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Unity - Labour - Justice  

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REPORT OF TECHNICAL COMMITTEE,  
NO. 1/TC/R.C.R.S.O./77

July 1977

**REPORT OF THE TECHNICAL COMMITTEE  
TO ESTABLISH A  
REGIONAL REMOTE SENSING CENTER AT  
OUAGADOUGOU, UPPER VOLTA**

**JULY 1977**

**A REGIONAL REMOTE SENSING CENTER AT OUAGADOUGOU**  
**Report of the Technical Committee**

**PREFACE**

This report defines a program of international cooperation to establish a Regional Remote Sensing Center at Ouagadougou. It was prepared by representatives of or consultants to France (FAC), Canada (CIDA), United States (AID), Upper Volta, and the United Nation's Economic Commission for Africa (ECA). The program was defined to fulfill commitments of the development agencies of France, Canada, and the United States, as well as partial fulfillment of an overall African Remote Sensing Program, as recommended by an ECA sponsored study (Reference C), endorsed and defined in ECA sponsored meetings of African nations (References D, E) and approved by the ECA Council of Ministers in their meeting in Kinshasa in February 1977 (Reference H).

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## INTRODUCTION

The need and desire to establish a Regional Remote Sensing Center at Ouagadougou, Upper Volta, has been expressed through a number of resolutions, studies, and proposals. In February 1975, the Council of Ministers of the Economic Commission of Africa (ECA) adopted Resolution 280 (XII) (Reference A) which directed the Executive Secretary to take all necessary steps to ensure the establishment of a Center to provide Africans with the capability to receive and use satellite remote sensing data. Through requests from the government of Upper Volta and the Comité Interafricain d' Etudes Hydrauliques, the USAID Mission in Upper Volta proposed in June 1975 that the U.S. fund a regional remote sensing training center in Ouagadougou. In October 1975, the French Ministry for Cooperation proposed at an ECA meeting of potential donors that a French satellite tracking facility at Ouagadougou be converted into a Regional Remote Sensing Center for receiving Landsat data and training Africans in the use of such data. This proposal was considered by an ECA study team which visited Africa in February-March 1976. Included on this team were representatives from or consultants to ECA, USAID, Canadian International Development Agency (CIDA), UNDP and FAC. The team recommended that a Center be established in Ouagadougou as an important and critical component of a larger program to give Africans a capability to receive and use satellite remote sensing data. The recommendation was endorsed by an Inter-Governmental meeting of African nations which met in Addis Ababa in September 1976 and approved by Resolution 313 (XIII) of the ECA conference of ministers in Kinshasa in March 1977.

These actions led the development agencies of France, Canada, and the United States to meet in Ottawa during 26-28 January 1977 to define a multidonor program to establish a Regional Remote Sensing Center at Ouagadougou. At this meeting, a Technical Committee was established to develop a detailed design and implementation plan for such a center. The Committee was to have representation from France, Canada, the United

States, Upper Volta, and ECA. The plan was to be completed by July 1977 and would provide the information needed for authorization to proceed with establishing the Center. The Committee met in Upper Volta during 16-18 March 1977 to outline, define, and discuss solutions to key issues which needed to be resolved before the program could be implemented. Members were assigned the tasks of addressing these issues, and the Committee met again in Ann Arbor on 2-4 May to assemble and prepare this report for final review at a subsequent meeting in Paris on July 25-29, 1977.

**OBJECTIVES AND PRINCIPAL FUNCTIONS  
OF THE CENTER OF OUAGADOUGOU**

The Center defined in this report provides for (1) a ground station to collect Landsat data of cloud-free areas within a radius of approximately 3,000 kilometers\*, (2) a data storage, processing and distribution facility, (3) a data analysis facility, (4) a training program, and (5) a User Assistance Program. The overall center will service both English and French speaking countries and organizations within the region of its reception.

The purpose of the proposed project is to improve the information base used by interested countries for planning and administering regional and national development programs and policies. The project intends to institutionalize the use of modern remote sensing satellite data by governments and organizations in the region in preparing resource inventories and making environmental assessments. The value of remote sensing has increased manifold since the U.S. launched the Landsat series of remote sensing satellites. These satellites are programmed to view all cloud-free portions of the earth repetitively on an 18-day cycle. Existing and future satellite data can be used to provide accurate, up-to-date information concerning the location, extent, and nature of forestry, agricultural, hydrological, and geological resources within the countries concerned. In addition, the satellite data can be used for monitoring natural and man-induced environmental changes such as water quality or soil conservation.

To date, satellite data has not been generally available to, or used by, concerned African technical departments in preparing environmental analyses or obtaining resource information needed for sound development planning. One reason for this is that the imagery which is currently available is of a limited nature. Because no station for reception of

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\*Refer to Appendix IV

the data exists in the region, acquisition of imagery is totally dependent upon tape-recording of the data aboard the satellites as they fly over the area, and later read-out of these recordings to a reception station in the U.S. Since not all possible data can be recorded, acquisition of imagery for any area is dependent upon global priorities. The on-board tape recorders have also proven to have a lifespan much shorter than the satellite itself, and in fact, of the satellites currently in orbit, only one has even a very limited recording capacity remaining. The establishment of a reception station will avoid this difficulty, and since the data for every satellite pass would be collected, use of the imagery to monitor transient and dynamic phenomena on a regular basis would also exist. The proposed project is thus designed to provide ready access to data, helping African planners to interpret and use the data for development decision making, and training in the use of the remote sensing technology. For some applications, the information derived from the satellite remote sensor will be used directly. In others, it must be used in conjunction with more detailed or ancillary data acquired from aircraft or ground observation.

The center defined in this report is designed to give a broad range of African planners and technicians, a capability to acquire, interpret, and use remote sensing data. The Center will initially be staffed by expatriates and Africans drawn from the countries served by the Center. Much of the financial cost for initial operation will be provided by donor countries, but the plan aims at the Center to be self supporting and staffed completely by Africans within five years.

The success of the Center will be measured by how fast and extensively remote sensing technology will be understood, accepted and adopted for use in programs of the member countries and intergovernmental agencies. The Center is designed to accelerate this adoption by providing satellite data, training and assistance to African governments and organizations affected by the Center.

As discussed in the following sections, the Center will be developed in two phases. Phase I will consist of the immediate implementation of training and user assistance programs, including the necessary storage for existing imagery, and reproduction and interpretation facilities for Landsat products. It is scoped to begin at a modest level and grow as demands for services increase. The facilities and staff should be capable of conducting two courses in basic remote sensing per year, performing on several demonstration projects, and assisting visitors to the Center.

Phase II will consist of the establishment of a reception station to directly receive data from the Landsat satellites, and produce master images and tapes. The reception station would be designed to also allow future compatibility with other earth resources and meteorological satellites. It is anticipated that the reception station will become operational about two years after the beginning of the Center's operations.

**ADMINISTRATIVE ISSUES****2.1 ADMINISTRATIVE ORGANIZATION****2.1.1 INTERIM ARRANGEMENT**

It has been agreed that an interim national institution or agency would be established by the government of Upper Volta to serve as the legal and financial entity for the Center until a regional remote sensing organization is established. The establishment of this interim institution is necessary to serve as the custodian of the project, and to serve as the agent of the government of Upper Volta for the purpose of receiving and managing donations of equipment, services, and funds from the donors. The Upper Volta Government will also, for the interim period, select the Agency's Director, who will concern himself with these and other issues. He should be an administrator with both the personal experience and the prestige required, in Upper Volta and in the countries that the Center will serve, to perform these functions.

**2.1.2 DONOR AGREEMENTS**

The working principle recognized in the meetings of the Technical Committee is that the donor countries would conclude bilateral agreements concerning their contributions to the Center with the government of Upper Volta. Each of these bilateral agreements consists of a number of articles covering standard provisions of the usual type, followed by technical clauses. Among the latter would be a clause defining the process whereby the property of the Center and its equipment would be transferred to a regional organization. Upper Volta and the donor countries will conclude agreements for the reversion, if necessary, of the property to the Government of Upper Volta under agreed circumstances. The text for these clauses appear in relevant articles of the proposed Model Agreement contained in Appendix II, prepared by the Directorate for International Cooperation, Ministry of Foreign Affairs of Upper Volta. In preparing their bilateral agreement with the Government of Upper Volta, the donors will, to the extent possible, refer to the language and spirit of that Model Agreement.

### 2.1.3 REGIONAL ORGANIZATION

It was felt by members of the technical committee that the Ouagadougou Center would be one whose basic mission would be to serve those countries covered by the reception station. They believe that a regional governing board would be the preferred method of ensuring that this focus be met, within the framework of the coordinating policy functions of the African Remote Sensing Council.

The members of the technical committee agree however that the effort to establish a regional Remote Sensing organization is a matter of great urgency and should be pursued with vigor. The early establishment of such an organization is urgent because it will provide further assurance to both the African and Donor nations that the program has sufficient African support. Therefore, such an organization should be established before the end of phase I of the program. Operating expenses, salaries, and concurrent costs will rise abruptly as phase II commences and the functions of the Center broaden when it has a reception capability. Therefore, organizational arrangements should reflect these changed circumstances. Because the establishment of an organization will take time and should be done carefully, the technical committee believes it should be begun immediately so that the institutional arrangements can be completed before the end of phase I.

### 2.1.4 TECHNICAL COMMITTEE

Finally, the technical committee should, until a permanent regional organization is established, continue to meet from time to time to exchange views, to assist in planning and to facilitate the coordination of action by the various parties for the benefit of the project.

## 2.2 MEMBERSHIP

In view of the above recommendations, the following membership criteria could be suggested:

- a) African States within the area to be covered by the proposed Ouagadougou reception station (see Appendix IV) and having an interest in using and developing the application of remote sensing technology, and prepared to share in the cost of the Center, shall be regarded as eligible to be Members.
- b) African intergovernmental organizations active in the field of remote sensing shall be regarded as eligible to be Associate Members. Their admission shall be the subject of arrangements to be made by the Regional Governing Board.
- c) The Center may seek and maintain active cooperation with other governments not covered by the Ouagadougou station, especially those adhering to the proposed constitution of the African Remote Sensing Council, as well as with world and regional organizations (governmental and non-governmental), and with other institutions: this category shall be collectively designated under the title: "Cooperating States and Organizations". The criterion to be applied is the desire of such states or organizations to assist the Center or its members, to reach their joint objectives.

## **2.3 FINANCIAL ISSUES**

The question of financing of the Ouagadougou Regional Center over the long term contains some difficult issues. These are connected to the nature of the Regional Governing Board, and to the relationship between the Center and the African Remote Sensing Council. Because of the nature of these issues, no detailed financing plan of the Center has been developed. However, potential policy and procedures for developing the financing, and one possible plan are presented.

### **2.3.1 GENERAL FUNDING**

The intention of this section is to deal solely, at this stage, with general principles relating to the financing of the activities of the Center. These principles are taken from those proposed for the African Remote Sensing Council, and may serve as a useful model. They are based both on the text of reference documents D, E, F, and G, and on the discussions between representatives of the member States during the Addis Ababa and Nairobi meetings.

1) The Governing Board shall determine the annual and other contributions, to be paid by member States and Associate Members of the Center. The regional Center should coordinate this contribution schedule with that to be developed by the African Remote Sensing Council, under Article VII of the proposed constitution.

2) The Governing Board should also perform the following functions, with the assistance of the Liaison Committee (see Section 2.4.2):

- review, direct, and control the financial activities of the Center.
- mobilize and coordinate assistance from cooperating States and organizations.

3) The Director of the Center would be its legal representative. He proposes to the Governing Board the program of activities and draft budget of the Center and submits to the Governing Board the accounts of the Center. He also submits to it proposals on the annual subscriptions due from member States, in accordance with the formula agreed upon as

well as draft rules governing the financial, administrative and other activities of the Center.

4) In addition to this machinery, the Governing Board has the ability to set up special committees to deal with particular matters relating to finance, or other issues.

### 2.3.2 SELF SUPPORT

#### General

A common characteristic of technical centers such as that proposed for Ouagadougou, is their belonging to the regional tertiary sector of community organs whose operating expenses are generally regarded by macro-economists as deriving from a system of subsidies. In the case of such agencies, the proceeds from true sales of "outputs" and services are in general marginal. Consequently, it was felt by some of the Technical Committee members that having a set criteria for self-support at the start of the project was not required, especially while the political will of the member states to establish and maintain in service the infrastructure of an African Remote Sensing Council has been confirmed by the Kinshasa resolution and can henceforth hardly be questioned, and since this support should apply to a regional center as well. As for the economic realities, the resources of the member States should, it was felt, undoubtedly make it possible to mobilize resources corresponding to the annual operating budget. Other members of the Committee felt that other sources of possible revenues should be considered. A discussion of these is presented below.

#### User Assistance

A major source of income for the Center could be contract work. This includes involvement by the Center in regional and national development projects as a contractor, able to bid on and perform projects for other agencies and organizations. It is felt by the technical committee that this is a useful and desirable activity for the Center. On the other hand, the concept of the Member States derives from the

notion that the center is a regional service organ with well defined functions. Just as a National Cartography Center neither prepares nor executes civil engineering projects, but issues an intermediate product which contributes to the realization of projects of this type, in the same way the Center will supply products corresponding to the requirements of its users, to guide them where appropriate in the choice of the products to be ordered and in their operating methods.

#### Other

Other sources of income could include non-member student fees and imagery sales. Both of these are normal means of income for similar service centers. The amount of such tariffs, and the pricing policy covering members, non-members, and amortizing of costs, has again not been detailed. Policy guidelines on this point are anticipated from the African Remote Sensing Council.

#### 2.3.3 INCOME SOURCES (A Possible Plan)

The technical committee agreed that Africanization and self support of the Center should proceed as fast as possible, with a target date of three or no more than five years (see section 4.1). They also hope that African member states will progressively take over responsibilities now partly met by the donor countries in such a way that African salaries and the operating costs be paid by the member States within five years. This will put a burden on the African nations to develop support for the Center within a short time span. Although there remain many issues to be resolved, as noted above, it will be useful to present one possible plan for developing a self-supporting Center. This is shown in Table II-1.

**TABLE II-1**

**OTHER INCOME SOURCES**

	<u>YEAR</u>	2	3	4	5	6
<b>Member Donations</b>		60,000	240,000	270,000	450,000	720,000
		(3 x 20,000)	(8 x 30,000)	(9 x 30,000)	(10 x 45,000)	(12 x 60,000)
<b>Contract Work</b>		10,000	90,000	100,000	115,000	380,000
<b>Student Fees (non-members)</b>		7,500	7,500	7,500	15,000	15,000
<b>Imagery Sales</b>		1,000	10,000	30,000	75,000	100,000
		_____	_____	_____	_____	_____
<b>TOTALS</b>		\$78,500	\$347,500	\$407,500	\$655,000	\$1,215,000

## **2.4 INTERNAL ORGANIZATION**

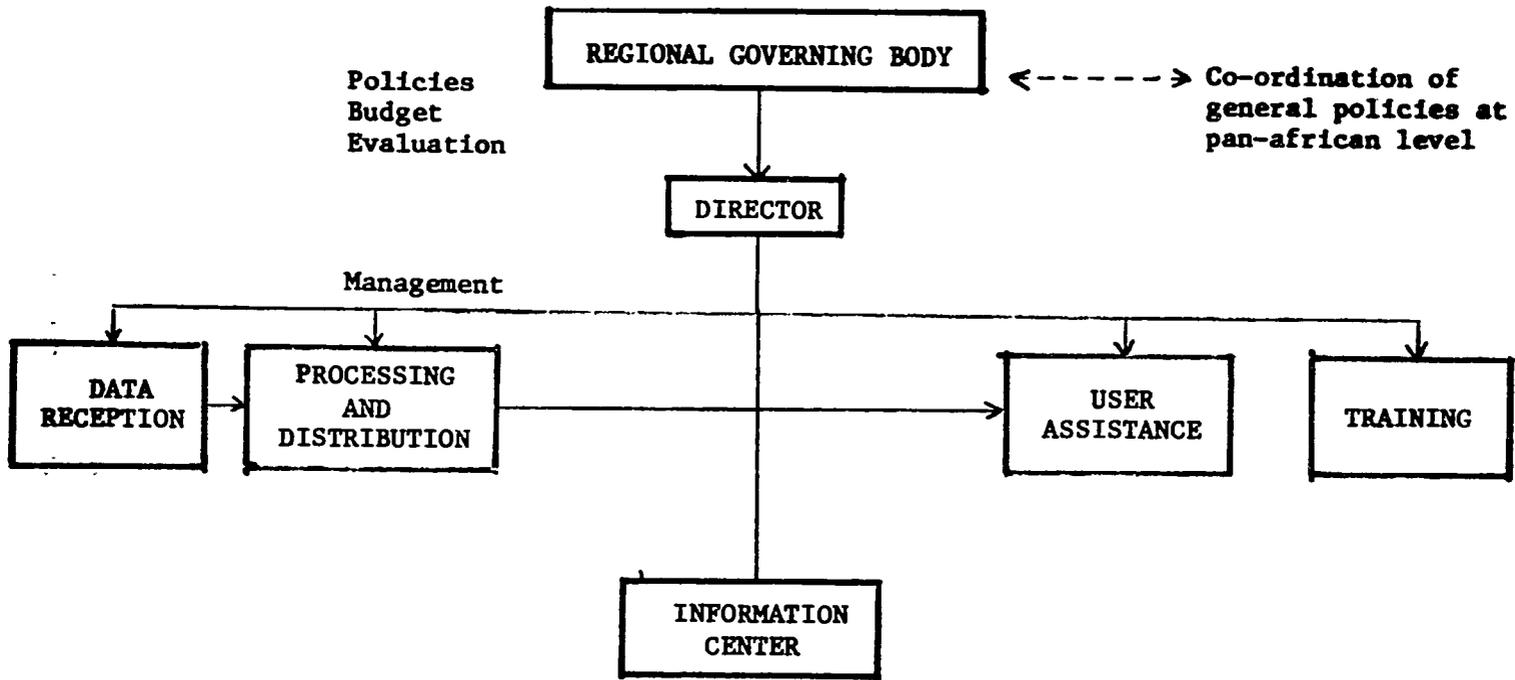
### **2.4.1 STRUCTURE**

The internal organization of the Ouagadougou Regional Remote Sensing Center will reflect its mission as a data collection and interpretation center, as well as a training and assistance facility. The Center's initial mainstay will be co-operation with development programs and research efforts throughout the region, while also serving to develop remote sensing applications.

Over time, however, as the success of the Center is recognized and its original mission is served, a need may well develop for more ambitious research activities in various application fields. Thus, the internal organization of the Center will and should change as its role in the development and resource management activities of African countries affected by the Center changes.

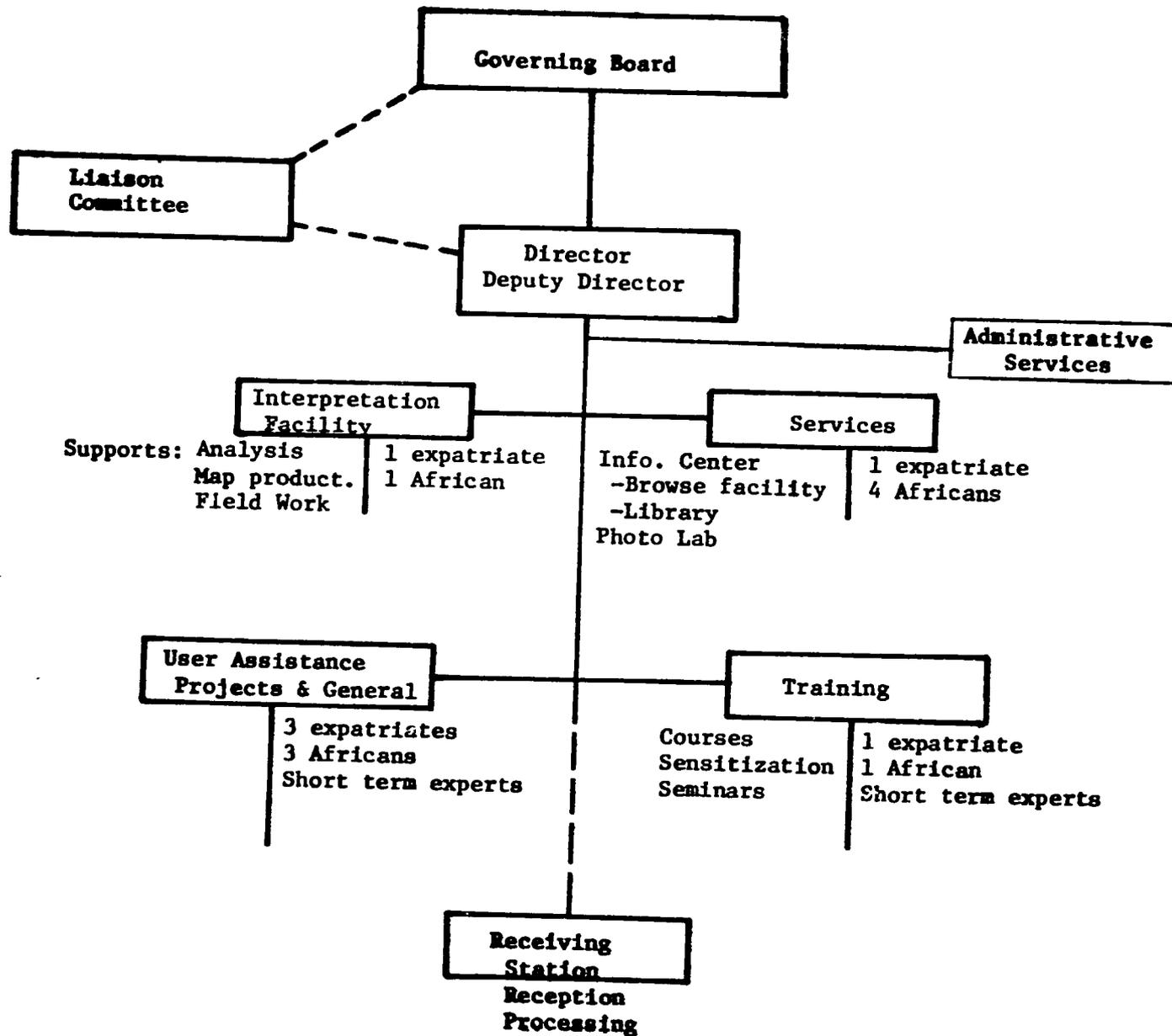
An outline of the organization of the Center is shown below (Figures 1, 2-A, 2-B). Figure 1 outlines the main functions of the Center and the sequence of operations to the end user. Figure 2-A indicates the initial structure for Phase I, which is designed to facilitate its primary goal of data dissemination, training, and applications assistance. It also represents a realistic, but modest, number of employees. The ground station (Phase II, shown in dotted lines) is anticipated to become operational around September 1979.

Figure 2-B represents a projected goal toward which the Center will progress. This long-term structure divides the Center into three main branches--the reception station, a services branch and an applications branch. This structure reflects the feeling that as the activities of the Center expand, they will logically encompass more work in both research and development of applications and larger, more ambitious applications projects. Because of the increased staffing needs, this work would be done more efficiently as a separate arm of the Center, leaving the data distribution and reproduction, the library services, and the ad hoc user assistance and visitor interaction functions to another branch.



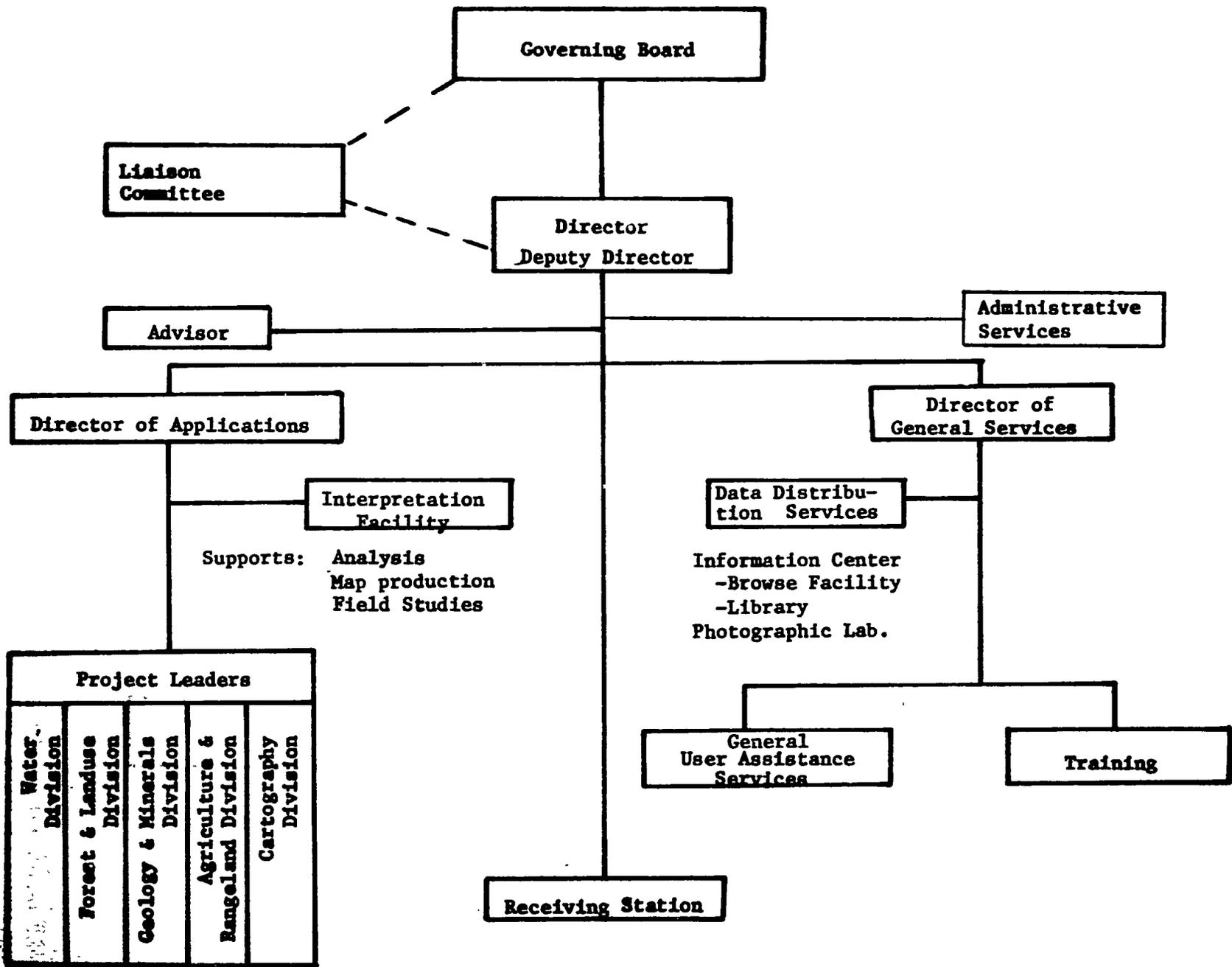
MAIN FUNCTIONS OF REGIONAL CENTER

FIGURE 1



PHASE 1 - INTERNAL STRUCTURE

FIGURE 2 A



POTENTIAL LONG TERM STRUCTURE

FIGURE 2 B

#### 2.4.2 GOVERNING RESPONSIBILITY

The Director, and the Deputy Director, will have responsibility for the management and the administration of the Center. They will supervise personnel and finances, and will represent the Center in regional and international affairs. The Governing Board<sup>1</sup> will determine policy, set goals, approve budgets, and review progress of the Center. It will also be responsible for personnel actions, upon recommendation by the Director. There will be a need for a liaison committee, on which donor countries are represented. This committee will serve as a liaison between the Center and the donor country agencies, and will consult on financial requirements and program activities of the Center. It will meet from time to time at the request of the Director or of two or more donor countries, and at least once a year.

The Governing Board will also have the power to establish such technical committees as it may deem useful to provide advice concerning the activities of the Center.

#### 2.4.3 FUNCTIONAL UNITS

The initial structure of the Ouagadougou Center shows five operating branches: data services, the interpretation facility, user assistance, training and the ground station. In reality, because the total number of technical personnel is small (initially 7 expatriates and 2-5 Africans, maximum 12 expatriates, 14 Africans) and because of the integrated nature of the projected activities, the Center will operate more as a cohesive unit. In order to demonstrate the various functions expected of the Center, however, each of these operating branches is discussed separately below, and in much greater detail in sections 3.1 through 3.6.

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<sup>1</sup> as indicated in section 2.1.3

### Data Services

The data services section will contain the necessary equipment and personnel for storage, reproduction, and dissemination of remote sensing imagery. It will include the Information Center comprised of the reference library and imagery browse file, and the photographic laboratory. The Information Center will act as a focus for outside requests concerning imagery and remote sensing information, and will also be the focal point for interaction with visitors to the Center. The photo lab will support both the training and the user assistance applications projects.

An expatriate photo technician will be necessary in the initial phase of the program. He will have one or two African assistants. It is expected that an African trained in library sciences can be found to run the archiving and reference facilities, with one assistant.

### Interpretation Facility

The function of the interpretation facility will be to support the user assistance projects and the applications oriented training program. The facility will house the necessary equipment, materials and supplies to perform simple and advanced interpretation of remote sensing imagery in photographic form. Also included will be equipment required for field studies, including a vehicle, needed in support of the remote sensing activities. It is anticipated that an image physicist with photo-interpretation background will have administrative responsibility for this facility. The image physicist will initially be an expatriate, who will train a qualified local resident to take over his responsibilities.

### User Assistance

The user assistance section will be the focal point, along with the training section, for the outreach activities of the Center in promoting actual use of remote sensing. It will consist of at least three expatriates with extensive applications experience in a field or fields pertinent to the region. Initially, these may be cartography, land use

and vegetation, water resources, and geology. These people will be expected to develop remote sensing projects with ongoing regional and national programs, and to organize and perform the necessary technical work. As the Center progresses, an African counterpart for each, coming out of the training program or with prior remote sensing experience, will be added to the staff to assist in the user assistance program, and eventually to take over its operation (see section 4.1 for a staffing schedule). In addition to the in-house staff, short-term consultants will be brought in to develop specific projects or to provide needed specialization in an application field.

The user assistance application experts will need to have both technical competence, and an ability to find and work with ongoing programs in the region. They will need to be dynamic and imaginative in envisioning the application of remote sensing capabilities, and inventive in devising and performing the interpretive and associative procedures for using the imagery under existing conditions. They must also be effective in transferring their knowledge and ideas to others.

#### Training

The training program will be three-fold: 1) conduct a sensitization program for high level officials; 2) train user agency personnel in remote sensing applications; 3) develop African personnel to staff the Center. The director of training will have overall responsibility for developing and organizing these programs. He will call upon the services of the rest of the staff at the Center for teaching assignments, materials and demonstrations. In addition, short term consultants will be brought in as visiting professors. After the initial phase, the director of training will be assisted by an African counterpart, trained in education, who will eventually assume the overall responsibilities.

#### Ground Station

The satellite data reception station will fill a major need in the region by providing timely, consistent, and continuing data from which

valuable information for national and regional development programs can be extracted. The establishment of the station at the Center however, dependent upon successful progress in the Phase I application programs, and upon the existence of an appropriate regional institution to manage this large capital commitment. In addition, studies will be performed to establish the socio-economic benefit to be expected from the station, and to define the technical details for this specific site location.

The requirements and specifications of the ground station should be completed in about six months and if the other criteria are met, it is expected that the station would become operational in mid-1979. It is estimated that the reception station will require a staff of 3 expatriates and 6 Africans.

#### Support Staff

In addition to the technical personnel, an initial support staff of about 6 Africans is anticipated. These will be secretaries (2), plus drivers, grounds and buildings maintenance personnel. Additional support staff will become necessary as the level of activity of the Center increases.

## 2.5 EVALUATION

A necessary part of any program is a means of evaluating its progress toward meeting its goal. This serves to keep the program in line with its objectives, and provides both users and donor countries with a means to justify and critically assess the success of their investment. The Ouagadougou Remote Sensing Center, because it is a new and unique venture, will be especially held up to scrutiny, and its internal review system must thus be well defined, as indicated in the sections below. The initial progress of the Center will focus on training and user assistance, followed by data reception and distribution. It is understood that satisfactory progress in establishing user assistance and training is a prerequisite for establishment of the reception facility.

The committee believes that an in-depth evaluation, including some experts not associated with the Center, should take place at least once every two years. This evaluation should cover technical, organizational and financial aspects of the program. The terms of reference for such an evaluation should be prepared by the Director of the Center and the Deputy Director in consultation with the liaison committee. The technical committee recommends that the first in-depth evaluation take place prior to the end of Phase I.

### 2.5.1 GOVERNING BOARD REVIEWS

The Governing Board of the Regional Center will have primary responsibility for establishing criteria for evaluation of its progress. It will be assisted by the liaison committee and such technical committees which the Governing Board establishes. The board will review the activities of the Center on a regular basis, by discussion with the Director and a formal review process. This process, which should take place once every six months during the first two years and at least once a year after that, will include a presentation on each of the user assistance projects, the training courses and general level of activity of the Center, the operating and capital budget and means of financing,

and also the progress toward Africanization. These reviews will serve to identify for the Board the level and type of activities underway, and whether these activities meet the goals and needs established for the Center and identified by the user nations. Recommendations and policy decisions aimed at meeting the program goals should be passed on to the Director and Deputy Director after each review session.

#### 2.5.2 USER ASSISTANCE PROJECTS

The user assistance programs will often provide an evaluation of themselves by virtue of the success or lack of success of the cooperative projects. Another criterion for evaluation will be the incorporation of remote sensing as a normal tool in the activities of many of the user agencies, both national and regional. These indicators will be monitored by the Center personnel through their contacts with the user agencies, and at a policy level by reports to the Governing Board from the member states. In addition, user agencies with which the Center cooperates will be requested, as part of their project, to submit an evaluation of the assistance which was offered, the benefits which accrued from the use of remote sensing, and any long term utilization of the technology which they envision. These evaluations will serve as a useful guide and critique for reviewing the activities of the Regional Center.

#### 2.5.3 TRAINING

The director of training will report on the success of the regular courses, the sensitization activities, and any special workshops or seminars which may be held. The major evaluation criterion for the training courses will be the number of students successfully completing the program of instruction. In addition, it is recommended that a regular policy be initiated which would follow-up with each student to see whether the remote sensing training is being incorporated into the student's normal activities, or is proving useful in other ways. The follow-up might be done by visits, or by reassembling a class for a one- or two-day evaluation workshop six months to a year afterwards. This type of follow-up will provide for a critical assessment of the type of

training being offered and its relevance to the regional situation. In addition to the review of the formal training, the success of the sensitization training for government officials will be evaluated. Increased awareness of the technology will probably best be indicated by the level of participation which the member states exhibit in the activities of the Center, and by their utilization of remote sensing in approaching national needs.

## 2.6 PROJECT IMPLEMENTATION

### 2.6.1 SCHEDULE

A project implementation schedule is shown in Figure 3. This schedule reflects the current anticipated timing of events, based upon donor funding schedules, and activities agreed upon by the Technical Committee. Section 4.1 shows the concurrent staff increases.

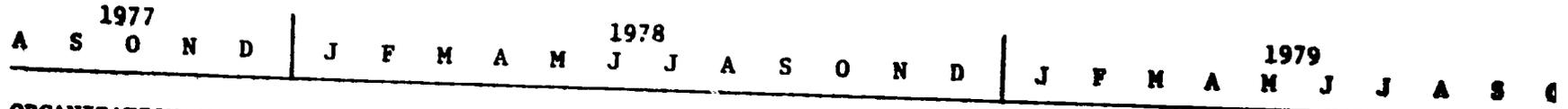
### 2.6.2 CRITICAL EVENTS

The critical events in the launching of the Ouagadougou Center are the establishment of a legal and financial entity by Upper Volta to host the Center and the appointment of a Director; the approval of funding by the donor governments; and the coincident signing of project agreements between the Upper Volta and the donors. The existence of an institution which can act as the legal and administrative entity for the Center is a prerequisite to the donor commitments and project agreements. This was made clear at the Ann Arbor meeting of the Technical Committee, and the representatives from Upper Volta were tasked to develop the necessary legal and administrative arrangements for this institution as rapidly as possible.

Meeting the donor country timetables for project approval and funding is also a critical issue. The situation is most pressed in the case of the French and the U. S. commitments. If the deadlines for submitting the necessary project documentation are missed, no funds or only interim funds may be available to the project in 1977. This would delay the implementation of the Program until 1978. Such a delay would also affect the schedule for installation of the reception station, since commitment is dependent upon reviews which indicate successful progress in establishing active use of existing data in the region.

FIGURE 3

SCHEDULE



ORGANIZATION AND FUNDING

- ▲ Final report of technical committee
- ▲ Funding agreements between Upper Volta and Donors
- ▲ Establishment of legal entity
- ▲ Interim Director appointed
- ▲ African Remote Sensing Council established
- ▲ Technical Committee Reviews
- ▲ Governing board established

CENTER ACTIVITIES

- ▲ Arrival of initial staff
  - ▲ Notification/Sensitization
  - ▲ Equipment procurement
  - ▲ Photo-lab construction
  - ▲ Demonstration/user assistance projects
  - ▲ Training courses
- ▲ Decision on ground station
- ▲ Procurement of ground station
- ▲ Start of building construction
- ▲ Ground station delivery▲

## TECHNICAL DESCRIPTIONS

The following technical sections provide a description of the operations and capabilities to be established at the Ouadagougou Center, including a summary budget of the initial and operating costs. Each section is also backed up by an appendix which provides a detailed listing of the equipment, materials, and supplies.

### 3.1 INFORMATION CENTER

The section identifies the materials, resources and procedures necessary to operate the Information Center of the Ouagadougou Regional Remote Sensing Center. The Information Center is comprised of a browse facility and a reference library. It will serve as the focal point for external users and visitors to the Center and provide support for the training and user assistance programs.

#### 3.1.1 THE BROWSE FACILITY

##### Goal

To allow a user to quickly scan imagery of a particular area to determine which frames should be acquired and studied in detail. User aids should be prepared to facilitate access to the browse films. One approach would be to prepare a large (perhaps 3m x 3m) wall map of the area served by the Facility, with the Landsat pass and row lines marked. Each image could then be marked with the proper coordinates. A visitor of any nationality could use this map, identify the area of interest and its coordinates, then go to the catalog to obtain the reel number and finally examine the images. Aids should provide graphic as opposed to verbal explanation of the search process.

##### Materials

16mm microfilm of Landsat imagery created especially for a browse file will be utilized. The EROS Data Center in the U. S. issues two such series of microfilm: U. S. and non-U. S. Since it is not possible

to receive only "selected" geographical areas, the entire non-U. S. microfilm series will be required. The microfilm contains both a band 2 (RBV) and band 5 (MSS) image for each scene. These are system corrected images and contain the image identifier and full annotation block. The microfilm is issued about once a month and directly correlates with the Standard Catalog, which is used to identify and locate the imagery by either (1) observation ID number or, (2) latitude and longitude.

### 3.1.2 THE REFERENCE LIBRARY

#### Goal

To provide access to information on remote sensing with particular emphasis on applications. The library will be co-located with the browse facility.

#### Materials

The materials housed in the Reference Library will of necessity be limited to the field of remote sensing and past and potential applications. It will not have comprehensive materials in the basic scientific fields in which remote sensing is applied (such as hydrology, geology, etc.).

The type of materials to be found are:

1. Reports (on microfiche)
2. Monographs
3. Journals (back issues on microfilm or fiche)
4. Conference proceedings
5. Pamphlets, brochures, etc.
6. Maps
7. Reference materials (dictionaries, thesauri, etc.)

### 3.1.3 GENERAL REQUIREMENTS

#### Organization

A wide variety of methods for information retrieval are generally available. A conventional index card system seems the most appropriate at this point. It requires a typewriter, a photocopying machine capable of printing card stock and paper cutter. At a later time, if another

system is required, the cards will still provide all the bibliographic information that any other system would require for input.

#### Reference Language

It is generally the case that descriptive cataloging (author, title, publisher, etc.) is done in the language of the document. Two key word catalogs will be established, one for documents in English and one for documents in French. Key words would have to be prepared in both languages for all documents if a unified catalog is required. This would require a fair amount of translation. An English-French, French-English guide to key words will, however, be provided. Total translation of bibliographic citations (either French-English or English-French) will probably not be economically feasible.

#### Personnel

Since the Library is to play a key role in the operation of the Remote Sensing Center the services of a professional librarian should be obtained. (A professional librarian holds a Master of Arts in Library Science.) A professional librarian is trained in collection development, information retrieval techniques, and is aware of pathways to international cooperation. If a librarian is not hired, another staff member would need to become very familiar with the collection and be free to assist users when needed. During the initial years, also, close cooperation with the existing library at C.I.E.H. will also be developed.

Facility users will come from diverse backgrounds and abilities. The facility must attempt to provide answers for a potpourri of these users' problems and the librarian must be able to interpret varied inquiries and then tap the relevant part of the collection. The librarian will also be in an excellent position to initiate cooperation and communication between the other libraries in the region, which should be of long-term benefit to the Center and its patrons.

### Location

The Reference Library and Browsing Area should be easily accessible, preferably near the entrance to the building. It should not be located near a source of heat or moisture production (the boiler room, etc.). The area of the CNES facility formerly used as a cafeteria and lounge is envisioned as the location of the Information Center (see Figure 5, section 4.2).

#### 3.1.4 COST SUMMARY

The initial cost for furnishing and stocking the Information Center is \$43,109. This includes \$23,859 for equipment and furniture, \$2,880 for microfilm imagery, and \$2,000 for books, journals and other reference library materials. Also included is 50% for shipping and checkout, and 15% of equipment costs for spares and maintenance. A detailed listing is provided in appendix III, part 3.1.

### 3.2 IMAGE INTERPRETATION FACILITY

This section presents recommendations for the design, instrumentation, and operation of a basic remote sensing image interpretation facility. The function of the facility will be twofold: (1) it will handle the interpretation of imagery, collection of ground data, and other support for the Center's own programs and user assistance projects, and (2) it will provide support for the training program and for visiting scientists.

To meet these objectives, the image interpretation facility must have the equipment and supplies:

- to provide users with professional assistance in obtaining and applying remotely sensed data.
- to evaluate the use of remotely sensed data to solve local resources allocation/management problems.
- to support the establishment and execution of demonstration projects which employ remotely sensed data in solving resource development and environmental problems.
- to support the proposed training courses each year.

#### 3.2.1 CRITERIA

Several criteria were used in the development of facility specifications. Of these, the single most important criterion was that visual image interpretation techniques would serve as the backbone of the Center's remote sensing data analysis capabilities, at least during the initial years of the Center. Experience in other developing countries, and in the U. S. as well, has shown that visual image interpretation can provide highly significant and reliable resource information, in both a cost effective and timely manner. In many instances, in fact, such interpretation has proven not only equal to but technically superior to current computer analysis capabilities. On the other hand, computer analysis can be used to extract some kinds of information from the imagery which cannot be done manually. In a region like the Sahel,

however, the basic resource information vital to development programs can for the most part be effectively obtained by manual interpretation of remote sensing imagery. It is anticipated that as the Center progresses and the data requirements of the user community become more sophisticated, a need for computer analysis and image processing capabilities will emerge. Funds to begin the investigation and use of computer processing are thus provided.

A related consideration was that the equipment selected should be of the type that can be operated by users with a limited amount of training or experience with the technology. This will promote earlier acceptance of these techniques by the national user agencies within the region.

Another important criterion was that the basic image that will be analyzed at the Center is Landsat data. Consequently, although the Center will have equipment to handle basic photo-interpretation, emphasis has not been placed on having all the possible aerial photo-interpretation capabilities. However, if a need for special air photo analysis capabilities is demonstrated during the first years of operation, such expenditures can be accommodated within the budget allocation for expanded capability.

In addition to the above criteria, it was assumed that wherever possible a given piece of equipment should be capable of supporting dual functions, i. e., being useful for both training and in user assistance projects.

At the end of each year of the Center's operation, records of use-load on each piece of equipment should be examined to determine whether it is essential, superfluous, or only marginally useful. If, on the basis of these records, it becomes obvious that an addition of certain types of equipment would greatly improve efficiency, it should be recommended for acquisition. Furthermore, if the need for an analysis capability is discovered that has not already been provided for, it too, should be

added as soon as possible. A major possibility in this latter regard would be to increase the amount of interpretation equipment that is designed specifically for the analysis of aerial photos, e.g., stereoscopic viewing and contour mapping devices.

### 3.2.2 SPACE REQUIREMENTS

The former operations room and adjacent rooms should be sufficient (see figure 7, section 4.2) for the image interpretation lab, imagery files and, temporarily, a small classroom or conference room. Additional space may be added in the future, as the laboratory acquires more equipment and/or a bigger user-load. It is also anticipated that the existing maintenance area will be used for maintenance of the receiving station, halting its interim use for image analysis.

Further, once Landsat data becomes available from local sources, the increased image storage requirements will necessitate the establishment of full-fledged archives.

### 3.2.3 DESCRIPTION

The program support functions of the image interpretation facility can be divided into three sub-areas, image analysis, training, and field reconnaissance. Each is described more fully in the following subsections.

#### A) Image Analysis

The function of the image analysis laboratory will be to provide interpretation and cartographic capabilities, and to provide a repository for the imagery. An important feature of the laboratory's data reduction potential is a basic cartographic capability. Most users will want a map as their final product and it is essential to provide them with something that is both attractive and accurate.

In operation it is expected that the lab will consume large quantities of supplies. An inventory system that permits keeping track

of the rate and amount of expendable items used will provide a valuable aid to planning for future needs and indicating when reordering is necessary.

The basic elements of operation and equipment associated with each component are described below.

**Image Viewing:** This includes direct observation of both prints and transparencies by individuals and small groups.

**Image Enhancing:** A density slicer is included as a first year capability.

**Mensuration:** The tools necessary to make the following types of measurements are included: lineal, areal, and relief (on air photos).

**Detail Transfer Equipment:** This includes the capabilities of transferring detail from images to map bases and changing scales.

**Imagery:** 9 in x 9 in Landsat data.

#### B) Training Support

The training program has three major budgetary elements that are considered here: the classroom, the audio-visual equipment, and the individual photo-interpreter kits that each visiting scientist will be furnished. 35 mm slide production and graphics production has been budgeted under the Photographic Laboratory Facility. The training program itself is covered in section 3.4 of this report.

The classroom (see section 4.2.3 and 4.2.4) will function as a common meeting area for the instruction staff of the Center and visiting scientists where technical material will be discussed and practical exercises conducted. Further, locating the classroom close to the imagery interpretation lab will facilitate demonstration of more advanced forms of image analysis and provide the students with the opportunity to use the equipment on a non-interference basis. When courses are not in session, the classroom will serve as additional work space for image analysis.

The audio-visual equipment can be used for the presentation of both commercial and in-house produced training material. High quality equipment is specified in all cases. Three basic media are emphasized: slides, movies, and overhead projectors.

The photo-interpretation kits are designed to include all the tools necessary to teach someone the fundamentals of remote sensing image interpretation. It is possible that the center may wish to give each student his kit (minus the portable light table) at the conclusion of a training course so that it could be used by his agency. Each complete kit costs \$144. Without the light table, it is worth \$74. Thus, giving each student a kit minus the light table would require an additional outlay of \$4,440 per year, counting 60 students, instead of just the one-time cost of \$2,160 for 15 permanent kits.

#### C) Field Reconnaissance

The function of the Center is to aid users within the region in the execution of high-visibility/user payoff resource development or management projects utilizing remotely sensed data. To do this a basic set of equipment is needed to make the type of environmental measurements needed to calibrate remote sensing data. It also requires a means of recording all this data and the logistical support required for the data collection team while it is in the field. The field support effort has been developed for a 4-person crew and is divided into three basic categories: ground data collection instrumentation, records, survey and ground photographic equipment, and logistical support.

#### 3.2.4 COST SUMMARY

The cost of the image interpretation facility is \$348,031. Of this total, \$178,681 is for capital equipment and furnishings, \$12,668 for supplies and operating expenses, \$24,750 for imagery and \$5,000 for aircraft rental in support of ground surveys. (A detailed listing is given in Appendix III, part 3.2). To these is added 50 percent of equipment and imagery, for shipping and checkout, \$101,716 and 15 percent of equipment for

spares and maintenance, \$25,216. An additional \$20,000 is also allocated for investigation and contracting of computer processing of satellite data. Additional imagery acquisition is scoped at \$9,000 for year 2. Operating costs for years 2-5 should remain about the same as above.

### **3.3 PHOTOGRAPHIC LABORATORY**

The photographic laboratory will serve a vital support role to the rest of the Center. It is required to produce working copies of the images used in interpretation, prepare training materials and displays, and develop ground truth photography. The photo lab, because it is a key to the success of the overall programs, has been scoped to provide the proper mix of black and white, and color processing capabilities to match the expected needs of the Center, while retaining the level of technology capable of easy maintenance and operation.

#### **3.3.1 CRITERIA**

The prime medium of Landsat imagery will be 9 in. x 9 in. black and white negatives. The photo lab will have the capability to make from these negatives:

- black and white enlargements up to 40 inches,
- black and white contact prints,
- transparencies, 9 in. x 9 in. and smaller,
- color composites from diazo.

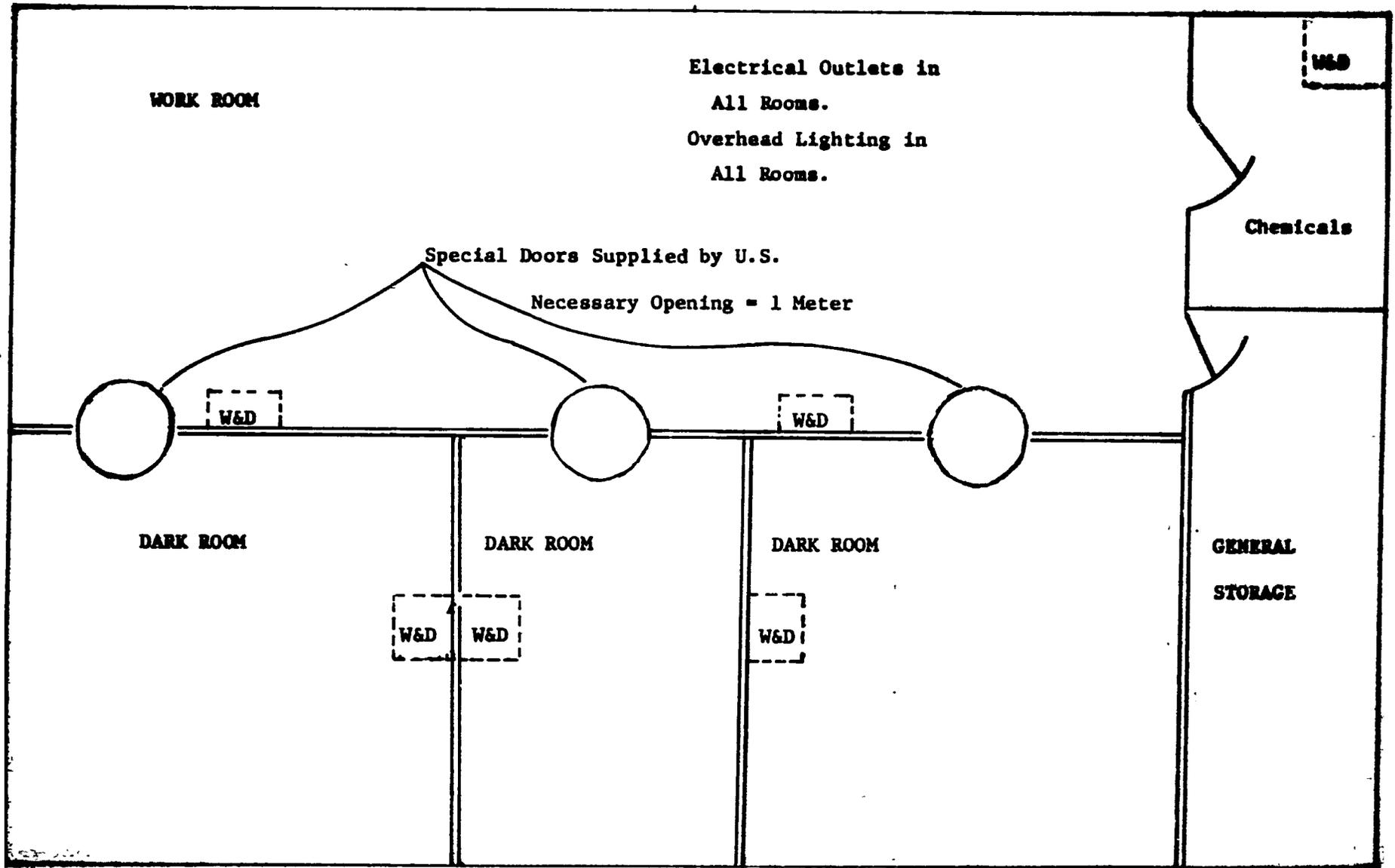
In addition, the facility will have the capability to process color film up to 4 in. x 5 in. and prepare color prints up to 9 in. x 9 in.. It will also have a copy camera for producing visual aids.

#### **3.3.2 INFRASTRUCTURE**

The complete photo lab requires an area of about 14.3 x 9 meters (see figure 4). Since this space is not available in the central building, it is proposed that either a new building be constructed or the out-building which CNES used for power generation be converted into a photo laboratory. The government of Upper Volta is preparing an initial engineering cost estimate and feasibility report for these options. An estimated cost for a new building is included in this report. The U. S. plans to include this cost in its first year funding.

FIGURE 4

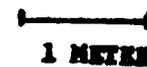
PHOTOGRAPHIC LABORATORY ~130m<sup>2</sup>



Water = Hot & Cold

W & D = Water & Drain

SCALE



In the interim, a minimum photo lab can be housed in the existing dark room. Obviously, this will restrict its capabilities, probably to simple black and white reproduction. However, this interim facility will allow projects to begin immediately, and should not impede the progress of the Center.

### 3.3.3 COST SUMMARY

A detailed listing and estimated cost of the photographic equipment is given in appendix III, part 3.3. The initial equipment costs are estimated to be \$42,000. To this must be added 35 percent shipping and check-out, \$21,700. The annual costs for materials and supplies would be approximately \$12,000, and 15 percent for maintenance, \$6,300.

### **3.4 TRAINING**

A major function of the Regional Remote Sensing Center will be to provide training in remote sensing applications to interested personnel from government agencies, universities, and regional institutions throughout the area covered by the Ouagadougou station. This training will be in the form of both formal classroom lectures and practical on-the-job experience. Also included will be a complementary program aimed at sensitization of upper-level managers and administrators in the potentials and promises of remote sensing technology.

Training courses will cover basic theories of remote sensing, and applications in various fields including hydrology, forestry, range management, geology, cartography, etc. Emphasis will, of course, be on those areas of greatest utility to the concerned countries, especially problems of the Sahel. The courses will be taught by experts in a specific field, brought in for this purpose, as well as by the applications experts located at the Center. Courses in both English and French will be offered with initial courses in French. The entire program will be coordinated and managed by the training officer.

Four types of training programs will be organized:

- 1) Sensitization: approximately one week duration, several times per year;
- 2) Short program: one to three months, two per year at set dates, except during the first year. (Early November or to coincide with the university year);
- 3) Long program: five months (a short program plus two months of individual work which can be extended to three or four months for training technicians);
- 4) On-project training: Long program plus 10 to 24 months training on a Center project under the guidance of the Head of the Project.

A summary of the anticipated number of trainees is given in Table III-1.

TABLE III-1  
MAXIMUM (AND EXPECTED) NUMBER OF TRAINEES

	Phase I		Phase 2	
	Per Program	Per Year	Per Program	Per Year
Sensitization	30 (10)	90 (20)	30 (19)	90 (45)
Short Program	(6)	(6)	12 (10)	24 (20)
Long Program	12 (6)	12 (6)	12 (10)	24 (20)
On-project training	5 (5)	5 (5)	5 to 8	5 to 8

During Phase 2 there will have to be two short programs per year.

Conditions for admission

- 1) Sensitization: all levels,
- 2) Short program: at least minimum bachelor's degree, advanced degree preferred,
- 3) Long program: same as for short program,
- 4) On-project training: minimum advanced university degree with at least two years experience.

3.4.1 SENSITIZATION

An initial series of sensitization seminars will be held in the countries served by the Center. The sensitization program is a means by which high level managers and administrators in the African nations can be made aware of and become interested in the utilization of remote sensing technology. Continuing interest at a policy level is critical to the successful institutionalization of the technology in the activities of the user agencies, and the sensitization program is designed to keep the African governments, which have already evidenced a great interest in remote sensing, abreast of the uses which are being made of the technology. It will also serve to develop specific interest in remote

sensing among key administrators, thus facilitating a dialogue between managers and technical personnel who attend the training course or participate in user assistance projects.

These seminars are thus designed mainly for senior administrative officers and heads of technical sections (geology, civil engineering, agriculture, etc.). The purpose is to make these officers aware of the potential use of remote sensing in their area of activity. During these seminars special emphasis will be placed on complementary aircraft operations (aerial photos, infrared sensing, etc.) when appropriate. Seminars can accommodate up to 30 trainees and will usually take the form of audio-visual presentations and round table discussions.

Each sensitization program will be developed and carried out by the personnel of the Center. It is envisioned to consist of individual visits with various ministers, followed by a two to three day seminar at each location. A brief overview of remote sensing benefits and possible applications will be given, progressing into more detailed applications discussions. Examples from the specific country or region will be used where possible and emphasis will be on visual presentation of uses and results. The final half day would be used to develop personal contacts with users in each country to define possible user assistance projects for the Center. These seminars will be conducted in the participating countries during Phase I of the Center. An estimated eight weeks will be needed to visit eight to ten nations. Estimated costs for the sensitization program are given in Table III-2.

**TABLE III-2**  
**SENSITIZATION VISITS BUDGET**

**Personnel**

Three staff members of Center (salaries covered) per diem \$40/day x 7 days x 8 weeks x 3.	\$7,000 (covered in salaries and travel)
--	---

**Travel**

Between one country to another (average \$160 one way) x 8 x 3	3,840 (covered in salaries and travel)
---	---

**Equipment**

Two slide projectors and spare parts	500 (covered in 3.2)
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**Supplies**

Slides and display preparations	1,000 (covered in 3.2)
Brochures and handouts	2,000

<b>TOTAL</b>	<b>\$14,340</b>
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It is expected that other seminars will be held throughout the life of the Center, both at the Center and in the participating countries.

Two types of seminars are envisioned:

- general introduction to remote sensing,
- specialized applications problems.

**3.4.2 SHORT PROGRAM**

The Short Program is designed to provide heads of technical sections with theoretical knowledge and a full overview of remote sensing application during a period of time that does not disturb their operations.

This is an intensive program limited to a maximum of 12 trainees each. A modular series of lessons will be used to teach techniques and applications. These modular series could also be used for the sensitization seminars. One-third of the program will be carried out by the training director, one-third by the Center project heads and one-third by visiting experts.

The formal training program will provide a firm background in remote sensing theory and use to a number of user scientists each year. It will also provide more specialized training to a small number of students (long term training).

The initial portion of the training program will consist of a four to six week course session at the Center for the 12 students. These sessions will initially be held twice a year and each will probably be focused toward one or two specific application fields (i.e., geology and cartography). They will include classroom lectures on principles of remote sensing, and practical exercises by the students ('hands-on') at the Center's analysis facility.

The estimated costs per student for training supplies is given in Table III-3.

TABLE III-3  
TRAINING SUPPLIES

15 images x \$10 each	\$150
Mylar, pencils, etc.	30
Workbook and syllabus	20
5 maps x \$5 each	25
Reprints (100 pages)	100
	<hr/>
	\$325 per student

\$325 x 12 students a \$3,900/session.

#### 3.4.3 LONG PROGRAM

The theoretical part corresponds to the short program to which three months of supervised practical exercises will be added. The program aims to make operational personnel familiar with theory and practice. Concurrently training will be provided on supervising remote sensing projects.

These trainees will be asked, whenever possible, to bring with them problems faced by their home organizations.

#### 3.4.4 ON-PROJECT TRAINING (see Table III-1)

On-project training is intended for advanced remote sensing engineers vis.

- section heads slated to replace expatriates in the Center within a period of two to five years,
- their assistants,
- heads of national remote sensing sections from countries within the region who will be the Center's contacts in their home countries,
- heads of remote sensing sections in other organizations.

Students will be encouraged to remain for this longer term training. Certain training will consist of on-the-job applications work under the supervision of the Center's applications experts. Specialized techniques or equipment use will be taught at the Center, but the work itself may be performed elsewhere, if the project chosen is not located near Ouagadougou. The 'apprenticeship' period may last several months, with short intervals being spent at the Center to learn special skills, or carry out special analysis, and the rest spent working on the project. In some cases, also, special training might be provided overseas, or at other regional centers in Africa.

The period of time which a trainee spends learning on the project will depend:

- on the type of project and its scientific sophistication,
- the trainee's aptitude and his future assignment (all the trainees in Phase I will not necessarily be qualified to become section heads in the Center). The long program will provide the theoretical background. On-project training could last between one and two years.

At the completion of the long-term training, the students would be expected to return to their appropriate agency and be able to initiate remote sensing programs, develop applications to ongoing projects, and

pass along their skills to others working with them. A certificate of expertise in advanced remote sensing applications would be awarded to those successfully completing the course of study.

#### 3.4.5 EDUCATIONAL EXPENSES

The following considerations are based on the system applied between 1970 and 1977 in the Ile-Ife Center, one of the organs of technical training set up for a group of African countries; it operates under the auspices of ECA.

In principle, the participants in the activities of the training Center are sponsored by the Member States and Associate Members; they will be responsible for acquiring skills in analysis based on remote sensing, relating to well defined problems and falling within the framework of the operational responsibilities of the agencies to which they are attached.

The expenditures relating to training activities constitute an integral part of the operational costs of the Center. Since these costs will be spread among member states, trainees from member states are not required to pay a tuition fee. Nevertheless, certain connected expenses corresponding, for example, to services of local agencies made available to the Center, may be regarded as recoverable: they might include, for example, food and housing costs, individual insurance, costs of registration in student organizations, and certain personal allowances to the participants. In general, the Center pays these costs directly and claims a debit from the agencies responsible for the participants.

It is possible, for example, to start from the following plan as far as these related costs are concerned:

a) The housing costs are those applicable to the Interstate School for Rural Engineering and Development (EIER) or in student housing in the University (see section 4.1.3 for further discussion).

b) The fees and expenses received (as appropriate) by the University for Center participation in courses given by the academic staff are equal to those of Upper Volta students.

c) The sums to be placed in a security deposit against laboratory and library equipment, will be equal to those required from Upper Volta students.

d) The fees to be paid to student bodies will be the same as those paid by University students.

#### 3.4.6 TRAINING OF CENTER PERSONNEL

There will be a distinct need for advanced training of African experts to assume various posts at the Center within the anticipated three to five year Africanization schedule. These people will be experts in their various scientific fields. A selection committee composed of the Director and the project heads will select appropriate candidates. When the candidates are considered capable of assuming the responsibilities of the section at the Center, they will receive a salary offer.

In order for them to learn certain specialities, and for them to obtain the broad background and experience which should be a prerequisite to their becoming the Center's expert in a given area, some training and practical experience overseas in various centers of remote sensing expertise will be highly desirable. Planning for such training should commence as soon as an individual is nominated to the Center staff, and his long term commitment to the Center is assured. The form which such training takes will vary, depending on the individual circumstances; the technicians to run the reception station will probably be given several months of intensive training in the donor country; the application scientists may attend several symposia on the topic, attend a leading university for a semester and/or work at a research institute. The training director and the appropriate expatriate expert will develop these programs of study based upon each individual's needs. The goal

will be to develop the individual so that he can assume the responsibility at the Center for project leadership, user assistance interaction, and teaching in his field of expertise.

#### 3.4.7 RESPONSIBILITIES

The training officer will be responsible for:

- designing the various training programs,
- assisting in publicizing the Center's training activities broadly,
- teaching the general sections of the training programs,
- carrying out the practical training elements of the long programs in conjunction with the project heads,
- bringing together the visiting experts who come to teach special subjects,
- constantly maintaining contact with the on-project trainees, together with the project heads.

The role of the project heads (expatriate experts during Phase I) in the training program will be to prepare a course on the application of remote sensing in his special field. He will organize practical exercises around the demonstration projects and will supervise the individual work of the trainees.

#### 3.4.8 MATERIALS

The equipment and facilities required for the formal training program are included in section 3.2 and appendices, since they represent a common resource for interpretation, teaching and use assistance.

#### 3.4.9 ORGANIZATION OF PROGRAMS DURING PHASE I

The beginning date for the first program will depend on the speed with which the Center begins its operations and the number of trainees that can be recruited. It seems reasonable to expect the program to begin around January 1, 1978. The date will ultimately be set by the Director of the Center. The normal schedule of programs will start towards the end of 1978.

Similarly, the training officer will be responsible for assisting in organizing the initial sensitization sessions in the various concerned countries, as soon as is practical.

### 3.5 USER ASSISTANCE

The benefits which can be expected from remote sensing will not accrue until interpretation of the imagery has occurred and the results are incorporated in specific projects, such as general resource inventories.

The user assistance section of the Ouagadougou Center is designed to seek out and assist potential users of remote sensing in integrating the capabilities and assets of this new technology into planned and on-going resource management projects in countries concerned by the station. It will do this by offering expert consultation and providing technical services while working closely with project personnel. A goal will be to demonstrate the successful use of remote sensing in a wide variety of natural resource programs, and thus to foster its adoption whenever applicable. Obviously, the limited staff of the Center necessitates the selection of just a few major programs on which to focus each year. Initial projects will be identified during the sensitization programs. Many smaller programs and assistance and guidance to visitors on an ad-hoc basis will also be actively pursued, and will be a major factor as well in spreading knowledge about remote sensing to a wide audience.

#### 3.5.1 TYPES OF ASSISTANCE

The assistance that the Center should be able to provide upon the request of the users can be divided into five main categories, based upon the time period required or by type of service.

1. Advisory role (between a few hours and a few days):
  - choose the most appropriate images,
  - recommend standard interpretation techniques for various applications.

2. Lending and providing assistance in the use of specialized equipment located at the Center.

After providing instructions on the use of equipment, some supervision should be provided at all times to ensure that the equipment is used properly and also to point out methodological errors which could alter the quality of the results and hence lower users' impressions of the Center.

3. Assistance in the implementation of non-Center remote sensing projects through expert assistance at the Center or in the country concerned.

4. Assistance in the design of complete remote sensing projects (choice of imagery, dates of acquisition, interpretation methods, types of results).

5. Operational programs including interpretation, field work and the preparation of results. This all important option should serve, during the initial years, to provide, without delay, information to countries and organizations within the region who do not have trained, operational specialists and, at a later date, to provide such information to countries and organizations that do not wish to set up their own remote sensing services.

#### 3.5.2 PROGRAM SELECTION

The assistance programs which will be pursued at any one time will have to meet several criteria in order to further the goals of the Center. Some of these criteria, especially during the initial phase, would be:

- high visibility to the user community
- regional application of the results
- high probability of successful use of remote sensing
- can be completed in a short amount of time
- broad transferability of the results
- provides a base for on-the-job training of students
- is within the capabilities of the Center
- is important to the development of the affected country or region.

Each potential project which might be assisted by the Center would be weighed according to these criteria. Obviously, projects where a successful result will be quickly disseminated to other users would be favored, since nothing develops enthusiasm like success. Projects of a regional nature, where several nations may be involved, would also be preferred, since they would expose a wider audience to the technology in use. Of course, a major constraint will be the level of assistance

required to achieve a successful result. The limited manpower and funds available at the Center will necessitate a wise selection between potential assistance programs.

The method for selecting and developing user assistance programs will vary. It was agreed that an initial request for potential projects be sent out to all of the cooperating nations, under the auspices of the host government, Upper Volta. Proposed projects would be reviewed by the Director and the staff in order to choose the most suitable ones. It was the consensus of the Technical Committee that initial emphasis should be on the Sahel region. As the Center develops and establishes itself, it is expected that the project leaders will have developed contacts with pertinent user agencies throughout the region, and thus be able to identify candidate assistance programs as they arise.

### 3.5.3 TECHNICAL COOPERATION

Any user assistance program developed by the regional Center will be a cooperative effort between the Center and the user agency. In general, the use of remote sensing will be only a part of the overall agency project, and it will be incumbent upon the agency to incorporate the capabilities or data supplied by remote sensing into the overall framework. It is anticipated that for each project a simple agreement or memo of understanding with the lead project agency will be developed which describes both its responsibilities and the services to be provided by the Center.

As pointed out above, the user agency must cooperate closely in any assistance program. It will be expected to make available the time of the necessary technical staff, both for learning remote sensing skills and for performing interpretation. Attendance at training sessions would be encouraged, although not all personnel working on a project will be formal students. In the major assistance programs, it is anticipated that the agency being assisted will also provide other types of in-kind contributions, such as travel for field work, work space, ancillary data

collection, etc., as appropriate. As noted in section 2.5, the cooperating agency would also be expected to provide a periodic evaluation of the progress of the assistance program.

#### 3.5.4 DEMONSTRATION PROJECTS

During Phase I substantial work will be done in demonstrating the possibilities of using remote sensing in vital fields such as mining geology, agro-pedology and agrostology, cartography and topography, general inventory making, etc.

Accompanying demonstrations on the usefulness of this new technology, application exercises will assist users from outside the Center in solving difficult problems concerning specialized materials and methods and also provide accelerated on-project training for Africans to take over from expatriate engineers and the heads of the technical sections (geology, agriculture, etc.).

#### 3.5.5 OTHER USER ASSISTANCE FUNCTIONS

Besides the several major assistance programs, the user assistance center will provide technical guidance and advice to many other projects on an ad hoc basis. It will seek to be responsive to the needs of its African clientele, including unanticipated requests arising out of emergencies, etc. The Center itself will be open to project personnel and individuals who wish to learn more about remote sensing. Consultations on potential uses of the imagery, interpretation techniques and other questions will be available. Reasonable requests for data will also be accommodated provided that a positive end-use of the imagery can be demonstrated. This type of capability to respond to the needs of potential users has proven to be very successful in other remote sensing centers.

#### 3.5.6 TECHNICAL ASPECTS OF USER ASSISTANCE

1) Installation: Users must be well received. For two or three years, or maybe longer, the number of users coming to consult or work in the Center should not require special premises. After that time, special

work rooms (tables, chairs, cupboards, lighting) may be needed (four or five 15 sq. meter offices totaling 60 sq. meters).

2) Loan of equipment: The fragile nature, environmental constraints, price, etc., of the Center's equipment will preclude loaning out equipment.

3) Technical assistance: Center specialists qualified to solve user problems and equipment will not always be available. Users must be well informed of the need to inquire and reserve dates well in advance.

### 3.5.7 STAFF ASSIGNMENT

The system for assigning personnel for user assistance should be flexible enough to satisfy the users and yet not upset the proper functioning of the other activities of the Center, especially since many projects are strictly timebound (in particular for climatic reasons). In the beginning no personnel should need to be assigned full time to user assistance. The work load should not exceed 1/4 to 1/3 man per month during the first two years.

At a later stage, as user awareness grows and posts become operational, one or more people may be needed on a full time basis.

During the first few years most of the assistance will probably be provided by the project heads because the problems that arise will be mainly one of obtaining operational results and hence information extraction using image interpretation.

Thereafter this type of assistance will become more varied as user awareness increases, and it may be expected that the first full time post relating to user assistance will focus more on imagery and equipment than on image interpretation.

The general quality of the technical assistance offered by the Center will depend on the number of active project heads and, thus, the number of projects actually in progress.

## 3.6 DATA RECEPTION

Phase II of the Ouagadougou Center encompasses the installation and operation of a ground station for reception and processing of Landsat and other satellite data. The implementation of Phase II is dependent upon progress in using existing data in various national or regional demonstration projects, making successful initiation of the training and user assistance functions of the Center a prerequisite. It is also dependent upon the establishment of a viable African institution to manage the Center in the best interest of the countries covered by the station. A study will be carried out prior to implementation of the station, to assess these parameters.

### 3.6.1 FUNCTION

One of the major advantages of remote sensing comes from the fact that the satellite helps the administrators in charge to keep easily informed of the evolution of phenomena having a great social and economic importance, such as surface waters and river basin runoff, the moisture conditions of soils, the extent and vigor of crops, the state of grazing lands, the migrations of the pastoral population, the movement of sands, etc.

Still, it is necessary that the data given by the satellite be effectively available locally and presented to the persons in charge within a time period which allows them to act, if so needed, in a useful fashion. Reliability of data acquisition is also critical, making dependence upon satellite tape recorders undesirable.

This brings about the interest and justification in installing a ground station which would assure immediate reception of data and diffusion on a regional scale. The following section describes briefly the type of station planned to answer the needs of the region.

### 3.6.2 TYPE AND VOLUME OF INFORMATION TO BE RECEIVED AND PROCESSED

a) The station must be capable of receiving data given by the multi-spectral scanner on Landsat (called MSS), which includes the basic four bands as well as the thermal infrared band planned for Landsat-C in 1978.

b) In the interval between the Landsat passes, the station should also be able to receive imagery of the cloud coverage of the region, produced by meteorological satellites such as NOAA and METEOSAT.

c) The station basic equipment should have an adequate capacity for preprocessing and archiving under the two forms of a high density magnetic tape and quick-look exposures, all the images of the territory covered by the station, such as the ones produced by at least two satellites carrying an instrument of the type MSS Landsat simultaneously in orbit. The station equipment should also be able to produce a limited number of computer compatible tapes per day.

d) The station design should take into account the foreseen evolution of the Landsat series as well as of other satellites capable of being useful to the region, in such a way that the required equipment for reading out these satellites could be added at minor costs.

In a similar manner, the project should take into account the integration possibilities of simple methods of numerical analysis taking advantage of the calculation capacity of the station equipment between the satellite passes.

### 3.6.3 CONCLUSIONS

A receiving station ensuring the effective availability of data at the regional scale is indispensable to the realization of the advantages of remote sensing as an aid to natural resources management. The installation and exploitation of this type of station is perfectly feasible.

The points to be noted are the following:

- The receiving station is integrated in a regional system of data dissemination, on-the-job training and aid to users who want to apply this data in fields such as cartography, hydrology, agropastoralism, geology and forestry resources.
- The station will be, from the beginning, capable of reading out the Landsat 2 and 3 satellites as well as meteorological satellite data such as NOAA and METEOSAT.

- The station will be designed in such a way as to be able to receive, at minor costs, the necessary equipment for data recording and preprocessing from future earth observation satellites.

### 3.6.4 COST SUMMARY

#### Installation Cost (January 1978 to September 1979)

● Building <sup>1</sup> (air conditioned)	
● Recording, tracking, processing, photo	70m <sup>2</sup>
● Archives (5 years)	70m <sup>2</sup>
● Workshop/Inventory: (existing areas, see Figures 5 and 7)	
● Transformer station 300 A, three phase regulated	\$ 100,000
● Foundation (8m <sup>3</sup> concrete) and pedestal (15 cm reinf. concrete) for antenna	\$ 100,000
● Antenna, tracking-recording, processing and photo equipment	\$2,500,000
● Shipping (air, crane, truck)	\$ 300,000
● Assembly (scaffolding, crane, one month)	\$ 100,000
● Initial inventory: spare parts, laboratory equipment	<u>\$ 100,000</u>
	\$3,200,000

#### Annual Expenditures

● Exploitation and Maintenance Costs		
● Station Head	1	\$ 70,000
● Electronics Technicians	2	\$ 130,000
● Operators (three teams)	6	
● Building Maintenance	1	
● Spare parts, laboratory equipment		\$ 100,000

1 To be provided by Upper Volta as an extension, adjacent to the main operations room of the ex-CNES facility. (See Figure 7)

● Film, video tapes, computer tapes, computer paper	\$ 200,000
● NASA fee*	<u>200,000</u>
	\$ 700,000

Total Costs in Five (5) Years

● Installation cost (1978)	\$3,200,000
● Exploitation (1979-1982 included) 3 x 700,000	\$2,100,000
● Contingency	<u>\$ 300,000</u>
	\$5,600,000

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\* To be paid by the Centre as a corporate entity.

4  
**TECHNICAL ISSUES**

**4.1 PERSONNEL**

**4.1.1 STAFFING SCHEDULE**

At start-up, the Center will be staffed by a Director, Deputy Director, a training officer, a librarian, three applications experts, an image physicist, a photo-technician, an administrative officer/accountant, and from four to six support personnel. African counterparts to the expatriate staff will be added as soon as possible. The staff will expand to its full extent within four years, as shown in Table IV-1. The full African complement is achieved at year 4. This may, of course, vary by one year either way. To the extent possible, all technical staff of the Center should be bilingual, or at least conversant in both languages since ability to communicate in both languages is important to successful interaction with the user community.

**4.1.2 SELECTION**

Selection of the expatriate staff will be the responsibility of the donor countries, subject to approval by the Director. It is assumed that the most highly qualified individuals available will be chosen.

At the present time it is anticipated that a Canadian will fill the position of Deputy Director. France, during the Phase I, will provide the training officer and two applications experts: mineral geology and agro-pedology. The cartography-topography post will be filled by a Voltaic engineer assisted by French visiting experts. Canada will provide expatriate support in the area of assessment of food production and need. The U. S. will supply the photo technician, the image physicist and up to three applications experts. The first year specialist will probably be in the field of soils/rangeland applications.

The expatriate positions associated with the ground receiving station will be filled by Canada.

**TABLE IV-1**  
**STAFFING SCHEDULE**

TITLE	NUMBER OF PEOPLE EACH YEAR				
	1978	1979	1980	1981	1982
Director	1	1	1	1	1
Deputy Director (Expatriate) C.	1	1	1	1	
Deputy Director			1	1	1
Librarian	.5	1	1	1	1
Assistant		1	1	1	1
Photography Technician (Expatriate) U.S.	1	1	1		
Photography Technician	.5	1	1	2	2
Assistant Technician		1	2	3	3
Training (Expatriate) F.	1	1	1		
Training		.5	1	1	1
Image Physicist (Expatriate) U.S.	1	1	1	.5	
Image Physicist		.5	1	1	1
Applications (Expatriate) F.	2	2	2	2	1
Applications (Expatriate) U.S.	1	2	3	2	2
Applications (Expatriate) C.			1	1	1
Applications		2	4	5	5
Administrative Officer/Accountant	1	1	1	1	1
Secretary (Personal)	1	1	2	2	2
Secretary		1	1	1	1
Station Head (Expatriate) C.			1	1	1
Deputy Station Head			1	1	1
Electronics Technician (Expatriate) C.			2	2	1
Electronics Technician			2	2	2
Operators			5	5	5
Support (Drivers, Groundskeeper, Etc)	5	6	10	10	10
<b>Total Professionals</b>					
Expatriate	7	8	13	9.5	6
African	2	8	16	19	19
<b>Total Support</b>					
African	7	9	19	19	19

The remaining staff positions will be filled by Africans and will be multi-national. The support staff will probably be from Upper Volta.

Selection of the African staff will be the responsibility of the Director, in consultation with the rest of the staff, and the Governing Board. It is anticipated that well qualified individuals from the government, universities and the private sector will be suggested by the various member nations for particular positions. The technical qualifications of these individuals, their experience, and their ability to interact with user agencies, donors, and others at the Center, should all be taken into account in their selection.

#### 4.1.3 SALARIES

An illustrative scale for staff salary allowances at the Ouagadougou Center is shown in Table IV-2. These figures have been used to estimate operating expenses for the Center.

The expatriate allowances are based upon costs for personnel at similar types of installations in Africa. They include all fringe benefits, travel costs to and from post and within Africa, housing and family allowances, relocation costs, etc. Actual salaries of the personnel will obviously be determined on an individual basis.

The African salary scales will follow the O.A.U. salary scale.

#### 4.1.4 INSTALLATION AND LODGING

The Government of the Upper Volta intends to include in the agreements to be concluded with the donor agencies and with the regional governing body of the Center, specific clauses dealing with the following points:

##### Lodging of the Staff of the Regional Center

The intention of the Government of the Upper Volta is to ensure - to the greatest extent possible - that modern, individual housing will be available for the personnel covered by the agreements and, if necessary, their families.

**TABLE IV-2**  
**SALARY ALLOWANCES**

	per year	AFR	EXP
DIRECTOR		\$20,800	\$
DEPUTY DIRECTOR (EXPATRIATE)			80,000
DEPUTY DIRECTOR		16,800	
LIBRARIAN		15,000	
ASSISTANT		5,000	
PHOTOGRAPHY TECHNICIAN (EXPATRIATE)			60,000
PHOTOGRAPHY TECHNICIAN		12,000	
ASSISTANT TECHNICIAN		6,120	
TRAINING (EXPATRIATE)			80,000
TRAINING		16,800	
IMAGE PHYSICIST (EXPATRIATE)			80,000
IMAGE PHYSICIST		16,800	
APPLICATIONS (EXPATRIATE)			80,000
APPLICATIONS		16,800	
SECRETARY (PERSONAL)		8,000	
SECRETARY		4,000	
STATION HEAD (EXPATRIATE)			80,000
DEPUTY STATION HEAD		16,800	
ELECTRONICS TECHNICIAN (EXPATRIATE)			60,000
ELECTRONICS TECHNICIAN		10,920	
OPERATOR		6,240	
SUPPORT (DRIVERS, GROUNDS MAINTENANCE, ETC.)		2,880	

**AFR** - African salary allowances do not include travel and benefits.  
**EXP** - Expatriate salary allowances include travel, housing and family allowances, and all benefits.

**Lodging of Training Program Participants**

The intention of the Government of the Upper Volta is to conclude appropriate arrangements, either with the National University, or with the Interstate School for Rural Engineering and Development (EIER) in order to ensure that participants are lodged in the best possible conditions following the practices normally applied to students.

## 4.2 SPACE REQUIREMENTS

This section considers the question of space availability and needs for the Center, including classrooms, offices, workspace and data archiving. Figure 5 shows the existing facility. Figure 6 shows a proposed allocation of space for the Center. Figure 7 shows the location of the additional space required in Phase II and beyond.

### 4.2.1 PHASE I - NEEDS

The question of space for classrooms, offices and archiving must obviously be considered in the context of the phasing of the Center, that is, that the needs will change as the Center expands and develops. An initial goal must also be to try to fit all of the requirements into the existing facility. In light of this, the following needs were identified for Phase I of the operation. Phase I is further divided into an interim start-up (pre-construction) and a post-construction period for the photo lab requirements. The locations refer to the layout in Figure 6.

#### Phase I - OFFICE SPACE

<u>Personnel</u>	<u>Potential Location</u>
Director	Office 1
Deputy Director	Office 4
1 Secretary	Secretaries office
Librarian	In Library and Browse Area
1 Assistant	In Library and Browse Area
Photo Technician	Interim in dark room/post-construction in photo lab
2 counterpart assistants (post-construction period)	In photo lab
Image Physicist	Maintenance shop and office (Phase I only)
1 counterpart	(Phase I only)
Training Director	Office 3
1 counterpart	

EXISTING FACILITY

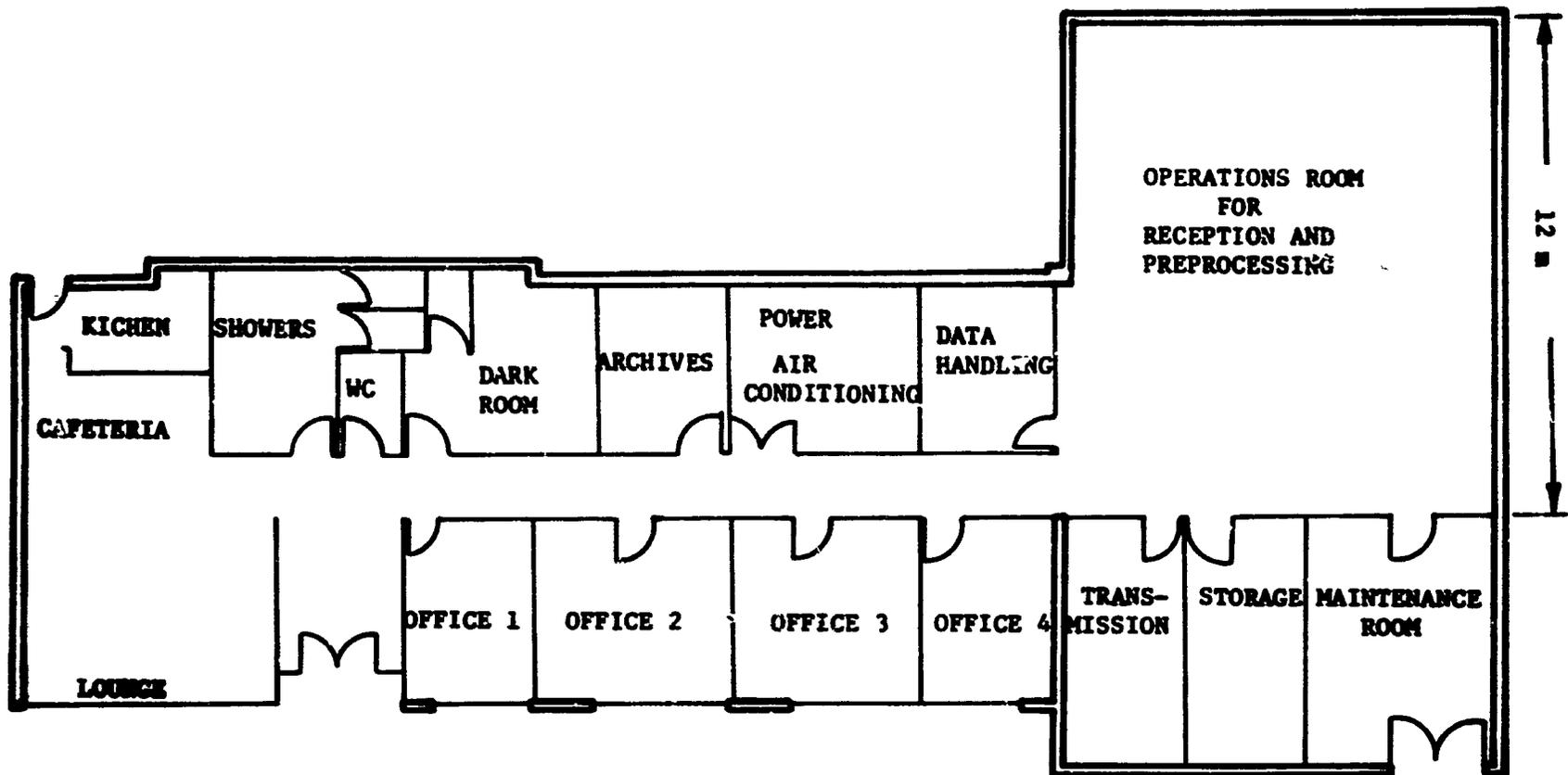


FIGURE 5

PROPOSED ALLOCATION

PHASE I

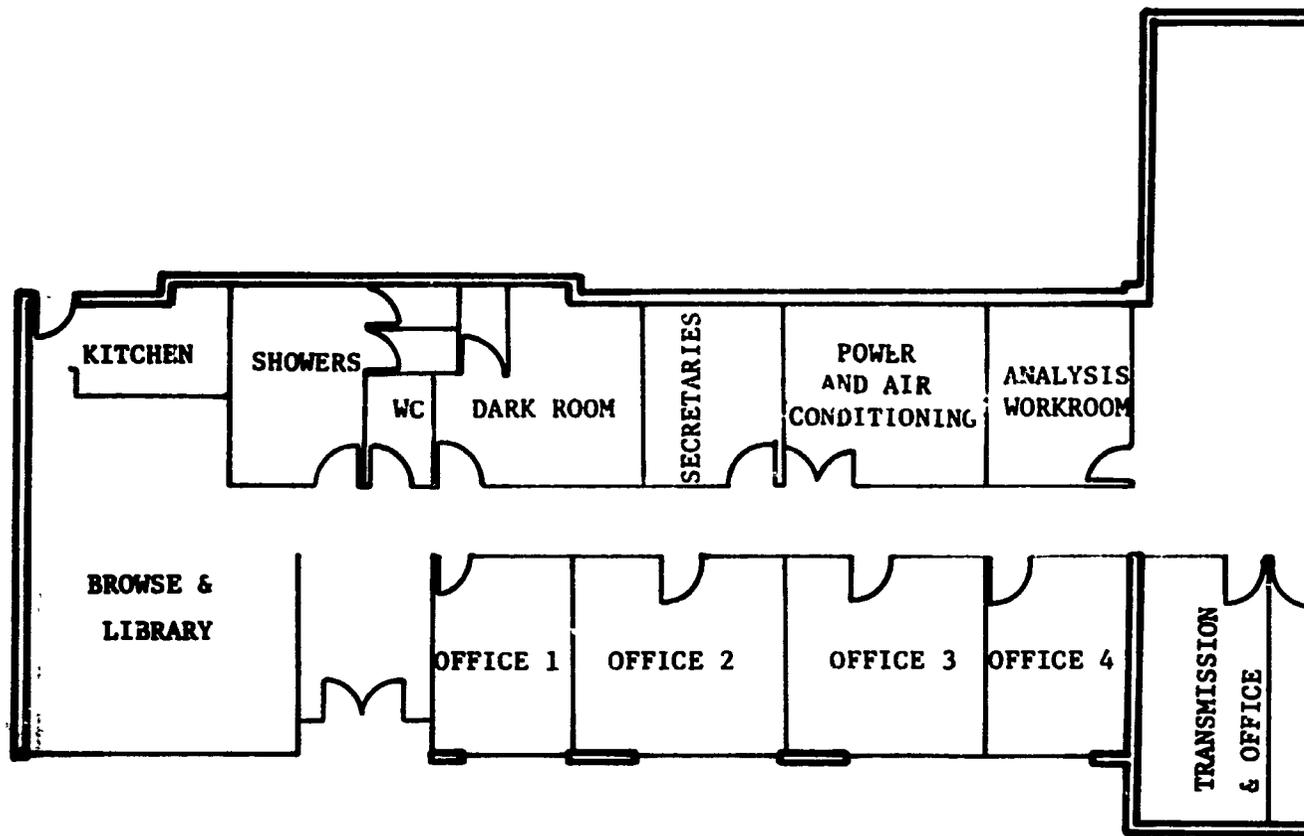


FIGURE 6

POSSIBLE ADDITIONS  
PHASE II

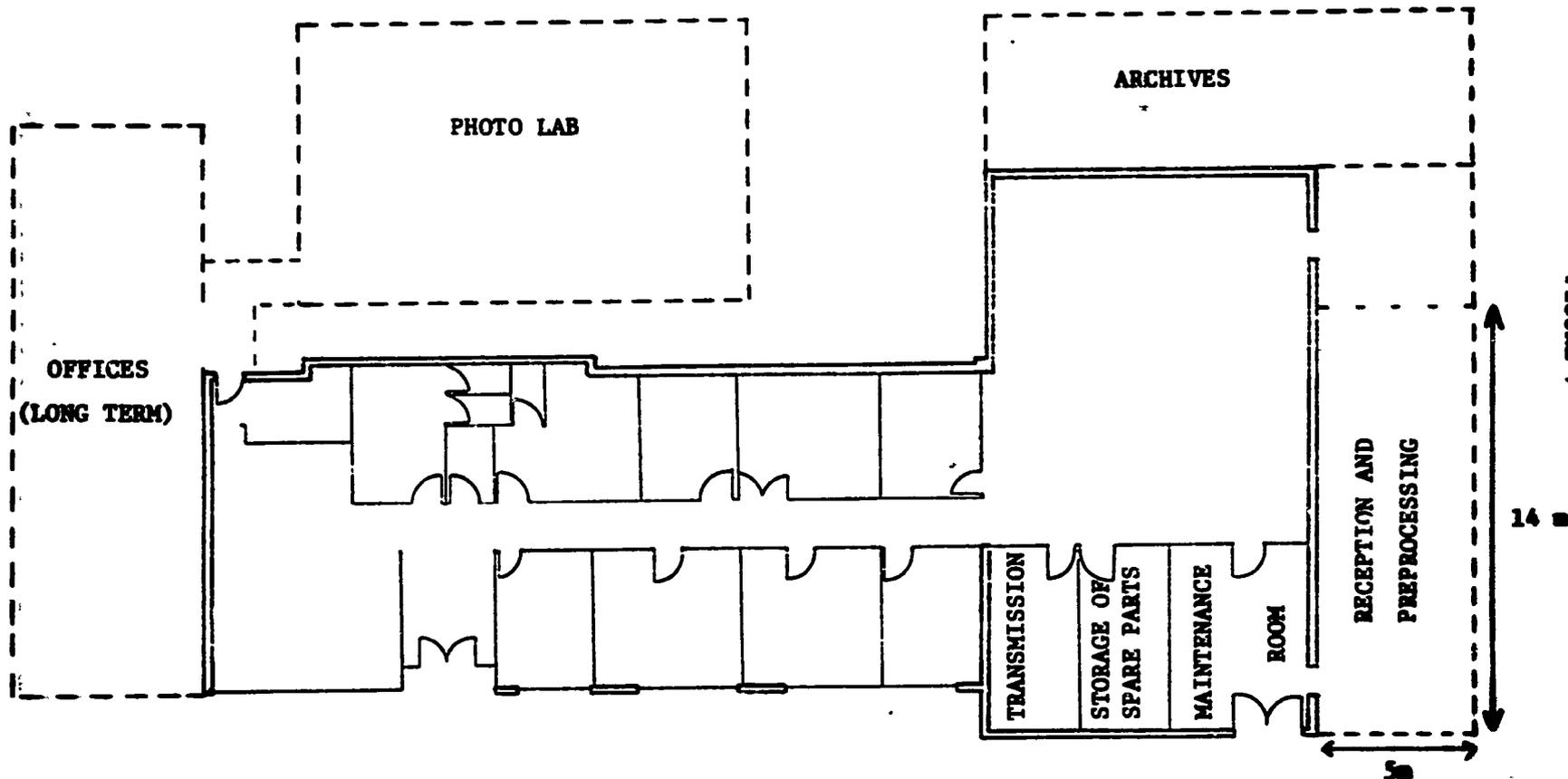


FIGURE 7

IMPORTANT NOTE:

REQUIRED BY  
JAN 1979

<b>3 Applications experts (projects)</b>	<b>Offices 3 and 4 plus post-</b>
<b>2 to 3 counterparts</b>	<b>construction period in old</b>
<b>1 secretary (for training and</b>	<b>dark room</b>
<b>projects)</b>	<b>Secretaries office</b>
<b>Short term experts</b>	<b>Old dark room and/or image</b>
	<b>analysis area</b>

**Classroom**

<b>Seating for 12 people for 2 to 3</b>	
<b>weeks, 1/2 time</b>	<b>Library area or analysis area</b>

**Archives**

<b>None needed</b>	<b>Imagery stored in analysis lab</b>
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**4.2.2 PHASE I - SPACE AVAILABILITY**

It is possible to fit all of the personnel envisioned for Phase I into the existing facility. This is especially true since it is probable that the full complement of applications experts (user assistance and project leaders) and their African counterparts will not join the staff immediately, but be chosen over the first year of operation.

It is also felt that it will be possible to house an interim photo facility in the existing dark room, until the new photo lab becomes available (see section 3.3). Obviously, this would mean that the photo lab capabilities would be restricted during such an interim period, probably to only simple black and white reproduction (prints and transparencies) of the imagery, with perhaps limited enlargement and reduction capabilities. However, setting up such an interim facility will allow projects to begin immediately and in addition gives considerably more flexibility in considering remodeling of an existing building versus building a new one, since the time factor will not be so critical.

During Phase I, the office space will be somewhat cramped. If all of the anticipated expatriate and African staff are present, there will be four people occupying each of the two large offices (#2 and 3). It is felt that this is not unreasonable, however, each room being about

4.5 x 4.5 m. When the new photo facility is completed it will also be possible for some of these people to move into the old dark room area. One inconvenience will be the separation of the Director and Deputy Director.

Concerning the classroom, it is felt that designation of a specific area for this purpose is not required. The only formal training will occur for groups of up to 12 people for short (four week) periods, a large portion of which will be spent in actual utilization of equipment in the imagery analysis area. When a formal classroom set up is required, the library area may be converted to this purpose. In addition, the use of EIER, or University facilities is also being considered. The library area may, by the way, also serve as a general meeting room when required.

#### 4.2.3 PHASE II-REQUIREMENTS

##### RECEIVING STATION

Receiving Station (also requires original maintenance area)	5 x 14 m (see Fig. 7)
Image analysis addition (may also serve as class/meeting room)	5 x 4 m

##### ARCHIVES

HDT Tapes and CCT Tapes	5 x 12 m
-------------------------	----------

This space is required before arrival of the station equipment, i.e., before January 1979.

#### 4.2.4 LONG TERM - ADDITIONAL SPACE REQUIRED

##### OFFICES - Additional to Phase I

Director of Applications	1 Office
Two Applications Experts (projects)	1 Office
Two counterparts	1 Office
One secretary	1/2 Office
Administrator of General Services	1 Office
One secretary	<u>1/2 Office</u>
<b>TOTAL</b>	<b>5 Offices = 6 x 18 m</b>

##### CLASSROOM (optional)

Also serves as meeting room	6 x 6 m
-----------------------------	---------

The additional space required to house the Phase II facility is the 5 x 18 m addition for the reception station and additional space for the image analysis lab, and the 5 x 12 m archive area.

The long-term Center, as envisioned, should add additional office space, however. A 6 x 18 m building would exactly double the current office space, including secretaries offices. This would allow for the additional application experts (project leaders) and an increase from two to four secretaries. The layout of the addition could also allow for consolidation of the Director's and Deputy Director's offices with an adjacent secretary. This doubling of office space would also give each individual more area, making the office less cramped.

If this additional office space is built, it might logically go along the west side of the current structure, especially if a photo lab is built along the north side. This would allow use of a common air conditioning unit (see Figure 7).

A major increase in the capabilities of the photo lab may be necessary if the demand for imagery from the reception station increases greatly. The photo facility should be constructed so as to be readily expandable to accommodate the necessary equipment.

5  
COSTS

This section includes detailed cost analyses for the Ouagadougou Center. These analyses are based upon the initial and operating costs identified in earlier sections of the report and represent one proposed distribution of expenses. Although the costs shown for Phase I are more refined than for Phase II, they are still only indicative estimates. Prior to the beginning of Phase II and in conjunction with the evaluation noted above a review of Phase II costs will be undertaken and those figures will be adjusted accordingly. Funding sources are those pledged or anticipated from the donor countries and Upper Volta. A possible scenario for other sources of African funding, leading to self-support for the Center, is also included. An inflation factor of seven percent per year is assumed throughout.

1. Donor Fund Allocation - Proposed five-year total
2. Donor Fund Allocation - Proposed annual expenditure
3. Center Budget - Costs
4. Other Income Sources
5. Operating Expense (excluding salaries)
6. Grand Totals - Initial capital costs
7. Capital Expense Items.

The following abbreviations are used below:

FX = Foreign currencies

LC = Local currency

Amounts are, nevertheless, expressed in dollars.

**TABLE 1**  
**DONOR FUND ALLOCATION - PROPOSED 5 YEAR TOTAL**  
**in 000 \$US**

	<u>PHASE I</u>	<u>PHASE II</u>	<u>TOTAL</u>
<b>USA:</b>			
Short Term Exp.	30	90	
Expat. Salaries	947	1,175	
Capital Costs	490	69	
Operating Exp.	255	934	
African Sal.	77	---	
Contingencies	52	205	
	<hr/>	<hr/>	
TOTAL	1,851	2,473	4,324
<b>FRANCE:</b>			
Short Term Exp.	130	190	
Expat. Salaries	480	750	
Capital Costs	60	100	
Operating Exp.	141	212	
African Sal.	---	---	
	<hr/>	<hr/>	
TOTAL	811	1,252	2,063
<b>CANADA:</b>			
Short Term Exp.	70	---	
Expat. Salaries	160	840	
Capital Costs	20	3,200	
Operating Exp.	143	600	
African Sal.	20	60	
Studies	120	150	
	<hr/>	<hr/>	
TOTAL	533	4,850	5,383
<b>UPPER VOLTA:</b>			
Capital Costs	780		
Operating Exp.	43	69	
African Sal.	86	183	
	<hr/>	<hr/>	
TOTAL	909	252	1,161
<b>OTHER:</b>			
Operating Exp.	50	713	
African Sal.	28	698	
	<hr/>	<hr/>	
TOTAL	78	1,411	1,489
<hr/>			
<b>TOTALS</b>	<b>4,182</b>	<b>10,238</b>	<b>14,420</b>

**TABLE 2**  
**DONOR FUND ALLOCATION-**  
**PROPOSED ANNUAL EXPENDITURES**

	1		2		3	4	5
	<u>FX</u>	<u>LC</u>	<u>FX</u>	<u>LC</u>			
<b>USA:</b>							
Short Term Experts	---	---	30	---	30	30	30
Expatriate Salaries	375		572		677	309	189
Capital Costs	200	70	115	105	21	23	25
Operating Expenses	56	10	115	74	382	339	213
African Salaries		37		40	---	---	---
Contingencies	2	---	40	10	100	65	40
<b>TOTAL</b>	<b>633</b>	<b>117</b>	<b>872</b>	<b>229</b>	<b>1210</b>	<b>766</b>	<b>497</b>
<b>FRANCE:</b>							
Short Term Experts	50		80		70	60	60
Expatriate Salaries	200		280		350	240	160
Capital Costs	60		---			50	50
Operating Expenses	31	61	22	27	92	70	50
<b>TOTAL</b>	<b>341</b>	<b>61</b>	<b>382</b>	<b>27</b>	<b>512</b>	<b>420</b>	<b>320</b>
<b>CANADA:</b>							
Short Term Experts	35		35		---	---	---
Expatriate Salaries	80		80		280	280	280
Studies	120		---		---	---	150
Capital Costs	20		---		3200	---	---
Operating Costs	69	19	45	10	200	200	200
African Salaries		10		10	30	20	10
<b>TOTAL</b>	<b>324</b>	<b>29</b>	<b>160</b>	<b>20</b>	<b>3710</b>	<b>500</b>	<b>640</b>
<b>UPPER VOLTA:</b>							
Existing Facilities		750		30	---	---	---
Operating Costs		20		23	19	23	27
African Salaries		41		45	57	61	65
<b>TOTAL</b>		<b>811</b>		<b>98</b>	<b>76</b>	<b>84</b>	<b>92</b>
<b>OTHER:</b>							
Operating Expenses	---	---	50	---	200	200	313
African Salaries	---	---	---	28	148	208	342
<b>TOTAL</b>	<b>---</b>	<b>---</b>	<b>50</b>	<b>28</b>	<b>348</b>	<b>408</b>	<b>655</b>

**TABLE 3**  
**CENTER BUDGET**

	1		2		3	4	5
	<u>FX</u>	<u>LC</u>	<u>FX</u>	<u>LC</u>			
Short Term Experts	85	---	145	---	100	90	90
Expatriate Salaries	655	---	932	---	1307	829	629
Capital Costs (+ 40% shipping & check-out)	280	70	115	135	3221	73	75
Operating Costs	156	110	182	134	693	632	490
African Salaries	---	88	---	95	87	81	75
Studies	120	---	---	---	---	---	150
Contingencies	2	---	40	10	100	65	40
Existing Facilities	---	750					
<b>TOTAL</b>	<u>1298</u>	<u>1018</u>	<u>1414</u>	<u>374</u>	<u>5508</u>	<u>1770</u>	<u>1549</u>

**NOTE: Does not include funds from "Other" sources**

TABLE 4  
OTHER INCOME SOURCES

Year	2	3	4	5	6
Member Donations	60,000 (3 x 20,000)	240,000 (8 x 30,000)	270,000 (9 x 30,000)	450,000 (10 x 45,000)	900,000 (60,000)
Contract Work	10,000	90,000	100,000	115,000	1,000,000
72 Student Fees (non-members)	7,500	7,500	7,500	15,000	5,000
Imagery Sales	1,000	10,000	30,000	75,000	1,000
	<u>78,000</u>	<u>347,000</u>	<u>407,500</u>	<u>655,000</u>	<u>1,000,000</u>

TABLE 5  
OPERATING EXPENSES (Not Including Salaries)

	1		2		3	4	5
	<u>FX</u>	<u>LC</u>	<u>FX</u>	<u>LC</u>			
Materials & Supplies -							
Assistance & Training	22.9	10.0	30.9	10.7	31.2	33.4	35.7
Materials & Supplies -							
Reception Station	---	---	---	---	200.0	214.0	229.0
Equipment Spares & Maint. -							
Assist. & Training	33.0	---	35.3	---	37.8	40.4	43.2
Equipment Spares & Maint. -							
Reception Station	---	---	---	---	100.0	107.0	114.5
Utilities	---	8.0	---	8.6	13.2	14.1	15.1
Bldg. & Grounds Maint.	---	20.0	---	21.4	22.9	24.5	26.2
Vehicle Operation & Maint.	---	5.0	---	5.4	5.7	6.1	6.6
Office Supplies	---	2.0	---	2.1	2.3	2.4	2.6
Aircraft Rental	---	5.0	---	10.0	10.7	11.4	12.2
Exp. Staff Travel (exclude U.S.)	---	13.6	---	13.6	17.0	17.0	17.0
African Staff Travel	---	5.3	---	6.0	8.0	8.6	9.1
African Staff Benefits	---	5.7	---	20.6	33.7	38.1	40.7
Scholarships	80.0	35.0	80.0	35.0	90.0	90.0	90.0
Computer Processing & Services	20.0	---	40.0	---	60.0	30.0	---
NASA Fee	---	---	---	---	200.0	200.0	200.0
	156.9	109.6	186.2	133.4			
<b>TOTALS</b>		265.5	319.6		832.5	837.0	841.9

TABLE 6

GRAND TOTALS - INITIAL CAPITAL COSTS

	<u>Year 1</u>	<u>Year 2</u>	<u>TOTAL</u>
A) Equipment	--- 225,683 ---		225,683
C) Imagery	27,630	*	27,630
D) Furnishings	--- 18,858 ---		18,858
<b>TOTAL</b>	<b>272,171</b>		<b>272,171</b>
B) Construction	70,000	105,000	175,000
<b>PROJECT TOTAL</b>	<b>342,171</b>	<b>105,000</b>	<b>447,171</b>

\* Imagery for Year 2 and beyond is included in operational expense.

**TABLE 7**  
**CAPITAL EXPENSE ITEMS**

	Item	Subtotal	Total
<b>A) EQUIPMENT (By Appendix Number)</b>			
<b>3.1 - Information Center</b>			
Browsing Area	7,110		
Reference Library	<u>8,468</u>		
Information Center Total	15,578	15,578	
<b>3.2 - Image Analysis Facility</b>			
Image Viewing	22,115		
Image Enhancing	14,300		
Mensuration	1,135		
Image Viewing (add.)	80,450		
Detail Transfer	<u>9,397</u>		
Image Analysis Subtotal	127,397		
Audio-Visual for Training	3,805		
Photography Interp. Kits	<u>2,160</u>		
Training Support Subtotal	5,965		
Ground Data Instrumentation	7,942		
Survey	1,158		
Ground Photography	<u>1,734</u>		
Subtotal	2,892		
Camping	1,527		
Vehicles	21,782		
Communication	<u>600</u>		
Subtotal	22,382		
Image Analysis Facility Total		168,105	
<b>3.3 - Photography</b>			
Film Processing	13,460		
Black & White Printing	8,000		
Color Printing	<u>20,540</u>		
Photography Total	42,000	42,000	
<b>EQUIPMENT TOTAL</b>			<b>225,683</b>

**TABLE 7 (cont'd)**  
**CAPITAL EXPENSE ITEMS (con't.)**

<b>B) CONSTRUCTION</b>			
Year #1	70,000		
Year #2	<u>105,000</u>		
<b>CONSTRUCTION TOTAL</b>	<b>175,000</b>	<b>175,000</b>	<b>175,000</b>
<b>C) IMAGERY (By Appendix Number)</b>			
3.1 - Browse Library Microfilm	2,880		
3.2 - 850 LANDSAT Scenes	<u>24,750</u>		
<b>IMAGERY TOTAL</b>	<b>27,630</b>	<b>27,630</b>	<b>27,630</b>
<b>D) FURNISHINGS (By Appendix Number)</b>			
3.1 - Information Center			
Browse Area	750		
Reference Library	<u>7,531</u>		
<b>Information Center Total</b>	<b>8,281</b>	<b>8,281</b>	
3.2 - Image Analysis Facility			
Lab Furnishings	4,045		
Drafting	1,767		
Imagery Files	535		
Training Classroom	<u>4,230</u>		
<b>Image Analysis Total</b>	<b>10,577</b>	<b>10,577</b>	
<b>FURNISHINGS TOTAL</b>			<b>18,858</b>

**APPENDIX I**  
**REFERENCE DOCUMENTS**

- A    **Resolution 280 (XII) - "African Remote Sensing Center" - of the ECA Conference of Ministers, 28 February 1975, Nairobi.**
  
- B    **"Project of a Regional Earth Resources Remote Sensing Center for West Africa" - CNES (French) proposal, 1975.**
  
- C    **"The Role of Remote Sensing in Africa" - report of the ECA technical team, February - March 1976. Document M76-923/NRSTD.**
  
- D    **Report of the Intergovernmental Meeting for the Creation in Africa of a Regional Ground Station for Reception and Processing of Satellite Remote Sensing Data. 28 September-1 October 1976, Addis Ababa. Document E/CN.14/NRD/HENV/2, 11 November 1976.**
  
- E    **Report of the Intergovernmental Meeting to Define a Constitution for an African Remote Sensing Council, 4-7 January 1977, Nairobi. Documents E/CN.14/670 and E/CN.14/NRD/HENV/3, 28 January 1977.**
  
- F    **African Remote Sensing Program. Estimation of costs for fiscal years 1978-1982. - version 2. Document M77/177, February 1977.**
  
- G    **Report of the Donors Meeting for the Creation of an African Remote Sensing Program, 17-18 February 1977, Kinshasa. Document E/CN.14/679, 22 February 1977.**
  
- H    **Resolution 313 (XIII) on the Establishment of an African Remote Sensing Program. Fourth meeting of the ECA Conference of Ministers, 24 February - 3 March 1977, Kinshasa. Document E/CN.14/L.637/REU.1, 1 March 1977.**
  
- I    **Agreement Concerning the Establishment of a Regional Center for Services in Surveying and Mapping, Nairobi, Kenya. Signed by five participating countries 18 April 1975.**
  
- J    **Agreement Between the Regional Center for Services in Surveying and Mapping, and the Government of Kenya, Regarding the Headquarters of the Center.**
  
- K    **Remote Sensing Applications to Resource Management Problems in the Sahel, Earth Satellite Corporation, July 1974.**
  
- L    **"An Economic Evaluation of the Utility of ERTS Data for Developing Countries", ERIM 105100-8-F, August 1974.**

**APPENDIX II**  
**MODEL AGREEMENT**

**DRAFT CONVENTION BETWEEN**

The Government of the Republic of the Upper Volta, herein after referred to as: "The Administration",

AND

The cooperating agencies of the French, Canadian, USA governments referred to as: "The Cooperating Agency"

have agreed to organize under the following terms the participation of the Cooperating Agency in the tasks undertaken or to be undertaken in the Republic of the Upper Volta, for establishing and operating the Regional Remote Sensing Center of Ouagadougou, herein after referred to as "the Center", composed of a receiving station and training and user assistance center in the field of the application of remote sensing for the analysis and management of natural resources.

ARTICLE 1/a

Within the framework of the Center, as defined and described in the documents drawn up by the Technical Committee, jointly formed by the donor agencies, the National Commission for Remote Sensing in Upper Volta, and the Economic Commission for Africa, the Cooperating Agency will provide the equipment, personnel and services as required by the project.

ARTICLE 1/b

On its part, the Administration will make available to the project the buildings and facilities of the former CNES Center in Ouagadougou. This Center will enjoy such privileges, immunities and exemptions as the Government of the Upper Volta agrees to grant it, and it will have a regional character.

## ARTICLE 2

For the implementation of this project, the Cooperating Agency will provide at its expense a center for training, reception, and processing of remote sensing data acquired by the Landsat and, if possible, METEOSAT and other earth observation satellites useful to the region. The Cooperating Agency will be responsible for the purchase of the equipment required, for smooth operations and for the recruitment of the cooperating personnel, in consultation with the other members of the Technical Committee. The purchases will relate to scientific equipment, supplies and vehicles, and subcontracting of specialized services, such as are necessary for the smooth operation of the Station and the Center. The total amount of this expenditure will be realized using the annual allocations that the U. S., French and Canadian governments will make available to the project.

## ARTICLE 3

The Cooperating Agency will regularly keep the Administration informed by a means of annual reports, setting out the progress of their share of activities. The Administration will keep the Cooperating Agencies informed of their own actions in relation to the project.

## ARTICLE 4

The Administration will secure exemption, for the project and the expatriate personnel working for the Cooperating Agency, from all direct taxes and similar impositions, excluding those in the following exhaustive list:

- the tax on motor vehicles
- the tax on arms
- the tax on bicycles
- the tax on live stock.

## ARTICLE 5

With the exception of consumables and drinks, the personal effects and items of the expatriate personnel working for the Cooperating Agency, as well as the professional equipment, materials and vehicles belonging to them and accompanying them on the occasion of their installation, shall benefit from duty-free entry into the Upper Volta. The introduction of these objects, vehicles and equipment should occur simultaneously with the installation of their owner. The Customs Department will nevertheless consider that this condition has been met, if the period which has elapsed between the two events does not exceed six months.

## ARTICLE 6

In the event that the Cooperating Agency is obliged to acquire in the Upper Volta vehicles, technical equipment and material necessary for the implementation of the project, such vehicles, technical materials and equipment shall be entitled to temporary duty-free entry, subject only to payment of fees for services rendered (tolls, statistics and customs stamp) which shall be paid or reimbursed by the Administration.

## ARTICLE 7/a

The equipment for the processing and interpretation of remote-sensed data as well as the vehicles and other technical equipment, for use in the studies and the operations, shall be transferred to the Administration within six months. They shall then automatically enjoy definitive tax-free status. Such vehicles, technical materials and equipment shall be handed over immediately and shall remain exclusively at the disposal of the staff of the Cooperating Agency and their African colleagues operating the station and the Center, for the entire duration of the Project.

The Cooperating Agency consents to assume responsibility for the maintenance of the vehicles, equipment and material delivered by it, until the end of the Project.

ARTICLE 7/b

Following the transfer of property mentioned in Article 7/a, the Administration may concede its rights to an African regional organization dealing with remote sensing, subject to the reservations set out in the above-mentioned Article, but this transfer shall be effected with the right to repossession, in the event that such organization ceases its activities.

ARTICLE 8

The Administration undertakes to facilitate by all the means within its power, the smooth running of the above-mentioned Project. In particular the Administration will encourage the assignment at its expense of the Upper Volta technical and administrative personnel, except where otherwise arranged, and the assistance of any Upper Volta technical researcher or staff member whose contribution may be considered useful.

ARTICLE 9

The Administration shall facilitate, as far as possible, travel by the staff of the Cooperating Agency, in the zones to be studied in the Upper Volta, and at the time of their entry and exit from the national territory. To this end, it shall obtain the travel authorizations and visas required.

ARTICLE 10

The Cooperating Agency shall take all necessary steps to cover the civil responsibility that itself and its staff may incur as a result of

their activities in the Upper Volta. It shall cover its staff against accidents and illness, during their entire stay in the Upper Volta.

#### ARTICLE 11

The Project is scheduled for a duration of five years, from its initiation on 1 September 1977. It is designed to be implemented in two phases, the first lasting two years and the second three years.

#### ARTICLE 12

The present convention shall come into force on the day of its signature and shall remain in force for a two-year period. It shall be deemed to be renewed for a period of three years, unless it is denounced, by one of the parties, or modified six months before the end of the current period. It may be extended for a future period of three years if need be.

#### ARTICLE 13

In the event of a dispute concerning the interpretation or application of any of the clauses of the present convention, the parties shall consult each other in order to achieve a negotiated or arbitrated solution using the good offices of a regional or international organization, or through any other means agreed upon jointly by the parties.

The following equipment will be needed for the Reference Library:

<u>Approximate Price</u>	<u>Quantity</u>	<u>Item</u>
-- <sup>1</sup> E	1	Paper cutter
28 E	1 kit	Microfilm repair supplies
766 <sup>2</sup> F	1	Microfilm cabinet (will handle 900 reels of film, not cartridges)
397 F	1	Fiche cabinet
205/each F	3	5-drawer, legal size file cabinets
370 F	1	Map cabinet
386 F	1	Card catalog (15 drawers x/1,200 cards/drawer)
180 F	1	Work table (for staff)
80 F	36	Plastic magazine holders
257 F	1	Journal display (browsing)
1,980 <sup>3</sup> F	9	Shelving units
300 E	1	Typewriter
450 F	1	Desk
1,500 F	2 tables w/8	or so chairs
150 F	1	Reference shelf
5,000 E	1	Fiche/film reader/printer
2,500 E	1	Fiche reader printer
600 E	2 <sup>4</sup>	Portable fiche reader
400 F	3	Tables for microfilm readers
40 E	1	Globe
<u>Furniture</u>	7,531	
<u>Equipment</u>	8,468	
<b>TOTAL</b>	<b>15,999</b>	

1. It is assumed these will be located elsewhere in the Facility.
2. Will depend on whether cartridge type viewer is needed.
3. This is totally dependent on the amount of microfilm used. The nine shelves is a maximum number.
4. One might be loaned out.

### APPENDIX III

All equipment named herein is used for example purposes only. Any other equipment which would supply the desired capabilities and be appropriate to the African environment should be considered.

#### PART 3.1 - Information Center

This Appendix provides detail concerning the Information Center (browse file and reference library). Included are discussions concerning the availability, acquisition, storage, indexing and use of the various data source types to be included in the facility.

1. Equipment and Supplies:

		Cost Type*
The following will be needed for the Browsing Area:		
16 mm Microfilm viewers (2)	\$ 6,000	
Empty film cartridges (dependent upon type of viewers)	500	
Microfilm splicer	150	
Film viewer (portable)	260	
World Atlas, comprehensive	200	
	7,110	E
Storage cabinets or racks (dependent on type of cartridge)	250	
Working tables (2)	500	
	750	F
EROS Microfilms	2,880	I
	yr 1, (600/yr 2-5)	
SUBTOTAL BROWSE FACILITY	\$ 10,740	

\* Cost Type

- E = Equipment
- F = Furnishings
- S = Supplies
- I = Imagery

The following equipment will be needed for the Reference Library:

	<u>Approximate Price</u>	<u>Quantity</u>	<u>Item</u>
	-- <sup>1</sup> E	1	Paper cutter
	28 E	1 kit	Microfilm repair supplies
	766 <sup>2</sup> F	1	Microfilm cabinet (will handle 900 reels of film, not cartridges)
	397 F	1	Fiche cabinet
	205/each F	3	5-drawer, legal size file cabinets
	370 F	1	Map cabinet
	386 F	1	Card catalog (15 drawers x/1,200 cards/drawer)
	180 F	1	Work table (for staff)
	80 F	36	Plastic magazine holders
	257 F	1	Journal display (browsing)
	1,980 <sup>3</sup> F	9	Shelving units
	300 E	1	Typewriter
	450 F	1	Desk
	1,500 F	2 tables w/8	or so chairs
	150 F	1	Reference shelf
	5,000 E	1	Fiche/film reader/printer
	2,500 E	1	Fiche reader printer
	600 E	2 <sup>4</sup>	Portable fiche reader
	400 F	3	Tables for microfilm readers
	40 E	1	Globe
<u>Furniture</u>	7,531		
<u>Equipment</u>	8,468		
<b>TOTAL</b>	<b>15,999</b>		

1. It is assumed these will be located elsewhere in the Facility.
2. Will depend on whether cartridge type viewer is needed.
3. This is totally dependent on the amount of microfilm used. The nine shelves is a maximum number.
4. One might be loaned out.

**The following supplies and materials are anticipated:**

\$ 350	Paper, stamps, cards, etc.
250	General Reference Books
200	Maps
300	Monographs
500	Proceedings
200	Journals
200	Abstracting Services
<hr/>	
\$2,000	

2. Reports: One possible way of obtaining relevant reports would be to use the National Technical Information Service (NTIS) SRIM (Selected Research in Microfiche) service. A subject profile is registered with NTIS, and all reports fitting the profile are automatically sent to the library. Another way of selecting reports would be by a subscription to the NTIS Weekly Government Abstract on NASA Earth Resources. The University of New Mexico bibliography on remote sensing is another source for selecting reports for purchase. NTIS will also run computerized searches on any topic, so a yearly or bi-yearly search on the proper topic could serve as a valuable resource. Whether selection is conducted from the Facility, or by researchers elsewhere, the above resources will be of value. Journals are also a source of report information.

Organization: Reports on microfiche from the U. S. should be stored by the accession number assigned the fiche (which is printed on the fiche in the upper left corner). Paper copy reports will generally exhibit an identifying number also.

The degree of bibliographic control available for the reports will be directly dependent on the strength of the library staff.

Some standard form for the cataloging of reports should be used. All the necessary descriptive elements will be found on the first page of U. S. reports, on the Technical Report Standard Title Page which is filled out by the author. The major bibliographic elements of a report which any system of organization will need to cite are:

- Title
- Personal Author
- Corporate Author (and their location)
- Date of publication
- Report number(s)
- Contract number
- Type of report (final, interim, etc.)
- Pagination
- Key words

Specific cards for title, corporate author (maybe personal author) and key words are needed. One basic card is typed on a master, duplicates are made and needed headings are added (see attached sample).

Reports from the U. S. on microfiche are \$3.00 per title. Hard-copy prices are reasonable based on the number of pages.

3. Monographs: On-going selection of books will mostly be through reviews in journals or references cited in the reports. The Facility will have a core collection to start with.

Organization: Alphabetical storage on shelves by the first author listed (or society, or corporation, or editor if need be) will be the easiest, and is entirely suitable to the scope of the collection. A card system similar to the reports can be used, and the key words would be consistent from genre to genre (see sample book entry).

4. Journals: A basic collection of key journals will be at the Facility from the beginning, and new journals can be added as they arise. The journals will be those stressing applications, though abstracting journals will be necessary. The journals will be utilized for:

- 1) Current awareness and keeping up in the field (reading or scanning each new issue).
- 2) Retrospective research based on a known citation (seeing the citation elsewhere and going to the article from that reference).
- 3) Retrospective searching based on a subject need (interested in soil moisture, and needs to know total holdings of the library in that area, yet has no specific references).

The utilization of #3 above may pose some problem for the Library.

For the Library to fully serve the research function, some method of accessing the information in the journals should be devised (after several years, it will be difficult to continually scan tables of contents, and journals are not systematically indexed). Also microfiche is not conducive to browsing. Depending on personnel resources, individual journal articles could be subject cataloged, or a book of photocopies of tables of contents could satisfy the short term need (i.e., a researcher could quickly scan the titles of articles for a particular journal). An abstracting journal will serve as a partial index to the journals and may suffice initially. This problem can probably be decided by the individual Facility researchers.

The major part of the Library materials budget will probably be spent on journals. This is because they are an expensive medium in comparison to reports and books, and are necessary in quantity to provide quick access to current trends in the field. Materials will

be needed to neatly store loose journals, such as plastic princeton files or boxes. Binding is probably not available locally, though if it is, money should be allotted to that function.

Pertinent articles from journals the Library does not carry should be ordered individually from the nearest lending library. With the U. S. connections of the Facility, photocopies should be available from many U. S. research libraries, including the Library of Congress. An easily completed standard interlibrary loan form is needed for this procedure, and the cost is usually minimal (photocopy charge plus postage--usually \$3 to \$6 for a normal article). The Research Library should quickly establish inter-library-library cooperation throughout Africa, and should be aware of international programs available through the U. N.

The reprints could be stored in small folders, filed by journal title, and shelved with the other journals.

Organization: Journals should be shelved in alphabetical order by title. Microforms can be stored in the same area as the hard copy (if both are held), or separately. Having them together on the shelf may be easier for the patron. Some of the journals will be available on microfilm, others on fiche, and others on paper (or any combination of the above). Small boxes on the shelves next to the hard copy journals would accommodate either form. The format of the journals (microform or hard copy) should be decided by the researchers who will be using the material. Certainly microforms are more efficient in terms of space, are not easily lost or "borrowed indefinitely", and are more physically resilient than paper. Yet, this medium is dependent on a machine that is bound to break, and many people experience eye strain, headaches, or fatigue from their extensive use. Certain environmental factors are important for micro-

form storage, such as a lower temperature and humidity level than is required for paper. The standard for microform storage is:

Temperature: between 60° and 80°F (70° is best),

Humidity: between 40 and 50 relative

The most damaging factor to microforms is rapid cycling of either temperature or humidity. Exposure to light is a problem only for diazo film, which is not widely used in libraries.

5. Conference Proceedings: Conference proceedings will be selected from descriptions in journals and abstracts, from citations, and from the knowledge that certain conferences are held on a yearly basis. Proceedings are expensive, and are also usually available in paper copy, so adequate shelving for them will be necessary.

Organization: Proceedings may be interfiled with books (by sponsoring agency) or shelved separately.

6. Pamphlets, Brochures, Etc.: Not all valuable material will arrive with clear identification numbers, or in a standard format. Brochures, pamphlets, booklets, etc., are not suited to full cataloging, cannot be stored with reports, and are not appropriate to shelving with books. This type of material is suited to a vertical file, arranged informally by subject. This will require one legal sized file cabinet and filing folders and supplies.

7. Maps: The number of maps will probably not be great. They should be stored by geographical name, and then type. For instance:

Upper Volta - Agriculture

Upper Volta - Geology

Upper Volta - Tectonics, etc.

Maps require special cabinets, suited to their varying sizes, and large tables for using them.

8. Reference Materials: Certain standard reference materials will be required for use by the Library staff and patrons. The atlas described in the Browsing Section will also be a Library reference. Two world atlases of differing character would probably be superior to one general purpose atlas. Foreign language dictionaries (especially French and English) will be needed including general and scientific terms. A standard scientific dictionary will be needed, as well as specialized dictionaries of geographic-geologic-earth resources terminology. These are necessary not only to find information on a topic, but in the formulation of a subject Thesaurus for cataloging. Certain agricultural and land classification statistics (such as those available through the U. N. - F. A. O.) may also be necessary. Specialized Thesauri (such as the NASA Thesaurus, and the Thesaurus of Engineering and Scientific Terms) should also be ordered. Certain special scientific or government dictionaries and the like will be needed for obtaining addresses and information concerning other organizations.

**SAMPLE CATALOG CARDS (MASTER CARD ONLY)**

**ERIM**  
**109600-66-F**

Wheat Signature Modeling and Analysis for Improved Training Statistics: Final Report / by W. A. Malila, R. C. Cicone, and J. M. Gleason, -- Ann Arbor: ERIM, May 1976.

170 p. : computer output ;

Sponsored by NASA, Contract No. NAS9-14123.

1. Wheat 2. Remote Sensing in Agriculture  
3. LANDSAT (Artificial Satellite) 4. LACIE  
I. title II. W. A. Malila III. R. C. Cicone IV. J. M. Gleason V. ERIM

**Report Card**

Smith, John R.

Remote Sensing for the Detection of Soil Moisture / by John R. Smith. -- New York: XYZ Publishing Co., 1977.

259 p. : maps, charts, color photos ;

ISBN 0-14569-856-X

1. Soil Moisture I. title

(FICTITIOUS TITLE)

**Book Card**

**APPENDIX III**  
**PART 3.2 - IMAGE INTERPRETATION FACILITY**

The unit costs for all the equipment recommended for inclusion as part of the image interpretation facility are summarized in this Appendix. Where more than one piece of a specific type of equipment is needed, total cost for the required number of units is also indicated. The lists are organized by program support function.

**1. IMAGE ANALYSIS LABORATORY**

**1.1 IMAGE ANALYSIS**

Cost  
Type\*

**a. Image viewing equipment**

Two (2) Richards Light Tables Model M1M231100  
 \*to be used for viewing roll transparencies  
 and single images. \$11,895

Bausch and Lomb Zoom Stereoscope w/rhombus  
 arms mounted on light table.  
 \*to be used for Landsat and aerial photo  
 analysis. Model 240R/15AB @ 5,150

Old Delft Scanning Stereoscope @ 4,650  
 (provides a portable mode of magnified image  
 viewing

Air Force pocket stereoscopes two (2) each of  
 2X and 4X lens types  
 \*to be used for photointerpretation and stereo  
 measurements @ 75 x 4 300

Tube magnifiers 7X @ 30 x 4 120  
 \*to be used for quick analysis of image detail

TOTAL \$22,115 E

**b. Image Enhancing Equipment**

VP-8 Density slicer @ 14,300  
 \*turns a black and white image into 8 gray-  
 scale tones with density profile, color  
 coding, automatic percent determination

TOTAL \$14,300 E

**\* Cost Types:**

- F = Furnishings
- E = Capital Equipment
- S = Operating Supplies
- I = Imagery
- A = Plane Rental

**c. Mensuration**

**Linear**

Box wood scales 0.5 mm/0.001 ft @ \$7 x 4 \$ 28.00

**Area**

Dot grids @ \$2 x 20 40.00

Dot counter @ \$33.00 33.00

Acetate rectangular grids, various sizes  
@ \$2 x 25 50.00

Polar Planimeter @ \$125 125.00

Digital electronic platimeter @ \$760 760.00

**Height**

Parallax wedges @ \$6 x 4 24.00

Abram's height finder @ \$75 75.00

TOTAL \$1,135.00 E

**d. Additional Image Viewing Equipment**

A rear projection viewer (e.g., a Variscan)  
@ \$75,000 \$75,000.00

\*used for rapid scanning of roll film and  
enlarged viewing of roll film or single  
transparencies by several persons

A second old Delft scanning stereoscopic 4,650.00

\*to be used with the other old Delft for  
simultaneous stereoscopic viewing by  
two persons

Stereo contour plotter type 121-GE 800.00

\*to be used with air photos to develop  
contour lines

TOTAL \$80,450.00 E

**e. Furnishings**

4 legal size file cabinets @ \$200 x 4 800.00

2 sets of metal shelves @ \$60 x 2 120.00

2 work tables @ \$418 x 2 836.00

1 storage cabinet @ \$418 418.00

2 tall drafting chairs @ \$60 x 2 120.00

2 pin boards @ \$75 x 2 150.00

1 map cabinet \$300 300.00

4 regular chairs @ \$75 x 4 300.00

1 ring light on a flex arm 80.00

2 programmable pocket calculators @ \$400 800.00

1 map tube rack w/tubes 121.00

TOTAL \$ 4,045.00 F

**f. Supplies**

Colored pencils, mylar for overlays  
cotton gloves, masking tape, grease  
pencils, etc.

\$1,100.00 S

**1.2 CARTOGRAPHIC CAPABILITY**

**a. Detail Transfer Equipment**

Mapograph @ \$3,397

\$3,397.00

\*to be used for projecting an image onto a  
plane surface and transferring detail, can  
be used with both prints and transparencies  
and roll films - 5 x to 5 x range

Bausch and Lomb Zoom Transfer Scope

\$6,000.00

\*optically superimposes two images and  
permits detail transfer from one to another;  
5 x to 14 x range

TOTAL

\$9,397.00 E

**b. Furnishings (drafting)**

2 drafting tables @ \$200 x 2

\$ 400.00

drafting machine @ \$98

98.00

drafting pen set @ \$66 x 2

132.00

Leroy lettering set

180.00

1 ring light on flex arm

80.00

2 fluorescent lights with flex arm

204.00

2 tall drafting chairs @ \$60

120.00

1 pinboard

75.00

1 set of metal shelves

60.00

1 storage cabinet

418.00

TOTAL

\$1,767.00 F

**c. Supplies**

T-squares, set squares, templates, 2H and 3H  
pencils, compasses, triangles, masking tape,  
etc.

\$1,100.00 S

**1.3 IMAGERY FILE**

**a. Furnishings**

2 legal size file cabinets @ \$200

\$ 400.00

3 file boxes @ \$20

60.00

1 bulletin board

75.00

TOTAL

\$ 535.00 F

**b. Imagery**

Year 1	800 scenes of 9" x 9" Landsat data 3 bands @ \$30.00	\$24,000.00	
	50 scenes of 9" x 9" Landsat color composites @ \$15.00	750.00	
	<b>TOTAL</b>	<b>\$24,750.00</b>	<b>I</b>
Year 2	300 scenes of 9" x 9" Landsat @ \$30	9,000.00	

**2. TRAINING**

**2.1 CLASSROOM**

**a. Furniture**

1 lectern @ \$320	\$ 320.00
8 long tables: 2 students/table @ \$215	1,720.00
20 chairs @ \$80	1,600.00
1 Blackboard/Pegboard 4' x 6' @ \$200	200.00
2 Easels @ \$40	80.00
1 cabinet for storing A-V equipment @ \$150	150.00
1 cabinet for storing A-V programs (carousels, cassettes, etc.)	150.00
2 projector stands @ \$45	90.00

**TOTAL** \$4,230.00 **F**

**b. Expendables**

Chalk and erasers; flip charts	\$ 150.00	<b>S</b>
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**2.2 AUDIO-VISUAL EQUIPMENT**

a. 35 mm Slide Program System, consisting of:

2 Kodak Ektographic 35 mm slide projectors AF-1 auto focus w/zoom: @ \$267.50 (European model \$600)	\$ 535.00
1 Audio Visual Lab (ABL) MkII. Dissolve Unit	365.00
1 Wollensak 25-73 cassette tape recorder	540.00
Extension speaker	50.00
Extra Carousels (5) @ \$3.78	20.00
16 mm sound movie projector, Kodak Pageant w/extra take up reels, assorted sizes	1,775.00
Overhead Projector with roll film adaptor	300.00
1 DaLite 70" x 70" tripod matte white screen	100.00
Electric light-arrow pointer	120.00

**TOTAL** \$3,805.00 **E**

### 2.3 PHOTO INTERPRETATION KITS (15)

Pocket Stereoscope (2X)	\$ 15.00
Photo interpreter's slide rule	7.50
Protractor	1.00
0.001' and 0.5 mm Boxwood Scale	6.00
Straight edge	3.00
Right triangle	1.00
7x tube magnifier	30.00
Parallalex wedge	6.00
Grease pencils, colored pencils	2.50
Dot grid	2.00

SUBTOTAL \$ 74.00

Portable light table 70.00

TOTAL \$ 144.00

15 complete kits \$2,160.00 E

### 3. FIELD RECONNAISSANCE

#### 3.1 GROUND DATA INSTRUMENTATION

##### a. Micrometeorology

Integrating anemometer (wind speed and direction)	\$ 75.00
Air temperature (1°C)	15.00
Psychrometer (relative humidity)	28.00
Rain gauge	32.00

TOTAL \$ 150.00 E

##### b. Radiance and Irradiance

Bendix 4-band (ERTS) field portable spectrometer w/tripod or equivalent	\$4,000.00
Standard reflectance panels (Kodak gray cards) 10%, 30%, 60% and others	5.00

TOTAL \$4,005.00 E

##### c. Vegetation

Plant press	\$ 20.00
Diameter tape	25.00
Relaskop	400.00
Quadrat templates @ \$5 x 4	20.00
Increment bores	50.00
Clippers	13.00
1 m sq plastic mirror	70.00
Meter stick	2.00

TOTAL \$ 600.00 E

<b>d. Soils</b>		
Auger	\$	13.00
Color kit		65.00
Sterile sample bags 500		28.50
Sieves (8)		50.00
Thermocouple psychrometer		450.00
		<hr/>
TOTAL	\$	606.50 E

<b>e. Water</b>		
Kempler bottles (10)	\$	24.95
Secchi disc		11.95
Plastic sample bottles (30) @ \$1.00		30.00
pH/conductivity		649.00
sample preservation kits for phytoplankton and zooplankton @ \$1.00		30.00
flow meter		800.00
water quality parameter test kits (dissolved O <sub>2</sub> , CO <sub>2</sub> , etc.)		150.00
thermistör x/sounding probe		188.00
recording depth meter		600.00
		<hr/>
TOTAL	\$	2,483.90 E

<b>f. Geology</b>		
rock hammer/chisels	\$	17.00
sample bags @ \$5 x 5		25.00
musette bag		34.00
streak plate		1.00
bottle of HCl		2.00
steel file		2.00
dental probes		15.00
		<hr/>
TOTAL	\$	96.00 E

### 3.2 RECORDS, SURVEY AND GROUND PHOTOGRAPHIC EQUIPMENT

<b>a. Record:</b>		
form holders @ \$6.50 x 2	\$	13.00
rigid plastic photo cases @ \$4.50 x 2		9.00
plastic map cases @ \$1.85 x 25		31.25
grease pencils, colored pencils		10.00
leather field case		30.00
		<hr/>
TOTAL	\$	93.25 S

**b. Survey Equipment**

scale	\$ 20.00
binoculars	150.00
Brunton pocket transit system w/tripod	135.00
hand magnifiers @ \$5 x 2	10.00
pocket lensotic compasses @ \$20 x 2	40.00
tall step ladder	15.00
clinometer	42.00
"chain" tapes 50 m, 100 m	205.00
surveyors stakes @ \$1.25 x 50	62.50
plane table and tripod \$200 plus \$250	450.00
plastic flagging, 12 rolls	11.10
pedometer	17.50

TOTAL \$1,158.10 E

**c. Ground Photographic**

35 mm SLR camera bodies 389 x 2	\$ 778.00
lenses - standard 50 mm	79.00
macro 55 mm/f3.5	214.00
telephoto 200 mm	200.00
fish eye 18	437.00
filters 1A @ \$13 x 2	26.00
film-100 rolls of color and black & white	225.00

TOTAL \$1,734.00 E

225.00 S

**3.3 CAMPING**

**a. Special Clothing**

Safety hats	\$ 5.70
Snake leggings \$20 x 2	40.00
Waders	35.00
Rubber boots \$20 x 2	40.00

TOTAL \$ 120.70 E

**b. Shelter**

2 wall tents @ \$163 x 2	\$ 326.00
1 dining fly @ \$40	40.00
1 folding table @ \$25	25.00
4 camp stools @ \$5	20.00
4 sets of mosquito netting and bars @ \$15	60.00
4 sleeping bags @ \$35	140.00
4 cots @ \$22	88.00
3 camp lanterns @ \$22	66.00
1 first aid kit	44.00
canteens (4) @ \$3.50	14.00

TOTAL \$ 823.00 E

<b>c. Cooking</b>			
Food storage boxes		\$ 30.00	
Food and water coolers		78.00	
Grill		9.00	
2 cook kits @ \$16		32.00	
1 cooking utensil kit		12.00	
2 camp stoves @ \$24		42.00	
2 vacuum bottles @ \$26.50		53.00	
	<b>TOTAL</b>	<b>\$ 256.00</b>	<b>E</b>
<b>d. Miscellaneous</b>			
4 flashlights @ \$5		\$ 20.00	
machette		35.00	
chainsaw		250.00	
bow saw		10.00	
axe		7.00	
sharpening stone		5.00	
	<b>TOTAL</b>	<b>\$ 327.00</b>	<b>E</b>
<b>e. Transportation</b>			
4-wheel drive pick-up truck or station wagon x/trailer		\$10,500.00	
boat w/motor, 4 hp		725.00	
winch		427.00	
Microbus and car rental		10,130.00	
	<b>TOTAL</b>	<b>\$21,782.00</b>	<b>E</b>
	airplane rental 66 hrs. at \$75/hr	5,000.00	<b>A</b>
<b>f. Communication</b>			
short wave radio		\$ 300.00	
walkie-talkies @ \$150 x 2		300.00	
	<b>TOTAL</b>	<b>\$ 600.00</b>	<b>E</b>
<b>g. Operations</b>			
food, gas, etc.		\$10,000.00	<b>S</b>

**APPENDIX III**

**PART 3.3 - Photographic Laboratory**

<u>FILM PROCESSING</u>	<u>COST</u>	<u>TYPE*</u>
Calumet 3-1/2 gal tanks (5) )		
Calumet 3-1/2 gal washer )		
Basket for roll film )	1,000	
Reels for roll film )		
Kinderman tanks for roll film (color)	7,500	
Calumet hangers - plastic	200	
Water jacket for tanks or deep sink	500	
Frigid-head temperature control unit	800	
Six 10x12 trays	60	
Wall mount roll film dryer	100	
Fisher or other cut film dryer	400	
Eastman 4x5 hangers	100	
Rotex silver reclaimer	600	
Nitrogen burst timer	200	
Darkroom doors	<u>2,000</u>	
	13,460	E
 <u>BLACK &amp; WHITE PRINTING</u>		
9x9 Enlarger equipped with glass carrier and roll film attachment and 12" lens	3,000	
4x5 Enlarger with condenser and diffusion heads	1,000	
180 - 150 - 100 - 50 mm lenses, mounted	800	
Tube processor for 36x36 prints	600	
4 trays 24x30 )		
4 trays 16x20 )		
4 trays 11x14 )	200	
4 trays 8x10 )		
Safe lights, timers, focusing aids, etc.	1,000	
9x9 contact printer, Morse or equivalent	500	
Diazo machine	1,000	
Negative carriers	<u>100</u>	
	8,000	E

**\* Cost Type**

**E = Equipment**

**S = Supplies**

**COLOR PRINTING****COST  
TYPE\***

Point source contact printer 9x9	1,000	
Calumet processors	3,000	
4x5 Beseler with color head	750	
Color head processor	1,500	
Filters for point source printer	75	
Tube processor for 36x36	1,000	
Ph meter	250	
Pako dryer for RC prints	4,500	
Screen rack dryer for Ceba prints	150	
Copy stand for opaque & transparent materials	1,000	
8x10 view camera with reducing back and assorted lenses	1,500	
35 mm SLRs 350 each x 3	1,050	
Tripods 75 each x 3	225	
Exposure meters 60 each x 4	240	
Densitometer, reflection and transmission	1,200	
Color analyzer	600	
Easels, including large vacuum easel	1,000	
Pako chemical mixer and storage tanks	300	
Refrigerator for storing films	500	
Aristo illuminator	400	
8x10 and 4x5 film holders	300	
	<hr/>	
	20,540	E
	<hr/>	
	42,000	
 <b><u>SUPPLIES</u></b>		
Chemicals, paper, film, etc.	12,000	S

**APPENDIX IV**  
**LANDSAT COVERAGE**

<u>Country</u>	<u>% Coverage by Ouagadougou Station</u>
Mali	100
Mauritania	100
former Spanish Sahara	100
Senegal	100
Gambia	100
Guinea	100
Guinea Bissou	100
Sierra Leone	100
Liberia	100
Ivory Coast	100
Upper Volta	100
Ghana	100
Togo	100
Benin	100
Nigeria	100
Niger	100
Cameroun	100
Cape Verde Islands	100
Morocco	100
Algeria	100
Tunisia	80
Libya	70
Tchad	100
Gabon	100
Congo	100
Central African Rep.	90
Equatorial Guinea	100
Sudan	20
Zaire	30
Angola	25

**APPENDIX V**  
**PARTICIPANTS**

**1. Ottawa Meeting 26-27 January 1977**

<u>NAME</u>	<u>ORGANIZATION</u>
Michel Aubert	C.N.E.S.
Hubert desCourtis	French Embassy, Scientific Attaché
Jean Devlin	CIDA, Upper Volta Planning Office
Jean L. Dizier	French Remote Sensing Research Organization
Ensley A. Godby	Canada Centre for Remote Sensing
Hubert Grandval	French Embassy, Commercial Attaché
Jean H. Guilmette	CIDA, Director, Sahel Regional Section
Peter Haines	Government of Canada's International Development Agency (CIDA)
Jean-Claude Henein	Canada Centre for Remote Sensing
Claude Laigle	Ministry of Cooperation (France)
Donald Lowe (USAID Consultant)	Environmental Research Institute of Michigan (ERIM)
John D. Blumgart	Bureau for Africa, AID

**APPENDIX V (cont)**

**2. Ouagadougou, Upper Volta, 16-18 March 1977**

**Donor Countries:**

Maxime Guy	G. D. T. A. (France)
Jean-Claude Henein	Canada Centre for Remote Sensing/CIDA
Laurence Istvan	ERIM/USAID
Donald Lowe	ERIM/USAID
Claude Torres	B. D. P. A. (France)

**Economic Commission for Africa:**

Jack Palgen .	Regional Advisor
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**Observer:**

Burkhard Ranft	Embassy of the Federal Republic of Germany
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**Upper Volta:**

Laurent Bado	Agricultural Services
Pierre Emile Bazie	Upper Volta Geographic Institute
Jean-Baptiste Djiguemde	Director of the Budget
Joseph Guissou	Information Department
Francois Kabore	H. E. R.
Michel Kafando	Director of International Cooperation
Jean-Baptiste Kambou	Forestry Management Department
Souleymane Kongoye	Planning Department
Gontimbo Ouedraogo	University of Ouagadougou
Jean-Pierre Ouedraogo	National Meteorology Department
Kouka Ousmane Sandwidi	Director, Upper Volta Geographic Institution

**APPENDIX V (cont)**

**3. Ann Arbor 2, 3, 4 May 1977**

J. Blumgart	US/AID
R. Chipman	Canada
J. C. Henein	Canada
L. Istvan	US/ERIM
M. Kafando	Upper Volta
R. Laurin	US/ERIM
D. Lowe	US/ERIM
J. P. Ouedraogo	Upper Volta
F. Thomson	US/ERIM
C. Torres	France
T. Wagner	US/ERIM
D. Wasawo	Economic Commission for Africa

**APPENDIX V (cont)**

**4. Paris 25-29 July 1977**

M. Guy	G.D.T.A.
Y. Lambert	FAC
C. Torres	B.D.P.A.
J. Palgen	ECA
D. Wasawo	ECA
M. Kafando	Upper Volta
J. P. Ouedraogo	Upper Volta
J. Blumgart	US/AID
W. Erdahl	US/AID (Ouagadougou)
L. Istvan	ERIM
R. Chipman	CCRS
J. C. Henein	CCRS