and 1:5 000.
 - (2) Coconut Growing Potential of Christmas Island. Completed 1966; scale 1:50 000 and 1:25 000; area about 100 sq. miles.

THE GEOGRAPHICAL DISTRIBUTION OF THE PROJECTS

The Division gives assistance when requested to do so through the Ministry of Overseas Development; it is not committed to give assistance in specific areas but so far almost all requests have come from members of the Commonwealth and from the dependent countries.

The location of recently completed and current projects given below will give an idea of the geographical distribution of the Division's work. At present there is a heavy concentration of work in Africa and the Pacific but a more widespread distribution is likely in the future.

DISTRIBUTION OF THE DIVISION'S PROJECTS AUGUST, 1967

(x recently completed xx in hand xxx at an early stage)

<u>Africa</u>	<u>Pacific</u>	<u>Caribbean and Central America</u>
Botswana x xx	British Solomon Islands xx	Cayman Islands xx
Cameróon x	Fiji xx	British Honduras xxx
Kenya xx	Christmas Island x	
Lesotho x	New Hebrides xx	
Malawi xx		
Nigeria x xx		
Tanzania x		
Zambia xx		



PUBLICATIONS OF THE LAND RESOURCES DIVISION, MAY 1967

The Division makes a report on each completed project. The report is published as a Land Resource Study or Technical Bulletin only with the consent of the government concerned.

Out of print:

- | | | |
|---|--------|---|
| BAWDEN, M. G.
and
STOBBS, A. R. | (1963) | The Land Resources of Eastern Bechuanaland |
| LANGDALE-BROWN, I.
and
SPOONER, R. J. | (1963) | Land Use Prospects of Northern Bechuanaland |

In the press:

- | | | |
|---|--------|---|
| SPOONER, R. J.
and
JENKIN, R. N. | (1967) | Land Resource Study No. 1
The Development of the Lower Mgeta River Area of the United Republic of Tanzania |
| BAWDEN, M. G.
and
TULEY, P. | (1967) | Land Resource Study No. 2
The Land Resources of Southern Sardauna and Southern Adamawa Provinces, Northern Nigeria |
| CARROLL, D. M.
and
BASCOMB, C. L. | (1967) | Technical Bulletin No. 1
Notes on the Soils of Lesotho |

Prepared for press:

- | | | |
|--|--------|--|
| BAWDEN, M. G.
and
CARROLL, D. M. | (1967) | Land Resource Study No. 3
The Land Resources of Lesotho |
|--|--------|--|

In preparation:

Reports on the Seychelles Islands and Christmas Island.