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PRELIMINARY WORK PLAN FOR THE IMPLEMENTATION OF THE COMPREHENSIVE RESOURCE INVENTORY AND EVALUATION SYSTEM (CRIES) PROJECT IN THE REPUBLIC OF HAITI

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1. PROJECT SUMMARY

This work plan involves an systematic, nation-wide inventory and evaluation of Haiti's natural resources by the integration of existing information, augmented with limited surveys to permit a consistent classification of its resource production potential for support in integrated rural development planning and policy analysis.

The main objective of this project is to develop an operational capability in Haiti to monitor the status and trends of the resources and their related uses, while permitting the resource analysis needed to provide the critical information needed to maximize socio-economic benefits derived from the renewable resources sector, within a sustained productivity framework. The approach used by the CRIES project provides a low cost systems capability, able to produce statistical summaries and computer-derived map products (e.g commodity specific crop suitability maps)in a timely manner with adequate spatial detail to reflect the best data available. The various data bases can be linked to permit agricultural sector analysis given various policy alternatives.

The first phase of activities compiles the national land resource data base, conducts the initial resource classification for multiple resource uses, such as agriculture and forestry, while installing the data base and the supporting system capabilities in Haiti.

The second phase provides the regional, economic analysis focus based on the physical and socio-economic priorities defined in the first phase in combination with policy concerns such as food self-sufficiency, employment or income distribution.

At all times, analysis will be conducted within the environmental and agronomic realities, such as the degradation resulting from erosion and the declining productivity of the renewable resource sector.

Given the objectives of the the project, various funding sources are identified. They include appropriations from AID/LAC, PL 480 funds for counterpart staffing, development assistance under the Title III, Local Resources Development Project and ADS II (see also 11.2).

2. INTRODUCTION

According to Zuvekas (1978), agriculture's contribution to the Gross Domestic Product has varied during the period 1960-'76 from a high of 50.8% (1966) to a low of 44.1% (1976). These figures indicate that the renewable resource sector is still largely responsible for approximately 45% of Haiti's Gross National Product. The Science and Technology Division (1979) indicates that agricultural production is limited to 32% of the total land

area dedicated to cropland of which 60% reflects steep hill side farming. Traditional population pressures have severely affected the sustained production capacity of the land resource base through erosion resulting from poor farming practices, overgrazing, deforestation and slash and burn cultivation associated with small scale subsistence farming with limited inputs. In part, this situation is created by the large segment of the population (61.4% in 1971) depending on marginal agriculture for their livelyhood. These facts are adequately illustrated by the breakdown of cultivated land; 300,000 hectares (34%) on productive slopes, 100,000 hectares (11.5%) in rain-fed production and 70,000 (8.0%) under irrigation in the plains, while the rest is distributed in the remainder of the hill-country and listed as 150,000 hectares (17%) and is considered semi-productive and 250,000 (28.7%) under semi-arid conditions (ibid.,1979). The relative high population density and the topography -approx. 79% of the landscape is in slopes of 8% or more (Talbot,1984)- provide additional insight for the reasons and the extent to which the carrying capacity of the land is exceeded.

All indications are that this condition has deteriorated in the last 10 years. Zuvekas (1978) states that the value of per capita agricultural product has declined by an average of 0.6% over the period 1960-'76. AID (1978) states that "since 1970, real per capita increase (author: growth rate) has been negligible" and that agriculture provides employment for 80% of the population with an average landholding of 1.4 Ha. This is caused, in part, by the increasing population presures, the limited resource base and the rising price of food and kerosene forcing the farmers on the steepest slopes and denuding them of vegetation cover in search of new arable land and an alternate fuel supplies. This process of deforestation has many dissastrous consequences such as the siltation of hydro-electric reservoirs and irrigation networks, the reduction of the water holding capacity of the soil profile, thereby increasing the the risk of crop failure and peak runnof, threathening human life and property. Foremost significant, however, is its severe impact on the long term productive capacity off the land resource base threatening the basic ability of the rural poor to meet their most essential needs.

In summary, this means that Haiti's most serious challenge in the years ahead is to prevent a further deterioration of the productive capacity of the land resource base and eventually reverse this trend through conservation practices and reforestation measures. At the same time, an integrated, systematic and consistent evaluation of the natural resources base should take place to delineate areas with the largest unrealized production potential and prioritize development and conservation needs subject to a large number of physical and socio-economic variables and policy concerns.

This work plan provides the conceptual and implementation framework for such a national assessment in combination with the spatial analytical capability to define regional and local development priorities based on alternative development scenarios and policy concerns.

3. PREVIOUS NATIONAL RESOURCE ASSESSMENT EFFORTS

Various efforts have been made in the recent past to assess the major resource attributes with respect to their potential for agriculture. None of these evaluations is truly comprehensive in nature and depicts homogenious resource production areas which can be used directly for agricultural zoning or production predictions under certain input regimes and management practices. The significance for resource analysis at a national or regional level is, therefore, limited. The most significant and country-wide efforts are summarized below:

3.1 Organization of American States.

The Organization of American States (OAS,1972) conducted a basic land resource assessment study with relation to the potential of Haitian Soils. The following breakdown was provided in map format at a scale of 1:250,000 (Map a):

- Soils suitable for intensive cultivations and irrigation
- Soils suitable for extensive agriculture but non-irrigable
- Soils appropriate for rice cultivation
- Soils appropriate for terraced cultivation
- non-agricultural soils: suitable for forests and national parks

The study did not specifically include climatological parameters in the evaluation. However, a general map (b) with surface hydrology was prepared including information on streamgage and precipitation data (yearly total and monthly distribution). Additional attribute maps include:

c) A transportation map (scale 1:500,000) with primary, secondary and tertiary roads, traffic volumes and import and export flows in local currency.

d) A general geology map, scale 1:250,000

e) Ecology, according to the Holdridge life-zone classification, scale 1:500,000, incorporating 9 zones.

f) Educational facilities with political subdivisions (departements and arrondissements), and

g) Population Distribution, Scale 1:500,000, with relative population densities by political subdivisions (Departements, Arrondissements and Communes).

This study did not make an effort to systematically evaluate comparative production advantage based on the various resource attributes (e.g. no effort was made to develop homogenuous resource areas with predictable crop response or related yield levels for production planning, conservation priorities,etc.) In addition, the level of detail is inadequate to make spatial inferences with reasonable reliability and predictive value on crop-specific, production potential. Incidental field observations point out that the accuracy of the classification is doubtful, as indicated by Carmean in visit at a FAO forest plantation site in the Cul-du-Sac area (Carmean, 1984) where land potential was misclassified. Obviously, this can be expected with a general,reconnaisance level study.

3.2 French Government, Fonds d'Aide et Cooperation

A more recent effort was conducted with the assistance and support of the Assistance Externe Fonds d'Aide et de Cooperation Francaise by BDPA (BDPA,1982), a French consulting firm in cooperation with the Direction de l'Amenagement du Territoire et Protection de l'Environnement (DATPE), Secretairerie d'Etat du Plan, Republique d'Haiti. This work involves a nation-wide interpretation of general soil potential for agriculture, mapped at a scale of 1:250,000 (map a). General potential is defined according to the following classes <u>independent of climatic conditions</u>; however a separate graphic anotation on the map reflects major climate conditions referenced by 4 precipitation zones and 2 elevation classes. A listing of the map legend (translation by author) follows:

SOIL POTENTIAL CLASSES(USDA)	CAPABILITY (independent of climate)	PRINCIPAL PHYSICAL CHARACTERISTICS
I Excellent Potential	Large scale mechanized cultivation, Gravity irrigation possible with local drainage, High productivity	alluvial, well drained soils flat topography (slopes 0-2%)
II Very Good Potential	Mechanized Cultivation, Irrigation possible Good productivity	well drained soils, flat or gently slop- (slopes 2-5%) alluvial soils with heavy or course texture
III Good Potential	Little mechanization possible,sprinkle irrigation with anti-erosion measures, medium productivity or limited by crop choice	flat or hilly soils, 5-8% slopes, medium depth, alluvial soils stony and hydromorphic profile

SOIL POTENTIAL CLASSES(USDA)	CAPABILITY (independent of climate)	PRINCIPAL PHYSICAL CHARACTERISTICS
IV Medium Potential	Mechanization difficult Little local irrigation Traditional agriculture with conservation measures	Soils mostly on hilly terrain, slopes 8-15% limited depth
V Limited to Riceculture or low producing crops	mostlymarsh,requires intensive water management for agriculture (drainage, irrigation, acidity control) rice and seasonal crops	semi-permanent marsh, hydormorhic or waterlogged seasonaly, mostly clay, occasionally saline
VI Low Potential	(a) Little, localized crop production, little irrigation, mainly forestation	steep, erodable soils with various depth and slopes of 12-30%, eroded soils on recent parent material
	(b) localized rice culture, saline conditions permitting	saline soils subject to waterlogging or flooding
VII Limited Potential	(a) Horticulture small-scale agriculture forestry	shallow soils,very erodable with slopes up to 60% "bad-lands" (on unconsolidated material - marl)
	(b) Idle Drainage in general inpossible	soils permanently waterlogged,saline, often flooded
VIII Very Limited Potential	(a) Forests,not suitable for agriculture in the intermediate term	soils with variable depth with slopes of more that 60%, subject to accelerated erosion if cultivated (on consolidated material - basalts)
	(b) Mangroves	saline,waterlogged soils
	(c) River beds of course material and streams	fragmented, stony soils subject to flooding

The map units depicted on the map represent in many cases mixed units, virtually limiting the usefulness of the map in terms of spatial detail and reliability. No soil descriptions were available with textural information permitting a prediction of general crop response for the mapping units depicted. The map legend does not list the source of the soils information (a

statement that the information is based on previous soil surveys and photo interpretation is included), which makes field verification and accuracy determination difficult.

Another map of this series (b) reflects erosion risk listed as limited (2 categories), medium (3 categories), high (2 categories), very high with actual erosion present and eroded zones.

Current vegetation cover with a general breakdown of agricultural land use is provided for the plains and foot hills (map c). Agriculture is broken down in dominant cultivations and include rice, sugar cane, annual crops under irrigation, bananas, sisal, vetiver and coconuts. The other classes reflect vegetation densities and related tree cultivations at varying densities up to very sparse, abandoned cultivations, range, decidious and conniferous tree cover. Map (d) represents a distribution of dwelling units and depicts the administrative unit boundaries of the region, departement, arrondissement and commune. The last available map (e) presents the current transportation network, urban centers and population and markets.

3.3 National Oceanic and Atmospheric Administration

The Climatic Impact Assessment Division, NOAA, is involved in the development of an agrometeorological data base to examine the impact of climate and large-scale atmospheric systems and their possible significant changes relating to severe drought (NOAA,1979). The purpose of this impact assessment effort is to develop a reliable food production and monitoring capability for use in an early warning system of potential food shortages in the Caribbean basin.

The significance of this effort is the linkage between soil moisture requirements for the various subsistence crops at selected growing stages based on local cropping practices and objectively weighted meteorological data, rather then relying on cumulative precipitation analysis. For that purpose a monthly precipitation data base was developed for Haiti in combination with agronomic data relating to corn, rice and sugar cane. This data base is, therefore, suitable for trend analysis and can be used to predict average soil moisture conditions during the critical periods in the growing season. It is feasible to extend the significance of this analysis to more location specific agro-ecological zones, defined according the criteria used by the CRIES project, such as soil, topography, ecology and water balance (soil moisture) conditions. This assessment would include the spatial variability of available soil moisture based on soil texture classes. The current predictions, as used by NOAA, are based on limited soils information, namely the general breakdown provided by Haspil and Butterlin (1955) in Aridisols, Entisols, Ultisols and Oxisols (combined) and Vertisols. Since the NOAA study is primarily aimed at the forecasting of aggregate regional effects of drought, the detail of the data base is insufficient to support integrated rural planning. In addition, yield analysis should support a greater variety of food and cash crops

than the major three listed in the study.Other climate data sources for Haiti include Wernsted (1972) and Alpert (1937).

3.4 Climatic Analysis for Rainfed Agriculture

Hardgraves and Samani (1983) conducted a climatic analysis for rainfed agriculture, listing the main study emphasis as the "approximately 80,000 ha. of non-irrigated land classed as arable". The study includes tables that indicate the length of the growing season in combination with mean monthly temperatures to facilitate the selection of crops based on general crop suitability zones. Six crop suitability zones are defined for the country. Suitability ranking are based on the moisture availability index (MAI), defined as the 75 percent probability of precipitation occurence divided by potential evapotranspiration. Ranges of this index were used to provide a general zoning for Haiti.

The study is a very useful effort to quantify soil moisture availability for general agricultural zoning purposes. The method used in quantifying potential evapotranspiration, can be questioned. The formula used: ETP= .0075 * RS (Incident solar radiation) * TF (temp. in degrees Fahrenheit), ignores, however, the great local variations in soil moisture tension based on texture, and uses only 2 values of RS computed from extraterrestrial radiation and temperature range. Coffey et al. (1984) indicates the inconsistency of local field conditions observed in the Caynes Plain Basin as compared to the expections derived with the use of the MAI index. In short, the method used is too general to have confidence in its predictive value for more detailed local variations. The CRIES project proposes to expand this agro-climatic analysis by linking climate data with soils groups based on texture classes and associated variations in soil moisture holding capacity using the Resource Production Unit (RPU) concept.

4. PROBLEM STATEMENT

Haiti's economy, and even more so the great majority of its population, is heavily impacted by internal land use policies permitting the deterioration of its productive capacity through soil erosion. In addition external forces and declining per capita agricultural outputs have created a increasing number of production and marketing constraints. The paramount challenge in the coming years is to combat a further deterioration of its land and water resource base through preservation and rehabilitation measures while increasing agricultural production through integrated rural development planning.

Development of a reliable resource data base with know accuracies and spatial detail is essential in a successful resource management and planning process. The ability to store, retrieve and analyze large amounts of data to provide useful information to decision makers, in a timely fashion and in the right format is of paramount significance in renewable resource oriented

economies such as Haiti. The ability to use scarce human and financial resources in concert and optimally in combatting and reversing the declining output of the agricultural sector, resulting from a decrease in productivity of the land resource base is closely linked with a resource inventory, monitoring and analysis function.

Currently, neither the integrated resource data base nor the computer-aided analysis capability of spatially referenced data, exists in Haiti. This capability is critically needed to monitor the type and impact of current and alternative resource uses, their physical and socio-economic consequences in magnitude and by location. In addition, integrated rural development planning can not adequately be supported without a direct linkage between anticipated performance characterics of alternative land uses and locations. This means that the installation of an integrated data base and associated analysis capability is critically needed to maximize efficiency in erosion control programs, identify the areas with the largest potential for sustained agriculture and reverse the trend in declining per capita output in the renewable resource sector.

5. PROJECT OBJECTIVES

5.1 Establishment of a National Integrated Resource Data Base

The first objective is to create an integrated resource data base for Haiti, were all data are spatially referenced in order to maintain optimum locational information during subsequent computer-aided analysis. The data base will be installed in Haiti using existing CRIES Geographic Information System (GIS) software on a low cost micro computer obtained under auspices of this project. The system will support spatial data storage, retrieval, analysis and updating if more data become availble in future years. Users will be able to conduct resource analysis for development planning, monitor trend and status of natural resouce by means of data updating and time series analysis. The CRIES-GIS software permits crop suitability analysis, impact analysis, erosion modeling and various statistical summary analysis such as the production of area specific histograms and crosstabulation. Results of the various analysis stages can be statistically summarized or displayed as computer generated maps. The micro computer version uses of the shelf hardware components to reduce cost, maximize compatability and facilitate system maintenance.

The system will be installated at a counterpart institution in combination with the data base. At the same time a work shop will be conducted to introduce selected counterparts in system capabilities and use. It is expected that the system will constitute the core of a new Land Resources Information Center, with a mandate to compile and distribute relevant resource information to decision makers and government institutions in Haiti.

5.2 Institutionalization of CRIES

The first objective, the installation of the integrated data base with the CRIES-GIS software will be part of the future installation of the CRIES Agro-economic Information System, which includes the reference data on crop requirements, cost of inputs and commodity prices to conduct a systematic evaluation of comparative production advantage for selected location. This CRIES capability provide policy analysts with an important tool to conduct the resource and policy evaluation for development planning.

5.3 Data Base for Country Environmental Profile

The data base which will be established during the first phase of the project will provide the essential base line data for a country environmental profile. The system's capability to generate data summaries by any geographically predefined zone, permits a comparison with previous statistical summaries and permits to quantification of environmental trends.

It will help to identify major areas of existing problems, concerns and potential associated with the use and management of the land and water resources in Haiti, including the analysis of the area magnitude and significance with respect to existing and future public policies. This last element will assist the GOH to develop a realistic planning and policy analysis capability within the framework of sustained agriculture.

Specific elements in the integrated data base which have relevance (in concert or combined) to the development of a country environmental profile include: existing land use types, intensities and distribution by administrative and environmental boundaries (e.g. Macro- or microwatersheds), erosion risk indices derived from, among others, climate, topography, soil cover and texture and farm management/conservation practices, population distribution and related pressures on land and water resources, production potential for food and export crops under various input scenarios, access to resources and marketing facilities, potential for hydro electric power generation, status and trends in deforestation and reforesatation, socio-economic profile of resource use by selected geographic area and revenue producing capacity of land use alternative based on input costs and commodity prices.

5.4 Food and Cash Crop Suitablity Assessment

The CRIES-GIS software in combination with the integrated data base will be used to conduct a crop suitability analysis based on the physical parameters included. This unique capability provides the country with a national systematic and consistent classification of physical resource production potential for food and cash crops prior to economic feasability analysis conducted in phase II. With the use of the critical soil, climatic and topographic information, areas will be defined which can be considered homogeneous with respect to their ability to resource production potential, the so-called Resource Production Units

(RPU's) or agro-ecological zones. This information provides sector analysts with the quantitative and qualitative spatial framework for resource performance evaluation.

5.5 Forestry Planning and Management

The same RPU's, as defined in 5.4,can be used to support forestry planning and management. Obviously the less productive units will be selected for less intensive land use based on the revenue generating capacity and erosion risk factors. Matching site characteristics with tree species requirements, facilitates reforestation efforts and species selection. The system can aid in the identification of sites meeting predefined requirements and can produce statistical summaries by watershed boundaries or other administrative subdivision. In addition computer maps can be produced to facilitate field work.

5.6 Resource Stratification for Area Sample Frame Design

Various sources identify the lack and reliability of socio-economic data in the agricultural sector as a major constraint in rural development. The use of a good and proven sample survey strategy as represented by the area-sampling frame used in various countries, can provide the needed data cost effectively. Jamaica represents a good example of a successful area-frame sample survey program. The effectiveness of a frame design is greatly influenced, however, by a good pre-stratification of the landscape. The land resource inventory and the national landscape map produced under this project will provide the required stratification of agricultural land use.

6. LAND RESOURCE EVALUATION APPROACH

The methodology suggested, emphasizes the need for a systematic and consistent evaluation of the land resource base, its attributes, associated values and their related performance characteristics for alternative land types and intensities. This evaluation needs to be detailed enough to permit reliable predictions on general crop response (food and cash crop under various input scenarios and farm management practices). This comparative analytical framework should permit an assessment of resource production potential at the national level with the secondary data available and limited additional field surveys. This assessment should include relative quantification of location specific comparative production advantage, taking into consideration crop and tree species site requirements (the physical dimension) as well as the cost of production and its revenue generating capacity (the economic dimension). Ideally, this comparative analytical framework should be used to evaluate development priorities by type and location based on alternative policy choices (the socio-economic and public policy dimension).

This analytical framework is based on the linkage of two computer-based software modules; the CRIES-Geographic Information System (GIS) and the CRIES-Agro-economic Information System

(AES). The GIS handles the storage, retrieval and analysis of all resource data with an intrinsic spatial component (e.g. soils, climate, etc), while the AES maintains the data which are essential in determining the production potential in terms of yield ranges or economic revenues generated (e.g. master file on crop requirements and enterprise budgets).

6.1 Physical Land Resource Production Assesment

The initial step involves the computerized storage of the various attributes significant in predicting land capability for cropland and forestry use. This process involves the computerized storage of national data on soils, climate, ecological zones, topography, hydrology, etc. Matching the site conditions (stored in the computer by geographic location) with the crop requirements, permits an evaluation of the theoretical production potential under good farm management practices without input constraints.

6.2 Sustained Agricultural Productivity

This issue represents a critical dimension in development planning since it involves the assessment of realistic production levels which can be sustained by the resource base over a long period of time, without depleting or negatively affecting the production capacity of the resource for future generations. This issue is of paramount concern in Haiti since soil erosion and nutrient depletion have already limited the productive capacity of the resource base. This process can be halted by careful soil conservation practices or measures controlling the soil denutrification by replenishment of essential minerals and trace elements trough natural soil regeneration or fertilization. In practice, this means that agricultural development policy should clearly recogniz the elements of sustained production and carrying capacity by setting realistic priorities over time and by location. Every land use alternative and derived economic benefit should be viewed in this context in order to remain a viable, long term option.

6.3 Current and Potential Production Levels

The potential production levels, based on physical criteria and adjusted for sustained production (see 6.1 and 6.2) need to be compared with current land use types and intensities by location. Production potential, quantified in tons/hectare and at current market prices needs to be compared with current land use output for a given location to determine unrealized production potential, to provide an important criterion for determining development priorities by type and location. This requires a national inventory of existing land use type and intensity (e.g. farming systems).

6.4 Landrent

The analysis, as described in 6.3, can include a relative determination of the comparative production advantage on a locational basis for a given land use type (LUT). This comparative advantage can be expressed in economic terms as landrent, a fiscal measure indicating the revenue producing

capacity of an alternative land use at a certain location. The concept of landrent permits the planner or policy analyst to determine the relative revenue producing capacity for a single location, region or country based on a selected land use or land use mix. This assessment of economic feasibility can be accomplished in a very dynamic fashion, considering existing and anticipated cost of inputs and commodity prices under varying marketing scenarios. National or regional level policy analysis can be supported by linking a certain commodity mix based on production and resource constraints with an applied economic model (e.g. a linear programming model minimizing the cost of production for a given land unit and land use/crop type, subject to various resource, production and input constraints).

6.5 Unrealized Production Potential and related Constraints

The difference between current land use and related performance characteristics and theoretical production potential, derived from matching the physical site characteristics with crop requirements, can be expressed as unrealized production potential. The magnitude might indicate which geographic areas are under-utilized and provides for an additional project focus on those locations with respect to the constraints which might play a role. Typical constraints are the availability and cost of inputs, at that location via the distribution and marketing network or at the regional or national level. Sometimes infrastructure can play a double important role since it depresses farm gate prices as a result of an inadeaquate marketing and transportaiton networks. Experience in other countries has shown that differences in farm management practices (e.g. mulching) can account for significant variations in yield as a result of preserving soil moisture early in the growing season. In any case, this concept is critical in defining priority areas for future development and prioritizing more detailed on-site farming systems research.

6.6 Comparative Advantage and the Spatial Dimension

Traditional agricultural sector efforts are limited in scope in terms locational significance, since analysis is only relevant for the geographic areas for which reported statistics exist. This is usually the case at the aggregate level, relating to cost of production or other statistics employed for a specific commodity compiled for the nation or a specific administrative district. The CRIES system employs a resource analysis approach which combines data with intrinsic spatial significance, such as soil and climate parameters, with survey data with regional or national significance. This approach provides the advantage of incorporating the spatial dimension at all stages of the analysis, while providing information on a comparative advantage basis by location. This means that all information is displayed with the maximum spatial relevance based on the variables employed in the various analysis stages.

6.7 The Role of Resource Information Systems

The most significant role of resource information systems, such as CRIES is that it allows the policy analyst or planner to incorporate two essential elements in the resource assessment process, namely space and time. Space, since all resource attributes are linked to a unique geographically defined location and time, since the computer-based modeling can simulate various policy scenarios (e.g. cost minimization, income distribution, food selfsufficiency) with current and anticipated input costs and commodity prices.

6.8 Status and Trends in Natural Resources, their Uses and related Remote Sensing Inputs

Resource evaluation can not be accomplished without the capability to determine the status and land use trends. Sample surveys were frequently employed for this purpose but compromised the aspects of spatial and temporal variation and associated accuracy of estimates. With the advent of new remote sensing technology in the 70's it has become possible for many developing nations to conduct nationwide resource surveys depicting aspects such as land use, deforestation, erosion with civilian remote sensing satellites. The resolution of the systems (e.g. 80m. of Landsat) posed still a significant restriction for many contries were subsistent agriculture, crop mix and general field sizes made it difficult to conduct a detailed land use inventory. However, the new system capabilities in the mid-to-late 80's will introduce resolutions of 30m. (Landsat-TM), 20m. (SPOT) and, even 10m. (Large Format Camera on the space shuttle missions and Mapsat). In combination with a topograhic mapping capability from space (e.g.Mapsat with 1:50,000 scale and 20m. contours), these systems will introduce a new unique resource inventory capability for Haiti. The CRIES project proposes to fully utilize this potential for the surveys in Haiti and to install a basic satellite remote sensing analysis capability in country using analog image processing and interpratation techniques.

7. NATIONAL WORK PLAN, PROJECT PHASE I

The following components summarize the major activities envisioned under the first project phase. They represent a resource assessment focus successfully employed by the CRIES project in other countries but are carefully adapted to the priorities, data availability and financial constraints encountered in Haiti.

7.1 Development of the National Integrated Land Resource Data Base

An inventory of the quantity, quality and spatial distribut'on of the land resources of Haiti will be conducted to provide descriptions of their physical setting, soil properties and climatic dimensions. This information will be digitized for computer storage and analysis. Computer-derived printermaps and tabular information will be produced denoting the various

resource attributes at the national level. At this time, it is expected that the spatial detail (the resolution of the computer data base) will be 100 x 100 meters.

7.1.1 Soils and Topography
The best available soil data (and relevant information on geomorphology and topography) will be used to define a consistent soil data base (scale 1:250,000) based on the USDA soil taxonomic criteria for use in land capability analysis. Topograhic data have specific relevance in erosion risk analysis and agricultural zoning decisions.

7.1.2 Climate
Past climatic records for all stations in Haiti will be studied to evaluate critical parameters for crop growth and yield response for the major food and cash crops. Climatic analysis will include the determination of critical temperature and soilmoisture regimes for agro-ecological zoning. Climatic variables that will recieve major consideration include annual and monthly (seasonal) measures of temperature and precipitation and derived evapotranspiration estimates for water balance (soil moisture calculations).

7.1.3 Life Zone Ecology
The Holdridge Life Zone Classification will be used to better delineate regional variations in climatic regimes in support of the final definations of agro-ecological zones and their agro-climatic characteristics. This information is critical in predicting the long term crop response with the highest spatial and temporal accuracy.

7.1.4 Population Distribution
Population distribution will be stored on the basis of an average population density by 1 hectare. Sources will include the various reported statistics and maps available referenced on a political boundary basis. This information is critical in determining regional or locational food requirements and other spatial impacts of policy options translated in socio-economic needs and benefits.

7.1.5 Transportation Network
The form, capacity and condition of infra-structure is critical in evaluating the transportation function and related costs of agricultural imputs and commodity prices in rural development. The various transportation networks will be stored by location for inclusion in the analysis of comparative location advange for crop prodution (expansion or intensification). In addition, transportation networks determine the availibility and cost of essential rural services such as education and health care.

7.1.6 Land Use and Farming Systems
Contingent to the availability of the 1978-'79 Color Infrared Photography, Scale 1:40,000 this source will be used in addition to more recent Landsat (and possible space shuttle)imagery to

develop an up-to-data land cover/use map of Haiti. The CIR photography, financed by the French Fonds d'Aide et de Cooperation, is deposited at the Institute Geographique National, Haiti. Personal communication with the French Chief the Mission (May 28,1984) indicate that the photography may be obtained for use if a request is made through official GOH channels (Min. of Ag. or Min. of Plan). The CRIES project proposes to duplicate a set of the photography for use in areas in intensive, small scale agriculture. Current boundaries of land use patterns will be obtained from new high resolution Thematic Mapper data (30 meter) obtained from Landsat Missions in late 1984 or '85. Land Use Maps, scale 1:250,000 will be prepared on the existing DMA series, Universal Transverse Mercator Projection, Sheets: NE 18-4, NE 19-1,NE 19-5, NE 18-8 and NE 18-7. Land cover/use categories will reflects the greatest possible detail to depict agricultural production and related farming systems. (Land Use Maps at a scale of 1:100,000 will be prepared under the second phase of the project).

7.1.7 Administrative units and Political Boundaries
All external and internal boundaries will be digitized as a separate attribute in the national data base. Boundaries will include the international territorial boundary, the boundaries of the department, arrondissements and communes. This permits a crosstabulation of all physical and socio-economic attributes by administrative and political boundaries, an important element in the analysis process of integrated rural development planning.

7.1.8 Watershed boundaries
Watershed delineations will be digitized to facilitate cross referencing of all resource attributes and derived composite indices, such as erosion risk by watershed. This information is critical in successful watershed management operations such as soil conservation and reforestation.

7.2 National Resource Assessment
The assessment envisioned under the first phase of the project will produce a overview of the quantitative and qualitative resource attribute with specific significance for agricultural and forestry development. All statistical summaries will provide a breakdown of soils, climate, life zones, population density, transportation system aand land use by national totals, departments, arrondissements and communes. In addition, computer generated maps and derived map products on stable base mylar (and paper copies) will be transferred to Haiti. The CRIES system installed in Haiti will be able to crosstabulate all data files (e.g. provide area and percentage statistics on all locations with a given soil type, climatic condition, life zone by selected administrative district or watershed.

7.2.1 Agro-ecological Zoning and Crop suitability Assessment
The resource attributes will be combined to derive a composite index reflecting physical resource production potential for a selected crop or crop group. This information will be compiled in

the form of Resource Production Units (or agro-ecological zones) and depicted on the map at a scale of 1:250,000. Relative production ratings for the various food and cash crops will be prepared to provide a measure of comparative production advantage per location. This permits a relative identification (especially if compared with existing land use) with trespect to the development potential of any predefined area. These production assessments will be refined in Phase II to adjust the theoretical production levels based on the typical inputs and farm management practices identified from a farming systems survey.

7.2.2 Soil Erosion Potential Assessment
With the use of a standardized erosion equation, adapted to local soil conditions, site erosion sensitivity indices will be calculated for every grid cell in the data base. Indices will be displayed in map form (scale 1:250,000) and crosstabulated for selected watersheds and development districts. The permits a direct comparison with site and area specific production potential and erosion risk. This information is essential in realistically assessing development priorities while minimizing the aggregate risk for soil erosion.

7.3 CRIES systems and products transfer, training and installation
After the national resource data base is compiled in Michigan and subsequent analysis conducted, installation of the CRIES-GIS software on a micro computer in combination with the data base will take place in Haiti. To facilitate hardware procurement, the CRIES project will assemble all system components in the U.S. and install and fieldtest software and analysis operations on the Haiti data base.

7.3.1 CRIES Systems Installation
System installation will take place in Haiti under supervision of a CRIES systems analyst. Hardware configuration will include a power backup unit and stable voltage supply to minimize interruptions in use damage to the hard disc unit.

7.3.2 Products Transfer
Products to be transfered to the GOH, include a report of the resource assessment conducted and a seperate annex of attribute maps and derived products, such as a Resource Production Unit map and a map with erosion indices. The report will include tabular information on all resource attributes by political boundaries or administrative districts and selected crosstabulation of essential combinations.

7.3.3 Technology Transfer
After the resource analysis is completed, two groups of 5 GOH counterparts will travel to Michigan State University and receive training during the summer term. One group will be trained in <u>Resource Inventory Procedures and Applied Remote Sensing</u>, the other in <u>Resource Analysis and Applied Geographic Information System Techniques</u>. These counterparts will form the critical mass

of an operational Resource Information Center (Centre d'Information des Ressources Naturelles - CIRN) after their return to Haiti. At that time or shortly thereafter, the CRIES-GIS will be installed in Haiti and two workshops will be conducted for 20-25 participants. One workshop will provide instruction and hands-on experience in Applied Remote Sensing, the other in Applications of the CRIES Geographic Information System. Workshop materials will consist of english and french versions, while instruction will be in french or in english with simultanious translation.

8. REGIONAL WORK PLAN, PROJECT PHASE II

In discussions with AID/HAITI representatives during the development of this work plan, it appeared uncertain that funding for Phase II activities would be available or forthcoming. The request was made, however, to provide some general project suggestions and focus for possible inclusion in future economic analysis and policy evaluation efforts. These ideas might provide usefull in defining related funding appropriations by major areas of program emphasis for which the CRIES project can provide technical assistance.

8.1. Regionalization and Prioritization of Rural Development Areas by Watershed Management and Administrative Districts based on Resource Production Potential and Erosion Risk Indices

This project component will identify the geographic areas which represent the best development potential based on a composite analysis of a subjective weighing of aggregate crop/forest production potential and erosion risk. The weights will be primarily determined by "quantified" policy concerns such as benefits derived from food self-sufficiency and short-term revenue producing capacity of the renewable resource sector versus the costs of environmental degradation (e.g. expressed in reduced internal rates of return on hydro-electric projects and declining agricultural outputs). This direct relationship between policy choices and consequences will provide the spatial determinants necessary to select those areas which will become the primary focuss of integrated rural development planning. It will provide the first quantitative basis for area prioritization and related investments in soil conservation, social- and physical infrastructural development, cash crop expansion and intensification.

8.2 Land cover/use survey

For the priority areas selected, more detailed base line data need to collected to support regional planning. Implementation actions at this level will reflect land use changes, in type, in intensity and over time. To realistically support land use evaluation at this level, more detailed land use data (e.g. scale 1:100,000 or 50,000) are needed. Gathering data at this detail earlier in the process (project phase I, the national level) would not be cost effective. This land use mapping effort can be

supported with the existing aerial photography (scale 1:40,000, 1978) supplemented with high resolution Thematic Mapper data from Landsat. The first source will provide the detailed land use category breakdown, while Landsat data will be used to delineate boundary changes over time (the period 1978 and 1985-'86).

8.3 Farming Systems and Enterprise budget Survey

The delineations compiled in the more detailed land use mapping will be used to stratify the landscape with respect to agricultural land uses by type and intensity. These agricultural farming systems strata will reflect the whole spectrum from large mono cropping, export oriented cultivations to the small scale subsistence farming systems. This stratification will be used to design a random systematic area-sampling frame. In this process areas of relatively identical size are selected within the selected strata, and sampled. Socio-economic data are compiled for those areas and the standard statistical inferences are made. The sample should include all household data and farming inputs, costs and product prices. On that basis a typical enterprise budget, reflecting the stratum of choice can be compiled. Sampling frames have successfully been used all over the world, and provide a cost effective data gathering alternative in many developing countries (e.g. Jamaica). It is possible, on the the basis of the farming system parameters, to make inferences about the average accumalated effect of various policies affecting input costs, land tenure status,commodity prices etc. on household income and regional income distribution.

8.4 Economic Analysis of Comparative Production Advantage

The farming systems parameters compiled in 8.3, permit the relative determination of effects of various cost/price scenarios on a specific farming system. Within the farming system strata, however, the significant physical characteristics (e.g.soils,topography, road access,etc) still exist which determine the comparative production advantage on site specific basis. These spatial variation can be plotted by the computer, displyed on maps, and be tabulated in terms of aggregate differences between and within areas subject to the analysis. This process provides for a further spatial differentiation of the geographic domain, maximizing the predictive value (confidence) of forecasts on derived public and private benefits.

8.5 Regional Optimization of Objective Function

Aggregate benefits can be maximized using a single objective function (linear programming approach) or multiple objectives (e.g.goal programming). Linear programming has been used by the CRIES project to define the optimum cropping scenario (crop mix) subject to various constraints, e.g.production (the type and amount of land available), resource (yields with certain inputs) and input constraints (availability and price of inputs). This approach can successfully be used in determining the optimum solution; the crop mix resulting in the lowest production cost for a selected development region. The approach can be dynamic when simulating for future cost/price expectations. This is

especially usefull in agricultural land uses requiring a medium-term investment in processing/marketing facilities (e.g. the sugar cane industry in many nations in the caribbean basin).

9. KEY PERSONNEL

The following CRIES project core and associated staff members are identified for the Project. For Phase I:

Team leader/Resource Analyst.
The team leader will work directly with the counterpart project manager designated by the GOH, and will have a reporting/coordinating role with the Assistant Rural Development Officer (ARDO), USAID/HAITI. He/she will work work with the various sections of the Secretariat of Planning (DATPE) or the Ministry of Agriculture and other Ministries involved in aspects of project implementation. The team leader will be responsible for the activities of all team members of the technical assistance team, coordinating activities to achieve maximum results, and coordination of the short-term assistence required. In close cooperation with the counterpart institutions, the team leader will:

a. Aid in the selection of counterparts and the forming of a multi-disciplinary counterpart team of specialists;

b. Aid in the establisment of inter-institutional working relationships, information dissemination and the formation of planning and policy analysis responsibilities;

c. Aid in the institutional capability development through the transfer of appropriate technology for resource inventories (e.g. remote sensing) and resource analysis (e.g. applied geographic information systems);and

d. Provide technical assistance in planning methods and evaluation of policy alternatives for rural development.

Qualifications:
The team leader will need to draw on his experience as a Resource Analyst. He should have a Ph. D. Degree in Resource Development and specific expertise in:

1) Coordination of a multi-disciplinary resource analysis team in national resource assessment studies in developping nations;

2) Integrated surveys for rural development planning;

3) Resource inventory and sampling survey design;

4) Computer-based Geographic Information and Analytical Systems.

Soil Scientist
This advisor will provide, via the project/team leader, technical assistance to selected counterparts in soil surveys and correlation. The advisor will:

a. Aid in the systematic assessment of physical production potential for food and export crops using existing data augmented with field surveys;

b. Provide advise on soil surveys and analysis procedures to improve the technical capabilities of selected host institutions;

c. Advise on training and equipment support in soil surveys.

Qualification:
Have a Ph. D. in soils science and relevant expertise in agricultural production assessment studies in the tropical regions.

Systems Analyst
This advisor will advise, through the project leader, counterparts identified in the use of computer-aided analysis for resource assessment studies. Specifically the advisor will:

a. Conduct the data base development and related training activities with respect to the use of the CRIES-GIS system;

b. Train counterparts in the use of a stand alone, micro computer-based geographic information system;

c. Advise on inter-institutional working relationships optimizing systems use and efficiency; and

d. Advise on information dissimination procedures and formats with respect to existing system capabilities.

Qualifications:
Background in information systems technology and a masters or equivalent in computer science with experience in systems design, operations research and geographic information systems applications.

Remote Sensing Specialist
This advisor will, through the team leader, conduct the land use identification and mapping and work closely with counterparts in maximizing the usefulness of selected classification criteria and subsequent definitions of land cover/use catagories using available remote sensing data sources. Specifically the advisor will:

a. Provide supervision to image interpretation and classification to ensure data quality and consistency;

b. Supervise the cartographic transfer of interpretations to a stable mapping base and conduct related quality control;

c. Assist in the improvement of remote sensing survey procedures and data extraction/transfer techniques;

d. Assist in identifying areas of technical assistance and counterpart selection for additional training; and

e. Provide on-the-job and workshop training in-country.

Qualifications

The advisor should have a minimum of a master degree in the Natural Sciences or related field with extensive experience in resource surveys and interpretations. Prior experience is required in aerial surveys in the tropics. Ability and experience in the teaching of the following topics: Satellite and air-borne remote sensing, resource inventories and thematic mapping.

For Phase II the following general advisor qualifications are identified, without providing a more detailed description of their inputs at this time, since project identification is not completed:

Agricultural Economist with a Ph. D. in Agricultural Economics and an emphasis on farm management/farming systems and micro-economics, specifically in farm management analysis for crops in the caribbean basin. Marketing analysis with some emphasis on export crops.

Resource Economist with a Ph. D. in Resource Economics and a solid background in research methods, with experience in applied resource modeling, forestry economics and regional science.

Regional Economist with a Ph. D. in Economics or closely related field. Experience shall include: input-output analysis, multiple objective goal programming, linear programming, applied economic base theory and teaching in regional economics.

10. PERIOD AND TIMING OF CONTRACT SERVICES

Phase I, 2 years and Phase II 3 years

Phase I Inputs by Period

	FY 1				FY 2			
	1	2	3	4	1	2	3	4
a. Integrated Data Base								
Carthographic Base Maps	***							
Digitizing Thematic Maps		****	***					
Development LU Classificattion	***							
Land Use Mapping		********						
Field Verification			***					
Computer File Editing				***				
Statistics Attribute Files				***				
Crosstabulations				****				
Computer Maps				****				
Carthography					****			
Report Writing				**		******		
b. National Resource Assessment								
Compiling Climate Data	***							
Compiling Soils Data	***							
Compiling Crop Requirements	****							
Compiling Topographic Data		***						
Water balance Analysis			*****					
Field Reconnaissance		****		******				
Define Agro-ecological Zones				*****				
Computer Analysis					*******			
Yield Analysis					****			
Field Verification					*****			
Statistical Analysis						*****		
Report Writing						******		
Compile Soil Erosion Data			******					
Calibrate USLE for Haiti				*******				
Erosion Modeling/Analysis				*******				
Field Verification					****			
Cartography					******			
Report Writing						*****		
c. CRIES System Transfer and Training								
System Assembly/testing (US)		****						
Data Base Installation (US)		*****						
Counterpart training US				*****				
System transfer and installation Haiti						****		
Counterpart Workshops Haiti							***	
Final Presentations and Products Transfer								***

Phase II input per Period

	FY 1				FY 2				FY3			
	1	2	3	4	1	2	3	4	1	2	3	4
a. Regionalization/Prioritizing Areas				****								
b. Land Use/Cover Survey			*******									
c. Farming System and Enterprise Survey				*******								
d. Economic Analysis							******					
e. Regional Optimization									*******			

11. ESTIMATED CONTRACT COST AND FINANCING

The following project budget represents an estimate of anticipated project cost based on the discussions, verbal commitments and information available at the time of finalizing this scope of work. No binding commitment for procurement of the services of Michigan State University staff or faculty, directly or via an OICD PASA should be inferred. Funding options include: 11.1.1, 11.1.1 and 11.1.2 combined or 11.1.1, 11.1.2 and 11.1.3 combined.

11.1 Estimated Contract Cost

To facilitate funding appropriations by AID by project source, a budget estimate is prepared for the tree major activities envisioned under phase I.

11.1.1 Development of the Integrated National Data Base including Landcover/use mapping and related map products.

A. Salaries:		
Remote Sensing Specialist.(26 p.w.).....	15,000	
Systems Analyst.(26 p.w).....	15,000	
Resource Analyst.(26 p.w).....	20,000	
	50,000	
Fringe benefits (17%).....	8,500	
Research Assistants	24,000	
Total:		82,500
B. Travel:		
3 trips for 2 persons @ $1400/trip.....	4,200	
18 p.w. per diem (126 @ $90).....	11,340	
1 trip to Washington for 2	600	
1 week domestic per diem for 2	840	
Total:		16,980
C. Contracts and Services:		
Printing Reports (200 copies).....	3,000	
Carthography	14,000	
Aircraft Rental	5,000	
Digitizing and computer time	18,000	
Aerial photography (70mm/35mm).....	2,500	
Map and CIR Photo Acquisition	6,000	
Car Rental	2,000	
Total:		50,500
D. Contingency		10,000
Total Direct Costs		159,980
Indirect Costs (30%)		47,994
Total Costs		207,974

11.1.2 National Resource Assessment

A. Salaries:		
Resource Analyst (26 p.w.)	20,000	
Tropical Soil Scientist (13 p.w.)	10,000	
Agronomist (13 p.w.)	10,000	
Systems Analyst (26 p.w.)	15,000	
	55,000	
Fringe Benefits (17%)	9,350	
Research Assistant	12,000	
Total:		76,350
B. Travel:		
2 Trips for 2 persons, $700/trip	1,400	
8 pers./w. per diem (56 @ $90)	5,040	
Total:		6,440
C. Contracts and Services:		
Computer Time	8,000	
Carthograhy	10,000	
Car Rental	1,500	
(other costs included in 11.1.1)		
Total:		19,500
D. Contingency:		4,000
Total Direct Costs		106,290
Indirect Costs (30%)		31,887
Total Cost		138,177

11.1.3 CRIES System and Products Transfer, Installation and Training

A. Salaries:		
Systems Analyst.(10 p.w.)	6,000	
Programmer.(10 p.w)	5,000	
Remote Sensing Specialist (5 p.w.)	3,000	
	14,000	
Fringe Benefits (17%)	2,380	
Total:		16,380
B. Travel:		
2 Trips, 2 persons, 1,400 @trip	2,800	
8 Person/week p.d.(56@$90)	5,040	
Workshop Manual 50 @ $25	1,250	
Misc. Supplies	250	
Total:		9,340
C. Summer Seminars at MSU:		
Remote Sensing.15 Person/month,	52,500	
Geographic Information Systems.(same)	52,500	
(based on $3,500/person month AID allowance includes travel, tuition, lodging, food, books, lab. fees, insurance etc.)		
Total (includes overhead):		105,000
D. CRIES micro computer-based GIS		
Software provided at no charge, hardware procured by MSU, overhead exempt. system includes power backup and stable voltage supply		13,000
Total Direct Cost		143,720
Indirect costs (30% of 25,720)		7,716
Total Costs		151,436

11.1.4 Technical Coordination and Administrative Support

A. Resource Analyst (15 p.w.)	10,000	
Administative/Clerical Staff	15,000	
Fringe Benefits (17%)	4,250	
Total:		29,250
Total Direct Cost		29,250
Indirect Cost (30%)		8,775
Total		38,025

11.1.5 Budget Summary Phase I

A. National Land Resource Data Base and Land Cover/Use Mapping	207,974
B. National Resource Assessment	138,177
C. CRIES System and Technology Transfer	151,436
D. Technical Coordination, Administrative Support	29,250
Total Project Cost Phase I	526,837

11.1.6 General Budget Estimate Phase II
Since the defining of more specific project content was deemed pre-mature, only a very general guideline of project costs can be provided. The final project cost will be largely determined by the size of study are(s) and the scope of project deatail. Based on similar project design in Jamaica, were a rather detailed nationwide study is in progress in which various international organizations are cost- sharing, a realistic estimate will be in the $ 500,000 to $1,000,000 range.

11.2 Proposed Financing
Financing of the first project phase is expected via funding appropriations by AID/LAC under the scope of the Haiti Country Environmental Profile and mission funding under the Agricultural Development Support Project II, Rural Economics and Agricultural Statistics component. The Project Paper, Supplement II states:

"the DARNDR must have the capacity to obtain, analyze and dissiminate on a timely and ongoing basis an integrated system of agricultural and socio-economic information. This information must be current and accurate in order to serve as abasis for agricultural sector planning and management decision making".

The proposed CRIES information system will go a long way in satisfying this requirement. The to be established Land Resource Information Center will have the first integrated data base on the Haitian agricultural sector in combination with a data processing and updating capacity. In addition, the resource stratification produced in project phase I will greatly facilitate the gathering of additional socio-economic statistics using an area-sampling frame methodology such as successfully employed in neighboring Jamaica and the Dominican Republic.

12. LOGISTIC SUPPORT TO CONTRACTOR

It will be essential to receive a firm commitment from the selected counterpart institution that during the first phase a full-time staff member will be made available to provide the liaison role with various counterparts. During field visits by U.S. team members the same institution shall provide transportation and administrative services as required. The contract shall contain a clause that, at the discretion of the

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contractor, such services will be adequatly provided or otherwise procured with contract funds.

13. NEGOCIATED OVERHEAD RATES

Indirect costs on technical assistance contracts excecuted via a OICD PASA and the existing cooperative research agreement between USDA/OICD and CRIES/Michigan State University vary but are estimated at 30% at this time. Equipment procurement, such as the hardware required for the CRIES-GIS is overhead exempt.

14. POST PRIVILEGES

The contracter shall be provided with the standard post privileges including embassy health care facilities, commissary and mailing privileges.

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Appendix A.

Option I

INTEGRATED NATIONAL RESOURCE DATA BASE, AGRO-ECOLOGICAL ZONING AND STATISTICAL ANALYSIS

At the request of AID an alternate, low-cost option is provided to:

a) assemble the computerized data base for Haiti based on a compilation of secondary data;

b) to develop a national agro-ecological zoning; and

c) conduct the statistical analysis of the data base on the basis of potitical/administrative boundaries and watersheds.

The following components summarize the activities in this project option:

1. Development of the National Integrated Land Resource Data Base. An inventory of the quantity, relative quality for the purpose of renewable resource use and the spatial distribution of the land resources of Haiti will be conducted to provide descriptions of their physical setting, soil properties and climatic dimensions. This information will be digitized for computer storage and analysis. Computer-derived printermaps and tabular information will be produced denoting the various resource attributes at the national level. The following attributes will be included:

1.1 Soils and Topography.
The best available soil data (and relevant information on geomorphology and topography) will be used to define a consistent soil data base (scale 1:250,000) based on the USDA soil taxonomic criteria for use in land capability analysis. Topograhic data have specific relevance in erosion risk analysis and agricultural zoning decisions.

1.2 Climate
Past climatic records for all stations in Haiti will be studied to evaluate critical parameters for crop growth and yield response for the major food and cash crops. Climatic analysis will include the determination of critical temperature and soil moisture regimes for agro-ecological zoning. Climatic variables that will receive major consideration include annual and monthly (seasonal) measures of temperature and precipitation and derived evapotranspiration estimates for water balance (soil moisture) calculations.

1.3 Life Zone Ecology
The Holdridge Life Zone Classification will be used to better delineate regional variations in climatic regimes in support of

the final definitions of agro-ecological zones and their agro-climatic characteristics. This information is critical in predicting the long term crop response with the highest spatial and temporal accuracy.

1.4 Population Distribution

Population distribution will be stored on the basis of an average population density by area unit. Sources will include the various reported statistics and maps available referenced on a political boundary basis. This information is critical in determining regional or locational food requirements and other spatial impacts of policy options translated in socio-economic needs and benefits.

1.5 Transportation Network

The form, capacity and condition of physical infra-structure is critical in evaluating the transportation function and related costs of agricultural imputs and commodity prices in rural development. The various transportation networks will be stored by location for inclusion in the analysis of comparative location advange for crop prodution (expansion or intensification). In addition, transportation networks determine the availibility and cost of essential rural services such as education and health care.

1.6 Administrative units and Political Boundaries

All external and internal bounderies will be digitized as a separate attribute in the national data base. Boundaries will include the international territorial boundary, the boundaries of the department, arrondissements and communes. This permits a crosstabulation of all physical and socio-economic attributes by administrative and political boundaries, an important element in the analysis process of integrated rural development planning.

1.7 Watershed boundaries

Watershed delineations will be digitized to facilitate cross-referencing of all resource attributes and future composite indices, such as erosion risk,by watershed. This information is critical in successful watershed management operations such as soil conservation and reforestation.

2. National Resource Assessment

The assessment envisioned under this option will produce a overview of the quantitative and qualitative resource attributes with specific significance for agricultural and forestry development. All statistical summaries will provide a breakdown of soils, climate, life zones, population density, transportation system by national totals, departments, arrondissements and communes. In addition, computer generated maps and derived map products on stable base mylar (and paper copies) will be transferred to Haiti.

Agro-ecological Zoning and Crop suitability Assessment
The resource attributes will be combined to derive a composite index reflecting physical resource production potential for a selected crop or crop group. This information will be compiled in the form of Resource Production Units (or agro-ecological zones) and depicted on the map at a scale of 1:250,000. Relative production ratings for the various food and cash crops will be prepared to provide a measure of comparative production advantage per location. This permits a relative identification (especially if compared with existing land use) with respect to the development potential of any predefined area. These production assessments can later be refined to adjust the theoretical production levels based on the typical inputs and farm management practices identified from a farming systems survey.

This funding option does not include a survey of existing land use. Results will be summarized in a report entitled " Haiti: An Initial Resource Assessment ".

BUDGET

A. Salaries:		
Tropical Soils Specialist(13 p.w.)	7,500	
Systems Analyst.(26 p.w)	15,000	
Agronomist (13 p.w)	7,500	
Resource Analyst.(26 p.w)	20,000	
	50,000	
Fringe benefits (17%)	8,500	
Research Assistants	22,000	
Total:		80,500
B. Travel:		
3 trips for 2 persons @ $1400/trip	4,200	
18 p.w. per diem (126 @ $90)	11,340	
1 trip to Washington for 2	600	
1 week domestic per diem for 2	840	
Total:		16,980
C. Contracts and Services:		
Printing Reports (200 copies)	3,000	
Carthography	14,000	
Aircraft Rental	2,000	
Digitizing and computer time	18,000	
Aerial photography (70mm/35mm)	1,500	
Map and Photo Acquisition	2,000	
Car Rental	2,000	
Total:		42,500
D. Technical Coordination and Administrative Support:		
Resource Analyst (10 p.w.)	8,000	
Administrative/Clerical Staff	15,000	
Fringe Benefits (17%)	3,910	
Total:		26,910

E. Contingency	10,000
Total Direct Costs	176,890
Indirect Costs (30%)	53,067
Total Costs	229,957

Appendix B.

Option II

INTEGRATEDNATIONALRESOURCE DATA BASE AND STATISTICAL ANALYSIS

At the request of AID a second alternate, low-cost option is provided in case no mission funding would be available. This option includes:

a) assemble the computerized data base for Haiti based on a compilation of selected secondary data; and

b) conduct the statistical analysis of the limeted data base on the basis of potitical/administrative boundaries and watersheds.

The following components summarize the activities in this project option:

1. Development of the National Integrated Land Resource Data Base. A digitizing of selected resource attributes for computer storage and data base development and a statistical analysis of the data base to summarize the data base with respect to the spatial distribition by political/administrative boundaries and water sheds. Computer-derived printermaps and tabular information will be produced denoting the various resource attributes at the national level. The following attributes or derived indications from secondary sources will be included after compilation on a 1:250,000 stable cartographic base:

1.1 Soils Potential
Soil potential will be defined based on the criteria used in the general land capability analysis as defined by the previous BDPD/DATPE study (1982). Some grouping and reclassification of the map units will have to take place, in combination with a refinement of the legend place to formulate new homogeneous map units usefull for renewable resource production assessment.

1.2 Life Zone Ecology
The Holdridge Life Zone Classification will be used to delineate regional variations in climatic regimes in support of the later definitions of agro-ecological zones and their agro-climatic characteristics for resource production potential. This information is critical in predicting the long term crop response with the highest spatial and temporal accuracy.

1.3 Population Distribution
Population distribution will be stored on the basis of an average population density by area unit. Sources will include the various reported statistics and maps available referenced on a political boundary basis. This information is critical in determining regional or locational food requirements and other spatial

impacts of policy options translated in socio-economic needs and benefits.

1.4 Transportation Network

The form, capacity and condition of physical infra-structure is critical in evaluating the transportation function and related costs of agricultural imputs and commodity prices in rural development. The various transportation networks will be stored by location for later analysis of comparative location advange for crop prodution (expansion or intensification). In addition, transportation networks affect the availibility and cost of essential rural services such as education and health care.

1.5 Administrative Units and Political Boundaries

All external and internal bounderies will be digitized as a separate attribute in the national data base. Boundaries will include the international territorial boundary, the boundaries of the department, arrondissements and communes. This permits a crosstabulation of all physical and socio-economic attributes by administrative and political boundaries, an important element in the analysis process of integrated rural development planning.

1.6 Watershed Boundaries

Watershed delineations will be digitized to facilitate cross-referencing of all resource attributes and future composite indices, such as erosion risk,by watershed. This information is critical in successful watershed management operations such as soil conservation and reforestation.

The output products of the study will consist of the various stable base mylar maps, depicting the attributes in the data base, the associated map legends, 10 (ten) paper copies of each map and a complete statistical summary including all histograms and essential cross tabulations of factors by political/administrative and watershed areas.

BUDGET

A. Salaries:		
Systems Analyst.(8 p.w)	5,000	
Resource Analyst.(4 p.w)	3,000	
Agronomist. (4 p.w)	3,000	
	11,000	
Fringe benefits (17%)	1,870	
Research Assistant	12,000	
Total:		24,870
B. Travel:		
2 trips for 1 person @ $ 700/trip	1,400	
2 p.w. per diem (14 @ $90)	1,260	
1 trip to Washington for 1	300	
1 week domestic per diem for 1	420	
Total:		3,380
C. Contracts and Services:		
Carthography	5,000	
Digitizing and computer time	14,000	
Map Acquisition	500	
Total:		19,500
D. Technical Coordination and Administrative Support:		
Resource Analyst (2 p.w.)	1,500	
Administrative/Clerical Staff	2,000	
Fringe Benefits (17%)	595	
Total:		4,095
E. Contingency		2,000
Total Direct Costs		53,845
Indirect Costs (30%)		16,053
Total Costs		69,898