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UNITED NATIONS
ENVIRONMENT PROGRAMME



FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

**A SUGGESTED
NATIONAL SOILS POLICY
FOR JAMAICA**

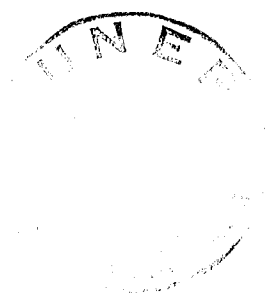


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Foreword

It is evident that the Government of Jamaica continues to give importance to agricultural development, for which soils form a basic resource. The agricultural sector is highly diversified and forest cover has been extensively cleared and degraded. Crop yields are generally high on the plains while on the hill lands substantial improvements in productivity are needed. Soil erosion is a serious problem in the hill lands. Other soil problems are urban encroachment onto agricultural land, rehabilitation of mining land and soil salinization.

This proposed National Soils Policy for Jamaica was prepared under UNEP/FAO Project FP/6101-91-02 (2921) by fielding a multidisciplinary team of two national experts and one international expert who worked from 10 August to 18 September 1992. The team held discussions with government officials, visited all Jamaica's 14 parishes, consulted background documents and held a national seminar in Kingston which discussed the First Draft of the Suggested National Soils Policy.

The soils policy suggested in this document is meant to be illustrative rather than exhaustive in character, and by no means a substitute for local experience, foresight or prudence. The Suggested National Soils Policy is meant to form an element within the national policies on land use, forestry and the environment. It sets out specific issues related to soil productivity and conservation which can then be incorporated in the different aspects of planning and development.

I sincerely hope that the Suggested National Soils Policy will meet the practical needs of the Republic of Jamaica.



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Arrangement of report

This National Soils Policy document for Jamaica consists of an **Executive Summary** followed by three parts:

Part One sets out the background to the formulation of the Policy, its objectives and its relations with other aspects of national policy (Chapter 1).

Part Two is an account of the present situation with respect to the soils of Jamaica. It covers three aspects: technical, institutional and legal (Chapters 2-4).

Part Three represents the actual National Soils Policy. It begins with an examination of the problems and policy issues involved. These are divided into technical issues (Chapter 5), institutional issues (Chapter 6) and legal issues (Chapter 7). This leads to a set of proposals and recommendations for follow-up action (Chapter 8). The report ends with a summary statement of policy (Chapter 9) and a proposed statement of commitment by the Government of Jamaica (Chapter 10).

List of acronyms

CARDI	Caribbean Agricultural Research and Development Institute
CIDCO	Coffee Industry Development Company
COA	College of Agriculture
CRIES	Comprehensive Resource Inventory and Evaluation System
ECD	Environmental Control Division
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organization of the United Nations
FIDCO	Forest Industries Development Company
FSCD	Forestry and Soil Conservation Division (former, or alternative, name, now the Forestry Department)
GEMS	Global Environment Monitoring System (of UNEP)
GIS	Geographic Information System
GOJ	Government of Jamaica
HAP	Hillside Agriculture Project
IBSRAM	International Board for Soils Research and Management
ICRAF	International Centre for Research in Agroforestry
ISSS	International Society of Soil Science
JADF	Jamaican Agricultural Development Foundation
JAMGIS	Jamaican Geographical Information System
JAMPLES	Jamaican Physical Land Evaluation System
JARP	Jamaican Agricultural Research Project
JAS	Jamaican Agricultural Society
LICJ	Land Information Council of Jamaica
MOA	Ministry of Agriculture
NEAP	National Environment Action Programme
NFAP	National Forestry Action Programme
NIC	National Irrigation Commission
NRCA	Natural Resources Conservation Authority (formerly NRCD = Division)
NSCC	National Soils Coordinating Committee
PIOJ	Planning Institute of Jamaica
RADA	Rural Agricultural Development Authority
RPPD	Rural Physical Planning Division
SIRI	Sugar Industry Research Institute
SNAP	Soil Nutrients for Agricultural Productivity Project
STATIN	Statistical Institute of Jamaica
TCPA	Town and County Planning Authority
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Scientific and Cultural Organization
USAID	United States Aid for International Development
UWA	Underground Water Authority
UWI	University of the West Indies

A suggested National Soils Policy for Jamaica

Executive summary

PART ONE: BACKGROUND AND OBJECTIVES

1. Origin and Objectives of the National Soils Policy for Jamaica

The Food and Agriculture Organization of the United Nations' (FAO) World Soil Charter and United Nations Environment Programme's (UNEP) World Soils Policy draw attention to the importance of soils as a basic natural resource, and the need for their conservation and sustainable use. These documents urge governments to draw up national soils policies. (1.1)¹

The Government of Jamaica (GOJ) entered into an agreement with FAO/UNEP for a technical cooperation project to draw up a National Soils Policy for Jamaica. The project team worked in Jamaica from August to September 1992. It consulted government officers, made field tours and held a National Soils Seminar to discuss the first draft. This document was subsequently reviewed by FAO, UNEP, the International Society of Soil Science (ISSS) and the Jamaican National Soils Coordinating Committee (NSCC). Following a meeting of all collaborating parties, which was held in Jamaica from 25 to 29 October 1993, the present document was agreed upon and finalized.

This document is now submitted to the GOJ for consideration as the basis for its National Soils Policy. (1.2)

A national soils policy comprises technical aspects, institutional aspects and legal aspects. The objectives of such a policy are to enable all aspects of policy that relate to soils to be viewed as a whole; to provide a framework within which specific projects can be evaluated; and to strengthen the ability of Government to conduct soils activities, including through opportunities for training. (1.3)

A soils policy forms a component of Jamaica's national policy on land use. It should also be integrated with Jamaica's National Forestry Action Programme (NFAP) and with its policy on environment. (1.4)

PART TWO: THE PRESENT SITUATION

2. Soils and Soil-related Problems

Jamaica is an island nation in the Caribbean with an area of 10 940 square kilometres. A basic division for soils and agriculture is the hill lands, the central core of hills and

¹Numbers in brackets refer to sections of the main report.

mountains, and the plains, comprising coastal plains and interior basins. Most of the island receives a moderate to high rainfall.

The population in 1991 was 2.37 million, of whom 600 000 live in metropolitan Kingston. The economy is diversified, with three main sources of foreign exchange: tourism, bauxite and agriculture.

The agricultural sector is highly diversified, with many other crops supporting the traditional exports of sugar and bananas. There is a marked contrast in farm size, with predominantly small farms in the hill lands and large farms on the plains. The original natural forest cover has been extensively cleared and degraded. The Government continues to assign importance to agricultural development, for which soils form a basic resource. (2.1 - 2.3).

Jamaica is exceptionally well covered by soil surveys, continuing from 1953 to the present. It also has a system of land suitability evaluation, of which the physical evaluation section is based on computer-stored information. There is a wide range of climatic conditions, landforms and soil types. A consequence of this variation is the need to give attention to the differing responses to soil management. (2.4 - 2.5)

Soil productivity, in terms of crop yields, is generally high on the plains. On hill lands, management standards are variable, with substantial opportunities for improvement. (2.6)

For many years, soil erosion has been a serious problem in the hill lands. Past attempts at soil conservation were based on bench terracing and other physical structures. Viewed overall, this approach was not a success. A change has now been made towards methods based on biological conservation with emphasis on soil cover. (2.7)

Other soil problems, discussed further in Part Three, are:

- urban encroachment onto agricultural land;
- rehabilitation of mining land;
- soil salinization. (2.8)

A substantial amount of soil research has been conducted in the past, but staffing and facilities are at present inadequate to maintain this strong basis. (2.9)

3. Institutions and Projects

The major institutional responsibilities for soil activities within the MOA are as follows:

- Rural Physical Planning Division (RPPD): soil survey, land evaluation and land-use planning.
- Rural Agricultural Development Authority (RADA): agricultural extension, including soil conservation on farming land.
- Forestry Department: forests and forestry, including soil conservation on forest land.

- Research and Development Division: agricultural research, including soil research.

A statutory body within the Ministry of Public Service and Environment, the Natural Resources Conservation Authority (NRCA), has overall responsibility for environmental conservation and proper use of natural resources.

A wide range of other institutions also contribute to soil activities. (3.1)

There have been a series of attempts to improve soil conservation and watershed management through projects. Currently a major effort at improved productivity and soil conservation in hill lands is being made through the Hillside Agriculture Project (HAP). An ambitious programme on watershed areas is proposed in NFAP. (3.2)

Both Government and public awareness of soil questions in Jamaica is generally high. (3.3)

4. Legislation

Four statutes have a major influence on soil resources issues:

- The Forest Act.
- The Watersheds Protection Act.
- The Rural Agricultural Development Authority Act.
- The Town and Country Planning Act.

Other statutes also have an impact upon soil issues, these include the Jamaican Constitution (Annex 4).

PART THREE: PROBLEMS AND POLICY ISSUES

Problems and policy issues may be divided into:

- technical issues;
- institutional issues;
- legal issues.

5. Technical Issues

Current policy for soil conservation and agricultural development in hill lands is based on the strategy adopted for HAP. This is aimed at intensified agriculture based on tree crops. Soil conservation is achieved mainly by maintaining a ground cover of living plants and plant litter. Emphasis is placed on active cooperation with the farmers. Substantial increases in tree crop yields have been obtained, and soil conservation appears to be good. RADA and other bodies are implementing this strategy. It is desirable to monitor the performance of this policy with respect to soil conservation. (5.1.1)

A second element in the strategy for hill lands is the reservation of steeper and more deeply dissected areas for non-agricultural uses. These areas have a particular value for production of water. This strategy is implemented through forest reserves, designated watershed protection areas, and a recently established national park. (5.1.2)

There is a need for further development of methods of soil conservation appropriate for Jamaica's different climatic conditions, soil types and cropping systems. A particular need is for methods to cover hill areas dependent on annual crops, particularly yams. The present emphasis is upon biologically based methods of conservation, but combinations with physical structures also have a role. (5.1.3)

There is an important potential in Jamaica for further development of systems of agroforestry. These can serve both productive purposes, e.g. for timber, stakes, fuelwood and fodder, and are also an effective means of soil conservation.

Urban encroachment onto Jamaica's limited resources of good agricultural soils could become very serious in the near future if steps are not taken to check it. Present planning controls are inadequate, both legislatively and with respect to their application. Better control could be achieved by legislative improvements, to facilitate better enforcement. Control should be based on a system of land zoning based on land suitability criteria. This problem is one of urgency. (5.2)

The rehabilitation of mined land and its restoration to agricultural use, including both mined areas and waste disposal sites, is well handled in Jamaica. This has been achieved by well-devised legal controls, coupled with a high sense of environmental responsibility on the part of the mining companies. (5.3)

Soil salinization has been encountered on some irrigated areas of the southern coastal plains. Early action to check this is needed to prevent costly loss of soil resources. (5.4)

There is a need for quantitative assessment and monitoring of soil erosion and other forms of soil degradation. Estimates in physical terms, such as tonnes of soil lost, need to be converted into economic and social costs to the people. (5.5)

Development of a system of land zoning, based on land suitability for different uses, would be of assistance in two respects. First, the designation of appropriate land for forest reserves, watershed protection areas and national parks; secondly, the control of urban encroachment. (5.6)

Soil research in Jamaica, which has substantial past achievements to its credit, needs to be revitalized. It should concentrate on applied and adaptive research. Priority areas for research are:

- updating of the national soil data base, in conjunction with the Land Information Council of Jamaica, using internationally accepted standards (e.g. FAO) to provide a sound basis for national soils legislation and conservation;

- methods of soil conservation, appropriate to different environments, soils and cropping systems;
- the potential of agroforestry;
- soil fertility;
- soil physical properties, particularly with respect to irrigation;
- soil restoration after mining operations, particularly reclamation of waste disposal sites;
- land use responses of soil types;
- updating of land suitability and land use planning criteria. (5.7)

6. Institutional Issues

All soil-related institutions in the Government are operating at the limit of their capacity with respect to staff and funding. To perform their work adequately, and still more to undertake additional tasks now required, institutional strengthening is required. This needs to be on a permanent basis. (6.1)

Institutional responsibilities for soils are quite well defined (see above). An institutional structure needs to be developed for agroforestry. This should be in the form of cooperation between existing bodies. It should be recognized that NRCA has overall responsibility for monitoring soils, as well as other natural resources. (6.2)

There is a strong need for continuity in soil activities, which this National Soils Policy is intended to strengthen. The recently created National Soils Coordinating Committee (NSCC) should play an important role in achieving this. (6.3)

Soil research activities are appropriately conducted by a range of institutions. These should, however, be coordinated through the Research and Development Division. For this purpose, a core of soil scientists is needed within that Division.

Whilst the standard of education of Jamaica's soil scientists is high, their numbers are insufficient for policy implementation, and additional education and training activities are called for. There is also a need for refresher courses to update staff in modern advances in soil conservation and agroforestry. (6.5)

7. Legal Issues

In order to adequately apply the Land Development and Utilization Act, appropriate criteria needs to be developed to determine improper land use. The Agricultural Small Holdings Act does not define the responsibilities of landlords and tenants with regard to proper land use. The Watershed Protection Act requires to be supported by the promulgation of regulations. The new Physical Planning Act, which will incorporate the

Town and Country Planning Act and the Local Improvement Act, should include provisions to ensure the preservation of land for agricultural purposes. (7.1)

Many of the laws affecting soil conservation are inadequately enforced. Reasons are:

- staff shortages;
- low levels of penalties in relation to the present value of money;
- absence of regulations to support laws;
- fragmented legislation.

This last problem could be addressed by preparation of a digest of laws affecting land use, which could be made available to relevant agencies. (7.2)

8. Proposals and Recommendations

The following proposals are made for action to be taken under the National Soils Policy, for the achievement of its objectives of soil conservation and productive and sustainable use. Many of these proposals are interlinked. Some will require international cooperation and additional funding.

Brief justification for each proposal is given in the corresponding sections of Chapter 8. The proposals are for:

1. Strengthening of soils and related institutions with staff and operating budgets. This is a prerequisite for other proposals.
2. Establishment of a permanent soil research capacity.
3. Research into soil conservation.
4. Development of the potential of agroforestry.
5. Monitoring of soil degradation, including both erosion and other forms of degradation.
6. Land zoning, as a basis for land-use planning.
7. Education, training and retraining.
8. Recommending amendments to legislation.
9. Recommending better enforcement of legislation.
10. The formalization of NSCC.

9. Statement of Policy

Definition of Zones

In summary, Jamaica's National Soils Policy can be expressed in terms of three major regional units, or zones. These comprise:

1. **Steeply sloping upper watershed areas.** This comprises those parts of the central core of the country which are of high altitude, very steeply sloping (>40%), or both. Soils are frequently shallow or stony. A substantial part of this zone is still forested. It includes the Blue Mountains, John Crow Mountain, the limestone "cockpit country", and some other mountain areas.
2. **Hill zone.** This comprises the remainder of the central core including hilly land, which is for the most part moderately or steeply sloping (22-40%). Soils may be shallow, moderate or deep. Most parts of this zone include cultivated land.
3. **Coastal plains and interior basins.** This comprises land of low altitude, mainly flat or gently sloping. Soils are mainly moderately deep or deep. Most parts of this zone are farmed. It also includes the main urban areas.

Summary of Policy

The steeply sloping upper watershed areas

In this zone, the policy is to preserve the land for water production, sustainable agriculture and tourism. Soil conservation will be achieved mainly through maintenance and improvement of the natural forest cover. There may be productive forest plantations on limited areas where land is suitable. Any existing agriculture in this zone will be discouraged (having due regard to personal rights and equity), or restricted as far as possible to valley-floors.

The hill zone

Here, the policy is based on making productive use of the good natural resources of soils and climate, for the benefit of both the population of the zone and the economy of the country as a whole; whilst at the same time, making the maximum effort to conserve these resources for the needs of populations of the future. In short, this is a policy of sustainable use. Land use will include tree crops (perennial crops), annual crops, forestry, and livestock production. Elements in the implementation of the policy include:

- The encouragement of tree crop production wherever landforms, climate and soils are suitable for this.
- Restricting the cultivation of annual crops as far as possible to sites that are less steeply sloping, in valley floors, or otherwise best suited to this use.
- Making a major effort to develop methods of soil conservation that will be both technically efficient and economically and socially acceptable, and which are

adapted to the varying soils and other environmental conditions of the area; and to promote the adoption of these methods by all land users. Emphasis will be placed on biologically-based methods of conservation, particularly maintenance of soil cover, but physical conservation structures will also contribute where appropriate.

- In those parts of the zones where mining operations occur, continuation of the present policy of strict enforcement of legally-based requirements for land rehabilitation and restoration to productive use, aided by the relevant research and responsible attitude of the mining companies.

The coastal plains and interior basins

This zone contains much of the most productive agricultural land of the country, and the major force of policy is to preserve these fertile soils for agricultural use as far as possible. At the same time, it is recognized that other uses of land, for urban and industrial purposes and for tourism, make competing demands for this land. Elements in the implementation of the policy include:

- Urban expansion will be strictly controlled, limiting the total area, seeking compact development, and directing development where possible to the less fertile soil areas. To this end, the legal basis for planning controls will be strengthened, and such controls will be enforced. A system of land zoning, based on relative suitability for competing uses, will be developed to guide development in critical areas.
- Development of tourist facilities will similarly be controlled, permitting development where this is in the interests of the country as a whole, whilst at the same time preventing unnecessary loss of good agricultural land.
- Every effort will be made to combat soil salinization; and a watch will be kept on other forms of soil degradation, in order to combat any future problems at an early stage.
- Mining and quarrying activities on this land will be required to conform with regulations limiting areas of activity and requiring land restoration.

Means of Implementation

This policy will be implemented through technical, institutional and legal means, as set out in this document.

10. Commitment by the Government of Jamaica

The following is a suggested statement of commitment to the National Soils Policy.

The Government of Jamaica **recognizing:**

- the importance of soils as a basic natural resource on which the country's agriculture and other kinds of rural land use are dependent;
- the extent and severity of soil degradation, particularly erosion, in the hill lands, and the adverse effects of this on the present and future well-being of the country;
- the danger of loss of productive agricultural land to urban uses;

The Government of Jamaica being aware of the recommendations of the FAO World Soil Charter and the UNEP World Soils Policy and of the efforts currently being made to implement the policies set out in these documents at a national level:

- **Reaffirms** its past efforts, including through cooperation with international agencies, to combat land degradation and to support rational land use;
- **Takes note** of the contents of this National Soils Policy for Jamaica; and
- **Declares its commitment** to support the implementation of this National Soils Policy, in particular by:
 - within the framework of its overall development planning, striving to ensure adequate and continuous support to the government institutions responsible for soils activities;
 - attaching importance to soil conservation in national development plans, and making corresponding budgetary allocations;
 - taking steps to ensure that the soils of the country are utilized on a sustainable basis, to meet the needs of the present and future population;
 - supporting measures for sound land-use planning, in accordance with the suitabilities of land for different purposes and with the needs of the people;
 - seeking to maintain a soils research capacity appropriate for the needs of the country, in collaboration with international agencies and external institutions where appropriate;
 - taking steps to monitor soil degradation and the effects of measures taken to control it, in order that its impact on the national economy and well-being of the people may be assessed;
 - examining its legislation with a view to consideration of amendments which would strengthen this in the areas of soil conservation and protection of agricultural lands;
 - integrating this Soil Policy with national policies on land use and the environment.

The Government further **notes** the importance of continuity in its national soils policy, to which this document makes a contribution; and that this policy will require revision from time to time, in the light of changes in circumstances.

PART ONE

BACKGROUND AND OBJECTIVES

Chapter 1

Origin and objectives of a Nation Soils Policy

1.1 INTERNATIONAL CONCERN FOR SOILS POLICY

In 1981 the World Soil Charter was adopted by the Conference of FAO and in 1982 UNEP issued its World Soils Policy.

Both documents draw attention to the importance of soils as a basic natural resource for agriculture, forestry and other rural land use, and stress two principles: first, to avoid soil degradation, and secondly, to utilize soils to their maximum potential. These principles are both incorporated in the concept of **sustainability**, the use of soil and other land resources to meet present needs, whilst at the same time conserving basic resources for populations of the future.

Following a series of international meetings, in 1983 UNEP issued its Environmental Guidelines for the Formulation of National Soils Policies, linked to the World Conservation Strategy. This document urges governments to adopt such policies, and outlines their principles and objectives. As a practical step towards this aim, selected countries have been invited for provision of international assistance, given by FAO as the implementing agency with the assistance of the International Society for Soil Science (ISSS). Draft policies have been completed for Uganda, Syria and Indonesia.

1.2 THE FAO/UNEP/ISSS ASSISTANCE PROJECT

In 1989 UNEP invited the GOJ, through the Minister of External Affairs, to enter into a Technical Cooperation Project for the formulation and implementation of a national soils policy; and later that year, the Planning Institute of Jamaica (PIOJ) stated willingness on the part of GOJ to participate in such arrangements. A round-table discussion was held in Rome, April 1992, attended by a representative of the MOA.

A team was formed, consisting of one international consultant and two local consultants, which worked from 10 August to 18 September 1992. The team held discussions with a range of officials in the MOA and the Ministry of Finance and Planning, and with staff of international projects. They conducted field study tours, visiting all of Jamaica's 14 parishes, and consulted background documents.

On the basis of these discussions and other work, the team prepared a First Draft. This was presented and extensively discussed at a National Seminar, Towards a National Soils Policy for Jamaica, held in Kingston, 9 September 1992.

In the light of this discussion, and further consultations, a revised Second Draft was prepared. This was thoroughly reviewed and amended by FAO. From this review a Third Draft was prepared which was presented to representatives UNEP, FAO, ISSS and the Government at a "round-table" meeting, held in Jamaica from 25 to 29 October 1993. The suggestions and comments of this meeting were incorporated into this Suggested National Soils Policy for Jamaica for review and adoption by the Government.

1.3 OBJECTIVES AND ELEMENTS OF A NATIONAL SOILS POLICY

A national soils policy is a set of guidelines which aims to ensure that the soil resources of the country are utilized on a productive and sustainable basis. In particular, it seeks to prevent erosion and other forms of soil degradation, and to increase the productivity of soils by applying improved management techniques. Emphasis is placed upon the varied nature and properties of soils, and the consequences of this for their appropriate management.

There are three elements in a national soils policy:

- **technical aspects:** relating to soil survey and evaluation, protection from erosion and other forms of degradation, and soil management and improvement;
- **institutional aspects:** the institution framework for soils policy, executive action, research, education and training, and extension;
- **legal aspects:** relating to land-use legislation as it affects soil use and conservation.

Potential benefits arising out of a national soils policy are:

1. To assemble and summarize all aspects of policy that relate to soils, enabling these to be viewed as a coherent whole, by both the Jamaican Government itself and by international and other external organizations.
2. To provide a policy framework within which specific projects relating to soil use and conservation can be evaluated. Specifically, it helps to achieve continuity, of objectives and methods, between successive projects.
3. To strengthen the ability of government departments to conduct soils research, monitoring, conservation and extension.
4. To provide opportunities for education and training, and in particular refresher and retraining courses, enabling staff to keep abreast of advances in knowledge.

5. To enhance the productivity of soils by applying improved and effective management practices.

This Report places emphasis on the specifically soil-related aspects of policy. It would be unprofitable, however, and contrary to modern practice, to discuss the purely technical aspects of soils in isolation from their economic and social setting. Technical measures alone are not enough. Equal attention needs to be given to economic and social aspects of soil management, to the acceptability of proposed changes to the farmers, and to the need for sound institutions to put policy into practice. Therefore soils policy necessarily interacts with wider aspects of land use and environment.

1.4 RELATIONSHIPS WITH NATIONAL POLICIES ON LAND USE, FORESTRY AND ENVIRONMENT

In the Jamaican context, it is particularly important that a soils policy should be linked with existing national policies in related areas: land use, forestry and environment. Jamaica has given considerable attention to its land use policy. A National Land Policy Committee exists, with seven subcommittees. A policy document is currently being finalized by the Office of the Prime Minister. The Manual for Development, which will now include design criteria and standards, is being revised and expanded by the Ministry of Public Service and the Environment in conjunction with other relevant government organizations.

The question has been asked, is there a need for a separate soils policy, additional to a land use policy? Inspection of land policy documents provides an answer. Land policy covers a wide range of issues, for example land acquisition and divestment, tenure, taxation, incentives for development, and access. The central issues of soils policy, productive use and conservation, are certainly included, as one aspect among many. A soils policy puts this specialised group of issues into focus, after which they can be linked with other aspects of land use.

Policy on forestry has recently been studied and set out in NFAP. This sets out an ambitious total of 30 projects. Among its goals is *"to preserve and protect the natural environment and sustain and expand the natural resource base within the context of sustainable development"*, whilst one of its five priority areas is forestry in land use, including watershed management. These features are clearly of the highest relevance to soils policy on forest lands.

Jamaica's policy on environment has recently been set out in the National Report on the Environment and Development prepared for United Nations Commission on Environment and Development (UNCED). This Report covers all aspects of the environment, e.g. health, pollution, and the impacts of mining, manufacturing and tourism. It specifies four environmental impacts of agriculture - erosion and sedimentation, less stable river flow, agricultural chemicals in groundwater, and saline intrusion; and it notes that soil erosion exacerbates the hazards of landslides and flooding.

In particular, there is much concern in Jamaica over water resources. Water can be considered as an output from land, comparable with agricultural production. Policy

and actions over water are linked with soils in several respects: the role of the soil cover, with that of forests, in stabilizing runoff from catchment areas; the need for agricultural chemicals to be used in such a way as to maximize recycling and so prevent pollution of groundwater; and the association of saline groundwater with soil salinization.

Thus, a National Soils Policy forms an element within the national policies on land use, forestry and the environment. The function of a soils policy is to assemble and set out the specific issues related to soil productivity and conservation. These can then be incorporated as an element in other aspects of planning and development.

PART TWO

THE PRESENT SITUATION

Chapter 2

Soils and soil-related problems

2.1 JAMAICA: RESOURCES AND ECONOMY

2.1.1 Environment

Jamaica is an island nation in the Caribbean with an area of 10 940 square kilometres or close to 1.1 million hectares. Some two thirds of its area consists of a central range of hills and mountains, rising to a maximum altitude of 2 256 m at the Blue Mountain Peak. The remainder consists of coastal plains, generally wider along the south coast than the north, together with some inland valley floors and basins. This broad division, into hill lands and plains, underlies all aspects of land use and soils policy.

Temperatures average 27°C in the lowlands, ranging from 24°C in January to 28°C in July, and falling with altitude. The country as a whole is well supplied with water, almost all of hill lands receiving over 1 500 mm annual rainfall, rising to above 5 000 mm in places. Irrigation is necessary on parts of the coastal plains.

For administrative purposes the country is divided into 14 parishes, 13 rural and one consisting of metropolitan Kingston.

2.1.2 Population

Preliminary results from the 1991 census give the population at 2.37 million. During the last inter-censal period the rate of increase was 1.3% per year. If continued, this would lead to a population of 2.74 million by the year 2000.

Some 600 000 live in metropolitan Kingston, but no other urban centre exceeds 100 000. Urbanization is likely to continue.

A feature of the population is its widespread distribution, within hill lands as well as on plains. Only the most remote and inaccessible areas are uninhabited.

The population in the hill lands is ageing, some estimates putting the average age as about 60. Certainly, many of the younger people have moved out to urban centres. Detailed results from the 1991 census show the extent to which there have been absolute decreases in population.

2.1.3 Economy

The country is fortunate in possessing three main sources of foreign currency: tourism, bauxite and agriculture. In addition, there is a developing manufacturing sector. This diversity has protected the country from the narrow dependence on one source of income that characterizes some island states.

During the 30 years since independence, Jamaica has been governed by a system of parliamentary democracy.

2.2 LAND USE, AGRICULTURE AND FORESTRY

2.2.1 Land use

Estimates for areas under different kinds of land use vary, as a result of differing definitions and methods of mapping. The report to UNCED gives agriculture (including pasture lands) as occupying 46% of the country, forest 24%, "scrub and woodland" 20%, and urban uses 3.7%; a survey, by remote sensing, of land cover in 1982 gave forest (of all kinds) as 48%, agriculture 44%, urban and industrial uses 5.5%, mining 0.4%, and water and wetlands 1.9%. (Annex 2)

2.2.2 Agriculture and farm size

The agricultural sector is highly diversified. The traditional export crops, sugar and bananas, are still the leading exports, but others of importance include coconut, coffee, cacao, tobacco, citrus fruits, yams, pimento and livestock products. In addition, a wide variety of vegetables and fruit trees are grown both for home consumption and export.

A long-standing feature of Jamaican agriculture is the contrast in farm size between the hill lands and the plains. This arose from the settlement of the hills by former slaves in the Nineteenth Century. In the Agricultural Census of 1978:

- farms of less than 2 ha, mainly in the hill lands, covered 82% of farmers but only 16% of farmland;
- farms of more than 40 ha, mainly on the plains and interior lowlands, covered 0.6% of farmers but 57% of farmland.

The Farmers Register of 1982 reported 155 314 farmers, 93% on less than 4 hectares. The National Report on the Environment gives an estimate that 193 000 farms, or 97% of all farms, are of less than 10 ha, most are less than 2 ha, occupying 38% of farmland. This contrast is not absolute; there are farms of intermediate size (e.g. 5-20 ha), and some larger farms are found in the hill zones. However, the basic contrast in farm size is a fact which fundamentally underlies soils policy.

2.2.3 Forestry

Centuries ago, virtually all of Jamaica was forested, but less than 77 000 ha (less than 15%) is now undisturbed forest. Large areas have been cleared for agricultural use, and clearance is estimated to be continuing at about 3% per year. Much of the remaining forest land has been severely degraded by shifting cultivation and cutting for timber, fuelwood and poles. The term 'ruinate' is used locally to refer to cut over and badly degraded forest.

As a consequence, Jamaica does not have a hardwood export industry from its natural forests. Timber production is mainly from plantations, predominantly Caribbean pine. Designated forest reserves occupy 113 000 ha, but there has been much encroachment for cultivation.

The aims of forestry are therefore jointly production and conservation: to permit controlled production of wood products for local use, and to conserve the watershed areas, as sources of water and in the interests of biological conservation.

In part arising out of NFAP, a National Park has recently been established in the Blue Mountains (John Crow Mountain).

2.3 THE IMPORTANCE OF SOIL RESOURCES

Soils and climate are the basic natural resources for agriculture. The relative importance of agriculture in the Jamaican economy has declined steadily over the last 50 years, but its absolute production has increased. Some 250 000 people, or 28% of the employed population, work directly in agriculture, whilst many others are engaged in industry and trading dependent on agricultural products. Agriculture contributes 8% of the gross domestic product but 20% of exports.

The Government continues to give importance to agricultural development. The target in the Jamaica five-year development plan 1990-1995 is a growth in agricultural production of 3.5% per year. The Foreword to that plan lists 'four imperatives', one of which is of the highest significance to soils policy:

"The third imperative is an emphasis on agriculture and other land based activities to develop the resources to create an environmentally sound self-sustaining economy; generating employment opportunities; and arresting the rural-urban drift."

A second basic role is that of soils, jointly with the forest cover, in watershed protection. There are 26 watershed management units in Jamaica, several of these are considered to suffer from high rates of erosion. Besides a future potential for controlled forest production, these areas supply water to the coastal areas of the country. Soil conservation helps to stabilize river flow, reduce sediment loads and reduce the hazard of flooding. Among the projects in the NFAP, those listed as "high priority" include agroforestry, land use control in watersheds, and a watershed management programme for 10 watersheds.

Taken together, the functions of production and conservation, and the importance given by Government to the development of the agricultural sector, it is clear that the sustainable use of soils, combining efficient production with conservation, is of the highest importance to Jamaica.

2.4 SOIL STUDIES

2.4.1 Soil surveys and land evaluation

By comparison with most developing countries, Jamaica has an outstandingly good basis of soil surveys and studies of land evaluation. These are now operated by RPPD of the MOA.

There have been four phases to these studies:

- | | |
|-----------|---|
| 1953-1970 | Soil surveys of all 13 parishes were completed by the Regional Research Centre of what was formerly the Imperial College of Tropical Agriculture, now the Agriculture Faculty of the University of the West Indies (UWI). These were conducted at a scale of 1:12 500 and published at 1:50 000. |
| 1980-1982 | Under a USAID project, a computerized land evaluation system was established, Comprehensive Resource Inventory and Evaluation System (CRIES). This included transfer of the existing soil maps to a Geographical Information System (GIS), and the first establishment of criteria for land evaluation. |
| 1982-1989 | Under a survey project with the assistance of the Netherlands, the computerized land evaluation system was developed to its present capability. This consists of the Jamaican Geographical Information System (JAMGIS) which stores areal data on soils and other factors of the environment; and the Jamaican Physical Land Evaluation System (JAMPLES) which is a program for calculating land suitability for specified uses. Some more detailed local soil surveys were also conducted. |
| 1990-1992 | JAMGIS and JAMPLES are in active use, operated by the RPPD and used also by HAP. Evaluations are conducted for various clients, government and private sector. |

It would be a useful service if the data in JAMGIS could be transferred from minicomputer to microcomputer form, and made available to other users on diskette. A channel of communication for this exists in the Land Information Council of Jamaica (LICJ).

2.4.2 Soil classification

The original surveys established a system of soil types (comparable to soil series) with local names. These names and the numbers used to map them (e.g. 38 Cuffy Gully gravelly sandy loam; 43 Highgate clay) are familiar to local soil scientists and agriculturalists, as are their land-use potential and limitations. They are well suited for continued local use.

A provisional conversion of the soil types to units of the United States Soil Taxonomy has been made, has also a map showing units (generalized soil associations) classified by the FAO/Unesco Soil Map of the World System. At present, soil maps of the country on these two international classification systems are not available on JAMGIS. For purposes of international technology transfer, it is desirable that they should be completed.

Also produced from JAMGIS are a national agroclimatic zones map, giving 75%-dependable growing periods for annual crops, and a land cover/land use map, both at 1:250 000.

2.4.3 Land evaluation

The main output currently produced by the RPPD consists of resource atlases, for parishes or selected project areas. Examples are atlases for the Parish of Clarendon at 1:100 000 scale, and for a Cocoa Pilot Project in part of the Rio Cobre Watershed, Parish of St. Catherine, at 1:50 000. Among the computer-produced and colour-printed maps in these atlases are maps of agroclimatic variables, slope, soils, land cover/use, erosion hazard, population, and land suitability for selected land-use types. Following computerized physical land evaluation, results are further analyzed for land suitability in economic and social terms.

The staff and equipment resources of RPPD are at a level only just sufficient for the continuation of these activities.

2.4.4 Soil analysis

The Government soils laboratory is situated in RPPD. It has the equipment and ability to conduct the standard range of analyses for soil fertility and soil survey purposes. The laboratory presently suffers from understaffing and shortages of chemicals.

Further soil analytical facilities are available at the Sugar Industry Research Institute (SIRI) and the mining companies.

2.5 MAJOR TYPES OF SOILS AND LAND

2.5.1 Soil types

For its size, Jamaica has a substantial variety of soil types, based on its contrasts in relief, climate and parent material. Nearly 300 local soil types are recognized.

The hill lands are formed predominantly of limestones, with shales and other sedimentaries in the Blue Mountains and some other central areas. Soils on the limestones range from shallow rendzinas to moderately deep or deep, red to brown, strongly weathered clays. Cracking clays are also found. The sedimentaries have loamy or clayey soils, often shallow and gravelly.

On the plains and interior lowlands, brown cracking clay soils are widespread, together with alluvial soils, calcareous in places. Poorly drained alluvial soils and peats occur on tidal flats and swamps.

A listing of the most common soil classes according to two internationally used classification systems is given in Annex 3. At the highest level of classification, the classes of greatest extent are:

A. *Based on the FAO/Unesco classification*

On the hill lands:

Regosols
Cambisols
Lixisols (formerly called Luvisols)
Acrisols
Ferralsols
Vertisols

On the coastal plains and interior lowlands:

Cambisols
Lixisols
Vertisols
Phaeozems
Fluvisols
Histosols

B. *Based on the United States Soil Taxonomy*

On the hill lands:

Entisols
Inceptisols
Alfisols
Ultisols
Oxisols
Vertisols

On the coastal plains and interior lowlands:

Inceptisols
 Ultisols
 Alfisols
 Vertisols
 Mollisols
 Entisols

The percentage areas under these classes is not presently known. It is clear, however, that research into soils and technology transfer needs to give predominant attention to the FAO/Unesco classes of Cambisols, Regosols, Lixisols and Vertisols. The main message, however, is the need to give attention to the wide variation in soil properties and potential, and the consequences of this for soil management.

2.5.2 Slope and land classes

Geomorphology, particularly slope angle, is as important to land use in Jamaica as is soil type itself. The CRIES survey gives the following frequency distribution of slope angle:

0-5 degrees	(0-9 percent):	15%
5-10 degrees	(9-18 percent):	12%
10-20 degrees :	(18-36 percent):	15%
Over 20 degrees	(Over 36 percent):	58%

This reflects the fundamental division of the country already stressed. The plains and interior lowlands are level to gently undulating, whilst over half the area, the core of hill lands, has steep slopes. Some are excessively steep; cultivation has been known on slopes of more than 45 degrees, or 100 percent.

A Jamaican system of land capability classification exists, with land classes from I to VII. Classes I-III are suitable for cultivation (in the case of II-III with limitations), IV-V for tree crops, VI for forestry, and VII for conservation only. Slope is the main determinant of land capability, although other limitations are also used. For purposes of detailed agricultural planning, this system has been replaced by land suitability classification, based on suitability for specified crops or other land uses. It remains of value for purposes of land use zoning, as between urban and rural use.

A feature of much significance to soils policy is that the hill lands are by no means uniform. They vary both in dominant slope angle and in relative relief (depth of valleys). Thus, there are areas dominated by valleys several hundred metres deep and with steep to very steep slopes (e.g. the Upper Yallahs Valley), and other areas with lower relief and predominantly moderate slopes, (e.g. the uplands south of Ocho Rios, or around Mandeville). This variation provides the opportunity for rational land-use planning, the encouragement of different kinds of land use (annual crops, tree crops, forestry, conservation) in accordance with resource potential.

2.6 SOIL PRODUCTIVITY

On the larger farms, which are mainly on the coastal plains, standards of farm management are generally high. Crop yields compare well with those of other tropical countries with similar climatic and soil resources. Crop selection is well adapted to land potential, as well as for markets. Some gently-sloping, fertile land is under pasture. Livestock products are an essential part of the agricultural economy.

A problem of soil productivity on the lowlands is what is referred to as "idle lands". These refer to land of good agricultural potential which is unused, or farmed extensively. The problem is decreasing, and legal means to reduce it exist (see below).

The situation is different on small farms in the hill lands. The areas of "home gardens", mainly diversified fruit trees, can be highly productive. Studies of coffee and cacao, however, have shown productivity levels well below those for which the land has a potential. Yields of annual crops suffer when grown on soils that are eroded or depleted in fertility.

There is opportunity to improve soil productivity in hill lands, through application of improved management techniques, combined with land-use planning based on evaluation of land potential. This approach is being applied in HAP.

2.7 SOIL EROSION

2.7.1 Extent and severity of the problem

Of the various forms of soil degradation - physical, chemical and biological - that of soil erosion in hill lands is by far the most serious. Erosion as discussed in this document refers to water erosion; wind erosion is not a substantial problem in Jamaica.

For many years, Jamaica has had a severe problem of soil erosion in hill lands. The basic reason is the growing of annual crops, particularly root crops, on steeply sloping land. The origin of the problem is historical, arising from settlement of hill lands by farmers for whom the growing of subsistence crops was the only means of livelihood.

The problem is most serious in those watersheds which are the most steeply sloping and at the same time settled, for example the Rio Cobre, Rio Minho, and upper Yallahs watersheds. Eroded, abandoned land is commonly under guinea grass or bamboo.

Jamaica's soil types differ widely in their resistance to erosion, capacity for regeneration, and in the methods of conservation effective upon them. As a generalization, erosion is more serious in areas of shale parent material.

The major adverse effects of erosion are:

- a substantial lowering in the productive capacity of the soil, for both agriculture and forestry;
- more rapid runoff and hence destabilization of river flow from eroded catchments;
- increased hazards of flooding and siltation on the coastal plains, and of landslipping within the hills.

Where erosion is severe, the loss of soil productivity is for practical purposes permanent; restoration can only be by natural pedological processes taking thousands of years. Where it has reached an earlier stage, the trend towards declining fertility can be at least partly reversed.

Some work has been done to assess the erosion problem in specific areas. However, because of the severity of the problem there is a need for an on-going assessment of the rate of erosion at a national scale. There are thus far indications that over large areas substantial amounts of soil have been lost.

2.7.2 Past attempts at soil conservation

There is a long history of soil conservation in Jamaica. In 1946 a soil conservation officer held a post in the Department of Agriculture, and 40 soil conservation demonstration plots were started at that time. FAO cooperation dates at least from 1956, with a Report to GOJ on land and water conservation and utilization.

The main collaborative effort, however, began in 1968 with a forestry development and watershed management project (Section 3.2). This initiated what will be called the "physical structures approach", which remained the main basis for conservation effort for the next 15 years.

The physical structures approach was based on the use of earth, or in some cases concrete, structures on farmland. Bench terraces were the principal basis, but other structures included hillside ditches, orchard terraces, individual tree basins, and both grass and concrete waterways. The methods were adapted to different slope angles, soils and crops. Experimental work was carried out showing that when such structures were properly designed and well maintained, erosion was reduced to acceptable levels.

This approach was largely a failure. It was fundamentally an attempt at technology transfer, having been applied with success in some parts of Asia. There were two basic reasons for failure, cost of construction and inadequate maintenance. Construction was mainly by earth-moving machinery, owing to the very high labour requirements of terracing by hand. The costs of such construction were so high as to make it impossible to apply over the large extent of the cultivated hill lands. Terrace damage or collapse often occurs in such systems, and maintenance had to be by hand labour. Such maintenance was frequently inadequate or absent. Many areas of terraced land were allowed to degrade, with renewed onset of erosion and sometimes abandonment of cultivation.

It is inappropriate in this report to analyze reasons for failure, but one generalization may be made. This is that the physical structures approach was applied without adequate consultation with the farmers, and with insufficient research into its economic and social aspects. On-farm research would have revealed serious problems within 5-7 years.

This failure resulted in considerable economic and social losses. These were ineffective use of development aid funds, and of Government effort and funds; the wasted effort put in by the farmers; and above all a discrediting of soil conservation in the eyes of the people.

A reservation must be added to the above, strongly-worded, generalization. There are farms in Jamaica where physical conservation structures have been maintained, and farming on them is economically successful. There are also certainly sites where such structures are a necessary means of conservation. Research into the different requirements and responses of Jamaica's soil types could help to identify such sites.

From 1987 a new approach was adopted, based on biological conservation methods. This is described in Section 5.1 below.

2.8 OTHER PROBLEMS OF SOIL DEGRADATION

2.8.1 Loss of agricultural land

Much urban and industrial development has taken place on good agricultural land. The problem is most serious on the St. Catherine Plains. The 1980 aerial inventory of land cover showed urban and industrial uses to occupy 5.5% of the country, but inspection of the more recent land cover map suggests this proportion is increasing. The requirements of some kinds of industrial and urban development mean that some loss of agricultural land cannot be avoided. However, given the limited extent of Jamaica's good agricultural land, the certainty that urbanization will increase, and the fact that conversion of land to non-agricultural uses is for all practical purposes irreversible, there is an urgent need to control this problem, before it becomes more serious.

A related problem is that of tourism development, mainly on the north coast, which involves some loss of productive soils and needs to be considered.

2.8.2 Rehabilitation of mined land

The need for rehabilitation of mined land arises mainly in bauxite mining. Bauxite is mined by extraction of earth from deep, open pits, which initially leave scars on the landscape. After extraction of alumina, the waste is discharged as a suspension, known as 'red mud', which is disposed of into "red mud lakes". An alternative method of disposal more recently developed is one of dry mud stacking.

The rehabilitation of mined land is handled by a combination of legal requirement, in the granting of mining licenses, and a high sense of environmental responsibility on

the part of the companies concerned. The topsoil is removed prior to quarrying, the quarries are subsequently filled in, the land contoured and the topsoil replaced. Rehabilitated land is initially placed under pasture, but may subsequently be returned to arable use.

The red mud lakes are initially sterile and toxic to life forms but are of limited extent and are carefully monitored and controlled. After the lakes dry out sufficiently to acquire an adequate bearing capacity, a range of plant species has been identified which will revegetate them, with ultimate return to agricultural use over the span of a human lifetime. It is hoped that this recovery will be more rapid under dry mud stacking.

Thus neither the mined land nor that used for waste disposal is permanently lost from agricultural or forestry use.

2.8.3 Soil salinization

On parts of the southern coastal plains there is a problem of saline intrusion. This arises on areas which are level, with mostly alluvial soils, which dry and require irrigation. At present it is due to a combination of the intrusion of saline sea water into the groundwater and poor soil and water management practices. Some naturally occurring saline soils are also present.

2.8.4 Soil pollution

The extent of soil and groundwater pollution from agricultural and industrial activities are not presently known. The Government is aware of the possible hazards and monitoring of the situation needs improvement. This responsibility now falls with the Underground Water Authority (UWA). Due to the extent of limestone as a parent material, soil acidification is not a widespread problem.

Soil acidification caused by the emission of industrial chemicals, a problem in industrialized countries, has not been reported for Jamaica. NRCA should monitor this danger.

2.9 SOILS RESEARCH

In relation to the importance of soil conservation and soil productivity in the environment and the economy, there is relatively little current soils research in Jamaica. There is no soil research institution.

Research into soil conservation has taken place sporadically in the past, through watershed measurements and erosion plots. Such work is at present being conducted by two individual scientists, working in conjunction with the Research and Development Division of the MOA; and by a U.K.-funded project studying agroforestry for soil conservation in the Blue Mountains.

In the past there has been considerable work done on soil fertility in relation to identified soil types and major crops of the country. The Research and Development Division has a mandate for such research, but through lack of funding it is largely in abeyance at present. Soil fertility research is being revitalized by contracts with the Soil Nutrients for Agricultural Productivity (SNAP) project. This has as its focus the efficient use of fertilizer, both for production and to reduce groundwater pollution. Crop-specific fertility studies are also being done.

There is inadequate knowledge of the physical properties of soils, necessary as a basis for methods of conservation, and for water relations, including irrigation.

Chapter 3

Institutions and projects

3.1 INSTITUTIONS

3.1.1 Overview

Institutions which have responsibilities for soil productivity and conservation include the following:

Ministry of Agriculture:	(MINAG or MOA)
Planning and Policy Division	
Rural Physical Planning Division	(RPPD)
Rural Agricultural Development Authority	(RADA)
Forestry Department	
Research and Development Division	
Ministry of Public Service and the Environment:	
Natural Resources Conservation Authority	(NRCA)
Office of the Prime Minister:	
Planning Institute of Jamaica	(PIOJ)
National Land Policy Committee	
Parastatal organizations:	
The Commodity Boards, e.g. for Coffee, Cocoa, Coconut, Banana	
Forest Industries Development Company	(FIDCO)
The Coffee Industry Development Company	(CIDCO)
Research and educational organizations:	
University of the West Indies:	(UWI)
Soil Science Department (Trinidad)	
Geography Department	
Caribbean Agricultural Research and Development Institute	(CARDI)
College of Agriculture	(COA)
Jamaican Agricultural Research Programme (part of the Jamaican Agricultural Development Foundation)	(JARP/JADF)
Jamaican Agricultural Society (representing the private farming sector)	(JAS)

Other Government institutions which have responsibilities related to, or with consequences for, soils policy include:

Lands Department	
Town and Country Planning Authority	(TCPA)
Underground Water Authority	(UWA)
National Irrigation Commission	(NIC)

3.1.2 Institutional responsibilities

The institutional structure with respect to soil activities is fairly complex, and there have been a number of recent changes in responsibilities. The present position is as follows.

The Planning and Policy Division of the Ministry of Agriculture coordinates overall policy. It is the channel of communication between other divisions of the Ministry and central Government. Questions of the allocation of responsibility for soil matters, as between different parts of the Ministry, are thus decided by this Division.

RPPD carries out soil surveys and land evaluation studies as a basis for rural land-use planning. Studies are carried out on request, and clients may be government departments, technical assistance projects, commodity boards or private institutions. The nature of this work has been noted above (Section 2.4). It is basically concerned with planning, although an element of research is present in the determination, and refinement, of criteria for land evaluation. Its staff includes soil scientists and land evaluation specialists. Whilst formerly organized into four regional units, its work is now very largely based on Kingston.

RADA provides the agricultural extension service. It operates through parish offices, found in every rural parish, and extension areas. Most parishes are divided into 4-6 extension areas, giving a total of 60 such areas. The grass-roots staff in each area are an area extension officer and agricultural assistant. The emphasis is on helping farmers with holdings of less than 2 ha, but advice is available to farms of any size.

RADA's responsibilities include promoting the use of appropriate soil conservation measure on farms. Its staff includes four soil conservation officers, one in each region. The current practice is to integrate soil conservation advice with other aspects of agricultural improvement.

RADA also contains a Technology Transfer Unit, with the valuable function of conveying research results to demonstration staff.

The Forestry Department² is responsible for forestry and forest lands, the latter including forest reserves, other government land under forest, and assistance to private forestry. The forest plantations are managed by the Forest Industries Development Company (FIDCO).

² Formerly, or alternatively, called the Forestry and Soil Conservation Division (FSCD).

Because of the nature of the Jamaican environment, with its central core of hills forming the source areas for watersheds, conservation is a highly important part of the role of this Department. Soil conservation is largely equivalent to maintenance or improvement of the forest cover in these areas.

The Department has conducted some research into agroforestry. It also operates a soil conservation demonstration area at Smithfield, in Hanover Parish, which is currently short of staff and funding and is not fully maintained.

The Research and Development Division is responsible for agricultural research, including research into soils. It operates three research stations and three substations, situated in different environmental conditions, the principal one being Bodles Research Station, west of Kingston. It communicates research results with the extension service through the Technology Transfer Unit of RADA. Its current activities are strongest in the area of livestock production. In the past, this Division has conducted research both into soil fertility and soil conservation, but its capacity for soil research is at present weak.

Within the Ministry of Finance and Planning, PIOJ is responsible for coordination of national planning. Proposals from ministries are passed on to it for analysis. It includes a Technical Cooperation Division, which provides the link between the Jamaican Government and international aid agencies.

NRCA is responsible for the effective management of the physical environment to ensure conservation and proper use of its natural resources. This is a very wide-ranging mandate, covering minerals, coasts, water and forest resources, wildlife and biological resources, and soils. It is concerned with the use and conservation of resources by agriculture, forestry, fisheries, mining, tourism and energy, as well as with environmental health. It is responsible for environmental impact studies of proposed new developments. There is a Watershed Division, which conducts field investigations.

Thus both soil conservation and the productive use of soils fall technically within its field, as do many other aspects of the economy. It is apparent, however, that many questions of resource management must be, and are, delegated to appropriate ministries and divisions, in the case of soils to the MOA. NRCA's responsibility is overall conservation, including the monitoring of the resource base to enable it to do so, and the establishment of regulatory regimes. A further role is in public education into awareness of the environment.

The UWI operates on an inter-island basis, and the Faculty of Agriculture, including the Department of Soil Science, is in Trinidad. Many Jamaican soil scientists received their education there, and links through PhD-based research continue. Agricultural research is also conducted by CARDI, which has an office on the Mona (Kingston) campus of the University; and through the Jamaican Agricultural Development Foundation through its Jamaican Agricultural Research Programme (JARP). The College of Agriculture (COA) is currently responsible for diploma level education, but its upgrading to first degree status is under consideration.

The National Land Policy Committee has members drawn from a number of ministries, including the MOA, and from the private sector and professional organizations. It includes a Subcommittee on Land Resources and Land Use. This Committee can receive information and proposals concerning soils and their utilization, and review them in relation to the many other aspects of land policy.

The division of responsibilities for soils policy and activities is considered further below.

3.2 DEVELOPMENT PROJECTS

Attempts to achieve better soil conservation have been conducted to an important extent through projects. The following are the most relevant.

Forestry Development and Watershed Management in the Upland Regions (1968-1975). A soil conservation unit was established in the MOA. Four demonstration watershed sites of 80 hectares each were set up, and training provided. A survey was conducted of the protection needs of watersheds. It appears to have been this project which established the use of bench terracing and other physical conservation structures as the principal method of soil conservation for the next 20 years.

Second Integrated Rural Development Project (1978). Among other measures, this promoted the use of physical conservation works. Farmers were given subsidies to construct bench terraces and related structures. This approach was not successful, in that the structures were not maintained.

Strengthening the National Soil Conservation Programme for Integrated Watershed Development (1979-1982). Detailed proposals were prepared for six watersheds but it appears that these were not implemented.

Strengthening of the Department of Forestry and Soil Conservation (1982-1983); and Institutional Strengthening of the Department of Forestry and Soil Conservation (1982). The Department was reorganized, including a soil conservation section. Training was provided and draft forest law prepared. In the context of soils policy, it may be noted that the project report on the above included a Statement of Soil Conservation Policy.

Hillside Agriculture Project (1987-1997). This is the largest project currently being implemented in the hill lands. Its aims and strategy are set out in Section 5.1.1 below. It operated initially in the Rio Cobre and Rio Minho watersheds, but has recently been extended to watershed areas in eight eastern parishes. To date it has contacted about 6 000 farmers. The project is recognized for funding purposes as being 70% agricultural in aims, and 30% environmental.

This project marks a turning point in policy on soil conservation. Biological methods of conservation are used, primarily the maintenance of soil cover. Close involvement of the farmers is maintained.

The National Forestry Action Programme (1990-). The programme notes the extreme seriousness of forest clearance, erosion and resulting watershed degradation. It identifies five priority areas, relevant of which in the present context is Forestry in land use. The programme sets out a large number of proposed projects. Among those indicated as "high priority" are: Project 1.02 Agroforestry; 1.03 Land use control in watersheds; 5.03 Strengthening of the Forest Department; and 5.06 Natural resources legislation. Project 1.04 is for land-use planning of 10 watersheds.

The Agroforestry Development Project. This is a one-year project in the Christiana area, the primary aim of which is the on-farm growing of stakes for support of yams. It has made a substantial impact in the area in a short time. A proposal has been prepared for an expanded three-year project.

There is a recent U.K.-funded research project on Forest Clearance, Agroforestry and Soil Conservation which is investigating the effects of contour hedgerows on soil conservation in the Blue Mountains.

Preparatory documents exist for a future FAO/Investment Centre project in the area of watershed protection and small farmer development, but this has not yet received approval.

3.3 GOVERNMENT AND PUBLIC AWARENESS OF SOIL QUESTIONS

The Government's awareness and concern for soils policy is indicated in the series of projects outlined above. It has given attention to soil conservation for at least 50 years. Soil productivity receives attention within the context of improved farming methods. An indirect indicator is the ambitious target for growth of agricultural production during the current five-year plan. The Government's acceptance of this National Soils Policy project is a further indication of its awareness and concern!

The Jamaica National Report on the Environment to the UNCED (1992) notes among many other problems those of mined land rehabilitation, watershed degradation, deforestation, and four environmental impacts of agriculture: soil erosion, reduced river flow, agricultural chemicals in the watertable, and saline intrusion. Among the "key issues" of land, it notes the absence of a comprehensive land use policy; ill-defined responsibilities; and inadequate staffing and facilities of institutions.

It is difficult to generalize about public awareness, but it may be said that the farming community at least is well aware of the importance of soils as a basic resource. The past failure to maintain soil conservation structures can be explained on the grounds of availability of labour and, primarily, absence of an adequate economic return. There is a much better response to the current approach to conservation.

In summary, both Government and public awareness of the importance of soil resources to the economy and well-being of the people, and the need for their conservation and sustainable use, in comparison with that of other countries, is good. It is vital that this awareness, and the impetus for sustainable land use, should be maintained.

Chapter 4

Legislation

Four statutes have a major influence on soil resources issues:

- The Forest Act (1937).
- The Watersheds Protection Act (1963).
- The Rural Agricultural Development Authority Act (1990).
- The Town and Country Planning Act (1957).

Other statutes which have an impact upon soils issues, including the Jamaican Constitution, are presented in Annex 4 of this Report.

Forest Act (1937)

The Forest Act repealed and replaced the Afforestation Law of 1927. This statute reenacted the provisions of the Afforestation Law and introduced a number of new provisions, including a provision for the appointment of forest officers who were to be given power to ensure the proper execution of the objectives of the Act. These officers are the Director of Forestry and Soil Conservation and other officers of his department. The Forest Act falls under the authority of the MOA.

The Minister is empowered to make orders declaring any Crown lands to be a forest reserve. During the period from 1938 to the 1970s numerous areas of land in all parts of Jamaica were declared as forest reserves.

Section 5 of the Forest Act sets out a number of prohibited activities in a forest reserve. The prohibited acts include the felling, girdling, making, lopping, uprooting and burning of trees and the stripping off of the bark or leaves from trees, kindling and carrying of fire, manufacturing or removal of forest produce, the carrying of firearms and certain tools and the killing or capturing of wild birds and other wild animals. The maximum penalty is a fine of \$50.00, and the Court can order an offender to pay compensation for any damage done to the forest.

The Minister is also empowered by the Act to declare any area of Crown land to be a prohibited area for the purposes of protecting the land from fire, theft of forest produce or any other abuse. In Section 7 it is an offence for any person

to enter a prohibited area without a permit from an officer who has been authorized to issue a permit.

Section 15 establishes a mechanism whereby landowners who desire to establish or conserve forests on their lands can apply to the forest officer to do so, and the Minister is empowered to apply to such land provisions of the Forest Act as he considers suitable in the circumstances.

Section 10 enables the Minister to make orders declaring land other than Crown land to be protected areas. These orders may prohibit or regulate the breaking up or burning or clearing up of vegetation. Forest officers are empowered to carry out work in protected areas.

Under Section 10 of the Forest Act, the Minister may declare private lands to be protective areas and may impose regulations upon the use of such land. The owner of such private lands which are declared to be protective areas is entitled to remission of property tax so long as he complies with regulations or direction in regard to such land. The owner is also entitled to compensation in accordance with the formula spelt out in Section 12 of the Forest Act.

The Forest Act (S. 26(1)) permits the Minister to grant permits or licenses in respect of trees on forest lands.

The Forest Rules, 1945, governs the granting of licenses to fell trees and extract product in Crown lands, the fees to be paid for such licenses and the issuing of permits to use trails in prohibited areas, to camp in forest reserves, to hike through certain parts of the forest reserves or to occupy forest huts.

Watersheds Protection Act (1963)

The Watersheds Protection Act is designed to provide protection of watersheds and areas adjoining watersheds to ensure the conservation of water resources. Under Section 3 NRCA has responsibility for watersheds management and Section 4 confers upon NRCA the duty to promote the conservation of water resources and to institute such measures and to recommend to the Minister for implementation of such programmes as it considers necessary for the protection and management of watershed areas or areas adjoining watershed areas.

The Minister may upon recommendation of the Commission by order declare any area to be a watershed protection area. Watershed Protection Area orders under Section 5 have been made for various areas. While a Watershed Protection Area order is in force the controls and restrictions imposed under the Watersheds Protection Act have effect notwithstanding the provisions of any other enactment (See Section 6).

Under the Act, NRCA may enter into an agreement with the owner or any other interested persons of lands within watershed areas to carry out improvement works in relation to such land. Where no agreement can be reached for the carrying out of an improvement scheme which has to be published in the Gazette,

persons affected may object to the scheme and their objections along with the proposed scheme are then sent to the Minister. If the Minister is satisfied that the scheme is in the public interest he may take such necessary steps to oblige the owner or interested persons to carry out the scheme or NRCA may arrange for the scheme to be carried out. The Act provides for compensation arising from the substantial diminution in value of the affected land.

While a number of watershed areas have been declared under this Act no regulations have yet been promulgated.

Comparison between Forest Act and Watershed Protection Act:

- While the Forest Act and the Watershed Protection Act appear to have overlapping functions there are some important distinctions.
- The Forest Act establishes forest reserves (primarily on Crown land) and makes provision for regulations of the use of and the activities on such forest reserves. The Watershed Protection Act provides for the designation of watersheds (on both Crown land and private land) for conservation purposes. In addition, the Watersheds Protection Act is intended to reduce soil erosion, ensure a regular flow in rivers and streams, encourage optimum levels of groundwater, and encourage proper land use. Under the Watersheds Protection Act there is an override clause i.e. the Act provides that it prevails over all other acts dealing with the same subject matter.

Rural Agricultural Development Authority Act (1990)

Under the Rural Agricultural Development Authority Act (13/1990) RADA is established to *inter alia*:

- (a) provide an efficient agricultural extension service and participate in the formulation and implementation of appropriate rural development projects with a view to stimulating and facilitating the development of agriculture in Jamaica;
- (b) encourage and, so far as may be practicable, having regard to the financial and other resources at the disposal and to the statutory powers of the Authority, to secure the proper economic and efficient utilization of all land in the rural areas;
- (c) encourage and, so far as may be practicable, having regard to the financial and other resources at the disposal and to the statutory powers of the Authority for such purpose, to assist or to participate in the doing by private enterprise of any improvement work in the rural areas to such extent and in such manner as the Authority may consider expedient;
- (d) provide technical and advisory services in connection with agriculture, including:

- i) research, training and development programmes;
- ii) the development and operation of agricultural service centres in the rural areas.

This Act repealed the Land Authorities Act.

The Town and Country Planning Act (1957)

The Town and Country Planning Department is the agency which deals with physical planning, and serves as the secretariat of the Town and Country Planning Authority (TCPA). This Authority administers the Town and Country Planning Act, which regulates all development activities. The Authority, by virtue of its membership, also serves as the principal coordinating body for environmental management. It is chaired by the Government Town Planner, and has representation from the NRCA, the Environmental Control Division (ECD) and PIOJ, as well as the development agencies, all of whose projects must receive the Authority's approval. In addition, the NRCA and the ECD have independent refusal authority over projects by virtue of their respective authorizing legislation.

The role of the Town Planning Department is to carry out comprehensive and balanced development of land throughout the island along the national/regional and urban development policy guidelines of the Government. Inherent in these functions is the vital role of development control with respect to the orderly and progressive development of cities and towns and their necessary amenities, as well as education of the public regarding the role of the planning process as a critical aspect of community life. The Town Planning Department is represented on TCPA. The Town Planning Department is responsible for: preparation of the National Physical Plan; recommendations for public policies on land use and development; preparation of land use studies, plans and regulations; preparation of development orders; coordination of inter-agency review of subdivision applications; and the preparation of development suitability maps and studies.

It is necessary to strengthen the existing basis for planning control. This would include provisions for environmental impact assessment, declaration of areas as environmentally sensitive areas, power to impose stop orders and injunctions in regard to illegal development. In addition, given the past history of lack of enforcement of planning legislation, an institutional analysis needs to be undertaken to review needs for the effective enforcement of planning legislation. This should be coupled with a public awareness programme of the need for effective planning legislation.

It will also be necessary to introduce a system of land zoning to guide development in critical areas.

PART THREE

PROBLEMS AND POLICY ISSUES

Chapter 5

Technical issues

Soil policy can be considered under technical, institutional and legal issues. Technical issues cover soil classification, mapping and evaluation; the identification and monitoring of soil degradation; and productive and sustainable soil management. For each of these, both research and implementation are included. Institutional issues include the further development and updating of policy; the development of strategies, programmes and projects; and the identification of requirements and implementation of programmes for research, education, training and extension. In simplified terms, the technical elements cover, "What needs to be done?" and the institutional elements, "How is it to be done?" Legal issues cover the effectiveness of existing legislation, including both the law itself and its enforcement, and the need for changes.

5.1 SOIL EROSION AND CONSERVATION

5.1.1 Strategy for the hill lands: the Hillside Agriculture Project's approach

An analysis of alternative strategies for hill lands was carried out in preparation for HAP. Four alternative strategies, or scenarios, were analyzed in terms of their environmental, economic and social consequences.

The three strategies **rejected** were:

1. *Do nothing* - Allow the population to decline, and the cultivation of annual crops without soil conservation to continue.

Agricultural production will stagnate and then decline as soils become more eroded. Ultimately, many areas will become severely eroded and abandoned. There will be low incomes, low employment opportunities, and low production.

This 'policy', one of inaction, is rejected as being unacceptable on all three criteria. Environmentally, the soil resources of the hills are destroyed, and there will be less reliable water supply and increased flooding hazard on the plains. Economically, the high potential of humid hill lands for production of tree crops will be lost. Socially, the displaced population will migrate to the towns.

2. *Annual cropping with physical conservation works* - Heavy use of bench terracing and similar measures, combined with increased inputs to annual crops. The farmers are subsidized, by capital construction works, to retain their present cropping patterns.

This was the strategy followed in earlier soil conservation projects (Sections 2.7.2 and 3.2). It is rejected for three reasons. First, the cost of constructing physical conservation works on steeply sloping land is unacceptably high. Secondly, experience has shown that such works are often not maintained. Thirdly, the soils are not being farmed in the way to which they are best suited, for tree crops.

3. *Planned resettlement of farmers onto the lowlands, with extensification in the hills* - The hills will be used for tree crops and livestock production, reducing erosion. The resettled farmers will practice intensified farming on the lowlands. This solution is environmentally acceptable, and it rationalizes land use. It is rejected on social and economic grounds, the need to find land and the high cost of resettlement.

The **current strategy**, as applied in HAP and in general in extension work by RADA, is the following:

Intensified agriculture based on tree crops. Hill farmers are encouraged and assisted to grow tree crops (coffee, cacao, fruit trees, timber trees, etc.) using improved management methods. Smaller areas of annual crops are grown on suitable sites, including by strip cropping. Agroforestry practices are encouraged. Population will stabilize at about its present level. Erosion will be controlled mainly by biological methods, particularly soil cover.

The economic basis to this strategy is to produce crops for which there are known markets. The social basis is to involve farmers in the design of improved management systems. Initially, scarce investment resources were directed into areas where they were expected to be most productive, but the strategy is now being extended more widely. Large increases in yields of coffee and cacao, of the order of twofold or more, have been achieved.

From an environmental, and particularly soils, viewpoint, this strategy has much in its favour. Erosion control is achieved at much lower costs than by physical conservation structures. Furthermore, soil conservation is achieved as part of total farming development, underlain by the economic incentive of higher yields and income. This economic incentive is more effective than the former financial incentive of subsidy payments. Soil conservation becomes a part of the total agricultural improvement package. The valuable soil and climatic resources of hill lands are put to the uses for which they are best suited.

The strategy of HAP is also being followed by RADA and the Coffee and Cacao Commodity Boards. A specific opportunity to promote conservation arises when

loans are granted. Loans and other incentives should be specifically tied to implementation of appropriate soil conservation measures.

From a soils viewpoint, questions which may be asked about this strategy are:

1. Does HAP experience to date, support the *ex ante* analysis of this strategy? Recent project reviews give a positive reply to this: substantial crop yield increases have been achieved and farmers' interest and cooperation is high.
2. Does the strategy in fact reduce erosion? Present evidence comes only from qualitative observation. The improved tree crop plots have a dense ground cover, both of living vegetation and plant litter; it has been established that such a cover greatly reduces erosion. Quantitative monitoring, either by erosion plots or of watershed sediment loads, has not been carried out.
3. How can a comparable strategy be applied in hill areas for which the main cash crops are annuals, particularly the yam growing areas? It would be contrary to the economic basis of the strategy to discourage cultivation of crops which produce high returns.

These questions are discussed below.

5.1.2 Strategy for the hill lands: reservation of areas for non-agricultural uses

Parts of Jamaica's hill lands are so steeply sloping, dissected or inaccessible that their potential for agricultural use is low, whilst soil conservation under such use would be difficult. The cost of conservation for agricultural use could not be justified by the returns.

On the other hand these same areas have a major potential for non-agricultural uses: forestry, water supply, biological conservation and tourism. Every effort should be made to encourage such uses on this land. This can be achieved by three legal and institutional means: forest reserves, designated watershed areas, and national parks.

Forest reserves are managed mainly for conservation, but with controlled forest production as an additional benefit. Protection of reserves from timber poaching and agricultural incursion is unsatisfactory. This problem falls within the scope of NFAP.

Watershed protection areas may be designated, with powers to regulate land use within these (Section 4.3). These will be most appropriate in the upper catchment areas of watersheds, with high rainfall. The basis for management should be to achieve soil conservation through maintenance of a forest cover, and thereby reduce runoff, increase infiltration through the soil to groundwater, and so stabilize river discharge. Water is an output from land, just as are agricultural crops.

As an early outcome of NFAP, two national parks have been designated, of which one is marine. The second is the Blue Mountains, John Crow Mountain National Park,

covering the highest mountain areas to the east of the country. These contain some areas of undisturbed natural forest, have rich biological resources, and are a source of water.

All of these measures - forest reserves, watershed protection areas and national parks - may be viewed as the selection of land suited to forestry and conservation but not to agriculture, and maintaining such land uses. As such, they are fully in accord with the principles of land suitability evaluation, the use of each type of land for purposes to which it is best suited. In these cases, the successful application of broad land policy will have the effect of achieving both soil conservation and appropriate soil management.

5.1.3 Methods of soil conservation

The former emphasis on bench terracing and other physical structures as the basis for soil conservation, and the overall failure of this approach, has been outlined above (Section 2.7.2). It has also been noted that such structures still have a role to contribute on certain sites. They are essential, for example, in association with road construction, both for public and forest roads.

The present emphasis is on biologically based methods of conservation. Methods available include:

- a continuous ground cover of living plants and plant debris, achieved by closely spaced trees, or trees with herbaceous plants;
- hedgerow intercropping³: hedges, or belts of trees, planted parallel to the contours;
- grass strips, planted parallel to the contours.

Both wider world experience and that of Jamaica indicate that for steeply sloping hill lands, biologically based methods are more effective than physical structures. This effectiveness is in part technical⁴, but lies also in the greater economic and social acceptability of such methods.

Particular attention is needed in yam-growing areas. "Continuous mounds" (contour ridges) reduce runoff at a micro-scale, and the miniset method improves soil cover. Combinations of structures with biological methods are often appropriate. A research study of the efficiency of contour hedgerows for soil conservation is in progress in the Blue Mountains.

Different methods are appropriate in different conditions, both environmental and socio-economic. For example, for yams, continuous mounds (i.e. contour ridges) are

³ Also called alley cropping.

⁴ In terms of the Universal Soil Loss Equation, a ground layer of living plants or plant litter lowers the cover factor; grass strips reduce the effective slope length factor; and contour hedgerows both reduce the slope length factor and give more rapid infiltration, thereby reducing the soil factor.

advocated. Biological methods can be used in combination with earth structures. Different methods will be appropriate in different conditions, including slope angle, soil type, cropping, and the socio-economic circumstances of the farmer. Research is urgently needed into appropriate conservation techniques.

5.1.4 The potential of agroforestry

Agroforestry is a collective name for land-use systems in which trees are grown in association with herbaceous crops, either in a spatial arrangement, a rotation, or both, and in which there are ecological and economic interactions between the trees and other components of the system. Agroforestry has both productive and conservation functions. Production includes wood products, fuelwood, fodder and fruit. By far the most important service function is soil conservation, including both control of erosion and maintenance of fertility.

Jamaica possesses well-developed indigenous agroforestry systems, particularly the tree gardens, containing a wide variety of fruit trees, and plantation crop combinations, such as bananas with coffee. There is also some awareness of the potential for further development, in particular in the current Agroforestry Development Project. Some trials of multipurpose trees have been carried out, and there are technical guide sheets.

The hill lands policy outlined above is one means of using agroforestry to control erosion. There are further possibilities for this. In particular, contour hedgerows, or contoured lines of tree crops, could be used as a means of control in areas under annual crops. These techniques should not be applied without being accompanied by research, both on-station and on-farm.

The agroforestry approach of diagnosis and design, in which farmers are consulted about the design of improved systems at all stages, is wholly consistent with current Jamaican extension policy.

5.1.5 Soil conservation demonstration sites

At times in the past, Jamaica has had a network of soil conservation demonstration sites. At present, these are represented by the Smithfield site, funding for which is inadequate for proper maintenance. HAP has demonstration sites which display conservation farming.

In association with research, it is desirable that an islandwide network of soil conservation demonstration sites should be rationalized and revitalized. The Smithfield site could be used for research, its erosion measurement plots restored but with additional treatments. Its bench terracing demonstrations could be maintained, but this should be alongside demonstrations of biologically-based methods of conservation. Selected HAP plots could be identified as specific soil conservation demonstrations. A network could be established, based on the principal agroclimatic zones, soil types and cropping patterns, with research into, and demonstration of, appropriate conservation methods for each.

5.2 URBAN ENCROACHMENT ONTO AGRICULTURAL LAND

The expansion of urban, industrial and tourist activities onto agricultural land is a serious problem. Jamaica's agricultural land is of limited extent and there is urgent need to plan, monitor and control the further loss of this land.

Private land owners will always find it financially profitable to sell land or lease agricultural land for urban, industrial and tourism uses. Hence, this problem can only be controlled by legislative and planning mechanisms. It is agreed that at present, such planning controls are not adequately effective. This matter of the law and its application is discussed in Section 7.

A Cabinet Sub-Committee on Land Policy has recently recommended, as a policy statement for the agricultural sector, that "All arable lands will be preserved for agricultural purposes", where agricultural lands are defined as Land Capability Classes I-IV. It is desirable from a soil resources aspect that this statement should be reaffirmed, and planning mechanisms necessary to implement it be established and applied. For this purpose, the existing Land Capability Classes should be re-examined and revised as necessary, as a basis for land suitability zoning (Section 5.6).

5.3 REHABILITATION OF MINING LAND

As already noted, the rehabilitation of mined land is very well handled for the principal mining activity, bauxite. Mined areas are restored to agricultural use, with replacement of the topsoil. Waste (red mud) disposal is confined to small, strictly controlled, sites, for which studies are in progress to lead towards their eventual reclamation. This success has been achieved through the existence first, of strict legal requirements in the granting of mining rights, and secondly, a high sense of environmental responsibility on the part of the mining companies. This action, and the soil research on which it is based, is commended and should continue.

It is expected that other mining and quarrying activities may be developed. Already occurring is illegal sand quarrying, partly on beaches but also through removal of sandy subsoil from agricultural land. Marble quarrying is also found. The legal basis for control exists in the Mining Act and the Quarrying Act, and the need is for enforcement.

5.4 SOIL SALINIZATION

Whilst primarily a problem of groundwater, soil salinization is found on some dry areas on the southern coastal plains. It is caused by excessive abstraction of groundwater for irrigation, leading to intrusion of saline sea water. Salinity has caused lowering of sugar cane yields followed by cessation of cane cultivation on some soils, for example on the Clarendon Plains and the Caymanas area of the St. Catherine Plains. Surveys of soil salinity in these areas were conducted in 1986-1988.

The extent of soil salinization should be ascertained. Research is needed into combinations of irrigation and drainage which will help to combat it. Soil scientists should work in collaboration with groundwater and irrigation authorities. SIRI is in a position to study this problem.

Legal controls on the sinking of new wells and on rates of abstraction exist, operated by a system of licensing from UWA.

5.5 MONITORING OF SOIL EROSION AND DEGRADATION

Environmental monitoring, by which is meant quantitative measurement of changes with time, is an established method internationally, through the Global Environmental Monitoring System (GEMS) of UNEP. For Jamaica, it may be considered with respect to monitoring, first of erosion, and secondly of other forms of soil degradation.

5.5.1 Monitoring of erosion

There has not been any systematic attempt to measure or monitor the rate of erosion for the country, nor to assess the consequences and costs. Figures in excess of 50 tonnes per hectare per year are sometime quoted, but there is no sound basis for these. Given the agreed extent of erosion, and the severity of its consequences, this situation should be remedied.

There are three steps to such monitoring:

1. Estimate present rates of erosion.
2. Assess the consequence of this erosion, including both on-site productivity and off-site effects.
3. Convert these estimates into economic terms, as financial and social costs.

For measurement of erosion on a regional scale, the primary technique is measurement of river sediment load, relating sediment to discharge. UWA⁵ has 130 gauging stations, but at present only makes very limited measurements of sediment load. For assessing loss of production as a result of erosion, FAO has developed techniques. Similarly, there are known means of assessing the off-site costs. The third step, that of conversion of physical data into economic terms, is important, as a means of assessing the real cost, to the country and the community.

5.5.2 Monitoring of other forms of soil degradation

Given the urgent need to check urban expansion onto agricultural land, the new air photographic cover recently obtained for the country should be interpreted to map the

⁵UWA has responsibility for both surface and underground water resources.

extent and location of urban uses. This can be compared with the estimate of 1982, to give the recent rate of land loss.

Monitoring of progressive changes in soil properties, such as salinization and industrial pollution, is a relatively new technique, now being advocated as a basic activity of soil survey organizations. It is based mainly on repeated soil sampling and analysis over time. Selective studies in priority areas are desirable.

Responsibility for environmental monitoring lies with NRCA, which delegates specific aspects to appropriate bodies. Direct measurement of river discharge and sediment loads is appropriately conducted by National Irrigation Commission and UWA. RPPD has the ability and facilities (although not, without assistance, the capacity) to conduct a national inventory of erosion, and to conduct monitoring based on methods of remote sensing.

5.6 LAND ZONING

There is a range of circumstances in which decisions on type of land use - agriculture, forestry, urban, tourism, etc. - are taken, in whole or part, on the basis of the inherent properties of the land.

In hill lands, the designation of forest reserves, protected watershed areas and national parks is made on the basis of low suitability for agriculture, but higher suitability for forestry, water yield and biological conservation/tourism respectively. This need is well served by the current system of land suitability evaluation.

At the opposite extreme, planning controls on urban and other non-agricultural uses of land should be based on a substantial part on the relative agricultural value of land. The guidelines for this control are currently based on a system of land capability classification. For administrative purposes, the simplicity of capability classification is an advantage. However, the physical basis of this classification may require re-examination in the light of advances in methods of land evaluation.

It is suggested that a system of land zoning should be considered. Such a land zoning system would first, set up objective criteria for defining land of high agricultural productivity, and secondly, map its extent. The system could be applied first to the high-risk areas for urban expansion.

RPPD would be the appropriate institution to establish such a system, working in cooperation with the urban planning authorities which would make use of the results.

A more comprehensive task would be the preparation of a National Master Land Use Plan. This has been done for a number of other countries. Such a plan would cover all aspects of land zoning on the basis of suitability, including those discussed above. The resource requirements to prepare such a plan would be substantial. The suggestion is put forward for consideration by the National Land Policy Committee.

5.7 THE NEED FOR RESEARCH

There is a spectrum of research activities: basic-strategic-applied-adaptive. Jamaica does not have the resources to engage in basic or strategic research, other than possibly in conjunction with the Soil Science Department of UWI, or in joint projects with foreign universities. Applied research into soils means the development of soil management systems that will effectively achieve stated aims, for example research into tree-based or other plant-based systems as a means of checking erosion. Adaptive research is directed at testing such systems on different soil types; for example, the formerly used systems of terraces were found to be unsuited to soils on soft shales.

There is an urgent need for research into methods for soil conservation in Jamaica. The lack of such work in the past led to the considerable expenditure of funds on methods which were later found not to be successful in the Jamaican context. It is the experience from that period that has led to the present basic change of approach.

With respect to soil fertility and productivity, the position is that much good work has been done in the past, and there is a store of knowledge on which to base recommendations. Such knowledge, however, needs to be updated and adapted to different soil types. There is a need to revive soil fertility research, and maintain it on a continuous basis.

Study of the physical properties of soils, particularly water relations, has lagged behind earlier work on soil chemistry. Such work is needed in particular as a basis for the efficient use of irrigation water.

Jamaica's experience shows that it is essential that research should cover not only technical but also economic and social aspects of proposed systems. A soil management system that is technically effective on a research station is of no use if it is not adopted by farmers. This means, first, that to be effective, systems should be of direct economic benefit to the farmer, in the short term as well as the long; and secondly, that it should not have unrealistic demands for labour or capital.

Matters into which soil research is needed include the following:

- *Methods of soil conservation* - Including development of biological methods, the potential of methods based on agroforestry, linking biological methods with physical structures, economics and acceptability of conservation methods.
- *The potential of agroforestry in Jamaica* - Including for production of wood products (timber, stakes, fuelwood), production of fodder, role in soil conservation, contributions to soil fertility, economics and acceptability of agroforestry systems.
- *Soil fertility* - Including fertility requirements of different soil types, efficient use of fertilizers, combination of fertilizers with biological means of sustaining soil fertility, impact of fertilizers on soils, economics and acceptability of chemical and biological methods of maintaining soil fertility.

- *Soil physical properties* - Particularly, but not only, soil water relations.
- *Soil restoration after mining operations* - Continuation of the present work on restoration of mined-over land and reclamation of mining waste disposal sites.
- *Land use responses of soil types* - Development of knowledge on the erodibility, resilience, productivity and land use responses of specific soils, in order to adapt land use recommendation to soil types.
- *Land suitability and land-use planning criteria* - Ongoing revision of Jamaica's physical land evaluation system and development of criteria for land zoning.

Chapter 6

Institutional issues

6.1 SHORTAGES OF STAFF AND FUNDS

The MOA has recently undergone severe cuts in staffing, leaving many divisions operating at the limit of their capacity. Levels of staffing and funding of Government services as a whole is a matter of general policy. It is relevant in this document, however, to state what are the needs if an effective soils policy is to be implemented.

In RADA, the ratio of farms to extension staff in RADA is such that only a limited proportion of farmers can be contacted. There are only four soil conservation specialists, who are working without supporting staff, equipment and operating budget at all commensurate with the size of their task. In some areas, support has come from the HAP, but this does not cover the entire country, nor is it permanent.

If the agreed strategy for the hill lands, which combines increased production with conservation, is to be effectively implemented, there is a need for a substantial and lasting strengthening of the extension staff in RADA, both in general and with specific reference to soil conservation.

RPPD is also operating at the limit of its capacity. It is currently assisted by the Watershed Inventory Subproject of HAP. An excellent basis for its evaluation and land-use planning work has been established, but this should not remain static. It needs to be continuously revised and updated, incorporating new findings. Its technical resources are at present fully occupied in meeting requests. An increase in professional staff and operating budget is needed in order to maintain this valuable service. If the additional tasks called for in this Policy Document are to be undertaken, further staff strengthening will be required.

The Research and Development Division does not have research staff in soil science. There will be some support from the SNAP project, but for a limited period only. Continuity is essential to research, for which soil research scientists on the establishment staff are necessary.

Strengthening of the Forestry Department is also needed. This forms the highest priority project within NFAP.

6.2 CLARIFICATION OF RESPONSIBILITIES

There have been some past changes in responsibilities for soils. In particular, the former Forestry and Soil Conservation Division carried out some on-farm soil conservation, and it retains the Smithfield demonstration site.

The following is a clarification of responsibilities for soils policy and activities:

- RADA is responsible for agricultural extension, and thereby for promoting soil conservation on agricultural land and for encouraging efficient soil management and the sustainable use of soils on such land.
- The Forestry Department is responsible for soil conservation on forest land, including both forest reserves and other forested areas.
- RPPD is responsible for soil survey, land evaluation and for giving technical advice as the basis for rural land-use planning.
- The Research and Development Division is responsible for research, both in soil conservation and soil fertility. It is also the appropriate body to coordinate research done by other institutions (Section 6.4).
- NRCA has overall responsibility for monitoring soils, as a major natural resource, at the national scale. It may operate through delegation of specific monitoring activities to other organizations.
- The Commodity Boards conduct research and extension for producers of their respective commodities. They have a responsibility to ensure that soil conservation practices are incorporated into the farm management systems which they promote.
- Non-governmental organizations can make contributions to extension, including soil conservation.

A problem arises over institutional responsibility for agroforestry. Most agroforestry takes place on farmland, and is thus relevant to RADA; at the same time, agroforestry involves the management of trees, in which the Forestry Department has expert knowledge. Countries differ as to which department is given primary responsibility; in some, an interdepartmental agroforestry committee has been formed. This question, which is relevant to soil conservation but extends beyond its scope, calls for further attention in Jamaica.

6.3 THE NEED FOR CONTINUITY AND COORDINATION

6.3.1 Continuity

A long-standing problem has been that of necessity, many developments in Jamaica have been carried out on the basis of projects, with partial external funding. This has resulted

in a serious problem of lack of continuity. First, staff and funding have been brought in from project funding, only to be lost at the completion of the project. Secondly, there has often not been continuity of aims between successive projects. The radical change in soil conservation policy, from the use of physical structure to biological means, is a clear instance of this.

There is no easy solution to the discontinuous nature of project funding. It is in the nature of aid projects that they are of limited duration, after which governments are expected to take over their functions. Through training and other means, government departments may have the technical capability to do this, but lack the level of ongoing funding needed.

The problem of continuity of objectives and methods can be greatly reduced through clear statements of policy. Policy will be modified from time to time in the light of changes in circumstances.

It is a major aim of this National Soils Policy to achieve continuity. A consistent Soils Policy provides a framework within which successive projects can be fitted. It thus helps to solve the inevitable breaks in funding, by ensuring that successive projects are directed towards the same set of objectives.

6.3.2 National Soils Coordinating Committee

A NSCC was established to help with the formulation of this policy and has effectively carried out this function. However, the work of this Committee should not stop at this point as it could now play an invaluable role in helping the Government to put the policy into effect. It is therefore proposed that the functions of this Committee be formalized by the Government (see recommendation under Section 8.10).

It is proposed that the primary function of the Committee will be to coordinate soil activities in Jamaica, including research, survey and evaluation, extension, education and training. In so doing, the Committee will be able to advise the Government on how to develop the necessary strategies, programmes and projects that will be needed to put the policy into effect. Proposed terms of reference for NSCC are given in Annex 5.

6.4 THE INSTITUTIONAL BASIS FOR SOIL RESEARCH

In contrast with most administrative activities, research benefits from a diversity of contributions from different institutions. They bring contrasting approaches, facilities and methods to bear on common problems. It is essential, however, that there should be ongoing coordination of such research, to assist in complementarity of studies and avoid duplication of effort.

The appropriate body to coordinate research is the Research and Development Division of the Ministry of Agriculture. Soils research could therefore be conducted by means of the following institutional structure:

Coordinating institution:

- Research and Development Division

Contributory research organizations:

- Research and Development Division
- University of the West Indies:
 - Soil Science Department (Trinidad)
 - Geography and Geology Departments
 - Caribbean Agricultural Research and Development Institute (CARDI)
- Jamaican Agricultural Research Programme
- College of Agriculture
- Commodity Boards
- Mining Companies

6.5 OPPORTUNITIES FOR EDUCATION, TRAINING AND REFRESHER COURSES

The standard of education of soil specialists in Jamaica is generally high. However, they are few in number, and in all of the Government departments noted in this review, staff are fully extended in the day-to-day conduct of their work.⁶ The additional activities called for in this Policy can certainly not be achieved without substantial increases in the number of soil scientists at all levels: research level, degree level, diploma level.

Substantial advances are currently being made in approaches and methods of soil conservation. In agroforestry, world research is highly active and advances in knowledge are being made. Other than during their initial education, staff have little or no opportunity to keep up with these advances. A mechanism should be found for refresher courses or study visits, for example in the International Centre for Research in Agroforestry (ICRAF) and institutes of soil conservation.

The public should be made aware of this National Soils Policy, particularly the farming community and school children.

⁶It may also be noted that a number of soil scientists have been lost to technical work through movement to unrelated activities.

Chapter 7

Legal issues

7.1 ANALYSIS OF THE CURRENT LEGISLATIVE FRAMEWORK, AND PROPOSED REFORMS

Most of the statutes that have been reviewed suffer from various deficiencies (e.g. low fines or absence of regulations). In addition, many of the statutes are not being enforced. For example, the existing Agricultural Small Holdings Act is not being enforced. With some strengthening of the regulatory provisions of this Act it could provide a useful mechanism in dealing with the responsibilities of landlords and tenants with regard to proper land use.

A fundamental problem is that the current planning legislation has not been an effective instrument for the control of urban encroachment on agricultural land. This stems from the inadequacy of the existing legislation as well as the fact that it is not being currently enforced. In addition, the current planning legislation does not apply to the development of agricultural land. The Jamaica National Report on the Environment notes that the Town and Country Planning Act has not been amended so as to take precedence over the Housing Act and the Urban Development Corporation Act. The present unfettered scope of the Housing Act and the Urban Development Act reduces the power of planning controls to check urban encroachment onto agricultural lands. There is also a need to strengthen the Local Improvement Act so as to prevent or control subdivision of agricultural land especially where this involves housing or other non-agricultural uses.

As presently structured, the Land Development and Utilization Act serves to encourage the development and use of land but little attention is given to the conservation of land or to the sustainable use of land. The Act does not contain any real criteria for determining improper land use. Appropriate criteria could be developed from a land classification system combined with criteria similar to those used to identify idle or under-utilized lands.

One of the key problems in soil conservation work in the context of watershed management on private lands has been the lack of titles to the land occupied by the farmers. This has restricted the granting of credit to farmers for the cost of soil conservation work and therefore has reduced the farmers' incentives to improve the holdings. Overall a major concern in land tenure is to facilitate the granting of titles (or

leased interests) to farmers in forestry areas. In addition, an attempt should be made to review and rationalize the existing land tenure legislation.

With regard to development planning, agriculture activity must come under the scrutiny of the national planning process i.e. TCPA in order to ensure that agriculture development plans are compatible and consistent with the national physical plan and overall environmental policy.

The Watershed Protection Act requires to be supported by the promulgation of regulations which will strengthen its powers under soil conservation, particularly control of the clearing and farming of designated hill lands.

The Forest Act, the Rural Agricultural Development Authority Act and the Watershed Protection Act have served as legal bases for the initiation of watershed management and soil conservation programmes. However, when more concentrated work in an important watershed is to be carried out, these statutes seem inadequate. The main reasons are:

1. They are rather passive, lacking measures of encouragement, incentives, and active involvement of farmers for grass-root planning and implementation.
2. The restrictions and prohibitions have seldom been enforced.

As a result of the multiplicity of statutes, one of the structural problems with soil conservation legislation is that the institutional frame is spread over three agencies: NRCA, the Forestry Department and RADA. In regard to NRCA, until Watershed Protection Regulations are promulgated there will be an insufficient basis for addressing the regulatory needs of an effective legal structure for soil conservation.

Where regulations, and especially standards for soil conservation and watershed protection are concerned, there is again the problem of division of responsibilities between several institutions. It would be appropriate if NRCA would take steps to develop and promulgate such regulations and standards.

7.2 THE ENFORCEMENT OF LEGISLATION

There is generally a lack of enforcement of most of the Acts that have been discussed. For example, the enforcement of the Forest Act or the Country Fires Act is almost non-existent.

Reasons for lack of enforcement are:

1. The acute staff shortage at the agency level.
2. The current level of penalties, for example, breaches of the Forest Act are subject to fines of J\$50.00, a trivial sum at the present day.
3. The absence of regulations to support laws.

4. Fragmented legislation coupled with lack of public awareness of its existence.
5. Lack of an effective enforcement machinery for existing legislation.

Staff shortages in soil-related agencies are noted in Section 6.1. Enforcement of laws and regulations calls for sufficient numbers of trained staff at field level.

Levels of penalties need to be amended by law, assuming that it is still intended that such penalties should be enforceable.

Similarly, the promulgation of specific regulations is an essential support for various laws.

The problem of fragmented or poorly-known legislation might be addressed by assembling a digest of the various laws and regulations pertaining to forestry, soil conservation and related land use matters. These could be synthesized, and expressed in plain language. The various agencies active in land use would then be in a joint position to assist with enforcement. NRCA would be the appropriate body to undertake such a task.

Chapter 8

Proposals and recommendations

A range of suggestions for action have been made throughout Part Three of this policy document. Whilst some can be accomplished through the present resources of the Jamaican Government, many will require staff strengthening or financial support. The purpose of this Section is to highlight the principal recommendations for follow-up action.

It may be noted that, from the point of view of soils policy, the following projects are commended and supported:

- The Hillside Agricultural Project.
- Projects under the National Forestry Action Programme in the field of watershed management.
- The Agroforestry Development Project for Central Jamaica.
- The Soil Nutrients for Agricultural Productivity Project.

Several of the following proposals are interlinked, and could be combined in various ways.

8.1 STRENGTHENING OF INSTITUTIONS ENGAGED IN SOILS ACTIVITIES

The current establishment of RADA is highly inadequate in the field of soil conservation. Means need to be found for institutional strengthening in this area. It will also be necessary to find some way to fill the gap left when HAP comes to an end.

RPPD will require substantial strengthening if it is to maintain its current survey and land evaluation activities, keep its land evaluation and land-use planning systems up to date, and take on the additional tasks proposed in this report.

It is essential that the Research and Development Division should have a core of establishment soil scientists, to conduct research, coordinate the work of other agencies, and maintain continuity.

The strengthening of institutions engaged in soils related activities, in staffing and operating budgets, is a prerequisite for other proposals.

8.2 ESTABLISHMENT OF A PERMANENT SOIL RESEARCH CAPACITY

The substantial needs for soil research have been summarized, and specific projects are noted below. A prior need is to re-establish a soil research capacity within the Research and Development Division, to provide coordination and continuity.

This will require:

- staff strengthening, as noted above;
- the designation of one station (Bodles or other) as the national centre for soils research, with a network of additional sites for experimental work;
- arrangements for adequate laboratory facilities for soils analysis.

It would be useful if a collection of documents were to be assembled, relevant to the soils of Jamaica and their management, to be kept at the designated soil research station.

8.3 RESEARCH INTO SOIL CONSERVATION AND DEMONSTRATION SITES

Among the various research needs noted, the priority is research into methods of soil conservation in the hill lands. This should cover research into methods of soil conservation appropriate for the different agroclimatic zones, soil types and cropping systems of Jamaica. The focus would be upon biologically-based methods, including agroforestry; but the appropriate use, alone or in combination, of physical structures should also be considered.

Linked to this research would be the re-establishment of a network of soil conservation demonstration sites, covering the principal cropping systems. Smithfield could be revitalized and used for both research and demonstration purposes.

A project status, with international collaboration, is necessary to implement this proposal.

8.4 DEVELOPMENT OF THE POTENTIAL OF AGROFORESTRY

The generally humid climates of Jamaica's hill lands provide, coupled with its needs for fuelwood, stakes and other tree products, a high potential for agroforestry systems. These could combine productive purposes with soil conservation. The hill farmers are accustomed to managing trees. Hence there are excellent opportunities for the development of agroforestry systems appropriate to the various soils, other environmental conditions, cropping systems and needs of the people.

A project based on the approach of diagnosis and design, which would combine on-station and on-farm research with extension work, would be appropriate. Cooperation with the International Centre for Research in Agroforestry (ICRAF) and other relevant international institutions, is desirable.

8.5 MONITORING OF SOIL DEGRADATION

Attempts to combat soil erosion at present lack the support of quantitative estimates of its magnitude and effects. An effort should be made first, to obtain a quantitative estimate of the rate of soil loss, and secondly, to assess the consequences, both for production and off-site effects; and thirdly, to convert these estimates into the economic and social costs of erosion.

It is a matter of urgency that a new estimate of the extent of urban encroachment onto agricultural land should be made; and that this should then be continuously monitored. Effort would be concentrated on areas of plains at most risk.

Soil salinization should also be monitored, by repeated sampling in critical areas. This should be done as a collaborative effort between relevant institutions.

Responsibility for the coordination of soil monitoring is appropriate for NRCA, with delegation of specific activities to RPPD the Research and Development Division.

8.6 LAND ZONING FOR LAND-USE PLANNING

A system of land zoning, based on land suitability for different uses, would greatly strengthen the basis for land-use planning decisions. These range on the one hand, to the division of land between agricultural and non-agricultural uses in the hill lands; and on the other, to the decision-making system for urban expansion on the plains. The existing system of land capability classification is not fully adequate for these purposes. There is an urgent need to have land zoning reviewed and regulations enforced.

The recently introduced land suitability evaluation system operated by RPPD forms an excellent basis for a system of land zoning.

8.7 EDUCATION, TRAINING AND RETRAINING

Whilst the quality of existing soils staff in Jamaica is high, their numbers are far from sufficient for the tasks required. There is also a need for refresher courses for existing staff, to update them in new developments in soil conservation and agroforestry.

Such training activities would contribute to the institutional strengthening noted above. They could be undertaken as an independent programme of training, or additionally, be an element built into one or more of the above projects.

8.8 LEGISLATIVE RECOMMENDATIONS

1. To improve the effectiveness of existing legislation, the definition of "development" in the Town and Urban Planning Act needs to be revised, for example, to agricultural development.
2. Regulations need to be promulgated under the Watershed Protection Act so as to strengthen soil conservation measures including controlling of the clearing and farming of hillside lands.
3. The Land Development and Utilization Act should be amended to establish specific criteria for determining improper land use.
4. The Local Improvement Act should be strengthened so as to allow control to be exercised over the subdivision of agricultural land where this involves conversion of such land to housing and other non-agricultural uses. This would for example make provision for the requirement of an agricultural assessment as well as an environmental impact assessment in appropriate cases.
5. The existing penalties under the Forest Act and other relevant statutes are outdated and steps should be taken to bring the level of such fines into line with the present value of money.

8.9 OTHER RECOMMENDATIONS RELATED TO LEGISLATION

1. NRCA should develop standards and regulations for soil conservation and watershed protection.
2. A summary, or digest, of the various laws and regulations controlling the use of rural lands should be drawn up, and made available to all institutions involved in such land use.
3. There should be improved enforcement of existing legislation affecting soil conservation. This would involve a monitoring of land uses; a system of wardens to take cases to court and a public awareness programme on soil conservation legislation. Apart from NRCA, none of the other agencies (Forestry Department or RADA) have an enforcement unit.
4. It is necessary to strengthen the existing basis for planning control. This would include provisions for environmental impact assessment, declaration of areas as environmentally sensitive areas, power to impose stop orders and injunctions in regard to illegal developments. In addition, given the past history of lack of enforcement of planning legislation, an institutional analysis needs to be undertaken to review needs for the effective enforcement of planning legislation. This should be coupled with a public awareness programme of the need for effective planning legislation.

It will also be necessary to introduce a system of land zoning to guide development in critical areas.

8.10 FORMALIZATION OF THE NATIONAL SOILS COORDINATING COMMITTEE

As already mentioned in Section 6.3.2, a NSCC was established to help with the formulation of this National Soils Policy. The Committee has very effectively discharged this function. However, the responsibilities of this Committee should not cease at this point as the government will need help and advice if it is to put the policy into effect. It is therefore proposed that NSCC be formalized by the Government. Suggested terms of reference and composition for the Committee are given in Annex 5.

Chapter 9

Summary statement of policy

9.1 DEFINITION OF ZONES

In summary, Jamaica's National Soils Policy can be expressed in terms of three major regional units, or zones:

1. *The steeply sloping upper watershed areas.* This comprises those parts of the central core of the country which are of high altitude, very steeply sloping (>40%), or both. Soils are frequently shallow or stony. A substantial part of this zone is still forested. It includes the Blue Mountains (John Crow Mountain) the limestone 'cockpit country' and some other mountain areas.
2. *The hill zone.* This comprises the remainder of the central core including hilly land, which is for the most part moderately or steeply sloping (22-40%). Soils may be shallow, moderate or deep. Most parts of this zone include cultivated land.
3. *The coastal plains and interior basins.* This comprises land of low altitude, mainly flat or gently sloping. Soils are mainly moderately deep or deep. Most parts of this zone are farmed. It also includes the main urban areas.

9.2 SUMMARY OF POLICY

9.2.1 The steeply sloping upper watershed areas

In this zone, the Policy is to preserve the land for water production, sustainable agriculture and tourism. Soil conservation will be achieved mainly through maintenance and improvement of the natural forest cover. There may be productive forest plantations on limited areas where land is suitable. Any existing agriculture in this zone will be discouraged (having due regard to personal rights and equity) or restricted as far as possible to valley-floors.

9.2.2 The hill zone

Here, the Policy is based on making productive use of the good natural resources of soils and climate, for the benefit both of the population of the zone and the economy of the country as a whole; whilst at the same time, making the maximum effort to conserve these resources for the needs of populations of the future. In short, this is a policy of sustainable use. Land use will include tree crops (perennial crops), annual crops, forestry and livestock production. Elements in the implementation of the Policy include:

- The encouragement of tree crop production wherever landforms, climate and soils are suitable for this.
- Restricting the cultivation of annual crops as far as possible to sites that are less steeply sloping, in valley floors or otherwise best suited to this use.
- Making a major effort to develop methods of soil conservation that will be both technically efficient and economically and socially acceptable, and which are adapted to the varying soils and other environmental conditions of the area; and to promote the adoption of these methods by all land users. Emphasis will be placed on biologically-based methods of conservation, particularly maintenance of soil cover, but physical conservation structures will also contribute where appropriate.
- In those parts of zones where mining operations occur, continuation of the present policy of strict enforcement of legally-based requirements for land rehabilitation and restoration to productive use, aided by the relevant research and responsible attitude of the mining companies.

9.2.3 The coastal plains and interior basins

This zone contains much of the most productive agricultural land of the country, and the major force of policy is to preserve these fertile soils for agricultural use as far as possible. At the same time, it is recognized that other uses of land, for urban and industrial purposes and for tourism, make competing demands for this land. Elements in the implementation of policy include:

- Urban expansion will be strictly controlled, limiting the total area, seeking compact development and directing development where possible to the less fertile soil areas. To this end, the legal basis for planning controls will be strengthened and such controls will be enforced. A system of land zoning, based on relative suitability for competing uses, will be developed to guide development in critical areas.
- Development of tourist facilities will similarly be controlled, permitting development where this is in the interests of the country as a whole, whilst at the same time preventing unnecessary loss of good agricultural land.

- Every effort will be made to combat soil salinization in susceptible areas; and a watch will be kept for other forms of soil degradation, in order to combat any future problems at an early stage.
- Mining and quarrying activities in this land will be required to conform to regulations limiting areas of activity and requiring land restoration.

9.3 MEANS OF IMPLEMENTATION

This Policy will be implemented through technical, institutional and legal means, as set out in this document.

Chapter 10

Commitment by the Government of Jamaica

The Government of Jamaica recognizing:

- the importance of soils as a basic natural resource on which the country's agriculture and other kinds of rural land use are dependent;
- the extent and severity of soil degradation, particularly erosion, in the hill lands, and the adverse effects of this on the present and future well-being of the country;
- the danger of loss of productive agricultural land to urban uses.

The Government of Jamaica being aware of the recommendations of the FAO World Soil Charter and the UNEP World Soils Policy, and of the efforts currently being made to implement the policies set out in these documents at a national level;

- **reaffirms** its past efforts, including through cooperation with international agencies, to combat land degradation and to support rational land use;
- **takes note** of the contents of this National Soils Policy for Jamaica; and
- **declares its commitment** to support the implementation of this National Soils Policy, in particular by:
 - within the framework of its overall development planning, striving to ensure adequate and continuous support to the government institutions responsible for soil activities within the framework of its overall development planning;
 - attaching importance to soil conservation in national development plans, and making corresponding budgetary allocations;
 - taking steps to ensure that the soils of the country are utilized on a sustainable basis, to meet the needs of the present and future population;
 - supporting measures for sound land-use planning, in accordance with the suitabilities of land for different purposes and with the needs of the people;

- seeking to maintain a soils research capacity appropriate for the needs of the country, in collaboration with international agencies and external institutions where appropriate;
- taking steps to monitor soil degradation and the effects of measures taken to control it, in order that its impact on the national economy and well-being of the people may be assessed;
- examining its legislation with a view to consideration of amendments which would strengthen this in the areas of soil conservation and protection of agricultural lands;
- integrating this Soils Policy with national policies on land use and the environment.

The Government further notes the importance of continuity in its National Soils Policy, to which this document makes a contribution; and that this Policy will require revision from time to time, in the light of changes in circumstances.

ANNEX I

Land use in Jamaica

A. According to interpretation of 1:50 000 scale air photography 1979-80.

	<u>Percent</u>
Urban uses	5.5 ⁷
Urban residential	1.7
Rural residential	3.3
Industrial and commercial	0.4
Resort development	0.1
Agricultural uses	18.9
Sugar cane	8.1
Other agriculture	10.8
Pasture	24.6
Improved pasture	11.3
Unimproved pasture	13.3
Forest	48.4
Deciduous	45.9
Brush (scrub)	2.1
Coniferous	0.3
Wetlands	1.4
Lakes and rivers	0.4
Surface mining	0.4
Bare sand and rock	0.1

B. As reported in the Jamaica National Report on the Environment to UNCED (1992).

	<u>Percent</u>
Agriculture	46
Arable	19
Permanent pasture	18
Permanent crops (perennial)	6
Irrigated	3
Forest	24.3
Scrub and woodland	19.7
Urban uses	3.7

⁷ 1.0% of land area = 10 940 ha.

ANNEX II

Soil types of Jamaica

Internally, most soil mapping and interpretation is carried out in terms of the soil types established during the initial surveys, each known by a number and name, e.g. 95 Waitabit Clay. The areal extent of soil classes according to international classification systems is not precisely known. Available information on the most widespread soil classes is as follows.

A. According to the FAO/UNESCO (1974) soil classification.

Mountains:

On calcareous shales:

Eutric Regosols

Eutric Cambisols

Orthic Luvisols

On non-calcareous shales:

Dystric Regosols

Dystric Cambisols

Hills and foothills:

On limestones:

Rendzinas

Eutric and Ferralic Cambisols

Humic and Ferralic Acrisols

Orthic and Rhodic Ferralsols

Chromic Vertisols

On calcareous shales:

Eutric and Vertic Cambisols

Eutric Regosols

Orthic Luvisols

On non-calcareous shales, conglomerates and tuffs:

Dystric Regosols

Dystric Cambisols

Orthic Luvisols

Chromic Vertisols

On granodiorite:

Dystric Cambisols

Dystric Regosols

Interior basins:

On old alluvium and hill-wash deposits:
Chromic Vertisols

Plains:

On old alluvium:
Orthic Luvisols
Chromic and Pellic Vertisols
On recent alluvium:
Eutric and Dystric Cambisols
Haplic and Calcaric Phaeozems

Swamps and tidal flats:

Eutric and Thionic Fluvisols
Eutric Histosols

B. According to the United States Soil Taxonomy.

Mountains:

Eutropepts
Dystropepts
Troporthents

Hills and foothills:

Eutropepts
Dystropepts
Ustropepts
Troporthents
Tropudalfs
Tropudults
Eutrothox
Chromuderts

Interior basins:

Eutropepts
Dystropepts
Tropudults
Paleudults
Eutrothox
Hapludolls
Tropaquepts
Paleaquults

Plains:

Eutropepts
Ustropepts
Haplustalfs
Paleustults
Paleudults

Calciustolls
Chromusterts
Pellusterts

Swamps and tidal flats:

Eutropepts
Tropopsamments
Fluvaquents

ANNEX III

Legislation

In addition to The Forest Act (1937), The Watershed Protection Act (1966), The Rural Agricultural Development Authority Act (1990) and The Town and Country Planning Act (1957), which are described in Section 4, the following statutes have an impact upon soil issues through rural land tenure:

- The Registration of Titles Act (1889)
- The Facilities for Title Act (1955)
- The Land Development and Utilization Act (1966)
- The Agricultural Small Holdings Act (1946)
- Rural Agricultural Development Authority Act (1990)
- The Natural Resources Conservation Authority Act (1991).

Additionally, the Constitution of Jamaica makes explicit reference to soil conservation.

Besides The Town and Country Planning Act, the main planning legislation, relevant to conflicts between agricultural and urban uses is:

- The Local Improvement Act (1914).

Mining and quarrying are legally controlled through:

- The Mining Act (1947)
- The Quarries Control Act (1983).

LAND TENURE

Overview of land tenure in Jamaica

Land tenure problems often aggravate land-use management particularly with regard to forestry in land use. Forest produce is sometimes harvested without reference to land ownership. Tenants of land (on Crown and private lands) who have occupied land by shifting cultivation without being able to secure freehold title often do not apply soil conservation and ecologically balanced cultivation methods. Moreover, the cultivation techniques on these cleared woodlands so impoverish the soil that declining yields force the squatters after a few years to move to new areas. Giving tenants the legal right to lands (where such lands are not under forest cover) they have occupied for long periods of time would provide the basis for agroforestry on private lands and for the

intensification of forest management on Crown and private lands. There is therefore a clear need for improved land titling and registration methods. In addition, the granting of title to squatters on such lands should be accompanied by provisions for solid conservation measures which should be attached to the land as a restrictive covenant affecting the land. In cases where the land is under forest cover or in a critical watershed area legal steps should be taken to remove squatters from such lands.

The system of land tenure in Jamaica recognizes an absolute right to ownership of land similar to that enjoyed in personal property. Complementary to absolute ownership is an absolute right of alienation subject only to equitable interests (e.g. easements, mortgages, etc.) and Transfer Tax burdens.

Land is held either under a system of centrally registered title or under a common law system where title is traced from one to another. Registration of land title is based on the Australian "torrens" system and although the land on the island which is being registered constantly increases, registration is not compulsory.

Statutes prescribe the means of compulsory acquisition of real property although they guarantee compensation. The primary statute in this connection is the Land Acquisition Act which is modelled on the U.K.'s Land Acquisition Act and finds its counterparts in other Caribbean countries.

Apart from freehold tenure, persons occupying land may hold leases under the Registration of Titles Act, as tenant at common law or under the Agricultural Small Holdings Act or as squatters. In general, squatters have no right or interest in the land save as such rights may be acquired under the Limitation of Actions Act.

Under the Limitation of Actions Act squatters on land may acquire legal ownership of such land if there has been undisturbed possession of the land for 12 years in the case of private land and 60 years in the case of Crown land.

In the area of private land located in watershed areas one of the key problems in soil conservation work in such areas has been the lack of titles occupied by the farmers. This is primarily because often such land is held in "common law" (or family) title (i.e. not registered) and there is uncertainty as to which persons are in fact the true owners of the land. In addition, banking institutions do not lend money on the security of such land.

Legislation affecting land tenure

The Registration of Titles Act (1889) - The Registration of Titles Act was first instituted in 1889 and may be regarded as a corollary to the Record of Deeds, Wills and Letters Patent Act which renders the recording of deeds compulsory in order to pass freehold, or to grant a lease for a term exceeding three years. While registration of titles is not compulsory; it has been found so convenient that over one-half of the land on the island has been brought under the operation of the Act.

Land is brought under Registration of Titles Act by the Registrar of Titles registering the title of some person as proprietor. Section 27 gives a list of persons who may apply for registration, the most usual being the owner in fee simple either at law or in equity and persons having the power of appointing or disposing of the fee simple.

The land is then subject to similar provisions as apply to freehold. Any person claiming any estate or interest in the land may, before registration, lodge a caveat with the Registrar. The title may be registered either as an absolute or qualified title.

Once land has been registered, no instrument, until registered, is effectual to pass any estate or interest in the land, or to render it liable to any mortgage or charge. Further, no certificate of title may be impeached for any informality or irregularity in the application for registration. In addition (subject to the subsequent operation of Statutes of Limitation), the certificate is conclusive evidence of its contents.

The land is, however, subject to certain encumbrances not specifically notified, including: exceptions, reservations, conditions and powers in the patent thereof; rights acquired under the Statutes of Limitation since the date of registration; public rights of way and easements; unpaid rates and taxes that have accrued since registration; and the interests of any tenant for a term not exceeding three years.

Except in the case of fraud, persons dealing with a registered proprietor are not concerned with the circumstances of the issue of the certificate, nor with notice of any trust, actual or constructive. The rights and obligations of the original proprietor pass to succeeding proprietors.

Facilities for Title Act (1955) - The Act provides that someone applying for a loan from an approved lending agency, but who is unable to show title under the Registration of Titles Act or title at common-law may adopt the procedure in the Act to establish his ownership by alternate means.

The procedure requires that verification of the rights of the applicant by neighbouring owners, tax and/or rent receipts, any documents relating to title and a complete statement of particulars supported by statutory declaration be submitted to the agency. If the agency is satisfied by the above and intends to make the loan with the land as security, the notice of application must be advertised in accordance with the provisions of the Act.

Once the mortgage has been executed, title to the land is capable of registration under the Registration of Titles Act and the certificate of the lending agency as to the execution of the mortgage is accepted as proof of the title to the land.

SOIL CONSERVATION

Review of soil conservation legislation

Land Development and Utilization Act (1966) - Under the Act, the Land Development and Utilization Commission is empowered to declare land as being "idle" land and to require the owner or occupant to submit a plan for its development and an subsequently to implement the plan. In case of failure to comply with such an order, the Minister is empowered to compulsorily acquire such land. The Act further authorizes the Minister to compulsorily lease such land from the owner for a period of ten years in the case of non-compliance.

Agricultural Small Holding Act (1946) - Under Section 3 of the Agricultural Small Holdings Act, a contract of tenancy for any small holding is required to be in writing and signed and witnessed by the parties to the contract.

The landlord is required to deliver a signed copy of any contract of tenancy to the tenant immediately upon execution of the tenancy intended for cultivation or pasturage, with or without buildings, consisting of not less than one acre nor more than ten acres. The Act empowers the landlord at the time when he enters into a contract of tenancy to reserve for himself the exclusive right to do a number of things including the power to fell or cut timber from any economic trees.

The Act also contains a variety of measures designed to protect tenants of such lands. Such measures include: control of rentals of small holdings; prohibition of contracts of tenancy for less than two or five years; certain terms in the contract to be invalid; mortgages in respect of small holdings subject to the contract of tenancy; compensation to tenants for improvements to the land; compensation to tenant for disturbances of his tenancy.

The Act provides that in the case of certain tenancies, where the tenant has been a tenant for five consecutive years, he is entitled to a further renewal for five years provided that he has committed no breach of the tenancy and has cultivated the holding according to practices of good husbandry. Included in the definition of "practices of good husbandry" is the consideration as to whether accepted measures and methods for the conservation of soil are adopted and the standards of maintenance introduced for soil conservation.

Natural Resources Conservation Authority Act (1991) - The Natural Resources Conservation Authority Act establishes the Natural Resources Conservation Authority (NRCA). The mandate of NRCA includes the management, conservation and protection of the natural resources of Jamaica. Among the key functions of NRCA are the following:

- taking steps for the effective management of the physical environment to ensure the conservation, protection and proper use of its natural resources;

- promoting public awareness of environmental issues.

Under the Act, NRCA is the new responsible agency under the Beach Control Act, and Wildlife Protection Act and the Watersheds Protection Act.

The Act introduces a requirement for an environmental impact assessment for certain types of development in prescribed areas. The Minister has also not prescribed the areas of development nor the categories of enterprises which will require an environmental impact assessment.

The Act introduces various new types of enforcement mechanisms to support the enforcement of its provisions. These include, cessation orders (S.13), notices to abstain from certain agricultural practices where these result in the pollution of waters (S.15), enforcement notices where there are serious threats to the natural resources or public health (S.18(1)).

In regard to environmental impact assessments where NRCA indicates that an EIA is required no other Government agency or department shall grant a licence, permit or consent unless it has been notified by the Authority that there has been compliance with the statutory provisions.

The Natural Resources Conservation Authority Act binds the Crown.

THE CONSTITUTION OF JAMAICA IN RELATION TO SOIL CONSERVATION

There is a specific section of the Constitution of Jamaica which refers to soil conservation.

The Constitution confers upon Parliament the power to make laws, subject to certain limitations in relation to interference with personal rights, one of which is the right to enjoyment of property. Section 24(1) provides that no property can be compulsorily acquired except under a law that establishes a clear mechanism for compensation. However, in Section 24(2) a number of exceptions are set out.

Included in these exceptions is where land is required for the carrying out thereon of soil conservation or the conservation of other natural resources or for agricultural development or improvement which the owner or occupier of the land has been requested to do and has without reasonable or lawful excuse failed to carry out.

This provision could be applied first, where a part of private land was required for public soil conservation works, for example the construction of a waterway passing through several properties. Secondly, it could be invoked in cases of extreme irresponsibility, such as the deliberate destruction of soil resources.

INCENTIVES, PLANNING AND OTHER LEGISLATION

Legislation relating to incentives

Income Tax Act (1955) - The Income Tax (Prescribed Agricultural Activities) Order 1982 provides for the "growing of trees for the purpose of producing timber" to be a prescribed agricultural activity in accordance with Section 36D (14) of the Income Tax Act. Therefore, a person engaged in that activity may apply to be designated an "approved farmer" and thus be relieved of paying income tax on income which arises thereby.

The Agricultural Incentives Act (1972) provides for a system of income tax benefits to agricultural producers so as to encourage investment in agriculture.

Planning legislation

The Local Improvement Act (1914) - The Local Improvement Act bears upon subdivision of land, such as might take place for conversion of agricultural land to urban uses.

The Act requires that anyone wishing to subdivide land for building, lease, sale or other purposes must provide the local planning authority with a plan for approval. The subdivision section of the Town Planning Department coordinates inter-agency review of subdivision applications and forward recommendations (approval, denial, approval and conditions) to local planning authorities.

Mining and quarrying legislation

The Mining Act (1947) - The Mining Act controls mineral prospecting in specific locations and the leasing of land for mining, depending on the minerals being mined. The Act provides extraction right to persons holding such leases and provides various royalty regimes, depending on the minerals mined. It is associated with the Health and Safety Regulations (1977) which provides regulations and standards for ensuring safe operations within the mining industry. The Act also contains general provisions relating to the rehabilitation of mined out land but the details are set out in the Mining Regulations (1947, amended 6 times to 1988).

Regulations 53 of the Mining Regulations contains various provisions relating to the rehabilitation of mined out bauxite lands. Under Regulation 53 as soon as practicable after mining operations are concluded in any sector the lessee of a mining lease is required to restore every acre of land in such section as nearly as practicable to the level of agricultural or pastoral productivity or of utilization for afforestation purposes which existed immediately prior to the commencement of the mining.

Apart from this general requirement the holder of mining lease also has to adhere to the following specific requirements:

- (a) before commencing mining operations in any sector to remove the top soil to a depth of not less than 6 inches;

- (b) keep the soil so removed or stacked and preserved until such time as it is replaced;
- (c) as soon as the mining has been concluded in the sector, utilize, remove, clear or dispose of all spoil, debris and rubble in such manner as to effect a smooth grading and prevent the creation of unsightly mounds and dumps on the sector and replace top soil which was removed therefrom;
- (d) construct drains, trenches or drainage works as will prevent the accumulation of water upon or within the sector, if such accumulation would (in the Minister's opinion) be detrimental to the well-being of the land;
- (e) provide reasonable means of access to the sector.

The holder of a mining lease is required to consult with the Minister or the Commissioner of Mines before and during the course of the above operations and shall comply with any reasonable directions from the Minister or the Commissioner as to the manner in which the operations are to be carried out.

The Commissioner of Mines is empowered to waive compliance with the above rules whence he is satisfied that it would:

- (a) not be practicable as part of the mining operations;
- (b) not be consistent with good mining practice;
- (c) be unreasonable or likely to raise costs out of proportion to the value of the ore body;
- (d) render the mining operations uneconomical.

Despite the Commissioner's power to waive the rehabilitation requirements such waivers are rarely granted in practice and emphasis is placed on compliance with the rehabilitation requirements.

The regulations also require that once mining operations are concluded the holder of the mining lease has to apply to the Commissioner for a certificate that there has been compliance with the rehabilitation requirements. In cases where this is not done the holder of the mining lease has two options. First, reclaim or clear for agricultural or pastoral or re-forestation one acre of land which was not being used for such purposes in place of one acre of land which he has failed to obtain a certificate. Secondly, pay the Commissioner of Mines US\$4500 for each acre of land in respect of which a certificate has not been obtained.

THE QUARRIES CONTROL ACT (1983)

The Quarries Control Act provides for the rational and orderly use of quarries in Jamaica. The Act makes it an offence to operate a quarry anywhere in Jamaica without a licence, and subject to violation on first conviction to a fine of \$500 or imprisonment for 12 months and \$200 per day for a continuous offence. One of

the main areas of prosecution under the Act has been in regard to illegal sand mining which has been a major area of concern in parts of the island.

The Act sets out various grounds for the refusal of a licence including:

- the preservation of the environment including flora and fauna;
- availability of the natural environment for the enjoyment of the public;
- possible effects on the water table or surface drainage pattern;
- danger of pollution to the neighbourhood.

It further requires that every licensee must establish financial security for rehabilitation of the land, which is subject to forfeiture where the land is not restored after use.

While the Act contains no specific rule on detailed environmental protection, the Minister is empowered to designate specific areas within which the quarry zones can be established. As a licence to quarry must be relative to an area located within a quarry zone, it follows that environmental planning can be undertaken by Government.

The Act empowers the Minister to make regulations concerning, *inter alia*, the rehabilitation of quarries. However, no such regulations have yet been adopted. Also noteworthy is the fact that the operational control is in the hands of the Commissioner of Mines. However, only three inspectors are available, and the statutory provisions are admitted to be unenforced in several respects. No attempt is made, for example, to enforce the requirement that small private operators make the security payment prior to the commencement of quarrying.

Water legislation

Underground Water Control Act

The Underground Water Authority (UWA) is a statutory body which was established under the Underground Water Control Act to provide for the conservation, a proper use of underground water resources and to control the exploitation of such resources. To this end, the UWA is empowered to issue licences for groundwater extraction. The Authority has rights of inspection and power to control the drilling of wells.

Water Act

The Water Act regulates the use of surface water. Under the Act all water other than private water is vested in the Crown.

Water Resources Bill

This Bill seeks to repeal the Water Act and the Underground Water Control Act, and to provide for a unified organizational framework for the administration of all surface and underground water resources. The Bill provides for the

establishment of a Water Resources Authority which will have overall responsibility for the management, protection and allocation of use of water resources, and exercise functions in relation to water quality. Existing agencies such as the Irrigation Authorities and the National Water Commission will continue to carry out their respective functions under their constituent statutes but will be subject to the controls provided in the Bill. The Bill also provides for the establishment of a broad-based Water Resources Advisory Committee which will advise the Minister.

There are other significant features of this Bill and these include:

- (a) the establishment of National Water Plan in respect of water resources in Jamaica and for Water Quality Control plans in designated areas;
- (b) the conferring of special powers on the Authority in respect of the allocation and use of water resources in areas declared by the Minister as emergency areas because of drought.

ANNEX IV

The National Soils Coordinating Committee

TERMS OF REFERENCE

1. The Committee shall be concerned with all aspects of soils with regard to their sustained utilization.
2. The Committee shall be responsible for obtaining the Government's approval of the Suggested National Soils Policy.
3. The Committee shall bring the National Soils Policy into application and see to its implementation.
4. The Committee shall be responsible for advising Government on the strategies, programmes and projects, as well as legal and institutional aspects as required to implement the National Soils Policy.
5. The Committee shall address any other relevant soil concerns and activities.

MEMBERSHIP

The Committee will be a standing committee with membership to represent:

- Government ministries;
- Private sector organizations;
- Non-government organizations;
- People in their individual capacities with the knowledge and ability to contribute to the National Soils Policy.

The Standing Committee will co-opt and appoint new members, as and when necessary, to maintain a balanced membership which will cover all relevant subjects to be addressed. Sub-committees will be appointed to address specific issues and subjects.

ANNEX V

Documents consulted

Reference citations have not been given in this report, as being inappropriate to a policy document. The following documents were consulted.

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