

A PROCEDURE USED IN THE CONDUCT OF A
RESOURCE SURVEY IN AN UNDERDEVELOPED COUNTRY

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DIRK VAN DER VOET

1969

THESIS



**SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK**

ABSTRACT

A PROCEDURE USED IN THE CONDUCT OF A RESOURCE SURVEY IN AN UNDERDEVELOPED COUNTRY

By

Dirk van der Voet

Large areas of Brazil, known to have potential for development under the right combination of crop, pasture, and forest use, and with management adapted to the type of soil and terrain are presently unoccupied. Settlement of these areas by low-income farmers from over-populated regions will contribute to Brazilian progress and stimulate economic and social development. This can be accomplished in an orderly manner if this settlement can be guided by knowledge of the extent, location and qualities of arable soils and requirements for proper cropping and soil management.

For the purpose of determining the extent, location and qualities of arable soils, the Resource Survey Project of the Frontier Development Program, Agrarian Reform, was established in 1964. The objectives of the Project were to locate 30,000,000 hectares (about 75 million acres) of fertile soil suitable for settlement in the interior of Brazil. The Project's area of operations consisted of the

western two-thirds of Brazil including the States of Acre, Amazonas, Goiás, Maranhão, Mato Grosso, Pará, and Piauí. Also included were the Federal Territories of Amapá, Roraima, and Rondônia.

The source of the Project cadre was the Division of Pedology and Soil Fertility of the Brazilian Ministry of Agriculture. Twenty-one trainees were added to the Project staff in January of 1966. These trainees were all recent graduates of Brazil's colleges of agriculture. An intensive training program was conducted for the new personnel during the period January 10, 1966 through March 15, 1966.

Two soil scientists of the United States Department of Agriculture, Soil Conservation Service, served as advisors to the Project during 1965 and 1966, and one during 1967 and 1968.

Operations were divided into a series of phases for the purpose of attaining the Project's objectives.

The first of these was referred to as the Preliminary Phase. This phase consisted of the orientation of new staff members; familiarization with the Project area; research, collection and cataloguing of basic material; establishment of contacts and relationships with other agencies, government and private; acquisition of supplies and equipment; and planning.

The Exploratory Survey Phase followed the Preliminary Phase. A schematic (exploratory) soil map of the

Project area was developed with accompanying legends and interpretations. The purpose of the schematic map was to determine where the best opportunities for increased intensity of land use existed in frontier areas. The objective of this survey was to locate sufficient unused or underused land of acceptable quality to settle seven to ten million people in a ten-year period. The construction of the map was based on (1) previous soil studies and experience; (2) exploratory field studies; (3) information on geology, climate, vegetation and topography; (4) aerial photo interpretation; (5) air observation.

The Reconnaissance Soil Survey Phase followed. The purpose of this phase was to confirm and more accurately identify those areas suitable for settlement which would permit efficient, sustained use of land. It was the goal to map 30,000,000 hectares at the reconnaissance soil survey level.

The final phase was the publication of maps with supporting descriptive material. The basic map published was the schematic soil map at a scale of 1:5,000,000. Three interpretive maps were developed based on the schematic map. Each one of these interpreted the schematic map for a defined level of management. The three levels were: (1) primitive, reflecting a low level of technical knowledge; (2) semi-developed, reflecting a

reasonable level of technical knowledge; and (3) developed, reflecting a high level of technology. The soils of the schematic map were rated for each of the levels of management according to the following four classes of suitability: (1) good; (2) fair; (3) poor; (4) not suitable.

Certain problem areas in the conduct of the Project's operations were identified as being of significance. The lack of administrative ability and managerial skill on the part of Project personnel was a cause for delays in reaching target dates. The attitude on the part of the indigenous personnel that they did not need technical assistance resulted in the failure to use the experience and knowledge of the American advisors to full advantage. The failure to provide sufficient funds on the part of the Government of Brazil resulted in delays, and failure to meet all of the Project's goals. The lack of coordination with other agencies in the early stages of the Project contributed to delays. Failure to adequately coordinate the efforts of the several institutions engaged in international resource development was a cause for misunderstanding and duplication of effort.

A PROCEDURE USED IN THE CONDUCT OF A RESOURCE
SURVEY IN AN UNDERDEVELOPED COUNTRY

By

Dirk van der Voet

A THESIS

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Appreciation is expressed to the author's supervisors in the Soil Conservation Service. Kenneth E. Grant, when State Conservationist in New Hampshire in 1962 encouraged the author to embark on this program of self improvement. Verne M. Bathurst, State Conservationist in Michigan is thanked for his indulgence in adjusted schedules and hours in order that the program of study might be completed.

To his wife, Hilda, and daughter, Deborah, he is thankful for the hours of typing and other assistance in preparing the original manuscript.

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The author desires to express his gratitude to Roy D. Hockensmith,, Director, Soil Survey Operations, Soil Conservation Service, United States Department of Agriculture. But for his recognition of the need, his interest, concern and perseverance there would have been no Resource Survey Project in Brazil. Because of his efforts the author was afforded the privilege of participating in the Resource Survey Project. The author and his family have the highest regard for this most able administrator, conservationist, scientist and above all gentleman and friend. The pleasant conversation and companionship of those tropical nights in the village of Santarém on the banks of the Amazon in May of 1966 are most fond memories.

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LIST OF ABBREVIATIONS USED

AID	Agency for International Development
BR	National Highway (Brasileira Rodovia)
CEA	Executive Commission on Alcohol (Comissão Executiva Alcool)
CEPLAC	Executive Commission for Research and Development of the Cocoa Crop (Comissão Executiva para Proteção à Lavoura Cacaueira)
CIDA	Inter-American Committee for Agrarian Development (Comitê Inter-Americano para Desenvolvimento Agrário)
CIVAT	Inter-State Commission of the Araguaia and Tocantins Valleys (Comissão Interestadual dos Vales do Araguaia e do Tocantins)
COCAP	Coordinating Commission for the Alliance for Progress
DPEA	Department of Research and Experimentation (Departamento de Pesquisa e Experimentação Agropecuária)
DPFS	Division of Pedology and Soil Fertility (Divisão de Pedologia e Fertilidade do Solo)
ETA	Office of Agricultural Technology (Escritório Técnico Agricultura)
FAO	Food and Agricultural Organization of the United Nations
FSI	Foreign Service Institute
IAGS	Inter-American Geodetic Survey
IBGE	Brazilian Institute of Geography and Statistics (Instituto Brasileiro De Geografia E Estatística)

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IBRA	Brazilian Institute of Agrarian Reform (Instituto Brasileiro de Reforma Agrária)
INDA	National Institute of Agrarian Development (Instituto Nacional de Desenvolvimento Agrário)
IPEAN	Institute of Agricultural Research and Experimentation-North (Instituto de Pesquisas e Experimentação Agropecuária-Norte) Belém, State of Pará
LASA	Aerial Photogrammetrical Surveys of South America (Levantamentos Aerofotogramétricos, SA)
OAS	Organization of American States
PASA	Participating Agency Service Agreement
PIO/T	Project Implementation Order/Technical Services
SCS	Soil Conservation Service
SP	São Paulo
SPVEA	Superintendency for Economic Improvement of the Amazon Region (Superintendência do Plano de Valorização Econômica da Amazônia)-Belém
SUDENE	Superintendency for Northeastern Development (Superintendência do Desenvolvimento do Nordeste)-Recife
USAF	United States Air Force
USAID	United States Agency for International Development
USAID/ARDO	United States Agency for International Development/Agricultural and Rural Development Office
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USGS	United States Geological Survey

INTRODUCTION

The objective of this thesis is to present a procedure used in the conduct of a resource survey project in an underdeveloped country. The basis of this work is the author's experience, supported by additional research, as an advisor with a resource survey project in Brazil during the period January 29, 1965 to January 29, 1967. This project was known in English as the "Resource Survey Project" and in Portuguese, the language of Brazil, "Projeto De Levantamento Dos Recursos Naturais." It is not intended that the procedures, organization, steps, and phases of that particular project are directly applicable to all resource survey projects being proposed in an underdeveloped country. There were, however, certain basic actions and steps taken in the development of objectives, and in the preparation, initiation and organization of the project, and the development of procedures, that are applicable with adaptations to similar types of projects in other countries that are underdeveloped.

The original intent was that in addition to the soil, climate, vegetative cover, surface water and other related resources be included. The project developed,

however, because of problems into what was primarily a soil survey. Certain basic procedures used and presented in this work, although developed from what was essentially a soils project, are applicable to projects concerned with other disciplines and resources.

The Resource Survey Project was closely related to and a part of the Agrarian Reform Program in Brazil. Its basic purpose was to determine the extent and location of relatively unsettled land areas which could provide land resources and economic opportunity for several million people from the overpopulated Northeast and other areas of Brazil of excess population. Specifically, the project had as its objective the location of 30,000,000 hectares (75,000,000 acres) of soil of relatively high fertility suitable for settlement within the interior of Brazil. This objective was to be reached through the development of a schematic (exploratory) soil map, and reconnaissance soil surveys. A second, but none the less extremely important objective, was to increase the size, scope, and effectiveness of the soils staff within the Ministry of Agriculture. This was referred to as institution building. These are related as the specific purpose and objectives of this specific project. Another type of a resource survey project would have a different purpose and other objectives.

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FIGURE 1.--Sugar Loaf Mountain, Rio De Janeiro. The headquarters of the Resource Survey Project was located here in Rio, the former capital of Brazil.

CHAPTER I

BACKGROUND OF THE RESOURCE SURVEY PROJECT

Introduction

Three areas of background information are presented in this opening chapter. The first of these is concerned with current data and statistics on the country of Brazil, which relate to the pressing need not only of frontier development, but development in such other areas as health and education. The second area discusses some of the events in the history of Brazil which have contributed to or affected the lack of development in the interior of the country, and the heavy concentration of population in the Northeast of Brazil and along the Atlantic Coast (see Map No. 2, Area of Major Demographic Density, in map envelope inside back cover). Attempts at penetration and development of the interior are also described in these paragraphs on Brazilian history. The final area discussed is that period immediately prior to the establishment of the Resource Survey Project, and the series of events which resulted in its establishment.

The presentation of this background material should provide for a better understanding and appreciation

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of some of the reasons why an accelerated program of resource development is vitally needed in Brazil. The Resource Survey Project is a basic element of this program of resource development.

Current Data and Statistics on Brazil

Brazil, which is the location of the Resource Survey Project, has been referred to by some writers as the sleeping giant of South America. She is the fifth largest nation in the world, having 3,290,000 square miles. Approximately one-half of the population of South America lives within her borders. The latest estimates are in the vicinity of 85 million, making her the eighth largest nation in the world in terms of population. More than 70 per cent of this population lives in a narrow strip along the Atlantic Coast (28).

The rural population of Brazil comprises nearly two-thirds of the total population of the country. About three-quarters of this rural population are either landless or live on uneconomic units. One per cent of the landowners control 47 per cent of the land. Much of this rural population lives in extreme poverty and subsists on inadequate diets. This situation is particularly acute in Brazil's Northeast area, where heavy over-population on resource-deficient land is resulting in unrest (3). Approximately 25 per cent of the total population of Brazil lives in this Northeast area.

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This country is reputed to have one-half the wealth of South America (28). Brazil is the leading producer of coffee in the world and is number three in the production of sugar, corn, cocoa and tobacco. The world's largest hydroelectric power potential lies within the borders of Brazil. The estimate is that Brazil has one-seventh of the world's iron ore reserves, 16 per cent of the world's timber, and incalculable wealth of gold, silver, diamonds, minerals and semi-precious stones. But most of all this is undeveloped.

Along with this tremendous potential Brazil has South America's highest child-mortality rate of 11.2 per cent; third highest illiteracy rate of 50 per cent; third lowest per capita income of \$285, and a ruinous state of inflation. Forty per cent of all Brazilians are affected with a major disease, and the average life span is fifty-five years.

These facts are presented here to enable the reader to have a better understanding of the need for a Frontier Development Program in Brazil.

Brazilian History and Frontier Development

There are events in the history of Brazil which have contributed to the problem of concentration of population in the Northeast and in the border along the Atlantic Coast. The Portuguese Mariner Cabral discovered Brazil

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in the year 1500, only eight years after Columbus had landed on the North American continent. The country is Portuguese in language and custom (6).

Early Exploration of the Coast

During the period from 1500 to 1526 Portuguese merchants were granted permission to explore and trade along the Brazilian coast (7). They discovered here the valuable red colored dyewood called "brazil," from which the country has received its name. This dyewood was the coast's only important article of commerce for a generation. This period also saw the start of miscegenation in Brazil as these merchants, and the workers they brought with them, intermarried with the native Indians (25). The Portuguese word "mameluco" is used as the equivalent of the Spanish "mestizo" meaning half cast. Other terms used in connection with miscegenation are "caboclos" for those born of white and Indian, and "curibocas" for those born of Negro and Indian. Many people in Brazil today blend all three strains.

Period of the Captaincies

During the period from 1531 to 1550 King John III of Portugal organized a system of proprietary grants. These were large tracts of lands known as captaincies, and were granted to individuals who had economic backing. The intent here was development by means of private means

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rather than by royal expense. These captaincies had rights similar to those granted to proprietors in the English colonies. The location of these captaincies started in the north at what is now the city of Belem at the mouth of the Amazon River, and followed the coastline south to what is now Santos in the State of Sao Paulo (see Map No. 1, Mapa Do Brasil).

There was a need of labor to operate the sugar plantations established on these captaincies. The first source of slave labor was the Indians. They did not adapt too well to plantation life, apparently, and so the Portuguese turned to the African slave trade as a source of labor. The Brazilian states of Rio Grande de Norte and Ceara were founded as slave trading centers. Through this system of captaincies, sixteen towns, fortified harbors, and colonies were established along the Brazilian coast. The colonists raised livestock, planted European-type crops, exported dyewood, sugar, cotton and tobacco, and profitted from the labor of Negro and Indian slaves.

Sugar had been introduced from the Madeira Islands as a quick money crop in the tropics. The establishment of the sugar plantations known as fazendas in the Northeast started during the period of the captaincies, and continued on during the 17th and 18th centuries. This was also the start of the problem of land reform which



FIGURE 2.--Sugar plantation in the State of São Paulo. Sugar was introduced into Brazil from the Madeira Islands as a quick money crop in the 1500's. Today Brazil is the world's number three producer of sugar.

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Brazil faces today. These sugar plantations were the start of the great estates, and their owners known as "fazendeiros," the landed aristocracy. Small tenancy was discouraged. Each fazendeiro was permitted to purchase 120 slaves a year in the early 18th century with a total import of approximately 50,000 Negroes each year. On the fazendas the fazendeiro had complete authority and often kept his own militia. It was thus that the population of Brazil became concentrated on the coast and in the Northeast. The book "Os Sertões" (Rebellion in the Backlands) by Euclides da Cunha is an interesting description of the physical, social, economic and political conditions in the Northeast at the start of the present century (10).

Movement to the Interior

It would be incorrect to say that there was no movement to the interior, but it was limited and cannot compare with that which took place in the United States. Reasons have been given for this lack of penetration. An escarpment hugs the coast and there is no true coastal plain, only a narrow shelf. This has hampered communication and penetration into the interior (16). Other reasons given are the desert behind Pernambuco, and the jungles and unnavigable rivers (7). (See Map No. 3, Types of Vegetation. This map shows a large proportion of the Northeast to be to caatinga type of vegetation which is a tropical thornbush to desert type of vegetation.)

The Bandeirantes

The accounts of attempts at development of the interior are found almost from the very start of Brazilian history and continue up to the present day. The first of these movements was by the "bandeirantes" from São Paulo (13). The "bandeirantes" have been described as pioneers. They were organized into raiding groups under their private banners or "bandeiras," and hence the name "bandeirantes." From São Paulo rivers led south and west to the Spanish colony of Paraguay and northwest into the Mato Grosso, Goiás and Minas Gerais areas. Indians, slaves, gold, diamonds, and rich pasture lands were the objectives of these movements by the "bandeirantes" into the interior along the rivers. They often drove cattle ahead of them and established ranches. The States of São Paulo, Minas Gerais and Goiás were founded by the "bandeirantes." They reached such distant points as Peru and Ecuador in their movements up the Amazon River, according to historical records. The activities of the bandeirantes took place during the 17th and 18th centuries. These activities also contributed to the establishment of the large landed estates. Despite the activities of the bandeirantes the bulk of the population of Brazil remained on the coast.

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The Amazon Basin, the Mato Grosso, and Goiás

The process of making latex used by the explorers of the Amazon in the 1700's was learned from the Indians. This was the start of the rubber trade and resulted in settlement of the Amazon Basin. Manaus became the center of this activity, 1,000 miles up the Amazon. This era collapsed at the end of the 19th century when Brazil's wild rubber lost the world market to the British plantation orchards of the East Indies and Malaya.

Other attempts at settlement and development of the Amazon Basin came during the administration of the Brazilian president Getulio Vargas. In the decade from 1930 to 1940 Vargas opened up the Amazon Valley to development. Today, exports from the Amazon region of Brazil consist of mahogany, carnauba wax, rotenone for insecticides, Brazil nuts, babacu oil and coconuts.

It was under Vargas that the government made an organized attempt to settle the interior. Exploring parties composed of botanists, doctors, agriculturists, and engineers surveyed routes into the Mato Grosso and Goiás Plateau. Goiânia, the new capital of Goiás, was founded in 1942. In 1966 its population was over 150,000 (5). This city of the interior has a fine middle class hotel which would compare in comfort, service and food with any similar hotel in the States. Large groups of self reliant middle class families cleared land in this area and started diversified farming.

It has been the dream of many Brazilian leaders for almost 200 years to move the federal capital into the interior (47). Under the administration of President Juscelino Kubitschek in the late 1950's the new capital of Brasília was built 800 miles in the interior in the savannah lands of Brazil's central plateau. It was also during Kubitschek's administration that BR 29 was built. BR 29 is the national highway which extends from São Paulo in the east to Porto Velho on the Madeira River close to the border of Bolivia. This highway crosses the sugar and coffee plantations of São Paulo, the savannah lands of the Mato Grosso and on through the tropical rain forest of the Territory of Rondônia.

Despite these attempts at development of the interior from the time of the bandeirantes in the 1600's to the construction of Brasília in the middle 1900's, the mass of Brazil's 85 million population still live within 100 miles of the coast. About two-thirds of the country is sparsely occupied with about 2 per cent of the total area in crops and more than half in forest. The savannah country of Mato Grosso and Goiás states, and the tropical rain forest of western Brazil and the Amazon Basin are still largely undeveloped.

Establishment of the Resource Survey Project

The purpose of the final section of this background chapter is to discuss in chronological order the significant events which started in 1963 and led up to the establishment of the Resource Survey Project of the Frontier Development Program. The complete list of these events appears below and then each is discussed in turn.

1. Survey Team of the United States Department of Agriculture in Brazil
2. Rio Conferences on Resource Development
3. The Project Agreement
4. The Project Implementation Order
5. Interagency Frontier Development Team in Brazil
6. The Participating Agency Service Agreement

Survey Team of the United States
Department of Agriculture
in Brazil

Organization and Purpose of the Team

Prior to 1963 the aim of the USAID¹ (the United States Agency for International Development) agricultural program in Brazil was to assist and foster

¹For explanation of abbreviations used see List of Abbreviations, p. **xi**

Brazilian agricultural development through the program of the AID Agricultural and Rural Development Division. Up to this point the program had consisted largely of a number of small and relatively limited agricultural projects carried out under a service arrangement. In fiscal year 1963 and 1964 a new approach was taken and funds for agricultural development were increased considerably. Part of the new approach was that emphasis be placed on contract personnel as opposed to direct hire. Objectives were developed and included the following:

1. The expansion and diversification of agricultural exports.
2. Improved food supplies.
3. Better land resource distribution.

The efforts of USAID to maximize the use of contracts to keep direct hire personnel to a minimum resulted in contractual arrangements with many organizations to undertake work related to agriculture and rural development programs. Primary emphasis was placed on Land Grant Colleges and the United States Department of Agriculture. The Secretary of Agriculture expressed the desire to cooperate to the maximum extent possible as requested by USAID. In 1963 the International Agricultural Development Service was established within the United States Department of Agriculture to handle cooperation with AID.

It was the position of the USDA (United States Department of Agriculture) that assistance to AID in Brazil would be provided on the basis of recommendations of a special survey team to Brazil and through the establishment of a USDA mission in Brazil rather than by supplying personnel to USAID. The composition of the USDA mission to Brazil and many of the details of its operation were to be developed based on recommendations of the survey team. The team was authorized on a reimbursable basis. The mission of the survey team was to analyze the agricultural situation of Brazil, the needs and possibilities, and to ascertain what assistance might be provided considering these factors, and the policies, programs and goals of USAID and the Government of Brazil.

After discussions both with AID and within the Department of Agriculture eight specialists were selected to serve on the team to represent the agencies concerned and to assure as broad coverage as possible. Agencies of the USDA represented were Agricultural Marketing Service, Agricultural Research Service, Economic Research Service, Farm Cooperative Service, Farmers Home Administration, Federal Extension Service and the Soil Conservation Service. The team leader was Charles R. Davenport, Chief, Western Hemisphere Branch, Economic Research Service. The representative of the Soil

Conservation Service was Roy D. Hockensmith, Director, Soil Survey Operations.

The team spent three days in intensive briefing sessions upon arrival in Rio de Janeiro in October of 1963. These sessions were with the American Ambassador, Lincoln Gordon; the Agricultural Attache, Ford Milam; Food for Peace; Brazilian Federal Ministry of Agriculture; and USAID officials.

Upon completion of the briefing sessions two and a half weeks were spent in the field to determine problems first hand. Following the field work two weeks of additional discussions were held in Rio with Brazilian and USAID officials and others familiar with all phases of Brazilian agriculture. During this final period the team prepared its report.

Considerations of the Team Report

The Brazilian Economy

In considering and analyzing the USAID objectives and requests the USDA Survey Team gave consideration to the current state of the Brazilian economy. The following paragraphs are a summary of some of the facts of the Brazilian economy which the team considered relative to the USAID objectives and requests for technical assistance.

The Brazilian economy has experienced political instability, serious regional and structural difficulties, severe inflation, and mounting social unrest. The rural population has been in a depressed condition as a result of prevailing types of agricultural systems, land holding patterns, inequitable prices, and production and marketing problems particularly in the Northeast.

Agricultural Problems

Agricultural development is a prerequisite for Brazilian economic progress. The agricultural sector is the source of livelihood for the bulk of the population.

Brazilian agricultural problems vary considerably by region and stem from many facts. The over-all problem is one of parallel development of human and natural resources in the agricultural sector. Strategic aspects of the over-all problem relate to transportation, land tenure, land utilization, literacy, agricultural technology, capital, the multiplicity of government agencies, and a combination of these areas.

The lack of adequate transportation is a central problem affecting production, marketing, and development of the interior of the country. A large part of Brazil is virtually isolated by the lack of transportation where such facilities are either inadequate or entirely lacking. It has been estimated that most of the



FIGURE 3.--The planalto of Brazil. Here on the planalto (central plateau) 800 miles from the coast, Brazil has built its new capital, Brasília, to encourage development of the interior. The three erosion surfaces described by Cornell soil scientist Reeshon Feuer may be identified in this picture.

country's transportation facilities lie within a coastal belt 300 miles wide. New settlers have been moving into the uninhabited regions of Brazil along transportation routes as rapidly as such routes are opened.

The existing system of land tenure is a serious handicap to agricultural development. The majority of farms are too small for the farmers to apply modern methods to significantly increase both output and income. Many such farmers are both deficit in basic needs and outside the market economy. Moreover, they are a source of economic and political instability and have little prospect of contributing to Brazil's economic progress. Complicating this problem is the lack of a cadastral survey and conflicts over property boundaries with many farmers occupying land without titles.

Land utilization problems are two fold: large areas in the interior have not been developed although they are potential agricultural areas, and much land is in large holdings and is either idle or underutilized. This situation precludes the solution of the land tenure problem within the agricultural sector, the possible absorption of excess urban population in agriculture, and the utilization of population increases in agriculture.

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Frontier Development

USAID Program Goals.--Frontier development is referred to in the Program Goals and Activities of USAID Brazil for the fiscal year 1964. The goal proposed in the area of frontier development was to assist in relieving the socioeconomic problem of the Northeast by improving the level of living of one million impoverished farm families; reducing political tensions; increasing the production of livestock and food crops; and providing opportunities for clear-titled and economic farm units for small farms through several activities.

A migration study was planned to determine movement characteristics of migrants, settlement problems, factors in success and migration motivation.

A resource survey was proposed to determine best settlement areas with emphasis on Goiás, Mato Grosso, Maranhão, Bahia, Paraná, and Amapá (see Map No. 1). Cooperating were to be SPVEA, CIVAT, SUDENE, Bank of the Northeast, Bank of Amazonas, Ministry of Agriculture, state governments, other federal entities, and international groups such as FAO, OAS, and CIDA. Estimates were that land was needed to settle 7-10 million people in ten years.

A resettlement project to assist 30,000 families to relocate by FY 1965 was planned.

A land transfer activity was proposed to include research and technical assistance and very limited

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financial assistance in developing a system to ensure efficient land use and improving the system of land description, title clearance, transfer and registration.

The USDA survey team was informed that the activities in which USAID had an interest in securing USDA assistance in addition to marketing, and livestock productive goods, included frontier development.

Situation in 1963.--The situation relative to the need for and possibilities for frontier development at the time the USDA survey team made its study in late 1963 is described in the following paragraphs (3).

The rural population of Brazil makes up almost two-thirds of the country's population. The estimate is that up to three-quarters of this rural population do not own land, or operate uneconomically small farm units. Many live in extreme poverty and subsist on inadequate diets. In the Northeast there was an estimated need for one to two million jobs with an expected need for 300,000 additional job opportunities per year. To create additional opportunities in agriculture or in agriculture based industries, there is a need to intensify agriculture. This should be done in areas where the greatest yield can be attained, measured in terms of new opportunities per unit of investment, under basically sound programs of economic development.

Brazil has great areas of undeveloped lands. These include the States of Mato Grosso, Goiás, Bahia, Maranhão and Pará, and the Territory of Amapá. The settlement of these areas could offer major relief to the problems of the Northeast, and bring appreciable areas into the economy of the country. Other areas include Amazonas, Roraima, Rondônia and Acre.

Brazil is concerned about frontier development. This is demonstrated by the fact that there are over fifty state, federal and private agencies

related to or concerned with frontier development in some way or other. Planning of the agencies is generally far ahead of activities. States which had settlement activities were Maranhão, Pará, Goiás, and Mato Grosso. Activities were generally related to federal and state owned land, and ranged from elaborated plans to simple land disposition.

Resource Survey.--As previously stated one of the segments of USAID's goals in frontier development was a resource survey. One of the early steps recommended by USAID was an exploratory study to determine where the best opportunities exist for increased agricultural use of land in the frontier areas, especially in Goiás, Mato Grosso, Maranhão, Bahia, Pará and Amapá.

It was USAID's belief that this exploratory survey should eliminate immediately areas unsuited to agricultural settlement; locate areas with apparent suitability some of which would need further study; and finally delineate areas clearly suitable for development where settlement should be encouraged immediately. This survey was not expected to be in sufficient detail for use in detailed land classification.

The objective of this survey would be to locate sufficient unused or under-used land of acceptable quality to settle 7-10 million people in the next ten years. Such land should have the following characteristics:

1. Sufficient natural fertility to meet needs for at least the first 3-5 years.

2. Be free of major natural obstacles which would necessitate immediate large investments in drainage, irrigation, terracing, etc.
3. Be reasonably accessible to transportation and marketing facilities or in areas free of major transportation obstacles.
4. Have reasonable control or potential for control of major health hazards without vast expenditures of funds.

To carry out this undertaking, USAID recommended that the USDA furnish one soil scientist and rural development specialist or land economist competent in rural development planning for one-year as resident personnel, and four short-term consultants for about three months. Personnel were to be based in the state of Goiás with considerable travel involved. Resident personnel were to revert to resettlement activity after the year on this activity. (These were the original recommendations and were altered considerably before the project was established.)

Recommendations of the Survey Team

The USDA survey team considered USAID's requests for technical assistance both from the USAID and the Brazilian point of view. They also considered agricultural problems as they related to the requests. The

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team then made recommendations aimed at providing the basis for a proposed PASA (Participating Agency Service Agreement) agreement between the USDA and AID personnel for technical assistance in Brazil. The team's recommendations were concerned with the procedure to be followed in making requests, the type of assistance, areas of responsibility, and short-term assistance.

Procedure

It was recommended that a written request be made to the United States Department of Agriculture by the Brazilian Ministry of Agriculture requesting that technical assistance be provided. This request was to cover the activities for which it was proposed that USDA should have primary responsibility. The request was to be addressed to the United States Secretary of Agriculture, and to be specific as to the type of assistance requested. It was recommended that the Brazilian Ministry be prepared to support these activities by the provision of adequate Brazilian resources and to be responsible for coordination in the areas concerned with other Brazilian entities.

It was recommended that USAID should enter into a new Project Agreement with the Ministry of Agriculture covering USDA activities. The USDA survey team was to prepare a proposed PASA agreement with AID, to be supplied to both agencies in Washington for negotiation. USAID/

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Brazil was to prepare a Plan of Implementation based on the Project agreement and forward this to AID/Washington for approval to permit final negotiations of the PASA agreement. It was recommended that the USDA be given opportunity to review both the Project Agreement and Plan of Implementation in draft form before they were finalized.

Areas of Primary Responsibility
Recommended for the USDA

The USAID requests for technical assistance were separated into two categories. The first category recommended those areas in which the USDA would take primary responsibility including long-term and short-term assistance. The second category recommended those areas in which USAID would take primary responsibility and in which USDA might or might not provide short-term assistance. The team recommended that primary responsibility be given the USDA in the following areas: cooperatives, credit, estimates and forecasts, market news, economic analysis, land transfer, and disease control. In addition the survey team recommended that an agricultural economist or agriculturist should be provided as the USDA Chief of Party. This resident Chief of Party was to carry out the functions of advisory and coordination, supervision, program planning and development and administration.

Short-Term Assistance

The team stated that it appeared that in view of the short time available exploratory surveys must consist largely of pulling together information which is now available in Brazil. Moreover, Brazilian and United States technicians who are familiar with the country's resources should be able to carry out such an exploratory survey more expeditiously than outsiders both unfamiliar with Brazil and with the information available in the many agencies involved. It would appear that USDA technical assistance might be appropriate for some short-term assistance. USAID Project leadership might be provided by direct hire personnel. It was recommended that USDA provide such short-term technical assistance as requested by USAID and recommended by the USDA Chief of Party for specific areas as needed.

Rio Conferences on Resource Development

The USDA Survey Team Report of December, 1963, had recommended short-term consultants only for the Resource Survey of the Frontier Development Program. It was the belief, however, of some of both USDA and USAID personnel that there was a need for long-term consultants. In May of 1964, Roy D. Hockensmith, Director, Soil Survey Operations, USDA, SCS was again in Brazil relative to Frontier Development. During May, conferences were held by Mr. Hockensmith with Dr. James L. Haynes, and

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Albert W. Pollard of USAID and Herodoto da Costa Barras, Marcelo Nunes Camargo, Leonardo Vittori, and Abilard F. de Castro of the Division of Pedology and Soil Fertility, Ministry of Agriculture. As a result of these conferences it was determined that two full-time consultants, as well as short-term consultants, would be needed on the Resource Survey Project. It was stated that:

. . . In this survey the USDA, if requested, may be able to give technical assistance to technicians in the appropriate agencies in Brazil in those phases of the work in which the USDA people can bring greater skills or improved techniques than now exist in Brazil. The bulk of the actual work, however, must be performed by Brazilians themselves.

As a start in this understanding, the USDA may be able to amend its PASA to furnish two soil scientists for two years and some soil consultants for short periods as required (18).

One of the two long-term consultants was to have experience in aerial photograph interpretation for soil survey. The second was to have experience in soil survey interpretations. It was hoped that they would be able to arrive in Brazil in September of 1964.

Another statement resulting from these conferences was that, "The Divisão Pedologia e Fertilidade do Solo, DPEA, in Rio had highly competent soil scientists. . . ." The "Division" was an important agency in the development of the Resource Survey Project of the Frontier Development Program.

The Project Agreement

On May 30, 1964, as a result of the conferences of that month in Rio, the Coordinating Commission for the Alliance for Progress, the Brazilian Ministry of Agriculture and the United States Agency for International Development with the concurrence of the Brazilian Government Representative for Point IV entered into an agreement for the Resource Survey Project (31).

The following are excerpts from the Agreement which are of significance.

- a. Large areas of Brazil known to have potential for development under the right combination of crop, forest and pasture use, and with management adapted to the type of soil and terrain, are presently unoccupied. Settlement of these areas by low-income farmers from over-populated regions will contribute to Brazilian progress, and stimulate economic and social development in an orderly manner, if this settlement can be guided by knowledge of the extent, location and qualities of arable soils and soil management.
- b. It is, therefore, particularly important to locate areas with soils that are suitable for cultivation by farmers who presently possess relatively little or no capital resources, education, and skills and to provide opportunities for these farmers to develop both skills and sound economic farm units.
- c. Cursory exploratory field studies, air photo interpretation and air observation will be the basis for developing an exploratory level soil survey of 600 million hectares in the States of Goiás, Pará, Mato Grosso, Amazonas, Maranhão, Piauí, and the Federal Territories of Amapá, Rio Branco (Roraima) and Rondônia.
- d. Surveys conducted at a reconnaissance level of selected areas thought to be suitable for settlement will be conducted on 30 million hectares (75 million acres). Extensive field work as well as aerial observation and air photo interpretation will be required.

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1. The first step is to identify the problem or question that needs to be addressed. This involves understanding the context and the specific requirements of the task.

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e. Major emphasis will be on soils, climate, vegetative cover, surface water, and related factors which determine resource capacity for possible agricultural uses of the land. This information on resource capability, together with information on markets, health, demographic and social aspects, to be developed in complementary research, will serve as a basis for developing policies and programs for frontier occupation and development.

The survey is expected to indicate the areas in which it may be possible to carry on intensive cropping, those which are likely to be suitable only for well managed forestry use, and those for which a combination of forestry, pasture and cropping is feasible.

f. The Ministry of Agriculture agrees to designate a member of the Division of Pedology and Fertility of Soils, acceptable to the Project Council, to serve as Project Manager to the exclusion of other duties, and to be immediately in charge of day to day operations, including supervision of the locally employed project staff, preparation and submission of detailed work plans and budgets for approval by the Project Council, preparation of periodic reports and management of property assigned to the Project.

The signing of the Project Agreement officially brought into existence and established the Resource Survey Project of the Frontier Development Program on May 30, 1964.

The Project Implementation Order

On June 30, 1964, a month following the signing of the Project Agreement, the Project Implementation Order/ Technical Services (PIO/T) was signed by USAID and the USDA. This was the official request from USAID to the USDA requesting the technical assistance in the form of consultants (32).

The following are excerpts from the PIO/T which are of significance.

a. Objective: Technical services are to be provided in support of Frontier Development Project to help produce (1) exploratory soil and resources capability survey in Maranhão, Goiás, Mato Grosso, Pará, Amapá, and other areas of the Amazon Basin, and (2) reconnaissance level surveys of the selected parts thereof. These surveys and complementary studies on markets, health, demographic and social aspects will serve as a basis for developing policies and programs for frontier occupation and development.

b. Scope: Within the policy guidelines of the Director, USAID/Brazil under the direction of the USAID Agricultural and Rural Development Officer, the technical personnel will include:

- (1) Two two-year specialists to assist soils specialists of the Department of Pedology and Soil Fertility of the Ministry of Agriculture with respect to:
 - (a) Planning soils surveys at both the exploratory and reconnaissance level
 - (b) Conduct of field operations as well as supporting laboratory work
 - (c) Correlation of data, preparation of maps and reports
- (2) Short term consultants to support the activity described by advising on highly specialized problems as need arises

Technical personnel will be required to spend a large percentage of their time in field investigation on extended field trips in tropical forest region travelling by air, auto, boat and horseback.

c. A well trained, competent but small group of soil survey specialists (formerly functioning under Soils Commissions) of Department of Pedology and Soil Fertility of Ministry of Agriculture, will be the Brazilian entity responsible for these surveys.

Interagency Frontier Development Team in Brazil

At the same time the Rio conferences described were taking place, and the Project Agreement and PIO/T

were being prepared a special team was in Brazil studying Frontier Development. Some of the participants in the May conferences were also members of this team. The team was officially designated "Interagency Reconnaissance Team on Brazilian Frontier Development" (4, 33). The team consisted of specialists from six agencies of the United States Government representing various disciplines, four Brazilian institutions, and Brazil USAID personnel. This team carried out its study in Brazil in May and June of 1964. The disciplines represented by the team were chosen as being those needed to select specific areas and make plans for the settlement or colonization of Brazilian pioneers in Frontier areas.

United States agencies represented on this team were: Natural Resources Division, Inter-American Geodetic Survey, Corps of Engineers, US Army; Soil Conservation Service, USDA; Forest Service, USDA; Bureau of Land Management, USDI; Rural Development Branch, USAID; and Community Development Division, Office of Technical Cooperation and Research, USAID. Representatives of the USAID Brazil, Agriculture and Rural Development Staff, and Government of Brazil including the "Division of Pedology and Fertility of Soil" of the Ministry of Agriculture, joined the team in Brazil. The team leader was Dr. Peter C. Duisberg of the Natural Resources Division, Inter-American Geodetic Survey. Representative of the United States Soil Conservation Service was

Roy D. Hockensmith, Director of Soil Survey Operations. Mr. Hockensmith had also been a member of the USDA Survey Team of the previous year and provided a link between the two teams.

The team studied and made recommendations in the following areas:

1. Natural Resources Inventory and Evaluation
2. Forestry and Forest Products
3. Agriculture
4. Public Health
5. Public Land Policies
6. Sociological Aspects of Settlement

In the area of Natural Resources Inventory and Evaluation certain recommendations were made by the team which were related to the Resource Survey Project. Among these recommendations were the geographic areas proposed for study and the use of aerial photography.

The Participating Agency Service Agreement

The final document signed by which the USDA agreed to furnish technical assistance to the Resource Survey Project, was the participating Agency Service Agreement (PASA) (29). The document was signed on October 1, 1964, by Matthew Drosdoff, Administrator of the USDA's International Agricultural Development Service. Under the provisions of this document the USDA agreed to furnish

the two long-term consultants and the short-term consultants as requested in the PIO/T signed June 30, 1964.

The signing of this Agreement was the final action necessary in the establishment of the Resource Survey Project of the Frontier Development Program of Brazil.

CHAPTER II

THE DEVELOPMENT OF A PROJECT STAFF

Introduction

The signing of the several documents described in the previous chapter officially established the Resource Survey Project of the Frontier Development Program. The next task was the recruiting, organizing and training of a project staff.

The Project Council

The Project Agreement stated that there would be a Project Council composed of a representative of the Ministry of Agriculture, the Brazilian Director of ETA (Escritório Técnica Agricultura), Office of Agricultural Technology, and the Director of the USAID/Brazil Office of Agriculture and Rural Development (or their designees) (31). The Project Council was to be responsible for the technical planning of the program and approval of detailed work plans, budgets and any work to be done by contract. The Project Council could enter into cooperative agreements with other interested government or private entities to receive financial, technical, material or other assistance needed for carrying out the purposes of the project.

The Project Council has been mentioned first since it was one of their functions to approve a Project Manager. The Ministry of Agriculture appointed to this Project Council as their member, Waldemar Mendes, Director of the Division of Pedology and Soil Fertility. ETA appointed its own Director, Hilton Salles to the Council. The USAID/ARDO representative was Dr. Richard Newberg, Director of the Agriculture and Rural Development Office.

The Project Council was to meet quarterly on the first Monday of each third month to review work plans, budgets and other items of major importance.

The concept of the Project Council and its functions is an excellent one. A properly functioning council can provide guidance and insure proper planning and execution of plans and reasonable progress of a project. It is strongly recommended in the organization of any resource survey project. It must meet regularly, however, and function in accordance with its concept. The Project Council of the Resource Survey Project failed to do this. The failure of the Project Council to function properly was partly responsible for many problems which developed and hindered progress of the Project.

Source of the Project Cadre

The responsibility for soil surveys at the national level in Brazil rests with the Divisão de Pedologia e Fertilidade do Solo (DPFS--Division of Pedology and

Soil Fertility) within the Department of Research and Experimentation (DPEA) of the Ministry of Agriculture. The DPFS is the group most concerned with the Resource Survey Project. The DPFS had at the time of the establishment of the Project a well-trained, competent but small group of soil survey specialists. This staff was composed at that time of twenty-one pedologists, nine chemists and two geologists. The DPFS was known originally as the "Soils Commission." In 1962 the Ministry of Agriculture was reorganized and the DPFS created. The duties and responsibilities assigned to the DPFS by law are:

1. Plan, promote and control research concerning soil science and soil fertility.
2. Conduct research and experimentation providing standardization of methods in fields of soils and soil fertility through regional research institutes.

The activities of the DPFS are principally in the field of soil survey and classification. The work of the DPFS in progress when the Project was initiated was:

1. In cooperation with CEPLAC, conduct a soil survey of cacao region in Bahia (90,000 km²).
2. In cooperation with CEA, conduct a soil survey of the humid coastal area in the sugar producing area of the States of Pernambuco and Alagoas.

3. In cooperation with the State of Rio Grande do Sul, conduct a soil survey of the state.
4. In cooperation with the State of Ceará conduct a soil survey of the state.

This information on the DPFS concerning its size, experience, and scope of activities is given here to indicate the source from which the Project was to recruit its cadre. Since one of the major resources with which the Project was to be concerned was soil, the DPFS was the logical source of a recruitment. Also as was stated in the introduction one of the objectives of the program was to increase the size, scope, and effectiveness of the soils staff (DPFS) within the Ministry. This objective translated into specifics called for:

1. Enlargement of the staff of the DPFS from 30 to 100 technicians.
2. Enlargement of equipment and facilities from a \$200,000 investment to a \$1,000,000 investment.
3. Enlargement of the scope of operations from a few east coast states to full national operations.
4. Development in depth and functions from a small purely scientific approach into a utilitarian institution that develops scientific information and interprets it for productive economic use.

Proposed Project Staff

During its first year of operation it was proposed that the Project have for a staff the following:

Project Manager--1
Assistant Project Manager--1
Field Coordinator--1
Assistant Field Coordinators--2
Regional Party Chiefs--5
Soil Surveyors--15
Photo Interpreters--3
Land Use Capability Specialists--3
Laboratory Analysts--3
Total--34

This staff proposal was developed prior to the time that the author joined the Project. Presumably, it was prepared jointly by members of the DPFS staff and members of the Brazil USAID/Agriculture and Rural Development Office. It would appear to be a little heavy in supervisory personnel, counting the first ten listed as being in the supervisory category, as against fifteen soil surveyors. Considering, however, that the ten in the supervisory capacity would probably be expected to remain fairly constant in the second and third years, while the number of surveyors would increase considerably as recruiting and training progressed, the proposal is reasonable.

What was of concern were the "Photo Interpreters." All soil scientists should be trained in the use and techniques of aerial-photograph interpretation in soil survey. It is an excellent tool and an aid to the soil scientist. Each soil scientist does his own aerial-photograph interpretation work, and it is recognized that some become more proficient in it than others. It was the concept, however, amongst the Brazilian members of the staff that there should be specialists in this area. It was kind of an exalted position, a status symbol if-you-will, to be known as a photo interpretation specialist.

Another comment regarding this first staff proposal concerns the three "land use capability specialists." What is meant here are specialists in soil survey interpretations. The need, however, is for training as soil scientists first, and then as certain individuals exhibit a talent or desire for a specialized field advanced specialized training can be given.

Although the Project did not attain this goal of 34 staff members in its first year, it did have, by September of 1965, a total of ten on it who were either part-time or full-time. Some reasons for delay and problems involved in acquiring even this much of a staff are discussed later in this chapter.

Project Manager

The Project Agreement of June of 1964 states that one of the responsibilities of the Ministry of Agriculture was to designate a member of the Division of Pedology and Soil Fertility, acceptable to the Project Council, to serve as Project Manager to the exclusion of other duties (31). He was to be immediately in charge of day-to-day operations, including supervision of the locally employed project staff. His duties included the responsibility for the preparation and submission of detailed work plans and budgets for approval by the Project Council. He was also responsible for the preparation of periodic reports and management of property assigned to the property.

The first man to be appointed to this position was Herodoto da Costa Barros. The exact time of his appointment is not known. The Project Implementation Order of June 30, 1964 indicates that one had not been appointed at that time (32). A Project Work Plan dated Rio, October 15, 1964, carries the name of Herodoto typed as the signatory with the title of "Project Administrator" (8). Herodoto should have been reasonably familiar with the Project. He had been a member of the DPFS for a number of years and had served on the USADI Interagency Reconnaissance Frontier Development Team described in the latter part of Chapter I of this thesis (33).

By late January of 1965, however, Herodoto had already left the Project and was on leave from the DPFS. The reason? The same reason that the United States Government also loses experienced and trained personnel--the offer of a higher salary in industry.

The next man to be designated as a Project Manager was Nathaniel José Torres Bloomfield. Nathaniel was another member of the DPFS with a certain amount of experience as a pedologist. He was in charge when the USDA advisors joined the staff and remained in charge until the fall of 1966 when a conflict with the Director of the DPFS resulted in his reassignment.

(As a sidelight on the manner in which a Latin American bureaucracy operates, Nathaniel is, of this writing, the Director of the DPFS and his former supervisor, the Director who disposed of Nathaniel as Project Manager, has now been reassigned.)

Nathaniel, born in Rio in 1923, was a graduate in 1948 of the Escola Nacional de Agronomia, Universidade Rural do Brasil.

The published soil survey of the State of São Paulo lists Nathaniel as having been a member of the field party. He also had been engaged in agricultural activities in Anapolis in the State of Goiás, west of the Federal District of Brasília. He was on a first name basis with the Governor of the State of Goiás,

and on a visit to Goiânia, capital of Goiás, introduced the USDA advisors to the Governor.

Assistant Project Manager

The Assistant Project Manager was Luiz Edmundo Rangel Souza Brito. He was, perhaps, one of the more level headed and stable individuals with whom the author came in contact in Brazil. Born in São Paulo in 1916, he was a graduate of the Escola Nacional de Agronomia, Universidade Rural do Brazil. He was not a pedologist but had many years of experience with the Ministry of Agriculture. His travels had taken him to Argentina, Chile, Peru and the United States. He spoke good English. His duties were primarily administrative, having little to do with the technical aspects of the Project. Considerable credit is due to his wise counseling of the Project Manager for much of the success the Project did have until September of 1966. When the Project Manager was relieved, however, his assistant received the same fate and the Project lost one of its better supervisory personnel. He was well qualified for his assignment on the Project staff.

Field Coordinator

Marcelo Nunes Camargo, the Field Coordinator, was also already on the job when the USDA advisors joined the Project. This man was probably the most qualified for

his assignment of any on the project. He is one of South America's leading soil scientists, in the area of soil classification. Born in São Paulo in 1927, the son of a colonel in the Brazilian Army, he graduated from the Escola Nacional de Agronomia, Universidade Rural do Brazil in 1952. He had spent several semesters at North Carolina State University doing graduate work in the mid-fifties, and had done considerable traveling in the United States, studying soils in the field. He had been a member of the field parties of all three of Brazil's published soil surveys.

This man made the major contribution to the Project of any single individual. His efforts and talents, unfortunately, had to be shared with two other institutions. Because of the low salaries paid by the Government of Brazil, many professionals have to have more than one job. In addition to his assignment on the Project, Camargo was Soil Correlator for the DPFS. He was also a member of the faculty of the Escola Nacional de Agronomia, Universidade Rural do Brasil. On Friday and Saturday of each week he instructed classes in soils at the University named above. (This University was commonly referred to as "Kilometer 47" because of its distance from Rio of 47 kilometers.)

Camargo had also served on the USAID Frontier Development Reconnaissance Team of 1964 (33). In addition to travel in the United States he had studied

soils in Argentina, Chile and Italy. It was understood that he had had opportunities of positions with the Food and Agriculture Organization of the United Nations at a salary several times that which he received in the DPFS. He recognized the problems and needs of Brazil, however, and was willing to make the personal sacrifice that he might contribute his skill and knowledge to his country. One cannot help but contemplate how much of this self sacrifice and discipline was the result of his upbringing as the son of a colonel in the Army of Brazil. The technical and scientific ability of this man have earned him the professional respect and admiration of soil scientists of the United States and Europe.

Other Staff Members

This group of three, Nathaniel, Edmundo and Camargo made up the Project staff in April of 1965. There were two additional experienced members who joined the staff in 1965. Luiz Gonzaga De Oliveira Carvalho was the first of the two. Born in Rio in 1922, he was another graduate of the Escola Nacional de Agronomia, the class of 1948. In addition to working on soil surveys in the States of Sao Paulo, Rio de Janeiro, Pernambuco and Rio Grande do Sul he had studied in the United States at both the North Carolina State University and Oklahoma State University. He was considered to be a specialist in aerial-photograph interpretation, and unfortunately tried to use it beyond its limitations.

The final staff member to be assigned was Flávio Garcia De Freitas. Born in São Paulo in 1927, he graduated from the Escola Nacional de Agronomia in 1952. He had experience on several surveys and was a capable pedologist. Prior to the time of the Project, however, he had refused any position with leadership responsibility. Not that he was not capable, but that the civil service system under which the DPFS came allowed for only one salary level regardless of responsibility of assignment, or length of service. Flávio's position, therefore, was that if he were not to be paid for responsibility he would not accept the responsibility. He performed duties on the Project staff that could be considered to be either those of an "Assistant Field Coordinator" or a "Regional Party Chief."

These five then, Nathaniel, Edmundo, Camargo, Gonzaga and Flavio were the experienced personnel of the DPFS who made up the cadre of the Project Staff.

The need for such a trained and experienced indigenous cadre in a resource survey in an under-developed country is important. Its existence is a significant factor in the initial establishment of a project, and in acceptance of the final product of the project by the government of the country. Its effect on recruitment, training and development of a staff is

very beneficial. To illustrate this point, all five of these cadremen were graduates of the Rural University of Brazil. Thirteen of the first forty-two recruits were also graduates of this same school. Failure to have such a cadre can bring about several undesirable situations. At one time it was proposed that this entire project be carried out completely by American personnel. It is reasonable to expect that it could have been faster and cheaper by such a method, but this would have presented several serious problems. First, the acceptance and use of the results by the indigenous government is doubtful. History will bear out that in a large number of cases, plans and projects developed and executed by foreign agencies, no matter how good, are accepted with reluctance, if at all, by the local government. It is more than likely that they will see little use except as dust collectors on a shelf.

Second, this approach would have done nothing to train, improve or enlarge the soil survey staff of the Ministry of Agriculture.

In the planning for a resource survey project, therefore, whether it be soils, forest, water, or other, provisions should be made, if at all possible, for a cadre of trained, experienced native professionals.

In addition to the cadre there were five trainees on the Project during 1965. Three were 1964 graduates

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of the Escola Nacional, and the other two were 1964 graduates of the Universidade Rural do Rio Grande do Sul. These five received no formal training during 1965 but worked alongside the experienced cadre and received on-the-job training.

Acquisition of New Trainees

Problems in Recruitment

The original intent had been to start recruiting new pedologists, that is recent graduates of Brazil's agricultural colleges, as soon as possible after the signing of the Project Agreement. As noted in the previous paragraphs, however, only five of the class of 1964 were on the roles of the Project by the end of 1965.

Several reasons were advanced for the failure to recruit more. First of these was the salary. The salary was low. As was mentioned in the case of Camargo, he needed a teaching job at the university in addition to his job at the DPFS to make ends meet. His case was the usual rather than the exception. Because of the low salary, scheduled hours of work with the DPFS were from 11:00 A.M. to 5:50 P.M. Despite the low salary a number might have been induced to join the Project had it been an office job located in Rio. They could have worked the reduced hours and spent their mornings on the beach

at Copacabana or Ipanema, or the more industrious ones could have found a second position. In addition to the low salary, however, there was the location of the work of the Project. This was the underdeveloped interior, the savannah lands of the Mato Grosso, Goiás, Roraima, Maranhão, and Piauí, and the tropical rain forest of Amazonas, Acre, Pará and Rondônia (see Map No. 3, Types of Vegetation). Risks and dangers were involved in working in these areas. The chance of contracting malaria or some other tropical disease was ever present. Dysentary could result from food prepared under unsanitary conditions, and drinking bad water. The work would be far from a doctor or other medical facilities. Lodging accommodations would frequently be a hammock in a palm leaf hut. In many of the areas hostile Indians still killed with the bow and arrow, and the knife. Travel over the jungle in single engine light aircraft was a risk. Chances of survival were slim if forced down in the jungles which, in addition to the Indian, were infested with the anaconda, the alligator, the jaguar, and other reptiles and beasts.

Source of Trainees

Somehow, these obstacles were overcome, and by the end of December 1965, forty-two recent graduates of Brazil's agricultural colleges had enrolled for an eight-week training course in soil survey to be



FIGURE 4.--The campo cerrado of the Mato Grosso. The savannah (campo cerrado) covers almost two million square kilometers of Brazil's vast territory. With modern agricultural techniques it could be part of the answer to the world food problem.

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administered by the Project. Approximately only half of the total forty-two were to be assigned to the Project because of its financial limitations, and lack of sufficient supervisory personnel. The balance returned to the States of Brazil and were employed by State and other agricultural agencies.

The sources of recruits were the agricultural colleges of Brazil. The schools represented were the following, with the number of students from each indicated (43):

1. National School of Agronomy of the Rural University of Brazil, State of Guanabara, thirteen students.
2. Superior School of Agriculture of the Rural University of the State of Pernambuco at Recife, ten students.
3. College of Agronomy of Santa Maria, State of Rio Grande do Sul, nine students.
4. School of Agronomy and Veterinary of the University of Rio Grande do Sul at Porto Alegre, five students.
5. School of Agronomy and Veterinary of the University of Parana at Cuitiba, four students.
6. School of Agronomy of the Amazon at Belem, State of Pará, one student.

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A study of Map No. 1, Mapa do Brasil, with respect to the location of these schools will indicate that the students came from Belém in the far north of Brazil at the mouth of the Amazon close to the Equator, from Rio Grande do Sul close to the national borders of Argentina and Uruguay in the far south, as well as points in between. It was a good cross section of the regions of the settled parts of Brazil. The method of contact with these agricultural colleges was through personal visitation by the Project Manager, Nathaniel Bloomfield, and other members of the DPFS, some of whom actually served on the faculties of these colleges.

Conspicuous by its absence was The Superior School of Agriculture of the University of São Paulo located at Piracicaba in the State of Sao Paulo which had no representatives on the Project. An unfortunate relations problem existed between the soil survey staff at the school at Piracicaba and the DPFS. Cooperation between the two staffs, and a mutual exchange of knowledge and ideas would have been of considerable benefit to the soil survey program of Brazil as a whole. The author spent a number of pleasant days at the Agricultural College at Piracicaba conducting seminars for the faculty on the use of aerial-photograph interpretation in the various disciplines of agriculture. They were an interested group anxious for progress.

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Training of New Personnel

Formal Training Course

A formal training course in soil survey for the new personnel was conducted at the Project Headquarters during the period January 10, 1966, through March 15, 1966. Subject matter covered in this course is listed in Appendix A.

The course included a two-week field trip. During this trip soils were examined in the field and practical instruction given in the description of soil profiles.

Instructors for the course were engaged from the following sources:

1. National School of Agronomy, Rural University of Brazil.
2. Division of Pedology and Soil Fertility.
3. Pan American Center for Improvement of Research of Natural Resources.
4. U. S. D. A. Advisors to the Project.

Since the individuals in attendance at this course were primarily recent graduates of Brazil's agricultural colleges the question might be raised as to the need for such a training course. Had they not had the subject matter presented in the course during their college career and would not it have been better to start them immediately on on-the-job training on reconnaissance surveys? This question was asked of both Brazilians and

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Americans with several years of experience in Brazil. The reason given was that the coverage of the subject matter in the Brazilian colleges was not broad enough or deep enough when considering the scope and objectives of the Resource Survey Project. The trainees came from a number of different schools. The emphasis on soils and the other subjects covered would have varied considerably from school to school. There was a need to insure that all trainees had received equivalent training.

Another advantage which this training course provided was that it gave the Project supervisory staff the opportunity of a good look at each individual before they were hired. Forty-two trainees took the course and only twenty-one were to be actually hired by the Project itself. The staff, who did a large amount of the instructing, were able to evaluate trainees throughout the progress of the course and eliminate the undesirable ones.

It also might be well to bear in mind when considering the need for such a course that the United States Soil Conservation Service conducts a four-week orientation course for its new employees within their first year of employment. Many of these are also recent college graduates but the course is still considered to be effective and worthwhile.

In evaluating the need for such a similar type of training course, therefore, regardless of the resource

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being surveyed, it should be kept in mind that such a training course will provide for the following:

1. An opportunity to observe and evaluate the potential employees of the project both in the class room and the field.
2. Insurance that each trainee has received instruction in those areas considered essential to the attainment of objectives of the project.

On-Site Training

In addition to the organized training course the trainees hired by the project received on-site training in the field. During the period April 1 to June 30, 1966, the quarter following the formal training program just described, four exploratory field parties operated in the States of Goiás and Mato Grosso. These four field parties had three objectives:

1. Write detailed profile descriptions of the principal soils of a specified area within the two States. Collect soil and geologic samples of the described soils for physical and chemical analysis.
2. Make and record observations on vegetation, topography and parent material.
3. Train new personnel.

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Each one of the four parties was under the leadership of an experienced pedologist of the DPFS, and was equipped with one to two vehicles depending on the size of the party. The duration of the stay in the field of each party varied from two to five weeks.

One of the four parties had planned to operate westward of the Mato Grosso into the Territory of Rondônia and village of Vilhena. The Indian Protection Service of Brazil, however, warned against this as the Cintas Largas Indian Tribe, in full war paint and with bows and arrows, had surrounded Vilhena and killed several of its inhabitants.

In addition to the four parties two other field operations, in addition to supplying data for the project, provided training for these new pedologists. The first of these included parts of the States of Pará and Amazonas and the Territory of Roraima. During this field trip, instruction was provided to three of the trainees in the method of collecting yield and other related data from agricultural technicians and farmers to be used in the development of soil survey interpretation.

The second field trip which provided training took place in the Federal District between the National Capital of Brasília and the town of Planaltina. This was a low intensity detailed soil survey of a federal experiment station and an agricultural school, totaling approximately



FIGURE 5.--Indian women and hovel in western Mato Grosso. Italo Falesi, Brazilian pedologist in charge of soil survey in the Amazon Basin, attempts to engage women of the Cintas Largas tribe in conversation. Note weaving activities directly in front of grass hut.

35,000 acres. Nine of the pedologist trainees received this training for about a three-week period. Training was given in the techniques of a low intensity detailed survey, and in aerial-photograph interpretation as a tool in such a survey.

Participant Training

Another method of providing training for selected members of the project who had demonstrated the potential for leadership and greater responsibility was referred to as participant training. Participant training consisted of training in the United States either at a university in the form of graduate study, or with a progressive soil survey party of the United States Soil Conservation Service.

Five pedologists of the Project received training of four months each in the United States in 1968 on the duties and responsibilities of a soil survey party leader on detailed surveys (20). They received individual training at selected locations as members of a progressive soil survey in the southern and southwestern areas of the United States. These participants returned to Brazil with a better understanding of the requirements of a total soil survey program. They will serve as soil survey leaders and train new personnel as the program expands (15).



FIGURE 6.--Project trainees in the field. On-site training in a low intensity soil survey is taking place near Planaltina in the Federal District. Monument marks location of the planned site of the Federal Capital of one of Brazil's former national leaders. It is 30 miles from the present site of Brasília.

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Other Advanced Training

A few individuals selected from among the trainees were assigned to work with both the United States Department of Agriculture advisors and the Project cadre to receive more detailed instruction in the areas of soil survey interpretation, and aerial photograph interpretation. This training consisted of study at the Project Headquarters in Rio and field trips to collect data and test out in the field methods developed in the Project Headquarters.

Technical Advisory Personnel

Long-Term Consultants

Qualifications

The series of events of 1963 and 1964 leading up to the establishment of the Project were discussed in Chapter I. The USDA Survey Team of 1963 had recommended only short-term assistance for the Project. The Rio conferences of May 1964, however, recognized the need for long-term assistance and recommended such assistance. The Project Implementation Order/Technical Services of June 30, 1964 provided for two two-year specialists to assist the Project with respect to:

1. Planning soil surveys at both the exploratory and reconnaissance level.

2. Conduct of field operations as well as supporting laboratory work.
3. Correlation of data and preparation of maps and reports (32).

The PIO/T further indicated the requirements and qualifications of the two soil survey technicians. One was to have experience in the specialized field of aerial photograph interpretation, and the other in the area of soil survey interpretation.

The PIO/T further provided for six short-term consultant visits of three months each.

The USDA Participating Agency Service Agreement agreed to provide both the long-term and the short-term consultants to the Project (29). The agency within the United States Department of Agriculture to furnish the consultants was the Soil Conservation Service.

Selection

The selection of the two long-term consultants by the Soil Conservation Service was carried out jointly by the Director of the Personnel Division, and the Director of Soil Survey Operations, Roy D. Hockensmith. Mr. Hockensmith had been a member of both the USDA Survey Team in Brazil in October and November of 1963, and the USAID Interagency Team in Brazil in May and June of 1964. He had also been a participant in the Rio conferences on

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the Project in May of 1964. He was completely familiar with the requirements of the two positions. By means of an "advisory notice" all soil scientists of the Soil Conservation Service were made aware of the two assignments and the necessary qualifications (1). Candidates were requested to indicate their interest in the assignment.

Selection of the two consultants was based on:

1. Requirements of the two positions as given in the PIO/T (32).
2. Experience and qualifications of interested candidates as related to the position requirements.
3. Interest, not only of the candidates in the assignment, but of their families as well.

Francis W. Cleveland, at that time, Assistant State Soil Scientist for the Soil Conservation Service in the State of Illinois was selected for the position of consultant in soil survey interpretation. The other consultant selected was the author, at that time State Soil Scientist for the Soil Conservation Service in the State of New Hampshire.

Orientation and Training

The consultants were notified of their selection on September 4, 1964. They reported to Washington, D. C. for orientation and training on October 26, 1964. The following is a breakdown of this training.

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1. United States Department of Agriculture:
October 26-30
 - a. Soil Conservation Service
 - b. International Agricultural Development Service
2. United States Department of State: November 2-December 11
 - a. Agency for International Development (3 weeks)
 - b. Foreign Service Institute (3 weeks)
3. Puerto Rico: Orientation and acquaintance with tropical soils and agriculture by soil scientists of the United States Soil Conservation Service: December 12-19
4. United States Department of Agriculture: January 4-8, Soil Survey Laboratories, Beltsville, Maryland.

The three weeks in the Foreign Service Institute, and the one week in Puerto Rico are considered to have been the most valuable of this nine weeks of orientation and training. The course completed in the Foreign Service Institute was the Latin America Area Study (11). In order that the purpose, scope, and content of the course might be better appreciated a description of it is given in Appendix B.

Practically every type of problem or situation that was encountered in Brazil had been referred to and discussed during the three-week course at the Foreign Service Institute.

The author and his family arrived in Rio de Janeiro, Brazil on the 29th of January, 1965. The other consultant and his family arrived a few days later. Following a day or two of orientation by American Embassy and USAID personnel, and the CHIEF of the USDA Technical Assistance Team, the next phase of training began. This was a twelve-week intensive language course in Portuguese, again administered by the Foreign Service Institute. The Department was supervised by an American who spoke fluent Portuguese. The instructors, however, were all native Brazilians who were fluent in English. A number of these instructors had actually done graduate work in the United States and one or two held Masters degrees. Classes started at 9 A. M. in the morning and ended at 4:30 P. M. To keep up with the class required an additional three hours of study at home each evening. This study consisted principally of memorizing vocabularies and dialogues.

At the end of the twelve weeks an oral exam is required and each student is rated. The exam consists of carrying on a conversation with one of the Brazilian instructors while the American Department Head listens

and rates the student. In addition to the conversation test, the student is given a daily newspaper in Portuguese and asked to translate an article into English. Twelve weeks of language study does not by any means make one proficient in Portuguese. American missionaries in Brazil normally are required by their sponsoring agency to complete one full year of language study before they are released to work in the interior.

Upon completion of the twelve weeks of language study during the last week of April 1965, the two consultants who had been selected the previous September, eight months earlier, reported to the Resource Survey Project to commence their duties.

Short-Term Consultants

Four short-term consultant visits were made to the Project.

The first of these visits actually took place prior to the initiation of the Project but was in preparation for it. This was in October and November of 1964 and was about four weeks in duration. The consultant was Dr. Guy D. Smith, Director of Soil Survey Investigations, of the United States Soil Conservation Service (34, 35). The objective of his visit was to observe soils in the field and discuss their classification with Marcelo Camargo, Field Coordinator of the Project. The purpose of this was to provide preliminary guide lines in the

classification of soils to be used for both the exploratory survey and the reconnaissance surveys.

The second visit took place after the initiation of the Project during the period August 14 to September 14, 1965. The consultant was Mr. Arnold C. Orvedal, Chief, World Soil Geography Unit, United States Soil Conservation Service (26, 27). A. C. Orvedal is probably as experienced and skilled as any soil scientist in the world today in the construction of small scale soil maps and the preparation of their legends. The objective of his consultant visit was to outline the steps in the construction of the schematic (exploratory) map and to assist in the preparation of the legend for the map.

The third consultant visit took place during the period March 7 to May 26, 1966. The consultant was Mr. Roy D. Hockensmith, Director, Soil Survey Operations, United States Soil Conservation Service. The objectives of Mr. Hockensmith's visit were:

1. Conduct the first Project operations review of the activities of the Project from its beginning through March, 1966.
2. Provide assistance in the field of soil survey interpretations at the various levels of management.
3. Advise and consult on administration and operations procedures of the Project (19).

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The fourth visit was again by Mr. Hockensmith and took place during April of 1968. Purpose of this visit was to evaluate the status of the Project, and make recommendations concerning future technical assistance (20).

The value of short-term technical assistance visits such as these by experts in their field cannot be over emphasized on a resource survey project. They are highly recommended and essential in conjunction with the long-term technical assistance.

Food and Agricultural Organization
of the United Nations

The FAO had with the DPFS a full-time consultant in the area of soil classification and interpretations. A native of the Netherlands, his name was Klaas Jan Beek. Although a capable and intelligent young man he lacked the tact and know-how that comes with years of experience. He became involved in Project activities because of the relationship of the DPFS and the Project. This resulted in a duplication of effort with the United States consultant in soil survey interpretations.

A second FAO consultant on a part-time basis was another native of the Netherlands, Jacob Bennema. An older and experienced soil scientist, his knowledge and ability in the area of tropical soils was well recognized. Bennema made an invaluable contribution during the exploratory soils expedition to western Brazil, in June of 1965 (36).

Local Technical Assistance

From time to time local specialists were contracted by the Project for short periods. These were in the areas of aerial photograph interpretation, geography, geomorphology and plant ecology.

Other Project Staff Personnel

In addition to the technical and scientific personnel of the Project an administrative staff was recruited in the early stages of the Project. This staff consisted of an administrative officer and an assistant who handled personnel records, budgets, pay rolls and purchasing of equipment. There were also approximately six clerk-typists and secretaries. Among these was an outstanding bilingual secretary, Dona Heloisa Seabra de Arango. She had studied two years at the University of Houston, taking an executive secretarial course. As the secretary of the United States Advisors she did a highly commendable job. In addition to typing, she translated United States Soil Conservation Service Soil Memoranda from English to Portuguese, as well as other documents and publications. Another task which she performed was that of assisting the author in preparing lectures in Portuguese, and helping him with rehearsals of their presentation by correcting his pronunciation.

Location of the Project Headquarters

The location of the Project Headquarters within the country of Brazil appeared to be a subject about which there were differences of opinion from the very start.

The Project Agreement signed May 30, 1964, stated that the "Brazilian and American personnel assigned to this project will be officed together in a location to be arranged for by the Ministry and agreed to by the Project Council" (31).

The PIO/T of June 30, 1964, stated that the Duty Post would be "Outside of Rio de Janeiro, probably Brasília or Belém" (32) (see Map No. 1, Mapa Do Brasil).

The United States Soil Conservation Service Advisory Notice to the field of July 9, 1964 regarding the Brazil assignment stated that "Headquarters will probably be in Rio or Brasília" (1).

In a work plan prepared in October 1964, by Hedodoto da Costa Barros, the original Project manager, it was recommended that the Project Headquarters be in Rio (8). The reasons for the recommendation were given as follows:

1. The headquarters of the various ministries that will be involved in the Project, such as Agriculture, Mines and Power Public Works, and Health, as well as the various scientific establishments are situated in the state of Guanabara (Rio).

2. The laboratory of the Divisão de Pedologia e Fertilidade do Solo, that will carry out the analysis of soil samples is also located in this state.

In addition the following statement is taken from the work plan:

. . . Therefore, we believe that the location of the Project Headquarters in the city of Rio de Janeiro, Guanabara, would satisfy most of the requirements with the advantage of avoiding the moving of the Project planning staff, most of whom live in this city. The only inconvenience would be in an addition of one or two hours, at the most, by plane to reach any of the areas of the project.

Somewhere along the line a decision was reached that the Project Headquarters be established in Rio. Actually Rio was some distance from the Project's area of operations as can be seen from a study of Map No. 1. In addition to the arguments which Herdoto presented it could be added that the members of the Project Council were located in Rio, the USAID Project Advisor was located there, and the USDA staff headquarters was located there. Considering the many difficulties and problems which beset the Project, and the problems of communications within Brazil it was fortunate that the Project was located in Rio. Had the Project functioned smoothly and moved on schedule progressively from phase to phase, as originally planned, a better location for the Project headquarters perhaps would have been Goiânia, the capital of the State of Goiás.

The actual location of the Project Headquarters within the city of Rio was in the headquarters of the DPFS in the Jardim Botânico--Rio's famous botanical gardens.

CHAPTER III

PROJECT OPERATIONS

Introduction

Project Objectives

The objectives of the Project were two fold. The first and primary objective was the location of 30,000,000 hectares (75,000,000 acres) of soil of relatively high fertility suitable for settlement within the interior of Brazil.

The second objective was to increase the size, scope, and effectiveness of the soils staff within the Ministry of Agriculture.

Project Area of Operations

The Project Agreement indicated that priority was to be given to the States of Amazonas, Goiás, Maranhão, Mato Grosso, Pará, and Piauí, and the Federal Territories of Amapá, Rôndonia, and Roraima (31). Herodota's work plan (8) adds to this the State of Acre. This group of States and Federal Territories, consisting of some 6,000,000 square kilometers (2,300,000 square miles) became known as the Project Area of Operations. It

made up the western two-thirds of Brazil. (See Map No. 1, Mapa Do Brasil.)

Phases of Operations

To develop these objectives, the operations of the Project were divided into phases. The phases were not separate and distinct, they could both overlap and be concurrent. The phases are listed first and then each phase is discussed in detail with comments and recommendations in the pages of this chapter.

- Phase I Preliminary
Planning, orientation, and other
preliminary operations.
- Phase II Exploratory Survey
Production of Schematic (exploratory)
map and accompanying legend and inter-
pretations.
- Phase III Reconnaissance Surveys
Soil surveys of 30,000,000 hectares to
confirm and more accurately identify
those areas suitable for settlement
which will permit efficient use of land
on a sustained basis.
- Phase IV Publication of Maps with Supporting
Descriptive Material
- Phase V Training Specialists in Soil Survey
Procedures
This phase is a concurrent phase with
all other phases.

Preliminary Phase

The Preliminary Phase might also be called the pre-mapping or preparatory phase, although certain aspects of it had a carry over into the other phases. It could

also be subdivided into subphases. Included among these subphases were the following:

1. Orientation of new staff members.
2. Familiarization with the Project Area.
3. Research, collection and cataloguing of basic material.
4. Establishment of contacts, and relationships with other agencies, government and private.
5. Acquisition of supplies and equipment.
6. Planning.

In the early stages of the Preliminary Phase the Project staff consisted of the Project Manager, Nathaniel Bloorifield; the Assistant Project Manager, Edmundo Brito; the Field Coordinator, Marcelo Camargo; and the two United States Advisors.

Activities of the subphases of the Preliminary Phase are discussed next.

Orientation of New Staff Members

The orientation of new staff members varied depending on the previous experience and training which an individual might have had. It consisted of a discussion of the objectives and organization of the project by the Project Manager and the Field Coordinator. In addition certain documents were reviewed such as:

1. Report of the USDA Survey Team, November, 1963 (3).
2. Report of the USAID Interagency Reconnaissance Frontier Development Team, June, 1964 (4).
3. Project Agreement, Frontier Development, May 30, 1964 (31).
4. Project Implementation Order/Technical Services, Frontier Development, June 30, 1964 (32).

A study of the maps of various scales of the project area was also a part of the orientation of new staff members.

The orientation described here was that given to experienced personnel such as members of the DPFS detailed to the Project, and short-term United States consultants. The trainees received their orientation as part of the formal training course.

Familiarization with the Project Area

Several methods were used to familiarize new personnel with the states and territories which made up the Project Area. The first of these was a map study of the area. Maps of Brazil vary in scale, coverage and accuracy. The three most common scales giving complete coverage of the Project area are: 1:5,000,000, 1:2,500,000 and 1:1,000,000. There is partial coverage of some areas at the scale of 1:500,000, and coverage of a few areas at the scale of 1:250,000.

A certain amount of aerial photograph coverage is available of the Project Area. A good method of general familiarization was a study of the mosaics used as aerial photograph indices where such cover existed.

Another method of familiarization was by air and ground travel. Both commercial flights and flights by chartered air taxi gave one a good concept of the terrain and vegetation in the Project Area. It was possible to keep oneself reasonably located during these flights by using the 1:1,000,000 topographical maps.

Familiarization with the Project Area was continuous and extended over all phases of the Project's operations.

Research, Collection and Cataloguing of Basic Material

This was a continuous task also that carried on throughout the course of the Project. Visits were made to many different agencies, government and private, both in Rio and outside. Purpose of the visits was to determine what kind, and how much information and data were already in existence and available that would be of use to the Project. The method by which this information could be made available to the Project, whether by loan, copying, donation or purchase was also determined.

Some of the kinds of data and information that were sought were: .

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1. Maps of various types and scales to include:
 - a. Soils
 - b. Topography
 - c. Geology and geomorphology
 - d. Climate
 - e. Vegetation
 - f. Transportation
 - g. Demography
2. Aerial photography
3. Professional and technical assistance available
4. Yield data
5. Soil management information

Agencies visited inside and outside of Rio in pursuit of this information were:

1. United States Geological Survey--Brazil Office,
Rio de Janeiro
2. LASA, Levantamentos Aerofotogramétricos of
South America (Aerial photo-grammetric surveys
of South America)
3. Conselho Nacional do Geographia
4. Serviço Geográfico de Exército (Army Map Service)
5. IAGS, Inter-American Geodetic Survey, Corps
of Engineers, United States Army, Brazil Office
6. IPEAN, Instituto de Pesquisas e Experimentação
Agropecuária do Norte, Belém, Pará (Institute
of Agricultural Research and Experimentation
of the North)

7. Instituto de Agronomia, Campinas, São Paulo,
State, Aerial Photo Interpretation Unit

As information became available and was collected it was catalogued and filed in map cases and file cabinets.

Establishment of Contacts
and Relationships

Contacts and relations with individuals and agencies outside of the Project, both government and private, were initiated in the early stages of the Project. The purpose of these contacts was several fold. Among these were the mutual exchange of ideas and information, the seeking out of data which was valuable and essential to the Project, the providing of channels of communications with agencies that would be using the surveys and information developed by the Project, and contacts with educational institutions which were a source of trainees for the Project.

These contacts were made by practically all of the leaders of the Project staff both Brazilian and American. The following are illustrations of some of the contacts made:

(a) United States Geological Survey, Brazil Office, Rio de Janeiro. Early in the preliminary phase the two American advisors called on the Chief of the USGS in Brazil. Through this contact, a list of available maps and publications, and their source, was

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obtained which was of value to the project. The names of individuals in the various professions who were experts in their field, or in certain regions of Brazil was also obtained. For example, it was learned that one, Jose Candido de Melho Carvalho, had as great a knowledge of the Amazon Basin as any other living individual. Instructions on how he could be contacted were learned. Another item gleaned from this contact was that in the almost uninhabited territory of Amapá, north of the Amazon, the ICONI Mining Company would put up travelers, and also ran an experimental farm. This item might not be considered important unless the reader has experienced travel in the interior of an underdeveloped country.

(b) Inter-American Geodetic Survey, Corps of Engineers, United States Army, Brazil Office. This contact, in the early days of the Project, provided location maps of all available aerial photograph coverage of Brazil. It gave the names of companies who had flown the coverage, the date flown, scale, and altitude of the flight. It was also learned, and surprisingly so, that the United States Air Force was currently flying coverage of Brazil in cooperation with the Brazilian Air Force. Details on the procedure of securing this coverage for the Project's use were given. In addition, the schedule and time table of areas to be flown were obtained and the Project was

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put on a distribution list which kept users informed when an area was complete and available for use.

(c) IPEAN (Instituto de Pesquisas e Experimentação Agropecuarias do Norte) (Institute of Agricultural Research and Experimentation of the North). Brazil has five regional institutes of research and experimentation. IPEAN, located in Belem at the mouth of the Amazon has a soil survey program. The two American advisors along with Nathaniel Bloomfield, the Project Manager, and Marcelo Camargo visited the Institute in May of 1965. The Director of the Institute, José Maria Pinheiro Conduru, upon hearing of the Project had made the statement that no one could carry on soil survey activities in the IPEAN area except IPEAN personnel. Since this area was over half of the Project area, his attitude presented obvious difficulties. One purpose of the contact with IPEAN was to explain the objectives of the Project to the Director, and solicit his cooperation. Other reasons for the contact were to appraise the IPEAN soil survey capability, determine how much mapping had been done, collect any survey maps published in the area, and determine availability of yield and other data available from the Institute which would help in developing soil survey interpretations.

The attitude of the Director of IPEAN changed when the objectives of the Project had been fully explained



FIGURE 7.--IPEAN at the mouth of the Amazon. Research on such tropical crops as cocoa, rubber and jute is carried on at this station at Belém in the State of Pará. It is also headquarters for soil survey activities in the Amazon Basin.

to him, and it was pointed out that funds would be available to increase the facilities of his soil laboratory and his soil survey staff. He became fully cooperative, and remained so throughout the time the author was in Brazil.

The Chief of the Soils Section at IPEAN was Italo Falesi, a Brazilian of Italian descent. He is a capable soil scientist. His soil survey activities carried him from Belém throughout the Amazon Basin to the State of Acre on the Bolivian border, almost a third of the country of Brazil. He was most cooperative and made his knowledge and files on soils of the Amazon Basin completely available to the Project. He conducted several soil tours in the area east of Belém during this visit. Later on he accompanied field expeditions of the Project far into the interior of Brazil. His knowledge of the soils, vegetation and agriculture of the Amazon Basin were an important contribution to the development of the exploratory survey conducted by the Project. (Falesi was affectionately referred to by the non-Brazilian members of the Project and DPFS staff as "the Amazon Man", see Fig. 5, p. 57).

Another contact made on this trip was with Lucio Salgado Vieira, a member of the faculty of the Agricultural College located at Belém. Vieira was a professor of soils with the college. Contacts like Vieira

were important in influencing students to join the Project upon graduation.

(d) Soils Personnel, United States Department of the Interior, Bureau of Land Reclamation, São Francisco Valley Project. Original contact with these soil scientists was made during the first three months in Brazil as students together in the language school at the American Embassy. Contact with them was maintained throughout the tour in Brazil. There was an exchange of ideas, techniques and information which was beneficial to both Projects. Apparently their Project was better off financially and they were able to use a helicopter to excellent advantage in gaining access to what would be normally almost inaccessible areas, to obtain soil information.

These are a few of the many contacts made in the Preliminary Phase of the Project. They are given to illustrate the types of contacts which can be made with other agencies and personnel and their value. Judgment needs to be used in the selection of contacts and amount of time spent on them. It is possible to spend all of one's time visiting without a worthwhile contribution or productive input being made toward the accomplishment of a project's objectives. The author is not an advocate of the cocktail circuit type of contact, and does not believe this to be the place to conduct business.

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Acquisition of Supplies and Equipment

Prior to departure from the United States, the United States advisors spent considerable time in developing lists of supplies and equipment which they believed to be essential to their own and Project operations. Unfortunately, due to USAID procedures of acquiring equipment, the tour of duty was almost complete before some of this equipment ever became available.

Through the foresight of the USAID advisor to the Project, the following equipment was available in the early stages of the Project: tiling spades; square spades; standard soil augers; Munsell color books; pH kits; stereoscopes, mirror type with binocular eye piece; portable light tables; universal sketchmaster.

Through the use of scientific supply house catalogues, and United States Government surplus lists, requisitions for supplies and equipment were made periodically. Some of the additional items obtained were: jungle hammocks, canvas with waterproof roof and mosquito netting sides; cameras; slide projectors; text books; pocket type stereoscopes; magnifying glasses, plain and illuminated; first-aid kits; and compasses.

One item which proved to be extremely worthwhile was seventy-five cases of United States Army, type C rations, obtained through the United States Military Mission in Brazil. These were quickly consumed by

both Brazilian and United States members of the Project on the field expeditions to areas where food was not available or was of questionable preparation from a sanitary point of view.

Motor vehicles were another item of equipment purchased during the preliminary phase. Five vehicles were purchased originally. Four of these were four-wheel-drive rural Willys jeep station wagons. These proved to be satisfactory for travel in the interior as well as the stop and go driving within the city of Rio. The author does not have experience with other types of vehicles built for rough travel in undeveloped country but would recommend the rural Willys. The fifth vehicle was a four-wheel-drive Willys pick-up truck. This vehicle was used to carry extra drums of gasoline, oil, spare automobile parts and C rations. It worked out quite well on extended trips into the interior. All of these vehicles were purchased and manufactured locally in Brazil.

In addition to these vehicles purchased locally, two Dodge trucks with "camper" bodies were ordered from the United States. The purpose of these was to provide a dry and reasonable comfortable place not only to sleep but also to work on maps and aerial photographs while operating on reconnaissance surveys in the tropical rain forest and the savannah country. Tools and spare parts such as tires, spark plugs, points, fan belts, carburetor

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FIGURE 8.--Vehicle ferry on BR 29 in western Brazil. The station wagon and pick-up are two of the four-wheel-drive vehicles used by the Project in activities in the interior. The ferry operator probably has white, Negro and Indian blood.

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repair kits, etc. must be purchased along with United States made vehicles such as these.

Maps of various types and scales of the Project Area and aerial photograph indices were also purchased.

The items discussed here were found to be sufficient to make the project operational from an equipment and supply point of view. It is important to insure that needed equipment and supplies are determined and orders submitted early enough to insure that the equipment is on hand when needed. With considerable money invested in salaries, training and travel, it does not make sense for operations to be held up because of lack of required equipment. This consideration is important. It must be considered very early in the preliminary phase or it can be a costly mistake in terms of delay of training and operations. This is true regardless of the nature of the Project.

Planning

Project planning actually had its start during the USDA survey teams visit to Brazil in October of 1963, and probably even before. In Roy D. Hockensmith's notes references are made to a proposal of James Haynes, a USAID soil scientist, for an exploratory survey (17). The same notes have an attachment on "Frontier Development in Brazil." This attachment describes the need for an "Exploratory Survey," the purpose of which was to:

1. Eliminate immediately areas clearly unsuited to agricultural settlement.
2. Locate areas with apparent suitability, some of which will need further study.
3. Delineate areas clearly suitable for development and where settlement should be encouraged immediately.

The same attachment states that the exploratory level survey would be followed by reconnaissance level surveys. It also states that the USDA could give technical assistance in these surveys.

This broad concept becomes more detailed in the Project Agreement of May 30, 1964 which describes the activities and operations of the Project to include:

1. Review of data
2. Exploratory survey
3. Reconnaissance level surveys
4. Publication of maps and interpretations
5. Training of specialists (31).

It can readily be seen that these five activities tie in exactly with the five phases of operations which are the subject of this chapter.

In October of 1964, Herodoto da Costa Barros, the first Project Administrator, developed a work plan (8). This work plan spelled out in more detail than the Project Agreement, the scope and objectives of the

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Project, the area of operations, phases of operations, organization, and his concepts of a procedure for moving ahead, with time estimates for the various steps.

In January of 1965 when the author was in Washington, D. C. just prior to departing for Brazil, he prepared, at the request of Roy Hockensmith, his concept of how the Project would operate. This concept, a broad plan of operations, was based on a review of the available documents and reports of the Project available at that time. Upon completion of language school, this concept was further elaborated on and the details enlarged (42). This broad plan of operations was based on the five phases of operations. A comparison of it with Herodoto's work plan will reveal many similarities.

Good planning is essential to the success of any project or activity. A general, broad plan should be initiated early as was done in the case of the Project under discussion. Plans can and will be changed as conditions change. More detailed planning for each phase of operations is necessary and should start well before the phase is initiated.

An additional discussion of Project planning is presented in Chapter V where operations management as it related to the Project is discussed.

Exploratory Survey

The Exploratory Survey followed the Preliminary Phase. A schematic (exploratory) soil map of the Project Area was to be developed with accompanying legends and interpretations. The purpose of the schematic (exploratory) map was to determine where the best opportunities for increased intensity of land use existed in the frontier areas. It was the concept of the exploratory survey that it would eliminate immediately areas clearly unsuitable for agricultural settlement, locate areas apparently suitable, some of which would need further study, and finally delineate areas clearly suitable for development and where settlement should be encouraged immediately. In arriving at the three general categories of the exploratory survey: unsuitable, apparently suitable--further study needed, and suitable, the following criteria were proposed.

1. Unsuitable:

- a. Soils not suitable, too wet or too dry, and drainage or irrigation not feasible.
- b. Topography too steep or too rough for cultivation.
- c. Rainfall unsufficient or distribution unsatisfactory.
- d. Inaccessible due to location and lack of transportation, no markets.
- e. Ownership title not clear.

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1961

2. Apparently suitable--further study needed:
 - a. Soil conditions borderline--perhaps irrigation or drainage could make suitable.
 - b. Topography borderline due to steepness, cultivation could result in serious erosion problems or equipment limitations.
 - c. Rainfall borderline due to amount and distribution.
 - d. Accessibility and transportation not adequate under present conditions but proposed roads or other transportation facilities would change situation in future.
3. Suitable or good potential:
 - a. Soils are satisfactory.
 - b. Topography not too steep for cultivation.
 - c. Rainfall sufficient with adequate and even distribution.
 - d. Access to area and transportation to markets satisfactory.
 - e. Ownership title clear and available.

The objective of this survey was to locate sufficient unused or underused land of acceptable quality to settle seven to ten million people in a ten-year period.

The concept of an exploratory survey is not something new. There are in the literature at least two publications of exploratory studies. These are

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An Exploratory Study of Soil Groups in the Belgian Congo by Charles E. Kellogg and F. D. Daval (23), and Exploratory Study of the Principal Soil Groups of Alaska by Charles E. Kellogg and I. J. Nygard (24). The USDA Soil Survey Manual (37) discusses both a schematic soil map and an exploratory soil map.

The Manual, on page 441, in discussing soil survey in undeveloped areas states,

. . . A schematic soil association map is compiled for the area on the basis of available data on soils, geology, relief, vegetation, and climate.

The Manual also states on page 435,

. . . Beyond reconnaissance soil surveys, and even less detailed, are exploratory soil surveys, in which the boundaries are obtained mainly through compilation from existing sources as in a schematic soil map but in which the soil associations are identified mainly through original field research.

An interpretation of this is that the first approximation of the map based on available data is a schematic map but that the following approximations which are supported by studies in the field are exploratory maps. It should be noted that although this phase of operations is referred to as the exploratory phase, the map produced by this phase is called by the Brazilians "Mapa Esquemático de Solos," which is translated, "Schematic Soil Map." It was observed in talking with members of the Washington Office Soil Survey Staff that they have used the two terms, exploratory and schematic, interchangeably.

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In A. C. Orvedal's Recommendations for the Preparation of a Schematic Soil Map for Brazil (26), he follows the word "schematic" by the word "exploratory" in the following manner: "schematic (exploratory)."

Based on the definitions in the Soil Survey Manual, it is believed that the product of the Exploratory Phase more nearly meets the definition of an exploratory map rather than a schematic map. Since it has been designated by the Brazilians as a "Mapa Esquemático," and thus to avoid confusion it will be referred to as a schematic (exploratory) map.

The preparation of the map can be divided into three areas. The first consisted of a period of consultation and planning. This was followed by two operations which went on simultaneously. These were the observation, collection and assembling of data, and the actual construction of the map. A discussion of these follows.

Consultation and Planning

Short-term consultants have been discussed in the previous chapters. Advantage was taken of this type of assistance in the preparation of the schematic (exploratory) map. It was obvious to both Brazilians and United States members of the Project that guidance and help was needed in getting this operation underway. A request was prepared, therefore, and submitted through USAID to the United States Soil Conservation Service in Washington,

D. C. for assistance. This request was for the services of Arnold C. Orvedal, at that time Chief of the World Soil Geography Unit of the Soil Conservation Service. It is the opinion of many that A. C. Orvedal is perhaps as qualified an individual in small-scale soil maps as any other soil scientist in the United States and the world. As head of the World Soil Geography Unit he had twenty years of experience studying and constructing small-scale soil maps of all parts of the world. His travels took him to several parts of the world in carrying out this work. The request for his services was approved and Orvedal was in Brazil working with the Project during the period August 16 to September 14, 1965.

The schedule of his tour in Brazil consisted of two days of orientation and discussion, fourteen days in the field observing soils, landscapes, and vegetation, and fourteen days at the Project headquarters developing the first approximation of the legend for the schematic (exploratory) map, and getting actual construction of the map underway.

This tour resulted in the preparation by A. C. Orvedal of a five page document entitled "Recommendations for the Preparation of a Schematic Soil Map for Brazil" (26). This document was used as a guide by members of the Project in the construction of the schematic (exploratory) map.

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Orvedal made recommendations in the following areas:

1. Scale of the map
2. Soil names
3. Legend preparation
4. Interpretations
5. Supporting pamphlet or bulletin
6. Methods to be employed in map construction

Data Collection

The sources of data to be used in the development and construction of the map were: previous soil studies and experience of personnel, available information on geology, climate, vegetation and topography; aerial photograph interpretation; exploratory field studies; and air observation. Each of these are reviewed.

Previous Soil Studies and Experience of Project Personnel

The Project obtained copies of soil maps of any areas within the Project area which had had any kind of a soil map made of it. There were not too many of these but soil scientists of the FAO had made a few reconnaissance surveys in northern Goiás state. In addition, the soil survey personnel of IPEAN with headquarters at Belém, had made a few reconnaissance surveys in the States of Acre, Amazonas, Maranhão and Pará, and in the federal territories of Amapá, Rondônia and Roraima.

These were not of extensive areas but were at least a start. Some exploratory studies had also been made in the Mato Grosso.

Another source referred to is the experience of Project personnel and others. This was not too extensive either. Italo Falesi, Chief of the Soil Survey at IPEAN, had examined road cuts and pits and made notes in his travels throughout the Amazon Basin. These were available to the Project. There had also been a Brazilian Soil Science Society tour by boat from Manaus to Belém on the Amazon. Every bit of information that could be gathered from sources such as these was recorded and utilized on preparation of the schematic (exploratory) map.

Available Information on
Geology, Climate, Vege-
tation and Topography

The Atlas Nacional do Brasil published by the Conselho Nacional de Geografia of the Instituto Brasileiro de Geografia E Estatística (5) contains a series of maps and charts on geology, geomorphology, climate, vegetation and topography. These were supported by more detailed maps of larger scale which were available to the Project. Brazilian personnel of the Project established excellent relations with geographers and geomorphologists of IBGE (Brazilian Institute of Geography and Statistics). Through these contacts considerable information, as well

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as professional assistance was made available to the Project, and was utilized in the map construction.

Aerial Photograph Interpretation

The aerial photograph mosaic indices were a better source of information at the scale of the schematic (exploratory) map than individual photographs. Broad vegetation patterns such as savannah and tropical rain forest, drainage patterns, and broad land forms could be determined from the indices. This subject will be gone into in more detail in the chapter on aerial photograph interpretation.

Exploratory Field Studies

The objective of the exploratory field studies was to obtain information on the soils of an area, and to determine the topography, geology and vegetation found in relationship with the soils. In addition, whenever possible, information and data on the land use and agriculture of the area were gathered. Information, when available, was collected on yields of crops, kinds and amount of fertilizers, strains and varieties of plants used, and special soil management practices such as drainage or irrigation, and any conservation measures applied.

These on-the-land exploratory field studies were the best method of obtaining soil and other information

for use in the construction of the schematic (exploratory) map. Soil samples were taken of the principal horizons of the major soils. These samples were run through the soil laboratory of the DPFS where significant chemical, physical and mineralogical determinations were made on them. The results of these determinations were used in properly classifying the soils, and in making interpretations affecting their management and use. Geologic samples were also taken.

The first field studies were made before the Project was actually underway. A few months after the Project Agreement and PASA were signed in 1964, advantage was taken of the provision for short-term consultants. Members of the DPFS felt the need for the advice and guidance of someone with a world-wide reputation and experience in soil classification. Dr. Guy D. Smith, Director of Soil Survey Investigations for the United States Soil Conservation Service with his work in the development of the new comprehensive system of soil classification has such a reputation. His soil travels had carried him throughout the world. A request for his services was submitted through the office of USAID to the Soil Conservation Service in Washington, D. C. The request was approved and G. D. Smith spent almost a month in Brazil in October and November of 1964 examining soils in the field and discussing and making recommendations on

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problems related to soil classification. The two papers, "Journals of Brazil Soils Study," (34) and "Impressions of Soil of Brazil" (35) resulted from this short-term consultant visit. The route of this study was Rio, Brasília, Belém, Recife and back to Rio by air, with side trips by motor vehicle out from these locations. A second trip was made by motor vehicle south into the States of São Paulo and Rio Grande do Sul (see Map No. 1).

The second field study took place during the period June 14 to July 10, 1965 and was a once-in-a-lifetime opportunity for the author. It was a trip by motor vehicle over 5,300 miles of roads and jungle trails from Rio de Janeiro to western Brazil and return. It crossed the savannah of the Mato Grosso and the tropical rain forest of the territory of Rondônia to Pôrto Velho on the Rio Madeira and on by air and vehicle to Placido de Castro on the Bolivian border. This exploratory field study was a joint operation of the Project and the "Soil Map of the World, FAO/UNESCO Project." It was participated in by twenty-three soil scientists and geographers of Argentina, Brazil, the Netherlands, Peru, Surinam, the United States and Venezuela. This expedition is described in detail in the FAO publication, Soil Resources Expedition in Western and Central Brazil (36), and in the author's paper, "Soil Correlation Trip," Brazil, June 19-July 10, 1965 (45).

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The author would like to digress at this point and mention several instances related to this trip which stand out in his memory.

One incident took place at a meal halt at a road construction camp of the Brazilian Army in the jungle of Rondônia. Our host was a Tenente Coronel (Lieutenant Colonel) of the army and while he fed us sandwiches of monkey meat, he entertained us with tales of the hostile Indians in the forests surrounding the camp. Recently they had killed a missionary and her two children with arrows. On our return through the same camp a week later we learned that the Indians had killed one construction worker and seriously wounded another working with a bulldozer a short distance from the camp.

A second incident did not actually take place as an incident. I carried in my handbag, which I kept fairly close to me, my service .45 caliber automatic pistol. When preparing to travel by air with a small group from Porto Velho on the Rio Madeira to the Bolivian border in the State of Acre I indicated my intent to leave the pistol with the bulk of my luggage at the hotel to which we would be returning. I was informed that if ever I might have a need for the pistol it would be the next few days on the border of Bolivia. I was not informed why at the time. Later I learned from a reliable source that three days before our arrival in the village of



FIGURE 9.--Construction camp in the tropical rain forest. Indians reportedly killed a construction worker at this camp in the territory of Rondonia the day before vehicles of the Project refueled here.

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Placido de Castro on the border, the revolutionary, Che Guevara, having recently left Cuba, had been in the same village. He was engaged in arms smuggling from Brazil across the Rio Abuna into Bolivia.

One evening, at about 9:30 P. M. on the road from Placido de Castro to Rio Branco, the capital of Acre, where we were staying, our vehicle became thoroughly mired in the mud with both axles resting on the ground. Although concerned about our situation, I could not understand at the time the almost panic stricken state of the Brazilian and other Latin American soil scientists. I am now convinced that they were aware that Che Guevara was operating in the area, and they did not relish the idea of encountering one of his arms smuggling parties there in the dark.

The third field study took place during the period August 18 to September 11, 1965. Itinerary and transportation used are described in Appendix C.

A fourth exploratory field study took place in May of 1966. This one was primarily in the Amazon Basin. A summary of the trip report which illustrates the objectives of such a study, the composition, methods and procedures used, and the kind of information obtained is found in Appendix D.

In addition to these exploratory field studies there were at least a half dozen additional exploratory



FIGURE 10.--The Rio Abunã, Brazil-Bolivia national boundary. Raw rubber collected from the jungle trails is being unloaded at Placido de Castro in the State of Acre. Che Guevara was reportedly active in this area in 1965.

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FIGURE 11. Amazon town of Santarém. Many of the inhabitants of Brazil's interior are the mamelucos, Portuguese equivalent of the Spanish mestizo or half breed. The mixture of their blood may be any combination of white, Negro and Indian blood.

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74-101
74-102



FIGURE 12.--Shifting cultivation in the Amazon Basin. This is the slash and burn, hoe and machete, primitive agriculture typical throughout the tropics. Low yields result in abandonment in five years and moving on to a new location.

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trips which Project members made into the Project area. Objective of each of these was to gather information to assist in development of the exploratory map.

Air Observation

Air observation has been mentioned in the previous paragraphs on exploratory field studies. There were two methods of air observation. The first might be called high level and was of the general type made on commercial flights. It was a common practice for all members of the Project, whenever making a commercial flight over the Project Area, to sit next to the window with a topographic map on their lap and a note book in hand recording observations of the topography, vegetation and land use below. Notations were made of time of take off, and time of each observation, as well as time of arrival at one's destination. The pilots of the aircraft were quite cooperative in indicating their air speed and altitude. Thus knowing the time of take off, speed and direction of the air craft, and time of observation, the observer could keep himself approximately located on the topographic map. The type of air craft, whether DC 3, 6, or Caravelle was a factor governing the altitude of the flight which determined the degree of detail one could observe and record. Sometimes when there was a choice, the lower flying and slower DC 3's were selected over the higher flying and faster prop jets to permit air observation.



FIGURE 13.--Use of light aircraft in resource survey. Single engine planes such as this are essential to the conduct of resource surveys in underdeveloped countries. Large stomachs on the children are evidence of malnutrition and inadequate diet.

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The second method of air observation was by low level single engine aircraft. Air taxis were common throughout the Amazon country, and in the interior of Brazil. They were used on numerous occasions to make a reconnaissance over an area that otherwise would have been inaccessible due to lack of roads and streams. Cessna 182's, 205's and 172's were used on different occasions by members of the Project as well as a Piper Cherokee Six. There was a certain element of danger and risk involved in making these flights in single engine air craft out over the jungles. Engine failure meant a crash landing in the jungle with chance of survival quite remote.

Identification of soil by Great Soil Group was not possible but it was possible to identify large wet areas, sandy areas, especially if blowing had taken place, and areas of rock out crop. Slope and topography could be determined fairly well. Species of vegetation could also be identified if one was familiar with them, as were many of the Brazilians.

This type of transportation used in conjunction with travel by vehicle on the ground was employed on many occasions. A sequence of methods of transportation sometimes used was as follows:

700
700
700



FIGURE 14.--The Amazon at flood peak. The alluvial plains of the Amazon are used for cattle grazing. Each year many are drowned during the annual floods at the height of the rainy season.

1. Travel by commercial flight to a location where air taxi was available.
2. Travel by air taxi to remote small villages. (Even the most remote and smallest village seemed to have an air strip.)
3. Travel by the ever-present and available-for-hire rural Willys jeep station wagon over any available roads, and trails.

Travel by single engine air craft in any type of resource survey should be considered as a means of collecting information.

Map Construction

The construction of the schematic (exploratory) map of the Project area was to be accomplished through a series of approximations. The first approximation was to be completed by the 30th of November, 1965. During the consultation visit of A. C. Orvedal, Chief World Soil Geography Unit, Soil Conservation Service which ended September 14, 1965, the recommendation was made that the first approximation be constructed without field trips, using only such knowledge as soil scientists of the DPFS had acquired through years of experience in soil survey of Brazil, plus any existing soil maps of the area, and available maps and information on geology, topography, vegetation, and climate (27). Completion of the first approximation in this manner would have

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resulted in what would have been a true schematic map, in that no field work would have been involved.

Marcelo Camargo, Field Coordinator of the Project supervised the exploratory survey. Flávio Garcia de Freitas was in charge of assembling and coordinating construction of the map and actually drawing the lines on the base map. Actually Camargo and Flávio worked together very closely on this task. Information was placed first on topographic maps of a scale of 1:1,000,000 and then transferred to base maps of a scale of 1:2,500,000. An honest attempt was made to complete the first approximation without field trips other than those which had already been made at the completion of Orvedal's visit. The opinion was expressed, however, that there were going to be too many gaps in the first approximation using this method. The problem here, perhaps, was that the Brazilian soil scientists did not have quite enough confidence in themselves, or were not willing to gamble enough by placing a line on the map and designating a mapping unit from the legend. At any rate, additional field trips were determined to be necessary and, therefore, field parties worked in the States of Mato Grosso, Goias, Maranhao, and Piaui collecting soil information. The resulting map ceased to be a schematic map at this point and became an exploratory map, if there is a difference between the two. Perhaps the name schematic-exploratory map best describes the final product.

A map was not available in completed form until June of 1966. This map was much more accurate than had been contemplated for the first approximation scheduled for November 30, 1965. Work sheets used were the topographical maps of a scale of 1:1,000,000. At this scale there were over 148 mapping units. When the delineations were transferred to a base map at a scale of 1:2,500,000 the number of mapping units was reduced to 85.

Delineation was made for those areas for which there were not adequate data based on what information was available. Those areas were designated as questionable requiring further study.

In summary the following sources of information were used in the development of this map.

1. Existing soil maps of small scattered areas.
2. Experience and knowledge of soil scientists based on their work and travel throughout Brazil.
3. On the ground exploratory field studies in the States of Acre, Amazonas, Pará, Goiás, Maranhão, Piauí and Mato Grosso, and the Territories of Rondônia and Roraima.
4. Low altitude aerial flights.
5. Aerial photographs and aerial photo indices.
6. Topographic maps.
7. Geological maps.

8. Climatic maps.

9. Vegetation maps.

Immediate use was made of the map both in the United States and Brazil. Volume I, The World Food Problem, A Report of the President's Science Advisory Committee lists the name of Arnold C. Orvedal as a member of the Subpanel on Water and the Land (39). Orvedal, short-term consultant to the Project at the start of the exploratory phase wrote for a copy of the map for immediate use upon being informed of its completion. It is believed that he used the map in connection with his assignment on the Water and Land Subpanel.

The completion of this schematic (exploratory) map was the major accomplishment of the Project during 1966. The map could and should be an important and significant contribution to the progress and development of Brazil if proper advantage and use is made of it.

A copy of this map is included as a part of this thesis, with the title, "Mapa, Esquemático De Solos, Primeira Aproximacao."

Reconnaissance Surveys

The Project Agreement provided for reconnaissance surveys. Part I, B 2 states,

Survey at a reconnaissance level selected areas thought to be suitable for settlement. This should result in classification and mapping of approximately 30 million hectares (75 million acres) suitable for settlement under intensive land uses. Extensive field studies as well as aerial observation and air photo interpretation will be required (31).

Part II, PURPOSE, states,

. . . It is now proposed to perform a reconnaissance level soil and resource survey of frontier regions. Major emphasis will be on soils, climate, vegetative cover, surface water, and related factors which determine resource capacity for possible agricultural uses of the land.

This information on resource capability, together with information on markets, health, demographic and social aspects to be developed in complementary research, will serve as basis for developing policies and programs for frontier occupation and development.

The survey is expected to indicate the areas in which it may be possible to carry on intensive cropping, those which are likely to be suitable only for well-managed forestry use, and those for which a combination of forestry pasture and cropping is feasible.

The survey has as a major aim the location of sufficient fertile soils having otherwise acceptable characteristics for relatively intensive cropping or crop and pasture combination to meet the settlement needs of Brazil of the next ten to twelve years.

Selection of Areas

The selection of areas for reconnaissance surveys was dependent upon several factors. One of these, of course, was the schematic (exploratory) map. The map was to indicate:

1. Areas clearly unsuitable for agricultural settlement.

2. Areas with apparent suitability, some of which will need further study.
3. Areas clearly suitable for development and where settlement should be encouraged immediately.

Logic would indicate that the latter of the three categories, "areas clearly suitable" should be those areas selected for reconnaissance surveys first, to pinpoint reasonably precise areas for settlement. The selection, however, was not that easy and there were several other considerations which entered the picture before the selection of areas for reconnaissance surveys was made.

Brazil has two agencies charged with responsibilities relative to frontier development, land settlement and colonization. These are INDA, the National Institute for Agrarian Development (21), and IBRA (22), Brazilian Institute for Agrarian Reform. INDA was an organization within the Ministry of Agriculture whose chief answered to the Minister of Agriculture. IBRA was an organization separate from any ministry and whose chief answered directly to the President of the Republic. IBRA was obviously the more powerful organization politically. As can be imagined from the similarity of the two names, there was considerable overlap in their functions and responsibilities.

Since INDA and IBRA were the agencies charged with frontier development, and settlement, it would be wasted time to make reconnaissance surveys of areas which they had no plans or intentions of settling or developing. Contact, therefore, had to be made with those two agencies and the selection of areas for reconnaissance survey coordinated with them.

Another factor which had to be considered was the political influence of the various State governments and their desires for colonization and development of their lands. Their influence was exerted, however, not on the Project, but on the federal agencies INDA and IBRA. Their influence was indirect and not direct.

Areas finally selected for reconnaissance surveys were in the States of Mato Grosso and Goiás. The decision by which these areas were tentatively selected was based on all of the factors discussed above, the schematic (exploratory) map and the future plans of development of INDA and IBRA.

Preliminary Work

The Reconnaissance Phase actually started prior to the completion of the Exploratory Survey Phase. In November and December of 1966, field studies preliminary to what might be termed an "Initial Field Review" were conducted in the southern part of the State of Mato Grosso in the vicinity of Campo Grande, and in the

southern part of the State of Goiás. The purpose of these studies was to collect data for the development of preliminary legends for the reconnaissance surveys. Soil samples of the principal soils were collected, road maps were checked for suitable routes, supply points determined, garages for motor vehicle repair, and possible lodging accommodations were located.

This was the situation with respect to reconnaissance surveys at the end of 1966.

Operations in 1967 and 1968

Project activities in the first half of 1967 according to the Annual Report of the USDA Technical Assistance Team Brazil were limited and not much was accomplished in the area of reconnaissance surveys (14). The lack of accomplishments was the result of several factors. Primarily because no funds were available from the Ministry of Agriculture. A new President of the Republic had been designated. The old administration was afraid to act or spend money knowing that it would soon be out of office. The new administration would not act or spend money until it was familiar with the situation and policy was established.

To describe the activities of the Project in the area of reconnaissance surveys during FY 1968 the following is quoted from the Annual Report of the USDA Technical Assistance Team for the year ending June 30, 1968 (15).

Selection of areas for reconnaissance level surveys on the basis of the schematic soil map. Ten areas were tentatively selected by the DPFS (Project) in early 1967 on the basis of the soil potential as indicated by the schematic map. The areas are generally located as follows: (1) six areas in central and southern Mato Grosso, (2) three areas in southern Goiás, and (3) one in Rondônia. Two other areas in central Maranhao and in southern Para indicate potential but aerial photos are not available to use as base maps at the present time. When new aerial photography is available these areas should also be considered in the priority listing.

Reconnaissance surveys of soil resources of 20 to 30 million hectares (50-75 million acres) within the priority areas. Full field operations have been in effect since October, 1967, and the accomplishments reflect that situation. Renewal of field operations after seven months of relative inactivity due to funding problems resulted from the highly significant achievement of the signing of the agreement between the Ministry of Agriculture (DPFS) and the Brazilian Institute of Agrarian Reform (IBRA) in August, 1967. This agreement provided funds for salaries and related operations to maintain continuity in reconnaissance surveys of 125,000 Km² in the priority areas of southern Mato Grosso from August, 1967, through August, 1969. The need for a sounder financial base for maintaining continuity of field operations cannot be overemphasized. As indicated by past delays, financing cannot be effective on an inadequate and highly erratic basis.

During this fiscal year field parties operating basically in the area of southern Mato Grosso developed their mapping legends, prepared the field mosaics, and completed the reconnaissance survey of approximately 50,000 Km² (5,000,000 hectares or 12,500,000 acres). Soil sampling was continued during the year and a total of 450 samples have been collected for surface fertility determination plus 15 profiles averaging 6 samples per profile for physical and chemical characterization. A new program of sampling the soils for engineering purposes is also being instituted as a part of the regular survey operations, and a preliminary form has been developed for the collection of yield and management data by kinds of soil.

Also as part of the field operations a preliminary report on the soil potential of the Iguatemi area of southern Mato Grosso (approximately 3,000 Km²) was prepared and submitted to IBRA in January, 1968. This area was expropriated by IBRA for colonization purposes. The preliminary report on the soil potential of the Iguatemi area included operational copies of the field sheets (1:60,000 scale), soil descriptions, laboratory data and interpretive maps and tables. This type of information should be of considerable value to IBRA in developing their colonization plans for the Iguatemi area.

The original objectives of making reconnaissance surveys of 20 to 30 million hectares was reduced to 12,500,000 hectares (the approximate area involved in the priority areas of southern Mato Grosso) in the 1968 Pro-Ag due to inadequate funding to provide for and maintain a larger field staff of soil scientists.

Publication of Maps with Supporting Descriptive Material

The Project Agreement provided for the preparation of maps with supporting descriptive material and the making of information available as rapidly as possible to serve the purpose of the agreement (31). The supporting descriptive material was to include interpretations of the schematic (exploratory) map and of the reconnaissance surveys.

Preliminary Work

During the short-term consultant visit of Roy Hockensmith, Director, Soil Survey Operations, United States Soil Conservation Service, March 7 to March 26, 1966 considerable time was spent on these interpretations (19). R. Hockensmith and Francis Cleveland, the other

United States Soil Conservation Service soil scientist with the Project, developed interpretations and a format for the publication of interpretations to accompany the schematic (exploratory) soil map.

The proposed outline for such a publication may be found in Appendix E. The original outline also contained sample write-ups of certain of the sections. A Table of Interpretations was also developed and appears in Appendix E.

Interpretive Maps

Three interpretive maps were developed based on the schematic (exploratory) map. Each one of these maps interpreted the schematic (exploratory) map for a defined level of management. The map titles and the three levels of management which were defined are as follows:

Map I, Management System A (Primitive)

Farming practices in this system depend on traditional methods reflecting a low level of technical knowledge. No capital is used for improvement and maintenance of the soil and crop conditions. Cultivation of crops depend mainly on manpower and manual implements. Some animal traction may be used with simple agricultural implements.

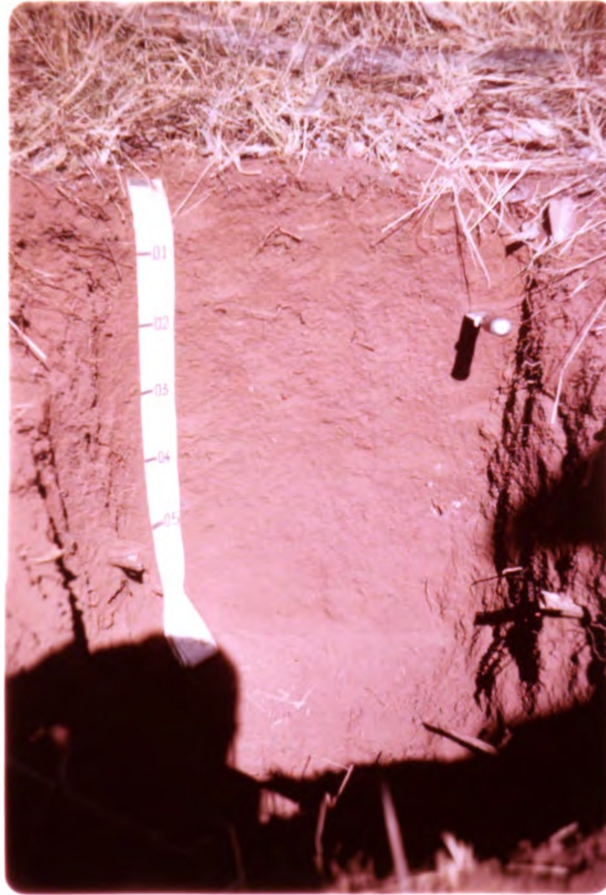


FIGURE 15.--Dark Red Latosol on the Campo Cerrado. This soil on the savannah would probably be classified as an Oxisol in the Comprehensive Soil Classification System. Its present use is extensive grazing of cattle.

Map II, Management System B
(Semi-developed)

Farming practices in this system reflect a reasonable level of technical knowledge. Some use is made of capital and research for improvement, and maintenance of the soil and crop conditions. Cultivation of crops depends mainly on hand labor and animal traction. If some power operated machinery is used it will mainly be for transport and processing rather than for proper field operations.

Map III, Management System C
(Developed)

Farming practices in this system depend upon a high level of technology. Intensive use is made of capital for improvement and maintenance of the soil and crop conditions. Management practices make full use of the results of modern agricultural research and include the use of power operated machinery in all phases of the farm operation.

Rating of Soils

The soils of the schematic (exploratory) map have been rated for each of the levels of management according to the following four classes:

| | |
|-----------|------------------|
| Class I | Good Suitability |
| Class II | Fair Suitability |
| Class III | Poor Suitability |
| Class IV | Not Suitable |

The three interpretive maps have been reproduced and published, and are a part of this thesis along with the schematic (exploratory) soil map.

Current Status

The current status of this phase of the Project's operation can be best set forth by quoting from the Annual Report of the USDA, Technical Assistance Team in Brazil, Year Ending June 30, 1968 (15).

All copies of the interpretive maps were printed with legends set in both Portuguese and English. The original press run of 5,000 copies, plus about 200 overrun, of each of the above maps was completed in January, 1968. Since the completion of the first press run it became apparent that demand for the schematic soil map might quickly exceed the supply and a second press run is now underway. The second press run will involve 2,000 copies, 1,000 with a Portuguese legend and 1,000 with an English legend. There will be a grand total of 7,000 copies of the schematic soil map, 5,000 with a Portuguese legend and 2,000 with an English legend. It is anticipated that 5,000 copies of each map will be folded and trimmed for inclusion in the final publication. The remaining copies will provide an overrun for special purposes that involve the use of the map only.

The narrative text describing the soils and presenting the soil classification scheme, laboratory data and interpretations is not at the same stage as map compilation and printing. It was anticipated that the manuscript would be submitted to the printers during the last quarter of this fiscal year. Demands on the time of responsible Brazilian soil scientists for other priority work

have resulted in serious delays in preparing the manuscripts for the printers. The best estimate that can be made at this time would indicate submission of the manuscript for printing by the end of August, 1968 and a probable release date of December, 1968, for the complete publication (maps and text).

This delay in completing the manuscript for publication is unfortunate since the information on soil resources is basic to the agricultural development of the frontier area. A few copies of the maps have been released on a selective basis, pending release of the entire publication, in order to provide soils information to resource development agencies of the GOB (Government of Brazil) during this interim period.

Training Specialists in Soil Survey Procedures

This phase is a concurrent phase with all other phases of the Project operations. The training of Project personnel has been described in Chapter II of this thesis in the various sections on training of members of the Project. No further comments will be made here.

CHAPTER IV

AERIAL PHOTOGRAPH INTERPRETATION

Introduction

A chapter is devoted to this subject of aerial photograph interpretation for several reasons. One reason is the value to be derived from the proper use of aerial photographs and their interpretation. Another reason being the need to stress the limitations of aerial photograph interpretation in soil survey in underdeveloped countries.

The first reference to the use of aerial photography and the strong emphasis to be placed on it is found in the "Recommendation of USAID Frontier Development Team in Brazil, July 6, 1964" (33). Here, both the need for aerial photography and "very highly competent photo interpreters" is stressed. The Project Agreement contains references to the requirement of aerial photo interpretations (31). The Project Implementation Order/Technical Service specifies that one of the two United States advisors will be a specialist in "Soil Survey-Air Photo Interpretation" (32).

The author was selected for this position of soil survey specialist in aerial photo interpretation. He had had perhaps average experience in the use of aerial photograph interpretation methods in soil survey. These techniques had been relied upon to a considerable extent in soil survey activities in the heavily wooded hill and mountain country of New Hampshire. In addition, he had experience in the military in the use of aerial photo interpretation as an artillery officer in Europe in World War II and in Korea in 1951. This designation as an aerial photograph interpretation specialist was unfortunate in the respect that it narrowed the sphere of influence somewhat in Project operations. He was looked upon by the Brazilian staff members as more of an aerial photograph interpretation specialist than anything else during the first year of the Project's operations.

Limitations in Use

The limitations of the techniques of aerial photograph interpretation are discussed first. In Brazil there appeared to be a certain status in being referred to as an aerial photograph interpretation specialist. As a result too much stress was put on the importance of aerial photograph interpretation techniques. Its value and use were over rated. Too much was expected from it. Soil scientists in the United States are trained basically and primarily as soil scientists. They receive training

in the techniques of aerial photograph interpretation as only one of several tools and aids to be used in soil survey. This fact was stressed at every opportunity in the work on the Project.

Wright and Bennema recognized this same problem in their work, "The Soil Resources of Latin America (48). They apparently felt that many of the Latin American countries were looking to aerial photograph interpretation as a short cut to getting the job of soil survey done quickly and cheaply. The following is quoted from their report:

. . . The rather wide spread lack of organization in respect to national soil resource evaluation in Latin America is particularly distressing at the present time when economic development programs and land reform programs are assuming increasing importance. A general lack of vital soil information has prompted a number of emergency measures which seek to evaluate soil resources by rapid methods that require little or no field study of the actual soils. One present trend is towards photo interpretation of existing land use patterns, and from this recommendations are made for the extension of certain kinds of land use. Another emergency measure now in use uses the rapid examination of a large number of soil samples to determine the mean available nutrient supply of the soils of the district, but the information is not related to individual soils and, as the soils themselves are not mapped, this method does not provide a reliable basis for agricultural or land development planning.

The execution of reliable soil surveys tends to be time consuming and is often rather costly, but is the only effective method of making a thorough evaluation of the soil resources in any area.

During a visit to the Project, Jakob Bennema, one of the authors of the above, and a soil scientist of the

Netherlands with seven years of experience in the tropics, made the statement, "Aerial photograph interpretation is an aid, a tool to be used in mapping but soil must be seen on the ground."

The USDA Agriculture Handbook 294, "Aerial Photo Interpretation in Classifying and Mapping Soils" also refers to this problem of using aerial photo interpretation as a substitute rather than as a tool and aid

(2). The following are quotes from this publication:

Aerial photographs are widely used as a base on which to plot data about soils and to draw boundaries between kinds of soil with or without the aid of a stereoscope. Stereoscopic interpretation of aerial photographs gives a soil scientist additional clues about the kinds of soil he is likely to find and especially about where the soil boundaries lie. There are, of course, limitations. No one can "see" a soil on an aerial photograph. A soil is a three-dimensional unit of the landscape. It has depth. From the picture the soil scientist can see only the surface--and that imperfectly. He can see the third dimension only by digging a pit.

It is extremely important that the limitations of photo interpretation in soil mapping be understood. Some so called soil maps have been made with little or no groundwork by soil scientists. Since soil maps made in this way are bound to be misleading if used for giving the definite recommendations that land uses require, such work discredits both soil science and photo interpretation of aerial photographs.

Aerial photographs and aerial photograph interpretation are an essential aid and tool to modern soil survey but they are not a substitute for on the ground soil survey. Both their value and limitations must be recognized in any type of resources survey that is to produce reliable and dependable information.

Assembly of Data and Information

The first step in the assembly of data and information on aerial photography is to determine what agencies, public and private, are active in this area. The second step is to contact them and gather all available information, as to what is currently available, what is planned for the future and other essential related data.

The Assistant Project Manager, Edmundo Brito, had many years of service with the Ministry of Agriculture and knew his way around Rio quite well. A list of agencies involved in aerial photography in Rio was developed based on Brito's knowledge. Calls were then made to each of these companies or agencies requesting appointments to visit their operations and gather together the information desired on aerial photography. Contact with one company sometimes gave a lead on an affiliate or competitor which was added to the list to visit. Appendix F indicates some companies visited in Brazil and the type of information gathered.

Through these and other contacts, the Project was able to build up a fairly complete inventory of data and information on aerial photography and aerial photo interpretation in Brazil. The following list indicates those companies and agencies in Brazil providing services in this field:

1. LASA
2. Serviços Aerofotogramétricos Cruzeiro do Sul, SA
3. Cruzeiro do Sul Airlines
4. PROSPEC
5. GEOFOTO
6. Serviço Geográfico do Exército
7. NATIVIDADE (São Paulo)
8. VASP (São Paulo Airlines)
9. Força Aerea (Brazilian Air Force)
10. Conselho Nacional de Geografica.

Information showing available coverage by company, scale, altitude and year of flight was plotted on an overlay of the operations map in the Project headquarters where it was readily available when needed.

Procurement of Photography and Equipment

It was determined that individual photographs would cover too small an area and not be of much value in the development of the exploratory map. They were not to be purchased, therefore, until areas were selected for reconnaissance level survey, except some for training purposes. Examination of the aerial photograph mosaic indices at a scale of 1:100,000 to 1:250,000 provided considerable information on vegetation, drainage and broad land forms. Every available mosaic indice, therefore, was purchased. These were not all purchased immediately but as an area was ready to be worked on

it was purchased. Scale of these mosaics varied as the coverage was from several different companies.

The second purchase of aerial photography was of individual stereo pairs for training purposes. The mosaics were carefully studied for representative samples of various kinds of vegetation and land forms. These were then purchased and used in the training of personnel in aerial photo interpretation procedures.

The third purchase was of complete stereo coverage, when available, of areas selected for reconnaissance surveys. Brazil is so large a country, and aerial photograph coverage so small that there was no choice in companies to purchase from. If an area had coverage only one company would have it.

The following equipment was procured from various sources for aerial photo interpretation work:

1. Thirty pocket lens-type Zeiss stereoscopes
2. Eight mirror-type Fairchild stereoscopes
3. One mirror-type, Tokyo Optical Co. LTD
stereoscope
4. One mirror-type, Zeiss stereoscope with
parallax bar
5. Ten electric illuminated magnifying glasses
6. One sketchmaster, Universal
7. Two sketchmasters, Zeiss, Aerotopo
8. Two light tables, Porta-Trace
9. Two fluorescent elbow type illuminating lamps

Training

Reference has been made in Chapter II to the formal training course conducted for the new personnel of the Project, which took place during the period January 10, 1966 through March 15, 1966. Seven days of this training course were devoted to aerial photography and aerial photograph interpretation.

Five instructors, each with a different background in aerial photograph interpretations, were used in this training. Each of the five is named with a brief description of his training and experience to illustrate the differences in background.

General Harold Osvaldo Cavellero dos Santos.--The general was a retired officer of the Brazilian army who had worked in the field of photogrammetry. The Project paid him a fee for six hours of instruction in the area of photogrammetry. He discussed the more technical aspects of aerial photography.

Rodolfo Condori Vega.--Vega was head of the Pan American Aerial Photo Interpretation Unit which was headquartered with the Ministry of Agriculture at the Jardim Botânico. The unit was a one-man operation offering an eight-month course which covered several different fields. His presentations in the Project training course covered the application of photo interpretation to geology, soil science, forestry, engineering, geomorphology,

geography, archaeology, etc. Unfortunately Vega was one of the individuals who felt that with a limited amount of field work an interpreter could sit inside with his stereoscope and identify soils, geologic formations, etc.

Paulo Klinger Tito Jacomine.--Klinger was one of the well-qualified soil scientists of the DPFS. He had just returned from six months in France where he had been enrolled in a course in aerial photograph interpretation. He had done work there in the use of infra-red and colored photography. His lectures were on panchromatic photographs, infra-red and colored.

Luiz de Gonzaga Oliveira Cavalho.--Gonzaga was the full-time Project staff member who carried the title of aerial photo interpretation specialist. He had worked on a reconnaissance soil survey in the south of Brazil using aerial photograph mosaics as the base map. His presentations covered the construction of mosaics and their use in reconnaissance soil surveys.

Dirk van der Voet.--The author was the last of the five instructors. He handled the classes on the basic use of the stereoscope, drainage patterns and delineation of watersheds. Except for a brief twenty-minute lecture on drainage patterns these classes were practical exercises using the stereoscope and stereo pairs of aerial photographs. Training materials used were obtained from the United States Soil Conservation Service, Washington,

D. C. Seven practical exercises were used as follows:

1. Basic exercise in image fusion.
2. Hidden message stereogram-a device to prove whether or not the student had stereo vision.
3. Floating circle examination.
4. Stereoscopic study of Lake Stereogram.
5. Location of principal points, conjugate principal points, line of flight of the air craft; and stereo study of a pair of aerial photographs.
6. Drainage delineation.
7. Watershed location problem.

These classes were in Portuguese. Instruction sheets were developed for each practical exercise in English. These were then translated into Portuguese by the bilingual secretary. Gonzaga then made a technical review of the work to insure that nothing was lost in the translation. Graphs and diagrams were prepared and keyed into the instructions contained in the work sheets. These diagrams were enlarged to 50" x 36" size by the Project's drafting section, and placed on the walls of the training center. Each student received a mimeographed copy of the instruction sheet for each exercise, and with the aid of the wall diagrams was able to complete the exercise.



FIGURE 16.--Training in aerial photograph interpretation. Pedologist trainees received several days of classroom training in the use of the stereoscope and other techniques of aerial-photo interpretation.

In addition to this formal classroom training certain individuals who had displayed talent and ability in the field of aerial photograph interpretation were given on-the-job training in the construction of mosaics, delineation of drainage patterns, and the identification of vegetation and land forms.

Procedures Used

Exploratory Soil Survey

The use of aerial photo interpretation in the exploratory phase was for the most part limited to the mosaic indices made up of the individual photographs. The large mosaic sheets were laid out on the floor and then matched together. Depending upon the amount of coverage and the scale these could cover an area about 15' x 15' on the floor. The scale of these indices varied from 1:100,000 to 1:250,000. By the use of China marking pencils, drainage patterns could be identified in blue, changes in vegetation outlined in green, and land forms in brown. These lines could then be transferred to topographic maps at a scale of 1:1,000,000.

The topographic maps, with this information delineated on them were then taken into the field for the purpose of visiting accessible sample areas and relating the delineated areas with the mapping units of the exploratory legends. Following this the information

could be transferred to the 1:2,500,000 exploratory survey base maps.

Reconnaissance Soil Survey

Not much was accomplished in the area of photograph interpretation methods for reconnaissance surveys during the first two-year period. This was due to the fact that the emphasis in that period was on the exploratory survey. A tentative procedure was suggested in anticipation of the reconnaissance surveys. The steps of the procedure were:

1. When areas for reconnaissance survey have been selected, determine availability of aerial photograph coverage.
2. If area has coverage, review for suitability of use in soil survey, and if satisfactory arrange for procurement.
3. If area has no coverage, arrange for coverage if at all possible. Contact Inter-American Geodetic Survey for possible arrangement of coverage by USAF.
4. When coverage is available, study areas on photographs with stereoscope, and select sample land forms for ground examination.
5. Develop procedures for improving speed and accuracy of survey through aerial photograph techniques without sacrificing quality of mapping.

Luiz Gonzaga, the Brazilian soil scientist with experience using aerial photographs in reconnaissance level soil surveys, worked with about five of the Project trainees in this area. His experience here indicated that the best base map was a semi-controlled mosaic made up of individual photographs. The scale of the mosaic was the scale of the original individual photographs. Several of these mosaics of an area were made up, and mounted on fibre boards about 3' x 3'. Following the construction of the mosaics the techniques of photograph analysis were applied as developed by Dr. P. Buringh and presented in the "Manual of Photographic Interpretations," American Society of Agronomy (9). There was no opportunity to observe or test the effectiveness of these procedures in the field prior to departure from Brazil.

Other

It would appear that with respect to the use of aerial photographs in the three levels of soil survey, the following applies:

1. Detailed soil survey: individual photographs.
2. Reconnaissance soil survey: semi-controlled mosaics constructed from individual photographs.
3. Exploratory soil survey: aerial photograph mosaic indices.

The techniques used will vary in each. Stereoscopic examination can be used for both the detailed and reconnaissance level.

Training Manual

After considerable information had been gathered together on aerial photography in Brazil as it related to the Resource Survey Project, it was thought to be worthwhile to gather this information together in one document. This project resulted in a "Training Manual, Aerial Photograph Interpretation for Soil Survey, for Use by Resource Survey Project" (46). This manual was prepared first in English. It was then turned over to the Project's bilingual secretary who translated it into Portuguese. The outline of this manual, section by section, is given in Appendix G with comments added on certain sections of it.

It is not necessarily recommended that a manual such as this is necessary for every resource development project. Some means, however, is advisable, of bringing all available information together in one place so that interested users may have access to it. The preparation of a manual such as this appeared to be a logical way of accomplishing the task.

Seminar With College Faculty

In August of 1966, a request and invitation was received from the College of Agriculture of the University of São Paulo in Piracicaba, S. P. for consultation with them on the uses of aerial photography in the different fields of agriculture. The request had originated with the chairman of the Department of Soils at the college and had been forwarded through the Ohio State University Contract Team at the college to USAID in Rio.

The invitation was accepted and a trip made to Piracicaba in early September. A conference was held there with staff members of the College of Agriculture and the Ohio State Team. They were interested in a series of seminars on the uses of aerial photography in agriculture, and recommendations on including a course in aerial photograph interpretation in their curriculum of study at the college. The people at the college recognized that aerial photography had a definite place in agriculture and were already using it in their soil survey work. They were seeking information as to how it could be used in the other areas of agriculture. One could not help but be impressed with the progressive attitude and interest displayed at this college. A willingness was evident on their part to recognize that they did not have all the answers and were ready to



FIGURE 17.--Campus of a Brazilian college. This is the Agricultural College of the University of São Paulo at Piracicaba, one of Brazil's more progressive schools. A soil survey program is carried on by the staff of the Soil Science Department.

look to someone, although no more intelligent than they, but perhaps with a little more experience. This attitude was the exception rather than the rule in Brazil and perhaps explains in part why the State of Sao Paulo is so far ahead of the rest of Brazil.

This conference resulted in an agreement to return to Piracicaba in November and conduct three days of seminars on the subject, "The Uses of Aerial Photography in Agriculture." The agreement was carried out and a most pleasant three days were spent on the campus of the "Universidade De São Paulo, Escola Superior De Agricultura "Luiz De Queiroz," Piracicaba, Estado de São Paulo.

The account of this seminar which appears as Appendix H is taken from the trip report to the Chief of the USDA Technical Assistance Team in Brazil. The purpose of giving this information is to indicate the background of the participants and the scope of the subject matter covered by the seminar.

In closing this chapter it is desired to stress once again the improved accuracy and quality of soil surveys which result from the proper use of aerial photograph interpretation. At the same time its limitations must be recognized. It is a tool and an aid but not a substitute for examination of the soil on the ground.

CHAPTER V

OPERATIONS MANAGEMENT

Introduction

"The scarcest and most needed resource in the developing countries is the scientific, technical, and managerial skill needed for systematic, orderly decision making and implementation." The above quote is from Volume I, The World Food Problem, A Report of the President's Science Advisory Committee (39). The reference to "managerial skill" and "implementation" is emphasized here. Ambassador Lincoln Gordon, prior to his departure from Brazil to assume the position of Assistant Secretary of State for Inter-American Affairs in February of 1966, addressed the personnel of the American Embassy in Rio. In this address the Ambassador stated that he believed that one of the principal problems which was holding back the development of Brazil was the lack of administrative and management ability on the part of its leaders, and of others in supervisory positions at all levels of government. D. C. Stone in his paper on, "Common Administrative Obstacles to Development," states,

. . . After many years of effort to further economic and social development, it has become clear to me that a basic requirement to further progress in this field is the deliberate and systematic training of administrative personnel capable of planning and implementing development programs and projects (38).

Not too many months had passed after the initiation of the Project's activities before it was apparent that this problem of the lack of managerial skill, systematic and orderly decision making, and implementation, the subject of the three references cited above, was also the problem of the project and its leaders. This was evidenced by failure to meet target dates, and general lack of progress.

A lack of knowledge and appreciation of the value of the tools of operations management, and the ability to apply them was apparent. Reference has been made in preceding chapters to delays in the completion of the first approximation of the schematic map, and delays in the initiation of reconnaissance surveys. Whenever questions were raised as to the reason for the lack of progress, a good legitimate reason was given each time that was difficult to argue with. Yet, target dates would come and go and the delays prevailed. An unwritten objective resulted to instill in the Project's activities as much of the principles of operations management as was possible. By operations management is meant the management of operations in such a manner as to improve quality and increase

quantity. The usual tools by which these are accomplished are: the development of long range plans, annual plans of operations, schedules, reasonable annual goals for accomplishments, progress reviews and inspections, annual individual work performance evaluations and ratings, recognition and awards program, diaries, a system of accounting of time and a proper distribution of time to various assignments, staff meetings, and other such devices.

Some of these tools and how they were introduced to the Project are discussed in the following pages of this chapter.

Staff Meetings

One of the first steps in this area of operations management was the establishment of periodic staff meetings. Three parties were concerned in the Project's operations: the Project Manager, the USDA Advisors, and the USAID Project Coordinator. The Brazilian Project Manager made the decisions regarding the Project's operations. He was strongly influenced, however, by the USAID Coordinator, who held the purse strings. The two USDA Advisors were in the middle. Any proposals of any significance which they wanted to see put into effect had to have the approval of both the USAID Coordinator and the Project Manager. Since the USAID Coordinator was headquartered

in downtown Rio, and the Project headquarters was in the southern outskirts of the city, it was difficult to get the parties together to get action on proposals and recommendations. A weekly staff meeting was proposed for each Tuesday morning. All parties agreed to the necessity for such a meeting but getting the Project Manager to recognize it as a firmly established part of his schedule with a high priority presented problems. At the first, he always had another commitment of higher priority which prevented his attendance. After a reasonable period of time, however, he came to recognize it as a means of getting the USAID Coordinator's approval of items which required the release of funds and thus he became regular in attendance himself.

The staff meetings between the three parties provided a means of communication and of making recommendations, getting approval on proposals, and exchanging ideas and information. An evaluation would be that they were beneficial to all three parties involved.

Project Operations Review

The next step in the area of operations management was afforded by the short-term consultant visit in March, April and May of 1966, of Roy D. Hockensmith, Director of Soil Survey Operations, Soil Conservation Service. The objective of this visit was several fold. The USAID Implementation Plan of the Project provided for a series

of progress evaluations. The proposal was made, therefore, that one of the objectives of Mr. Hockensmith's visit be to conduct a Project Operations Review. This proposal was accepted and became one of the official objectives of Mr. Hockensmith's visit in 1966. Mr. Hockensmith was ideally suited to conduct such an operations review. One of his responsibilities, with the aid of his two assistant directors, was to conduct periodic reviews or appraisals of soil survey operations of the Soil Conservation Service in each of the states in the United States.

This operations review was conducted by Mr. Hockensmith as requested, and was of considerable value both to the USDA Team Chief in Brazil and to USAID. Recommendations in his written report carried considerable weight, and affected decisions concerning the Project made by both agencies, the USDA and USAID (19).

Annual Plan of Operations

Purpose

Prior to the time of the operations review referred to above, it was determined that there was a need of an annual plan of operations for the Project for the year 1966. That is, a plan which spelled out the objectives for the year, the member of the Project staff to be responsible for each objective, and the steps by which the objective was to be attained and the target dates for each step.

Preparation of First Approximation

The obvious person to develop such a plan would be the Project Manager in consultation with his staff. This was not something with which he would be familiar, however, and thus would not have adequate knowledge and skill to develop such a document. The determination was made, therefore, that the first approximation of such a document be prepared by the USDA Advisors. This would be something to approach the manager with as a basis for discussion. The Project staff would have to participate in the preparation of such a document before they would accept and use it. It was understood, therefore, that the first approximation would have to have a certain amount of alteration before it became the Project Plan of Operations.

Review by Project Staff

The first approximation was completed and typed with several carbons prior to the arrival of Roy D. Hockensmith on his short-term consultation visit in early March of 1966 (44). Upon R. D. Hockensmith's arrival, the draft was presented to him for review and comment. After his review the next step was for R. D. Hockensmith, and the USDA Advisors to review and discuss the plan together word by word. After agreement was reached between the three advisors on the wording, the plan was translated into Portuguese by the bilingual secretary. English versions

were also submitted to the USDA Technical Assistance Team Chief and the USAID Project Coordinator for their review.

The plan was presented to the Project Manager as soon as the Portuguese translations were ready. He was requested to review it and then with members of the Project staff, to discuss it completely, objective by objective, and step by step within each objective with the USDA Advisors. He agreed to do this. Two full days were taken up by these discussions. Objectives were added and objectives were deleted. There was a thorough healthy discussion of each objective. Some of the ideas and procedures proposed were completely unfamiliar to the Project Staff and were accepted only after lengthy explanations and illustrations. Several times the comment was made, "This may work fine in the United States, but this is Brazil--it won't work here." In the end, after give and take, agreement was reached on what was an acceptable plan to all. It was no longer the USDA Advisor's plan but the Project plan. It was mimeographed in Portuguese as well as English, and copies made available to each Project staff member both Brazilian and American.

The introduction to the plan, the list of objectives and the development of one of these objectives have been reproduced in Appendix I to give the reader a concept of the plan and how it was proposed that an objective be reached, step by step.

The wording of the plan may seem a little awkward in places. Bare in mind that in the discussions that took place there were contributions in both Portuguese and English. Translation and retranslation from one language to another took place. This can result in awkward sounding English.

The comment of several was that the document was not only an Annual Plan of Operations but also a Standard Operating Procedure. The need for the development of such a plan of operations exists regardless of the type of resource project in an underdeveloped country. It will not be followed completely, nor objectives fully attained in the first year but it will provide for the establishment of the project's objectives, and serve as a guide for the orderly and systematic development of these objectives.

Translation of Soil Memoranda

To those familiar with the series of Soil Memoranda as developed and issued by the soil survey staff of the United States Soil Conservation Service it should be obvious that several of the objectives in the "Annual Plan of Operations" tie in closely with the Soil Memoranda. The purpose of the Soil Memoranda is to establish policy, and provide guidelines and procedures for the conduct of the soil survey of the Soil Conservation Service in the United States. They are the result of many years of experience in the development of the soil survey in the

United States. Having the information contained in these Memoranda available would be extremely valuable to the leaders of soil survey programs in a developing country.

With this thought in mind permission was requested and granted from the Soil Survey Staff of the United States Soil Conservation Service in Washington to translate these Memoranda into Portuguese, and to make them available to the soil survey leaders in Brazil.

The Memoranda were translated into Portuguese by the Project's bilingual secretary, and then reviewed by Brazilian soil scientists to assure that nothing had been lost in the translation. It was not intended or expected that these Memoranda would be adopted in full or in part by the Department of Pedology and Soil Fertility or by the Project. Nor is it known to what extent these Memoranda may have been used or referred to by the Project staff since their translation. What was wanted was to assure, however, that the information was available and that they have the advantage of it should they so desire. The intent was that after they were reproduced that they be made available to the following: (1) Director, DPFS; (2) Soil Correlator, DPFS; (3) Project Manager; (4) USAID Project Coordinator; (5) Party Chief, DPFS, Soil Survey, State of Rio Grande do Sul; and (6) Dean of the Graduate School, National School of Agronomy of the Rural University of Brazil (Km 47).

In order that the reader may be aware of the subject matter covered by these Memoranda the list of those translated follows:

- No. 1 Guide for the Federal Part of the
National Cooperative Soil Survey
- No. 2 Operations Management--Management and
Scheduling of Soil Survey Activities,
pp. 1-5.
- No. 4 Soil Survey Work Plans
- No. 5 Procedures for Legend Preparation and
Field Reviews of Soil Surveys
- No. 6 Soil Survey Laboratory Assistance in Soil
Investigations
- No. 9 Soil Survey Interpretations
- No. 10 Procedures in Soil Classification and
Correlation
- No. 11 Soil Series Descriptions
- No. 12 Storage of Soil Samples Submitted for
Laboratory Characterization
- No. 14 Collection of Samples for Laboratory
Characterization
- No. 20 Availability of Soil Survey Field Sheets
- No. 22 Land Capability Classification
- No. 33 General Soil Maps and Land Resource Maps
of Counties and States
- No. 41 Soil Survey Publication Areas
- No. 44 Requirements for Field Correlations

Increasing Effectiveness of Operations

Reference has been made to the slowness of progress and delays in reaching project objectives such as the exploratory map and the start of reconnaissance surveys. This slowness of progress and apparent lack of concern on the part of the Project Staff that they failed to accomplish tasks and objectives on schedule was a matter of concern. They seemed to accept this as a normal thing and always had what was to them a completely justifiable reason for the lack of progress. The belief was that not only were the USDA consultants there to advise and assist on matters pertaining to soil survey, but that if they could make a contribution that might change attitudes and improve the effectiveness of operations, that this was their responsibility also. Another concern was the fact that considerable of the funding of the project had originated in the form of tax dollars from American citizens. A responsibility to them existed also.

In late February of 1966, a copy of a speech delivered by the Secretary of Agriculture, Orville L. Freeman before the House Committee on Agriculture, February 23, 1966, was received in Rio (12). This speech had to do with Food for Freedom. Several of the statements made by the Secretary covered three areas which were related, not only problems of the Project, but to foreign aid, international development, and the role of the USDA in these areas.

Development of Proposal

With the concern about the lack of progress on the part of the Project, and the Secretary's speech as a basis, a proposal for "Increasing Effectiveness of Operations of the Resource Survey Project" was developed (41). The first draft of this proposal was completed shortly after the arrival of Roy D. Hockensmith in Brazil in March of 1966. It is not implied that he concurred in or approved of it completely, but after reading it he encouraged that it be polished-up and presented for discussion to USAID officials and the Chief of the USDA Technical Assistance Team in Brazil.

The proposal as prepared was as follows:

Increasing Effectiveness of
Operations of the Resource
Survey Project

(Proposed for consideration and discussion with Ford Milam, Chief, USDA Technical Assistance Team, Brazil; Roy D. Hockensmith, Director, Soil Survey Operations, United States Soil Conservation Service; A. Pollard, Chief, Agrarian Reform Division, USAID, Brazil; F. Cleveland, and D. van der Voet, USDA Advisors)

A. Reference:

Statement by the Secretary of Agriculture, Orville L. Freeman, before the House Committee on Agriculture, 10 A. M., February 23, 1966.

1. Closer Coordination of Food Aid with other Assistance Programs (p. 22, par. 3).
"But the kind of unified effort to which the President referred means that Agriculture (USDA) will also be called upon to participate in the planning of agricultural assistance activities and in reviewing the progress made in agricultural development."

2. Increased Technical Assistance from USDA (p. 23, par. 4). "We have just signed a new interagency agreement under which AID seeks to enlist as fully and effectively as possible on a partnership basis the pertinent resources of the Department (USDA) in planning, executing and evaluating those portions of the foreign assistance program in which it has special competence."
3. Effective Encouragement of Self Help (p. 24, par. 2). "This may mean agreements for no longer than one year, with provision for periodic reviews of progress made toward self reliance."

B. Proposal

It is proposed that this procedure of "Effective Encouragement" be discussed by the group above for use as a means of insuring reasonable progress each year by the Project towards its objective.

C. Procedure

The following is suggested for discussion as a procedure for carrying out such a proposal:

1. An Annual Plan of Operations be jointly prepared by Brazilian Project Leaders, USAID/ARDO Coordinator, and USDA Advisors. During following years, however, this APO should be developed by the Brazilians themselves, subject to thorough review, necessary revision, and approval by USAID and USDA personnel.
2. In this plan, reasonable but clearly and definitely stated goals and objectives for the following year should be established. Along with the objectives the details should be outlined as to how the goals and objectives are to be accomplished, what, who, when, where and how.
3. It should be clearly understood by all that failure to attain these goals and objectives could result in discontinuance of USAID funds for Project Operations. In evaluating accomplishments consideration will be given to any unforeseen extenuating circumstances that may have caused delays.
4. To determine and evaluate the year's accomplishments and whether or not goals have been met an Annual Project Progress Operations Review will be conducted in January or February of each year. This review will be conducted by a team under the leadership

of a representative from the Office of the Director, Soil Survey Operations, SCS, USDA, Washington, D. C. (see Reference A-2 above).

5. The findings of this Progress Review will be used to determine whether or not USAID financial assistance to the Project will be continued.
6. Additional periodic progress reviews, should be planned and conducted jointly every four months by Project, USAID and USDA personnel to insure reasonable progress throughout the year. These periodic reviews should result in more helpful guidance to the Project Manager in those areas where increased emphasis and progress is necessary.

D. Remarks:

1. Who has the authority to establish and carry out such a policy?
2. Such procedure should help to encourage Project leadership to look for advice and assistance from United States Soil Conservation Service advisors.
3. We are concerned with the Project meeting mutually "agreed to" target dates and attaining its objectives in an orderly and effective manner as possible in order to assist in the agrarian reform and agricultural development measures. In addition there is the obligation and responsibility to the American taxpayer to insure that dollars earned from his labor are spent in an efficient and as effective manner as possible. (End of Proposal.)

Discussion of Proposal

This proposal was discussed with the group referred to in the proposal. The group consisted of the Chief of the USDA Technical Assistance Team; the Chief of the Agrarian Reform Division, Agriculture and Rural Development Office, USAID; the Director of Soil Survey Operations, United States Soil Conservation Service; and the two USDA Advisors. The proposal had reasonable acceptance from

the group except that there were two dissenters on the most significant factor in accomplishing the objective of the proposal. The objective was raised to the statement in paragraph C-3 which read: ". . . failure to reach or meet these goals and objectives could result in discontinuance of USAID funds for Project Operations." The objection came from the USAID member of the group and was supported by the USDA Team Chief. Both of these men took the position that a clear understanding with an agency of a foreign government that unless they made progress and produced results could result in withdrawal of United States financial support was not the right way of accomplishing results. This position is disagreed with. The fact that the Alliance for Progress has not made more progress supports this position. There must be teeth in the encouragement of self-help if the encouragement is to be effective.

Both of the individuals who objected to this method of effective encouragement had spent at least the last ten years of their government careers on foreign assignments. They had been working with foreign assistance programs for many years and had adopted the attitude displayed here which is believed to be typical of many Americans, but not all, who are away from the United States too long. Encouragement, and other similar means, such as advice, training, and counseling are acceptable means but when these methods fail than a method with "teeth" must be used.

Application

As recommended in the proposal, an Annual Plan of Operations was developed, and there were Operations Progress Reviews by the office of the Director, Soil Survey Operations, United States Soil Conservation Service. The "effective" part of increasing effectiveness was not accepted, however.

Only time will tell how successful were these attempts at injecting the tools of operations management into the Project's operations, and exposing the Project's leaders to them. It was a challenge at least to try.

CHAPTER VI

PROBLEM AREAS

Throughout this thesis problems have been indicated and discussed to some extent in the particular chapter to which they applied. It is not the intent to repeat in detail in this chapter problems discussed previously, but to discuss some of the problems which were more general in nature rather than to be applicable to one particular phase of the Project's operations.

Language

The language of Brazil is Portuguese. It was not found to be particularly easy to learn and it would be pretentious to say that it had been mastered in a two-year period in Brazil. Language was not considered to have been a major obstacle, however, or serious barrier to working effectively with the Brazilian people.

It was normal procedure, within a week after arrival on assignment in Rio, to be assigned to the Language Department of the Foreign Service Institute in the American Embassy for twelve weeks of intensive language training. The course has been described on page 64.

It is assumed that the twelve weeks is a basis upon which the American will build, and will improve his ability

by day to day contact with the Brazilians with whom he is working. An obstacle was found which hindered considerably in the development of this proficiency. Many of the members of the Project wanted to learn English and instead of speaking Portuguese insisted on speaking English. The Project Manager was one of these. A compromise was attempted. This was that in the morning English would be spoken and in the afternoon Portuguese. This schedule was not rigidly held to. This position was taken: the objectives of the project were the most important. If progress toward these objectives could best be made by conversing with the several members of the Project who were proficient in English then English would be the language of the moment. If the member spoke only Portuguese then it would be the language.

Camargo, the Field Coordinator on the Project Staff, had spent several semesters of graduate study in the States. He spoke good English. Since most of the contact on technical matters was with him there was never a serious problem through misunderstanding because of a language barrier. Edmundo Brito, the Assistant Project Manager, had also spent several years in the States and spoke good English. Perhaps, had not these two spoken such good English, more proficiency might have been attained in speaking Portuguese.

In several places in this thesis, reference has been made to the bilingual secretary, Dona Heloisa Seabra de Arango. Her English was excellent. A native Brazilian, she had spent two years at the University of Houston in Texas, taking an executive secretarial course. As has been mentioned in previous chapters, she did a considerable amount of translation of technical material from English into Portuguese.

The problem of communication was at its greatest traveling in the interior when none of the above mentioned bilingual people were present. Even here, however, it never became a serious problem.

Throughout the course of the tour the language barrier was not considered to be a serious obstacle to participating in the project operations.

Hoarding of Knowledge

The hoarding of knowledge was a problem which came somewhat as a surprise. It first became apparent through the development of the manual on aerial photograph interpretation. The Brazilian counterpart in this field considered himself an expert in aerial photograph interpretation. It was the intent when the manual was complete that it be reproduced and be passed out to each student as he passed through the training course. When the counterpart learned of the development of the manual and of the intent to distribute it to all students he became

seriously upset. So much so that he went to the Project Manager and protested. The manager then came and discussed the problem. It was finally agreed that the manual would be distributed to the staff members only and not to the students. The problem then became apparent. If the students had all of this information in the form of a manual, the counterpart would then cease to be the expert on aerial photograph interpretation. Instead of going to the counterpart for information the students could get it from the manual if it were available to them.

This same problem apparently existed with respect to many who went to the States and earned a masters degree. When they returned with their research theses they refused to permit the thesis to be published and given general distribution. The reason being that any who read the thesis would have the same knowledge which they had and they, then, would cease to be the expert. They had worked to acquire this knowledge and they were going to protect it as their own.

This attitude might appear to be a little humorous at first but when thought about it loses any humorous aspect. It is just one more reason, of the many, that is holding back development in Latin America.

Attitude

Another problem which soon became quite evident was the attitude on the part of the Brazilian. He is a proud person and believes that he knows his country, and his country's problems better than any North American or European. He also believes that he knows how to handle and solve his country's problems without outside help. All he needs from the outside is the financial support for the development projects. He wants the financial help but does not feel the need for the technical assistance. He accepts and tolerates the technical assistance only because he knows that this is the way that he will be able to obtain the financial assistance.

This is an expression of nationalism. It is not the intent to dwell on this subject but a few additional words might be added. In conversation with some economists the concept was expressed by them that the prevalent attitude amongst most Brazilians in position of influence was that if Brazilians themselves could not develop Brazil, then no one else was going to. Brazil is going to swim or sink by herself. As indicated in Chapter I Brazil is a country with tremendous potential from the standpoint of natural and human resources. But to develop these resources she needs help, financial, technical, scientific and managerial. She cannot do it alone. If she continues in her attempt to go it alone, the real sufferers will not

be the Brazilians who make such statements of going it alone or else, but the sufferers will be the ill and diseased dwellers of the slums of Rio and Sao Paulo, the starving peasants of the droughty and poverty stricken Northeast, and the uneducated inhabitants of the interior trying to eke out an existence on the savannah and in the rain forest. These are the true sufferers of Brazil's lack of development.

Both of the USDA Advisors to the Project went there with the concept that their experience and ability were not only needed but wanted. They soon learned that this was not the case. They had assumed that they would be a part of the decision making, the policy making and the planning. It became a common procedure for them to learn of decisions and plans after they had been made. Very infrequently was the advice or the recommendations of the USDA Advisors voluntarily sought. With as much tact and diplomacy as possible they pushed their feet in the door at every opportunity, submitting their advice and recommendations whether desired or not. It was either this way or remain silent and be completely ineffective. In Chapter V some of the methods used in doing this such as staff meetings, plans of operations and progress reviews have been described. On occasions it was necessary to raise questions as to why certain decisions were made, and to refuse to accept assignments that were not in keeping with the objectives of the Project.



FIGURE 18.--Home in the tropical rain forest. Residents of these homes eke out an existence by gathering raw rubber, Brazil nuts, or surface minerals from the forest. These are the people, far from any health or educational facilities, who are suffering from Brazil's lack of development.

This attitude on the part of the Brazilian is a factor holding back the development of his country. The intelligence of the Brazilian is not questioned but they need to ask themselves the question: If I have the technical knowledge that I believe I have, if I understand the problems of my country better than anyone else, if I know the answers and the methods of solving these problems better than an outsider then why is it that the consultants country is so far in advance of mine, why must I turn to him for financial help, but don't need his technical assistance?

Project Funding

One of the most serious problems which affected progress and development of the Project was a lack of adequate funding on the part of the Government of Brazil. This existed from the very start when they failed to deposit on schedule in the Bank of Brazil those amounts agreed to in the Project Agreement. This funding problem plagued the Project and hindered operations throughout the course of the Project. At times exploratory trips to the interior had to be cancelled because of lack of funds. On several occasions Project personnel went without pay or received only partial pay for weeks due to this lack of funding. It was a cause of lack of recruitment and training programs after the one real effort in this area in December of 1965, and January, February, and March of 1966. It

delayed the start and prevented the expansion of the reconnaissance surveys.

This lack of sufficient funding is a serious obstacle to the attaining of the institutionalizing objective of the Project to expand the size, scope and effectiveness of the DPFS. There are apparently no funds available or serious planning to absorb Project personnel, other than two or three to the DPFS.

This matter of funding should be of real concern and a reason for thorough investigation on the part of anyone considering assignment as an advisor to a resource development program in an underdeveloped country.

Grants Versus Loans

The first American funding of the Project was in the form of grants of money through USAID. These grant monies were placed in the bank in the increments rather than in one lump sum equaling the total of the grant. Through this method the USAID Project Coordinator was able to keep a reasonable control of the spending of the Project. The Project Manager cleared through him any large expenditures which were not routine for supplies and salaries. It also had the effect of causing the Project Manager to give ear to some of the unsolicited advice and recommendations which he received from the USDA Advisors. He was aware that should the USDA Advisors do so they could cause considerable trouble by recommending the discontinuance

of American financial support of the Project. Towards the end of the second year a change was proposed in the method of financing development projects in Brazil. It was proposed that instead of grants that the financial assistance to Brazil be in the form of low-interest long-term loans. This applied to all areas of financial assistance and not just the Resource Survey Project. At the particular time this change in financing was proposed, the Project was without a manager since he had been dismissed by the Director of the DPFS. The Project Agreement provided that the appointment of a Project Manager must be approved by the Project Council made up of one member each from the Ministry of Agriculture, the Technical Agriculture Office, and USAID/ARDO (31). The Director of the DPFS, however, appointed a new manager without consulting the Project Council or requesting its confirmation of his appointment. When the question was raised as to why he had done it this way he replied that since the Project would now be operating on a loan instead of a grant it was no longer necessary to consult with or have the approval of the Council--in effect USAID--on such matters.

It is not believed that anyone was deceived by the use of the term "low-interest long-term loan." There was no more chance that this money would ever be repaid to the United States than there was from a grant. It was a device to help the recipient save a little face. It

was attempted to point out that there would be just as much restraint and control exercised over a loan as there would be over a grant. An illustration used was the experience normally encountered in obtaining a loan from a bank to build a home. The bank approved the loan only after they had thoroughly reviewed the detailed plans, knew who the contractor was to be, and the applicant was able to contribute 30 per cent of the cost himself. The bank then made available a certain amount of the loan to excavate for the basement and lay the foundation. Throughout the period of construction there was a series of inspections to insure progress and adherence to the plan before the next increment of the loan was made available.

If a procedure such as this were used with the loan it might be an even more effective method of controlling projects which were receiving financial assistance from the United States. It is true that Americans can become too involved in the decision making of a country receiving assistance from the United States. They must learn to plan and make decisions for themselves, this is part of the development. When domestic programs in the United States are limited, however, because of the foreign assistance program then the American taxpayer has a right to expect that his tax dollar is going to be spent wisely. This is not going to be done when administrators and managers in governments of countries receiving aid, with

a known lack of skill and ability in management and administration, are given a free rein in the handling of United States grants and loans. There must be effective controls on grants and loans to underdeveloped countries. Major decisions and plans, where United States financial assistance is a significant factor, must be subject to review and approval of United States technicians. Technical assistance must go hand in hand with financial assistance. There are merits to both types of financial assistance, grants and loans, provided there is effective control on the spending. The use of the loan type of assistance should be limited if it results in attitudes of too much independence such as was indicated in the appointment of the new Project Manager.

Coordination with Other Agencies

Reference was made in the Chapter on Operations to two agencies of the government of Brazil charged with responsibilities relative to frontier development, land settlement and colonization. These were INDA, the National Institute for Agrarian Development, and IBRA, the Brazilian Institute for Agrarian Reform. Since these two agencies were the ones actually concerned with settlement and colonization there should have been close liaison and coordination between the Project and these agencies. Unfortunately, at least during the first two years there

was a minimum of coordination. Later reports from the Project indicated that a closer relationship developed.

This lack of liaison resulted in a misunderstanding on the part of these agencies as to the purpose and objectives of the Project. This misunderstanding resulted in requests from those agencies for soil surveys and soil information on specific areas or institutions already in existence. The Project attempted to meet these requests. This was another reason for failing to meet on schedule the stated objectives of the Project. At one time the Project Manager proposed the visit of some fifteen INDA colonies, and through aerial photograph interpretation techniques the preparation of soil maps on them. This would have required two to three months of time. This assignment was refused based on the fact that it was not in keeping with the objectives of the Project, nor the purpose of the consultant in Brazil.

Fortunately, before the initiation of the reconnaissance level soil surveys, enough liaison was established with INDA to insure at least that the areas selected were areas that INDA had an interest in colonizing. Had this liaison existed in the earlier stages of the Project less misunderstanding would have existed regarding the Project's objectives. This should have helped to eliminate the side tracking requests for soils information on already established colonies. It is not intended to imply that

there was no need for this information but that it was not in line with the specific objectives of the Project. Earlier liaison with INDA and IBRA might also have resulted in financial and other support from these agencies in certain areas where such support was needed from time to time. It is only logic and common sense that there should be close liaison and coordination between an agency such as the Project whose objectives were to find land suitable for settlement and those agencies charged with settlement and colonization.

Duplication of Efforts

The last problem area upon which comment is made is that of duplication of effort by agencies concerned with international resource development. At one time or another during the tour in Brazil the Project and the DPFS had advisors or assistance from the following agencies:

1. United States Agency for International Development
2. United States Department of Agriculture, Soil Conservation Service
3. United States Department of the Interior, Bureau of Land Management, and Bureau of Reclamation
4. United States Army
Inter-American Geodetic Survey
Natural Resources Division

5. North Carolina State University Project
6. International Research Institute
7. United Nations Educational, Scientific
and Cultural Organization
Food and Agriculture Organization of the
United Nations
Soil Map of the World Project

The USAID Project Coordinator was supposedly to coordinate and supervise this assistance. Due to other responsibilities and time limitations, however, he was not able to do so. Also he had no jurisdiction over the FAO technician. It was with the FAO technician that the greatest duplication of effort took place. The FAO technician was a young, bright, but inexperienced soil scientist assigned to the Division of Soils in the area of soil survey interpretations. A native of the Netherlands, he was an outspoken and aggressive individual. One of the USDA advisors with the Project was also assigned to work in the area of soil survey interpretations. Thus a duplication of effort developed here which resulted in confusion and misunderstanding of responsibilities. The FAO technician had his concepts and ideas on soil survey interpretations which he endeavored to inject into the Project's plans and operations. The USDA advisor had his ideas and concepts which were not necessarily the same as those of the FAO representative. It was only

natural that competition between the two developed. This could only result in a certain amount of confusion and misunderstanding on the part of the Project Personnel.

Many pages could be spent on the problems which beset the Project and affected its progress and development. The principal ones have been discussed and should serve to illustrate the type and nature of problems that can and do plague a resource survey such as the one described in this thesis.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Objectives Reviewed

The specific objectives of the Resource Survey Project of Brazil's Frontier Development Program are summarized briefly here and the summary is related to objectives (30).

The primary objectives of the Project were:

1. The location of 30,000,000 hectares (75,000,000 acres) of fertile soil suitable for settlement in the interior of Brazil. Under this primary objective were the following steps:
 - a. Development of a schematic (exploratory) soil map of the Project area with accompanying legend and interpretations.
 - b. Reconnaissance soil survey of 30,000,000 hectares.
2. The build-up of the size, scope, and effectiveness of the soils staff within the Ministry of Agriculture. Under this primary objective were the following steps:

- a. Recruitment and in-service training of 75-100 technicians in soil survey to include:
 - (1) Field and laboratory methods of soil and land classification.
 - (2) Cartography.
 - (3) Air photograph interpretation.
 - (4) Preparation of reports.
 - (5) Interpretation and use of resource surveys in planning.
- b. Training in the United States of men having potential for positions of leadership, and proficiency in certain special areas.
- c. Absorption of the Project staff into the Department of Pedology and Soil Fertility.

Considering the problems and obstacles encountered, reasonable progress has been made in the first three years of Project operations.

Specific accomplishments are discussed in the following paragraphs.

Exploratory Soil Survey

The schematic (exploratory) soil map and three interpretative soil maps of the western two-thirds of Brazil have been completed and were printed in February, 1968. (Enclosures with this thesis.) The text and tables to accompany the soil maps are under development (June 27, 1968) and were to have been sent to the printer in August, 1968.

Reconnaissance Soil Surveys

Three field soil survey parties of up to five men each were in one area in southern Mato Grosso where they expected to complete the field mapping of 72,000 Km² (17,770,000 acres), by December 31, 1968. In early 1969, the parties are scheduled to move to a second area in Mato Grosso comprising 53,000 Km² (13,000,000 acres).

Samples of soil for fertility studies, soil characterization, and engineering tests have been collected concurrently with field soil surveys.

The operations in the area of southern Mato Grosso also have included the collection of some yield and management information from selected farms in the survey area. The information was collected by the field parties in the course of the survey and involved the major crops related to the important soils of the area. This program will be supplemented by the initiation of a systematic compilation of available crop, climatic and management data, by kinds of soils, from field experiments and trials in adjacent states. These results will be extrapolated to similar soils in the area of reconnaissance surveys.

A preliminary report of the soil potential of the Iguatemi area (approximately 3300 Km²) was completed and submitted to IBRA in January, 1968. This report provides IBRA with information on the agricultural potential of the area for use in their colonization activities. Field sheets at a scale of 1:60,000 were also included.

An agreement between the Ministry of Agriculture and IBRA was signed in August, 1967, and has made it possible to continue the reconnaissance surveys of 125,000 Km² (31,250,000 acres) in the two areas in southern Mato Grosso through August, 1969.

Training

A basic soil survey course was held from January 10 through March 15, 1966. Forty-two graduates of Brazil's Agricultural Colleges completed this training course.

On-the-job training is being carried on continuously in the following areas: (1) soil survey interpretations, (2) aerial photograph interpretations, and (3) soil survey operations.

Five Brazilian soil scientists with a high potential for positions of leadership were in the United States from March 28, 1968 to July 27, 1968, for intensive training in soil survey operations so that they may become more competent soil survey party leaders.

Conclusion

For any underdeveloped country embarking on an endeavor to develop its agricultural and other natural resources, a survey of these resources, their location and extent, is a necessity if the endeavor is to have any measure of effectiveness and success. The results from such a survey can aid greatly in the economic development of the country and in the betterment of the social welfare of its people.

The objective of this thesis has been to describe a procedure used in the conduct of at least a partial survey of these resources in Brazil.

It has been the attempt to set forth in this thesis, not only procedures and methods used in the Resource Survey Project, but also to describe some of the problems encountered, as well as to list some of the accomplishments, and make recommendations based on this experience. It is not proposed that the procedure as set forth here is the only or the best, but it is a procedure that did result in some specific accomplishments.

It is thought that it will have been well worth the effort if, in what has been recorded here, might be found certain guidelines, or at least some ideas, that would be of benefit and value to another person about to embark upon a similar type of resource survey project in an underdeveloped country.

CHAPTER VIII

RECOMMENDATIONS

Upon completion of the tour of duty in Brazil, a so-called "End-of-Tour Report" was prepared (40). A section of this report was devoted to "Recommendations for the Future." In addition to these recommendations, the "Review and Evaluation Report" of June 27, 1968, by Roy Hockensmith contains certain recommendations (20). A third source of recommendations affecting the Project is the Annual Report of the USDA Technical Assistance Team, Brazil for the year ending June 30, 1968 (15). Comments are made here on these recommendations, as well as making some general recommendations on resource surveys. In developing these recommendations the End-of-Tour Report will be used as a basis with the recommendations from the other sources related to it when they are applicable.

Expand Schematic Soil Map

Plans should be made for future expansion of the Schematic Map from the present boundaries of the Project area to the entire country of Brazil.

Comment: As of June 27, 1968, this recommendation had not been carried out. Roy D. Hockensmith's "Review and Evaluation Report, Resource Survey Project, June 27, 1968" contains the following statement on page 16:

A schematic soil map for all Brazil should be prepared. It is suggested that the level of generalization for the eastern one-third of Brazil be comparable to that of the map of the western two-thirds that was recently printed. This can be done by generalizing the more detailed soil surveys already made in this area and by exploratory studies for the remainder. Such a map can serve many agencies that are involved in the economic development of Brazil (20).

The expansion of the present map to all of Brazil should not be too difficult or too time consuming a job. There is no question as to its value. That it has not been done, two years after completion of the original map, may be attributed to the problems discussed throughout this thesis.

Initiate Program of Detailed Soil Surveys

The present policy of the Division of Pedology and Soil Fertility is to map Brazil completely on the reconnaissance soil survey level. There is at present a real need for detailed soil surveys of many institutions and other areas for planning purposes. If the DPFS is to have the leadership in soil survey there is an immediate need to adjust and revise its planning and policy to enable it to handle this capability of the detailed soil surveys.

Comment: This recommendation is still needed in Brazil as evidenced by the statement of L. E. Garland in the June 30, 1968, Annual Report of the USDA Technical Assistance Team, Brazil (15). Garland states on page four of Appendix B of the Report:

The progress of soil surveys in Brazil will need to move fairly rapidly into more detailed surveys for selected areas where more intensive use of the land is indicated. A combined program of reconnaissance surveys to provide general information and detailed surveys that can be interpreted more precisely is necessary in the immediate future.

Steps are being taken, however, in the direction of developing this detailed soil survey capability. This is evidenced by the fact that five men from the DPFS received training in the United States for four months each, in the duties and responsibilities of a survey party chief in detailed surveys. They received individual training at selected locations as members of a progressive soil survey in the southern and south western areas of the United States.

Reorganize Division of Pedology
and Soil Fertility

Because of the lack of experience and acquaintance with a sound soil survey program the Division of Pedology and Soil Fertility is lacking in the knowledge of the components that make up a total, balanced soil survey program. The problem does not lie in lack of skill, intelligence or ability but lies in lack of guidance and

supervision from someone who has the knowledge of all the component parts of a total survey program and how they should be integrated. It is recommended that the DPFS be reorganized to include a capable, aggressive director of soil survey operations. There is at least one individual with such a potential already on the DPFS staff. He should be sent to the United States for a year of training with the soil survey of the Soil Conservation Service at the national, regional, state and county level.

Along this same line Roy Hockensmith recommended the following in his May 26, 1966, Review Report:

It is recommended that one or perhaps two Brazilians be considered for participant training in the United States in "Public Administration in Agricultural Development" with emphasis on resource development and conservation projects such as this one (19).

It was pleasing to read in Roy Hockensmith's June 27, 1968, Review and Evaluation Report that the DPFS now has a soil scientist in charge of Soil Survey Operations and Soil Fertility (20). This man is Dr. Abeilard Fernando de Castro. Although not the man in mind when the original recommendation was made, Dr. Abeilard is an experienced Brazilian soil scientist. At one time he was the director of the DPFS. He resigned from this position to become Dean of the Graduate School of the Escola Nacional de Agronomia, Universidade Rural do Brazil. Now he is back with the DPFS in a lesser position than he once held when Director.

It was also pleasing to note in Roy Hockensmith's latest report the following from the schedule indicating planned training in the United States:

4. One soil scientist for training in the responsibilities and obligations of supervising soil survey operations on a national level and coordinating the operations at county and state levels. Length of training: 4 months, starting December, 1968 (20).

Because of personal interests and responsibilities recommendations were confined to the area of soil survey operations. There is a need, of course, for training at the national level in all those areas which are essential to a total balanced and effective national soil survey program. This need is reflected in the recommendations found throughout L. E. Garland's annual report of June 30, 1968, and Roy Hockensmith's Review and Evaluation Report of June 27, 1968 (20).

Insure Better Understanding of the Project's Objectives

The objectives and mission of the Project should be made clear to other government of Brazil agencies to assure the "Project's" being able to attain its goals in the prescribed time. An alternative to this is to take into consideration and allow for legitimate requests for soil information of other agencies by an adjustment in the budget, size of staff, and target dates of the Project.

This problem of requests to the Project from other government of Brazil agencies for soil information has been discussed under the section of this chapter devoted to problem areas. A discussion of a partial solution to this problem may be found in the paragraph of this section concerning the need for detailed soil surveys in Brazil.

Make More Effective Use of Technical Assistance

USDA and USAID should insure complete understanding by the Division of Pedology and Soil Fertility of the effective and efficient use of United States technicians. USDA, USAID and the DPFS each had differing concepts on the use of the USDA advisors. The concept of the USDA whereby the advisors would have a part in all policy and decision making, and in planning, is the only acceptable method by which their experience and ability can be utilized fully. This is a matter for consideration by anyone embarking on the role of an advisor or consultant in an underdeveloped country. This problem was common to all members of the USDA Technical Assistance Team in Brazil and not only the Resource Survey Project. Highly competent personnel with years of experience and training spent their first six months of the tour trying to find an assignment where their abilities and talents could be productively utilized.

Expedite the Acquisition of
Supplies and Equipment

A revision of USAID regulations is desirable which will permit qualified and experienced technicians to submit their supply and equipment list in advance, and prior to arrival on a foreign post. This is necessary to eliminate the situation of technicians not being able to effectively carry out their duties due to lack of essential equipment.

Roy Hockensmith's "Review Report, Resource Survey Project, May 26, 1966" also refers to this problem (19).

It was highly unfortunate we did not have field glasses on our trip to the Amazon in making observations from airplanes. A lack of this kind of equipment is a severe handicap to the work on this project. Immediate attention needs to be given to getting necessary equipment and supplies. We should not assign competent technical people to projects and then limit their usefulness by inadequate or lack of equipment.

This matter of having essential equipment cannot be over-emphasized. Unrealistic USAID regulations prevented equipment from being ordered prior to departure from the United States so as to be available upon arrival in Brazil. The order had to originate from the foreign post after arrival at the post. Then the order, prepared by experienced technicians, had to be argued and haggled over before it could be approved and submitted back to the United States. The binoculars referred to by Roy Hockensmith were on the technicians' supply list prepared in November of 1964, prior to leaving the United States.

They arrived in Brazil in December of 1966, too late to ever be used by the technicians during their Brazil tour. Proper and essential equipment procured in advance is a must for resource surveys.

Terminate Long-Term Consultant
Assistance

In conclusion the following is quoted from the "Summary of Evaluation of Resource Survey Project" of Roy Hockensmith's 1968 report (20):

In view of the high degree of technical competency of Brazilian soil scientists (although small in number) and the specific plans for training as outlined for fiscal years 1969 and 1970, it is my belief that a resident technical soil advisor from the United States will not be needed after December, 1968. This presupposes, however, that a free interchange of ideas and information between soil scientists in Brazil and the United States will continue and that short-term consultants from the United States will be provided if needed.

Thus, in December of 1968 when the term of L. E. Garland expired the technical assistance from the United States Soil Conservation Service to the Resource Survey Project of Brazil's Frontier Development Program came to an end. The author looks back on his Brazil years with mixed emotions. They were two of the most interesting and valuable years of his career in soil survey, and at the same time the most frustrating years.

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APPENDICES

APPENDIX A

SUBJECT MATTER INCLUDED IN
PROJECT TRAINING COURSE

SUBJECT MATTER INCLUDED IN
PROJECT TRAINING COURSE

1. History of Soil Science
2. Factors of Soil Formation
3. Physical, Chemical and Mineralogical Properties
of Soils
4. Soil Morphology and Genesis
5. Characteristics of Soil Profile Descriptions
and Their Determinations
6. Systems of Soil Classification
7. Types of Soil Surveys
8. Descriptive Legends
9. Interpretation of Soil Surveys
10. Aerial Photo Interpretation for Soil Surveys
11. Geology
12. Geomorphology
13. Ecology
14. Phytogeography

APPENDIX B

COURSE DESCRIPTION, LATIN AMERICA AREA STUDY
FOREIGN SERVICE INSTITUTE, UNITED
STATES DEPARTMENT OF STATE

COURSE DESCRIPTION, LATIN AMERICA AREA STUDY
FOREIGN SERVICE INSTITUTE, UNITED
STATES DEPARTMENT OF STATE

"The program is designed for United States officers who are scheduled to serve in a given area. The purpose is to enable such officers to acquire a broad understanding of those political, economic, military, social and cultural factors which should be taken into account in carrying out their professional responsibilities. This background knowledge is a common requirement for personnel of all agencies involved in foreign affairs. The countries are put into context, and the areas in turn are related to the changing world environment, partly by the presentation of a sequence of general analytical concepts or themes drawn from the behavioral and other sciences which have validity for the course. The program draws substantially on non-governmental as well as governmental lecturers selected for their recognized competence in their fields of specialization. The views of the lecturers do not necessarily reflect United States foreign policy or any official point of view. Independent critical thinking is encouraged in the analyses of problems which involve American interests."

"The program at the FSI begins with emphasis on geography, history, economic, political and social structures; religion; national character; and problems of cross cultural communication with respect to the various areas and countries concerned."

"Against this background the area course moves to consideration of factors involved in the process of transition and change. Particular attention is given to: the impact which both international communism and the free world are making in the area; rising nationalism; the roles of such significant groups as the middle class, youth, labor, and the military; the preconditions for economic development and the growth of democratic processes and institutions; internal and foreign policy problems of emerging nations in a great power world; trade, sovereignty and national development; regional and international organizations; the involvement of American interests."

APPENDIX C

TRIP ITINERARY

AUGUST 18 TO SEPTEMBER 11, 1965

TRIP ITINERARY

AUGUST 18 TO SEPTEMBER 11, 1965

- August 18: Rio to Goiânia, Goiás State, via São Paulo by commercial air.
- August 19: Goiânia to Uruaçu via Ceres in Goiás State on BR 14 by rural Willys station wagon. Study of soils, landforms and vegetation en route.
- August 20: Uruaçu to Goiânia by light aircraft and motor vehicle. Study of soils, etc. en route.
- August 21: Goiânia to Itumbiara, Minas Gerais State, via Itumbiara by motor vehicle. Study of soils, etc. en route.
- August 22: Itumbiara to Jataí, Goiás, by light aircraft and motor vehicle. Study of soils, etc. en route.
- August 23: Jataí to Goiânia by motor vehicle. Study of soils, etc. en route.
- August 24: Conference with CIVAT personnel, review of aerial photography, and conference of Project personnel on exploratory map.
- August 25: Goiânia to Brasília, Federal District by motor vehicle. Study of soils, etc. en route.
- August 26: Brasília to São Luís, Maranhão, by commercial air.
- August 27: São Luís to Peritoró by motor vehicle. Study of soils, etc. en route.
- August 28: 1. Peritoró to São Luís via Coroati by motor vehicle.
2. São Luís to Belém in Pará by commercial air.

- August 29: Belém to Castanhal and return via motor vehicle. Study of soils, etc. en route.
- August 30: Belém to Imperatriz on BR 14 and return by light air craft. Landings at Imperatriz and other available landing strips to study soils.
- August 31: Belém to Ilha de Marajó and return by light air craft. Study of soils on the island.
- September 1: Belém to Rio by commercial air.

APPENDIX D

EXPLORATORY FIELD STUDY IN THE

AMAZON BASIN

MAY 8-18, 1966

EXPLORATORY FIELD STUDY IN THE AMAZON BASIN

MAY 8-18, 1966

1. Area covered included parts of:
 - a. State of Pará
 - b. State of Amazonas
 - c. Territory of Roraima (Rio Branco on older maps)
2. Dates: May 8-18, 1966
3. Personnel:
 - a. Roy D. Hockensmith, Director, Soil Survey Operations, Soil Conservation Service
 - b. Francis W. Cleveland, Soil Scientist, Soil Conservation Service
 - c. Flávio Garcia de Freitas, Soil Scientist, DPFS
 - d. Antônio Manual Pires Filho, Soil Scientist, Project
 - e. João Maurício Gralha Tomasi, Soil Scientist, Project
 - f. Benedito Nelson R. Da Silva, Soil Scientist, IPEAN
 - g. Dirk van der Voet, Soil Scientist, Soil Conservation Service
4. Objectives
 - a. Become familiar with soils and agriculture of the region.
 - b. Test use of low altitude flights in acquiring information on soils and agriculture accompanied by ground examination.

- c. Check location of tentative soil boundary lines on Schematic Soils Map.
- d. Collect data from technicians and farmers to be used in development of soil survey interpretations.

5. Itinerary, Transportation and Activities

- May 8: Rio de Janeiro to Belém, State of Pará, via Brasília and Teresina and São Luiz, State of Maranhao, Varig Airlines, DC 6.
- May 9: Belém. Conferences with IPEAN personnel and visit to cacao plots. Discussion with Valmir Santos, State Secretary of Agriculture.
- May 10: Belém to Santarém, State of Pará on the Amazon River. Cruzeiro do Sul, (Southern Cross) Airlines, DC 3. P.M. visit to Fazenda Regional de Santarém, Ministry of Agriculture. (Regional experimental farm.)
- May 11: Santarém. Flight by single engine Piper-Cherokee. Six to vicinity of Monte Alegre and return. Unable to find or land at Monte Alegre due to heavy rain and clouds.
- May 12: Santarém. Flight by single engine Piper-Cherokee to Alenquer and Monte Alegre. Study of soils and agriculture on the ground by vehicle. Visited INDA (National Institute of Agrarian Development) Colony at Monte Alegre.
- May 13: Santarém to Manaus, State of Amazonas via Óvidos, Parentins, and Itacoatira. Cruzeiro do Sul Airlines, DC 3.
- May 14: Manaus to Boa Vista, Territory of Roraima (Rio Branco on old maps). Cruzeiro do Sul Airlines, DC 3. Visit with Territorial Military Governor, Colonel Dilhermando Cunha da Rocha in A. M. Visit agricultural colony at São Francisco in P. M.
- May 15: Study of soils and vegetation on BR 14 SW of Boa Vista in A. M. Boa Vista to Manaus in P. M. Cruzeiro do Sul Airlines, DC 3. Met American missionary with Uaica Indian tribe on flight.

- May 16: Manaus. 160 kilometer trip along Highway AM 1 east of Manaus studying soils and management of black pepper plantations operated by Japanese.
- May 17: Manaus. Conference with American Consular Agent, Marshall Whitlock, on resource potential of the Amazon area.
- May 18: Manaus to Rio de Janeiro via Brasília. Varig Airlines, DC 6.

6. Soils Observed

- a. Yellow Latosols
- b. Terra Preto de Indo
- c. Latosol Roxo
- d. Grumosols
- e. Dark Red Latosols
- f. Red Yellow Sands

7. Crops Observed

- a. Cacau (cocoa)
- b. Rubber
- c. Brazil Nuts
- d. Black Pepper
- e. Bananas
- f. Pineapple
- g. Sugar Cane
- h. Mandioca
- i. Rice
- j. Corn
- k. Elephant Grass
- l. Jaragua grass

m. Colonial Grass

n. Pangola Grass

8. Remarks

- a. The flight from Belém to Manaus was almost directly over the Amazon River. The river was at its flood peak and in some places was 25 miles wide. The large number of cattle grazing in the fields which were not flooded was quite striking.
- b. Another impressive sight was the nearly level to undulating area of grassland, that extends about 30 to 50 miles in each direction from Boa Vista, Territorial Capital of Roraima. After flying for miles over the rain forest this is quite a contrast.
- c. Shifting cultivation was observed throughout the Amazon Region.

APPENDIX E

PROPOSED OUTLINE AND TABLE OF INTERPRETATIONS

TO ACCOMPANY SCHEMATIC (EXPLORATORY)

SOIL MAP

PROPOSED OUTLINE AND TABLE OF INTERPRETATIONS
TO ACCOMPANY SCHEMATIC (EXPLORATORY)
SOIL MAP

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Technical Descriptions of Soil Profiles with
Laboratory Data

Appendix II

Placement of Soils of Brazil in 7th Approximation of
Soil Classification

Table of Interpretations

1. Map Symbol Name of Mapping Unit,
General Location and Physiography

2. Dominant Soil and Estimated
Proportions Within Mapping Unit

| Name of Soil | Estimated Percent |
|--------------|-------------------|
|--------------|-------------------|

3. Climatic Zone and Proportion
of Dominant Soil in Zone

| Climatic
Classification | Estimated Percent |
|----------------------------|-------------------|
|----------------------------|-------------------|

4. Slope Classes and Estimated
Proportions of Soils

| Percent Slope | Percent of soil |
|---------------|-----------------|
|---------------|-----------------|

5. Degree of Limitation Affecting Agricultural Use
 - a. Fertility
 - b. Soil Moisture for Crop Growth

| Excess water | Lack of Water |
|--------------|---------------|
|--------------|---------------|

- c. Modern Machinery
 - d. Susceptibility to Erosion
 - e. Susceptibility to Frosts

6. Soil Suitability Classes by Management Systems

| System A | System B | System C |
|----------|----------|----------|
|----------|----------|----------|

7. Remarks

APPENDIX F

REPORT OF VISITS TO AGENCIES IN BRAZIL CONCERNED
WITH AERIAL PHOTOGRAPH INTERPRETATION

REPORT OF VISITS TO AGENCIES IN BRAZIL CONCERNED
WITH AERIAL PHOTOGRAPH INTERPRETATION

1. May 10, 1965

Visited LASA (Levantamentos Aerofotogramétricos of South America) with Cleveland and Brito at 9:00 A. M.

LASA indicated their capabilities in the field of air photo interpretation and showed us their plant. They demonstrated their scanning stereoscope. When I asked how much it speeded up operations, they replied, "None." They believe that production is better using a regular stereoscope. I also noticed that they were not using the binoculars on the regular mirror-type stereoscope. They showed us sample photos indicating quality of work and photo indices.

They suggested that we visit the plant of Serviços Aerofotogramétricos Cruzeiro do Sul, with whom they are affiliated.

12:00: Visited Serviços Aerofotogramétricos Cruzeiro do Sul, SA

In the "Aerofoto" plant which was an impressive operation on the outskirts of Rio, we learned that there

are three separate affiliates working in cooperation with each other. LASA, whom we visited first, does aerial photo interpretation work in the fields of geology, minerals, soils, etc. Aerofoto plans flights, develops film and prints aerial photographs. A third member of the team is Cruzeiro do Sul Airlines. "Cruzeiro" has the planes and the pilots and flies the actual aerial photograph coverage. The whole setup appeared to be an organized and efficient operation. We later learned from the United States Air Force and Army that for their kind of operation they had the best reputation in South America.

"Aerofoto" supplied us with a map of Brazil, 1:5,000,000 which gave their up-to-date coverage indicating flights available, year flown, altitude of flight and scale of contact prints, and current price list.

They suggested that we determine the USAF coverage of Brazil through the Inter-American Geodetic Survey office in Rio.

2. May 11, 1965

Visited IAGS (Inter-American Geodetic Survey) office in downtown Rio. A Mr. Robert Smith, who handles the USAF coverage, supplied us with a map of Brazil, scale of 1:9,000,000 indicating aerial photograph coverage by the USAF, scale 1:70,000. Present flying is south of 14 degrees.

Additional information supplied:

- a. Prints available at cost, actually less than cost since cost of flight is borne by USAF.
- b. Tenth Aerial Photo Survey Team, 14th Recon. Wing hqd. at São Paulo does the actual flying.
- c. No plans for flying the Amazon area at present.
- d. Possibility of jet flight from NW to SE of Amazon at future date.

Smith made arrangements for us to visit PROSPEC another company in Brazil flying aerial photo coverage, and provided us with a map indicating their coverage.

3. May 12, 1965

Visited Ministério da Guerra, Serviço Geográfico do Exército (Ministry of War, Army Map Service). Arrived at 10:00 A. M. A Major Pericles and Tenete Colonel (Lt. Col.) Siguera Campos oriented us on their operations, provided us with lists of available maps, and showed us charts giving aerial photograph coverage, both military and civilian.

4. June 4, 1965

Visited Air Photo Interpretation Unit, Instituto Agrônômico do Estado de São Paulo at Campinas. Conference with Francisco de Castro Verdade, Chief, Air Photo Interpretation Unit, who conducted us on a tour of the unit

and explained its operations. Possible areas of cooperation between the unit and the Project were discussed.

Verdade explained that with a state the size of São Paulo and a staff of only three soil scientists it would take too long to map the state. Therefore, a system of aerial photo interpretation for soil survey was developed to speed up this work. Generally this method of operation is as follows:

- a. Examination of selected areas in the field and concurrent study of aerial photographs.
- b. Mapping of other areas by air photo interpretation techniques in the unit at Campinas.
- c. Spot check of areas in the field.
- d. Collection of soil samples from representative units in the field.

They had mapped 18,000 Km² in three months by this method. Previously they were able to map a square kilometer a day by the old method. Through the techniques of aerial photo interpretation they believe they can determine: (1) soil; (2) geology; (3) vegetation; (4) land use; and (5) soil conservation measures needed.

This is the type of short-cut to soil survey and other resource surveys which Wright and Bennema were concerned about, and about which Agriculture Handbook 294 warns. Their method goes far beyond the reasonable limits

of aerial photo interpretation in soil survey and cannot result in a reliable accurate soil survey.

APPENDIX G

TRAINING MANUAL, AERIAL PHOTOGRAPH
INTERPRETATION

TRAINING MANUAL, AERIAL PHOTOGRAPH
INTERPRETATION

Section I

Recommended Texts

1. Manual of Photographic Interpretation, American Society of Photogrammetry, 1515 Massachusetts Avenue, N. W., Washington, D. C.
2. Manual of Photogrammetry, Vol. I and II, American Society of Photogrammetry.
3. Aerial Photographic Interpretation, Principles and Application by Donald R. Laeder, McGraw-Hill Book Company, Inc., New York, 1959.
4. Soil Survey Manual, Soil Survey Staff, Agriculture Handbook No. 18, USDA, Washington, D. C. Superintendent of Documents, U. S. Government Printing Office.
5. Aerial Photographs in Geologic Interpretation and Mapping Geological Survey Professional Paper 373 by Richard G. Ray, U. S. Government Printing Office, Washington, 1960.
6. Forecasting Trafficability of Soils--Airphoto Approach Technical Memorandum No. 30331, Report 6, Vols. I and II, June, 1963, U. S. Army Engineers Waterways Experiment Station Corps of Engineers, Vicksburg, Mississippi.
7. Elementary Map and Aerial Photograph Reading, Field Manual, U. S. Army.
8. Advanced Map and Aerial Photograph Reading, Field Manual, U. S. Army.

Comments:

At one time or another each one of these texts was used as reference material. The first two listed above,

the "Manual of Photographic Interpretation," and the "Manual of Photogrammetry," were found to be extremely valuable. These would be recommended texts for anyone participating in a resource survey in an underdeveloped country. Agriculture Handbook 294, Soil Conservation Service, U. S. Department of Agriculture, "Aerial Photo Interpretation in Classifying and Mapping Soils" is not listed only because it was not available at the time that the manual was under preparation. It should be a part of any list of recommended texts on aerial photograph interpretation.

Section II

Training Aids Available

1. Eccentric Circles Diagram
2. Hidden Message Stereogram
3. Floating-Circles Stereogram Test Sheet
4. Lake Stereogram
5. Delineation and draining problem comprising photo prints DLV-56-174, 175, and 176, together with transparent overlay answer sheets.
6. Watershed Location Problem comprising photo prints DMM-3H-195, 196, 197, together with transparent overlay answer sheets.

Comments:

This set of training aids was made available from the Cartographic Division of the U. S. Soil Conservation Service, Washington, D. C. They are an excellent training device in teaching new people how to use the stereoscope. They take the individual step-by-step through the phases of using a stereoscope from the very simple up to the point where he is actually delineating a watershed and the drainage pattern. They are recommended for any one faced with the task of teaching the use of the stereoscope. Information on their cost and method of procurement can be obtained from the Cartographic Division of the U. S. Soil Conservation Service in Washington, D. C.

Section III

Equipment Essential to Aerial Photographic
Interpretation for Soil Survey

Comments:

The equipment listed in this section is essentially the same as the items listed previously in Chapter IV under the section on, "Procurement of Aerial Photography and Equipment for Aerial Photo Interpretations." The basic piece of equipment, of course, is the stereoscope. Both the pocket lens-type stereoscope and the mirror-type Fairchild stereoscope are recommended. The

mirror-type stereoscope has an accessory in the form of binocular eyepieces. It is believed that these are optional when purchasing the stereoscope since some of the Project's stereoscopes did not have them. They narrow the range of observation and not much use was found for them. Another essential item is the fluorescent elbow type illuminating lamp. The electric illuminated magnifying glass was also found to be helpful.

Section IV

Proposed Program of Training with References

Comments:

The schedule of instruction as prepared for the aerial photo interpretation portion of the Project training course appeared in this section. The schedule consisted of seven days of instruction both lecture and practical exercises, utilizing five instructors. Because of its length the program of instruction is not reproduced here.

Section V

Training References Included As A Part of the Manual

1. Making Effective Use of Aerial Photography, USDA, SCS Field Cartographic Unit, Fort Worth, Texas, May, 1964.

2. Photo Interpretation in the Soil Conservation Service, USDA SCS, August, 1956.
3. Interpretation of Aerial Photographs in SCS Operations, USDA, SCS, Cartographic Unit, Spartanburg, S. C., August, 1956.
4. The Use of Air Photos for Soil Classification and Mapping in the Field by John D. Rourke and Morris E. Austin, Reprinted from Photogrammetric Engineering, December, 1951.
5. Use of Stereoscope in the Field, Speed-Up in Soil Mapping by Joel Cawthorn, Reprinted from Soil Conservation, August, 1965, Vol. 31, No. 1, USDA, SCS.
6. Example of a Reconnaissance Soil Map Produced by the Pedological Analysis of Aerial Photographs, followed by the Study of Soils in the Field by P. Buringh and W. J. van Liere, Reprinted from Transactions of the Vth International Congress of Soil Science, August, 1964.

Comments:

All of the above references were a part of the English version of the manual. Two of these references, "Making Effective Use of Aerial Photography," and "The Use of Air Photos for Soil Classification and Mapping in the Field" were translated into Portuguese by the bilingual secretary of the Project. Authority to use and reproduce the translations was requested and received from the Washington office of the Soil Conservation Service. These two became a part of the Portuguese version of the manual. In the case of the other references the titles only were translated into Portuguese and made a part of the manual.

Section VI

Status of Aerial Photography in Brazil

- A. Institutions and Companies in Brazil Performing Aerial Photographic Services.
- B. Present Aerial Photographic Coverage in Brazil.
- C. Planned on Contemplated Aerial Photographic Coverage in Brazil for the Future.
- D. Procedures for Obtaining Aerial Photographic Coverage.

Comments:

The details contained in this section resulted from the visits during the early days of the Project to all of the known agencies in Rio having to do with aerial photography and its interpretation.

Section VII

Care, Maintenance and Storage
of Aerial PhotographsComments:

This final section of the manual was based in part on experience of twenty years of using and handling aerial photographs both in the field and in the office. Additional information was obtained from various texts and references already referred to in Chapter IV.

APPENDIX H

REPORT OF SEMINAR WITH COLLEGE FACULTY ON
AERIAL PHOTOGRAPH INTERPRETATION

REPORT OF SEMINAR WITH COLLEGE FACULTY ON
AERIAL PHOTOGRAPH INTERPRETATION

1. Dates: November 8, 9 and 10, 1966.
2. Objectives of Seminar: Acquaint faculty of agricultural college with the uses of aerial photography in the different areas of agriculture.
3. Participants: Nineteen faculty members of the following departments of the college:
 - a. Forestry
 - b. General Agriculture
 - c. Horticulture
 - d. Plant Pathology
 - e. Rural Engineering
 - f. Soils
 - g. Topography
4. Subject matter presented
 - a. History of aerial photography
 - b. Recommended texts on aerial photography
 - c. Status of aerial photography in Brazil
 - d. Characteristics of aerial photographs
 - e. Equipment used in aerial photograph interpretation
 - f. Aerial photography in agriculture

- (1) General
 - (2) Classification and mapping of soils
 - (3) Forestry
 - (4) Rural Engineering
 - (5) Rural and Urban Planning
 - g. Practical Exercises in the Use of Aerial Photographs and the Stereoscope
5. Remarks:
- a. Opening remarks on Tuesday morning, November 8, made by the Dean of the College and former Minister of Agriculture of Brazil, Dr. Hugo de Almeida Leme
 - b. Presentation was in English and translated into Portuguese by Dr. Silman Ziller Marcos, a member of the Soils Department, Piracicaba.
 - c. Twenty-seven charts, 3 x 4 feet in size in Portuguese, maps, overlays, mosaics, and photographs used.
 - d. Lecture notes retained at Piracicaba for translation into Portuguese, mimeographing and distribution to all participants of the Seminar.

APPENDIX I

PLAN OF OPERATIONS, RESOURCE SURVEY PROJECT, 1966

PLAN OF OPERATIONS, RESOURCE SURVEY PROJECT, 1966

"I. Introduction

The purpose of the Plan of Operations is to state clearly the objectives of the Project for 1966. It indicates the responsibilities and duties of the Project under the supervision of the Project Manager. These responsibilities and duties are expressed in terms of what, who, when, where and how.

Also included in this plan of operations are general procedures for the operation of Project activities.

The Plan of Operations has the purpose of helping each person concerned with the Project to understand clearly his work and when it should be done. Thus the work will be accomplished more efficiently. The objectives are stated and provisions are made for each phase of the work.

It is recognized that complete attainment of all of these objectives may not be accomplished in 1966, but at least a start will be made and work developed according to this plan."

"II. Objectives

- A. Training of new pedologists
- B. Selection and establishment of priority of areas for reconnaissance mapping
- C. Establishment of mapping goals for each reconnaissance soil survey area
- D. Development of soil survey interpretations
- E. Completion of the 1st approximation of schematic map of project area, and progressive development of exploratory map
- F. Establish field headquarters in appropriate cities in areas of field operations
- G. Preparation of a work plan for each area selected for reconnaissance soil survey
- H. Preparation of preliminary legend for each reconnaissance soil survey area
- I. Development of a plan of systematic collection of samples for characterization of soils in each reconnaissance soil survey area
- J. Initiate collection and classification of information for each reconnaissance soil survey area
- K. Develop system of field reviews and inspections to evaluate progress, effectiveness of training, field mapping, and procedures of operations

- L. Increase use of aerial photograph interpretation in soil survey
- M. Promote increased use of operations management techniques
- N. Initiate public information program
- O. Collect data, maps and photographs for each reconnaissance soil survey area
- P. Central control of project technical documentation
- Q. Publication of technical works and maps"

For the purpose of illustrating the procedure of developing an objective step-by-step, the development of Item K is reproduced here.

"K. Develop System of Field Reviews and Inspections to Evaluate Progress, Effectiveness of Training, Field Mapping and Procedures of Operation.

1. Person responsible: Project Manager
2. Target Date: Prior to start of first reconnaissance survey
3. Field reviews to consist of:
 - a. Initial review (field study of soils and preparation of preliminary legend)
 - b. Progress review (check on quality and progress of field work)
 - c. Final review (evaluation of entire survey)

4. Procedures

- a. Development of schedule of initial reviews, and make arrangement for carrying out provisions of initial review.

Who: Project manager in cooperation with Party Chief

When: At the initiation of survey work

- b. Designate person to conduct initial review

Who: Project Manager

When: After initiation of survey work

- c. Designate person to conduct progress review

Who: Project Manager

When: After initiation of survey work

- d. Conduct at least one annual meeting with staff members of all soil surveys for a joint discussion of progress and procedures.

Who: Project Manager

When: During rainy season prior to field season

5. Remarks

- a. Prepare written report of each field review
- b. Notify participants in advance of agenda of annual meeting
- c. Prepare report of annual meeting and distribute to all staff members and meeting participants

- d. Project Manager and Field Coordinator to review and approve all reports prior to distribution."



MAPA DO BRASIL

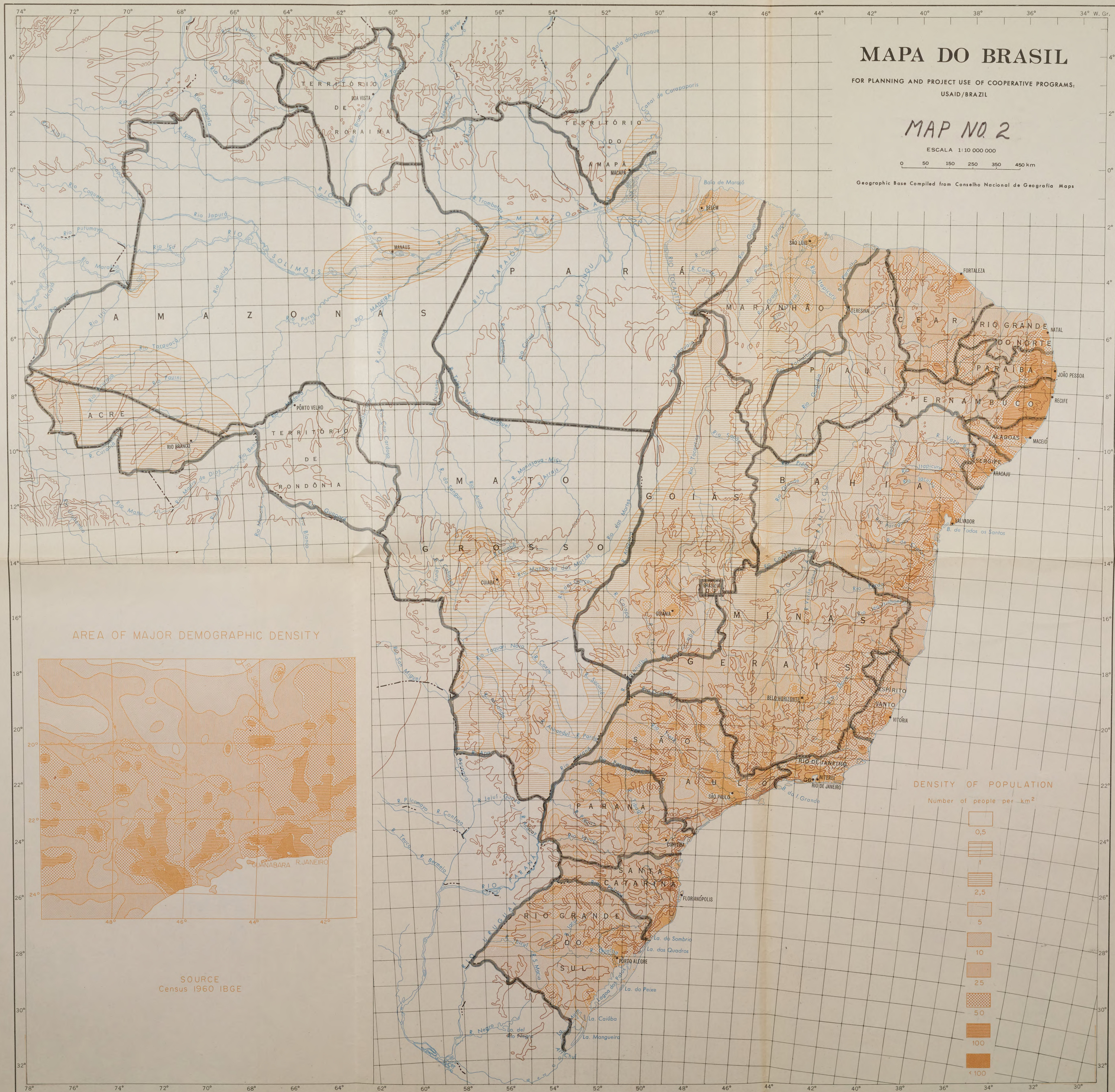
FOR PLANNING AND PROJECT USE OF COOPERATIVE PROGRAMS;
USAID/BRAZIL

MAP NO. 1

ESCALA 1:10 000 000

0 50 100 150 200 250 300 350 400 450 km

Geographic Base Compiled from Conselho Nacional de Geografia Maps





MAPA DO BRASIL

FOR PLANNING AND PROJECT USE OF COOPERATIVE PROGRAMS;
USAID/BRAZIL

MAP NO. 3

ESCALA 1:10 000 000

0 50 100 150 200 250 300 350 400 450 km

Geographic Base Compiled from Conselho Nacional de Geografia Maps

TYPES OF VEGETATION EXPLANATION

- Equatorial forest of floodlands and sloughs
- Caatinga (tropical thorn-brush to desert vegetation)
- Chaquenha (scrub forest of Paraguay flood basin)
- Cerrado (low forest to savannah)
- Swampland
- Campos (predominantly grassland)
- Floodplains
- Coastal scrub vegetation

INTERPRETATION: Shaded areas represent vegetation types associated with conditions of flooding or low rainfall or low fertility which usually require high levels of technology and/or capital for practice of general agriculture. Clear map areas represent forests which occur both on fertile and infertile soils.

SOURCE: C N G GEOGRAPHIC ATLAS, 1959

