PROTOTYPE FOR A RESOURCE BASE MONITORING SYSTEM

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ABSTRACT

(To be completed)

I. Introduction

The purpose of this paper is to discuss a prototype for a Resource Base Monitoring System with a potential for creating in developing countries a national capability for understanding, monitoring and managing their resource base. Many development experts might say--so what's new? And go on to point out that a resource base management capability is essential to an efficient allocation of resources and policy planning in a country serious about economic and social progress, and, thus, should be in place. This is generally not the base, because of a complex web of available technology, access to technology when it is available, the wrong mix of priorities and the influence of the distribution and structure of power on the policymaking process.

But, times are changing, mainly due to environmental concerns, population growth and demographic shifts, and an appreciation of the implications of sustainable development. In an article last spring, Jessica Tuchman Mathews observed that "Despite the headlines of 1988--the polluted coastlines, the climatic extremes, the accelerating deforestation and flooding that plagued the planet--human society has not arrived at the brink of some absolute limit to its growth. The planet may ultimately be able to accommodate the additional five or six billion people projected to be living here by the year 2100. But is seems unlikely that the world will be able to do so unless the means of production change dramatically,. Global economic output has quadrupled since 1950

and it must continue to grow rapidly simply to meet basic human needs, to say nothing of the challenge of lifting billions from poverty, But economic growth as we currently know it requires more energy use, more emissions and wastes, more land converted from its natural state, and more need for the products of natural systems. Whether the planet can accommodate all of these demands remains an open question.

Individuals and governments alike are beginning to feel the cost of substituting for (or doing without) the goods and services once freely provided by healthy ecosystems. Nature's bill is presented in many different forms: the cost of commercial fertilizer needed to replenish once naturally fertile soils; the expense of dredging rivers that flood their banks because of soil erosion hundreds of miles upstream; the loss in crop failures due to the indiscriminate use of pesticides that inadvertently kill insect pollinators; or the price of worsening pollution, once filtered from the air by vegetation. Whatever the immediate cause for concern, the value and absolute necessity for human life of functioning ecosystems is finally becoming apparent.

Moreover, for the first time in its history, mankind is rapidly--if inadvertently--altering the basic physiology of the planet. Global changes currently taking place in the chemical composition of the atmosphere, in the genetic diversity of species inhabiting the planet, and the cycling of vital chemical s through the oceans, atmosphere, biosphere and geosphere, are unprecedented

in both their pace and scale. If left unchecked, the consequences will be profound and, unlike familiar types of local damage, irreversible"(1).

All of us are aware of the extraordinary public and private, official and unofficial interest in these issues engendered over the last several years. And more of us understand, or are beginning to understand, that we are not dealing with singular issues or problems that can be addressed in absolute terms. U. S. Senator Albert Gore has bluntly reminded us that studies"--tell us that with our current pattern of technology and production, we face a choice between economic growth in the near term and massive environmental disorder as the subsequent penalty.

This central fact suggests that the notion of environmentally sustainable development at present may be on oxymoron, rather than a realistic objective. It declares war, if effect, on routine life in the advanced industrial societies. And--central to the outcome of the entire struggle to restore global environmental balance--it declares war on the Third World.

If the Third World does not develop economically, poverty, hunger and disease will consume entire populations. Rapid economic growth is a life-or-death imperative". He goes on to suggest that "--effort to solve the global environmental crisis will be complicated not only by blind assertions that more environmental manipulation and more resource extraction are essential for

economic growth. It will also be complicated by the emergence of simplistic demands that development, or technology itself, must be stopped for the problem to be solved. This is a crisis of confidence which must be addressed. The tension between the imperatives of growth and the imperative of environmental management represents a supreme test for modern industrial civilization and an extreme demand upon technology."(2)

The fundamental first step in addressing these imperatives, it is suggested, is information. Many of us are guilty, one fears, of what Brandon Robinson describes as "--a pretense to knowledge not truly possessed." In a paper entitled WHAT'S WRONG WITH FOREIGN ASSISTANCE?, Robinson articulates "an opposition between what is technically sound and developmentally advisable, on one hand, and what is attractive to the LDC and politically feasible on the other, continues to be the prevailing conception. And underlying it is the highly questionable assumption that the -- "provider of external assistance"--to sit, that neither the receivers nor the providers of foreign assistance possess the knowledge and understanding on which sound social and economic policy can be based." The proposition follows that policymaking improvements are essential, but that "significant improvements in LDC policymaking and planning are not likely to take place without better data collection, processing and analysis".

Further, he argues, "relevant information does not guarantee a satisfactory policymaking process. However, the absence of such

information IS a guarantee that the process will be unsatisfactory." Robinson concludes that "the role of the "providers of assistance"--should not be propose some master blueprint or solution, but to help establish a PROBLEM SOLVING PROCESS under which there will be a continuous expansion of the LDC capabilities in data collection, processing and analysis needed for the proper formulation of policy." (3)As Marley once noted, "It is not enough to do good; one must do it the right way".

It is clear from the ongoing debate that there are significant differences in scientists' estimates of the impact of global changes. To argue about who is right and who is wrong misses the point, and represents a serious impediment to coming to terms with what we do know--and what we do know is that changes are taking place. Thus, our attention should be directed to understanding and anticipating these changes sufficiently in advance that we can exercise options for adjustments. As Mathers suggested "The lesson is this: current knowledge of planetary mechanisms is so scanty that the possibility of surprise, perhaps quite nasty surprise, must be rated high.--We lack both crucial knowledge and early warning systems."(1)

The importance of information has been cited by others and is gaining weight as the keystone to whatever action we take. David Baker has opined that "Information is the key to better use of Earth's resources, the intelligent management of fossil fuels and the timely development of Third World economies."(4) Peter Thacher

argues that "continual monitoring and research are needed to detect changes and understand the linkages--e.g. to evaluate the relative contributions to CO2 levels and atmospheric heating of fossil fuels and biotic sources, and compare these to other heat-trapping gases (methane, CFC's, et al) and to assess their likely consequences, alongside demographic, economic, and other changes."(5) Senator Gore says that "Immediately, we should undertake an urgent effort to obtain massive quantities of information about the global processes now underway--."(2) The objective of Mission to Planet Earth "--is to understand the planet's dynamics well enough to anticipate ecological disasters--and find ways to forestall them."(6) A recent U. S. Congressional Research Service report for Congress strengthens the case of information by noting that "Congress and the general public have evidenced increasing concern about widespread hunger and poverty in the world and deterioration of the Earth's environment. There is a growing awareness about links between such phenomena as the persistence of hunger and poverty throughout the world, the loss of natural resources, and global warming--The Essential beginning point for such understanding is the gathering of data on current natural systems."(7)

It is not surprising that the high level of interest in environmental and related sustainable development, food security and population issues has produced a spat of meetings, conferences, symposia and workshops--local, national and international--covering every conceivable aspect of global change. These gatherings,

sooner or later, dwell on the common destiny, global nature of the issues, and appeal for a partnership of collaboration and participation between developing and developed countries. Yet the agenda remains essentially a Western one--and therein the paradox to which Senator Gore refers.

But, is there really a contradiction? Developed countries are concerned with global changes that affect their interests and welfare resulting from patterns of behavior for which they are largely responsible. In the medium to long term, however, "--demographic growth now underway in the developing world means that their_quest for energy and a decent life will become the preponderant source of atmospheric heating well before the end of the next century"(5), if not significantly sooner. Developing countries, on the other hand, are, and must be, concerned with the economic and social progress that will determine their survival (the alternative is a slow, steady decline in standards of living, already unacceptable, that will contribute to social, political and economic instability every bit as pervasive as environmental degradation). Yet, that progress will not be possible without a resource base which is conserved, maintained and used on a sustainable basis. Thus, developed countries cannot safely ignore the economic needs of developing countries, and developing countries cannot discount the global change agenda of developed countries. Like it or not, there is a common stake.

If one accepts that there is a common stake, and if

information is generally recognized as a requirement for understanding, for policymaking and a prerequisite for action, then what is the missing ingredient in bringing developed and developing countries together in a common endeavor--especially with the array of national and international information activities existing or being planned. The answer, in part, and in an important respect, is that they do not address the need for development of a national capacity in developing countries for monitoring the resource base through collection of data, access to regional and international systems, and an organizational structure for analysis, distribution and use of information in decision making. Existing efforts, including the oversight of encouraging national capacity, usually have sever shortcomings:

- o They tend to be paternalistic;
- o by being so, they are unlikely to have the full commitment and cooperation of the recipient;
- o they do not adjust well to local circumstances and needs and, inter alia, are likely to have less input on the learning/understanding process of the recipient, as well as the policymaking process;
- o the chances of realizing a self-sustaining activity is less likely without a recipient's strong enlightened self-interest and political commitment;
- o the prospects for long-term external support (even if it were politically acceptable) are not realistic.

The proposed prototype described in this paper seeks to redress this oversight and implicitly encourages the provision of technical assistance and training to permit developing countries to develop national capabilities able to participate in and contribute to the regional and international information networks being developed. For, as David Barker observed, "Real benefit can only be applied where individual countries can make sensible decisions about resources, management and internal distribution, related to investment and export potential, without interference.:"(4)

II. Summary

The Resource Base Monitoring System proposal (RBMS) [~~is to~~] suggests a prototype or first step in beginning a process aimed at creating national capacities in developing countries for continuous resource base monitoring.(8) Completion of this process is likely to take several years, and, in the course of that time, a national capability is expected to become associated with an emerging network of sub-regional, regional and global resources for information which includes, inter alia, the Global Environmental Monitoring System (GEMS), the Soil and Terrain Map and Data Base (SOTER), two World Climate Data Centers, the World Vegetation Map, the World Map of Soils, the Global Resources Information

The Global Information and Early Warning Systems (GIEWS) and Mission to Planet Earth initiatives.

Data Base (GRID), The World Digital Data Base for Environmental Sciences (WDDES), a national resource base monitoring capability is essential to permit individual countries to contribute to, participate in and effectively use this network of geographic information resources.

The global ability to rationally use natural resources for economic and social advancement consistent with environmental management will increasingly depend on a network which recognizes that output requirements, availability and/or justification for the necessary financial and human resources and level of technical complexity and sophistication are of quite different dimensions at the national, regional and global levels. A self-contained national capability able to benefit from existing technology, and that which is being developed, is probably not attainable for most developing countries in terms of financial and human resources required. Thus, a global network, not, perhaps, unlike the Consultative Group on International Agricultural Research (CGIAR) system, is beginning to emerge in response to national, regional and global natural resource and geographic information needs.

A resource base monitoring system is an urgent need for most developing countries. In the case of many African

countries, natural resources are only known at a superficial level and regular surveys are not common. Few countries have accurate records of the rates of depletion of such basic resources as fuelwood, agricultural land for food crops or water, and many have large areas of terrain still unmapped and undocumented.

This proposal was initially formulated for Sudan and references to Sudan are, in large part, retained in this paper.

The future for Sudan, as well as most other developing countries, turns on achieving sustainable development. Sustainable development generally means natural resources development, including maintenance of the resource base. The growing realization that sustainable development is the key to sound economic and environmental conditions must be accompanied by sound development plans based on this philosophy. Sound development plans require accurate, readily accessible, current data. Gathering such data is a costly undertaking and competes with traditional development activities, famine relief costs, or emergency expenditures only with great difficulty.

Earth resources satellites have made a valuable contribution to natural resource surveys by providing

data at low cost per unit area which can be effectively used to make existing natural surveys more efficient. Such surveys can provide useful insights into the natural resources of a country and can form the basis of a monitoring system. However, the data are difficult to use unless they can be combined with economic and social information and related to rural district or regional administrations.

A geographic information system (GIS) is an efficient system of natural resources data storage, retrieval and processing which stores information by geographic location. Thus, it is possible to ask for data about a specific place or area. Several donors have, in recent years, supported the development of training and user assistance centers which introduce the efficiencies of remote sensing technology to the natural resources agencies of African governments. This proposal seeks to capitalize on these efficiencies by beginning to develop a GIS which will store the results of surveys and make them accessible to planners and managers of natural resources in formats most useful and usable to them.

With such a system, economic planners and managers of natural resources can reasonably be expected to begin to understand and address the concept of sustainable development and produce realistic plans based on current, reliable data. The proposed Resource Base Monitoring System can make natural resources and other data available for this purpose. In addition, such a system can be up-dated, can grow with the needs of the country and the demands of its users.

The Resource Base Monitoring System acts as a central

point for the survey activities of natural resources agencies, and is so configured that it can accept the results of surveys utilizing remote sensing technology and other data sources. Further global development of both GIS and remote sensing is planned for the next decade and Sudan, as well as other developing countries, will have the opportunity to capitalize on the benefits these developments offer provided they have developed the national capabilities to access the systems and understand, distribute and use the data.

Effective GIS-based natural resource monitoring systems stand to benefit from the new generations of space technology. In particular, new satellite offering sensors capable of assessing soil moisture statues (and, thus, plant growth conditions) and sensors capable of gathering data through clouds (radar systems) will improve the flow of data. Space station's earth resources programs will offer many opportunities to survey forest cover, crop development, surface water availability, agricultural development and soil erosion status. By entering such information into a GIS every time it becomes available, it is possible to calculate rates of change and calculate the sustainability of any given natural resource. In effect, the next generation of space technology will improve our ability to observe earth resources. Resource based monitoring systems can

accept the information from satellites and space craft (including space-stations) and use this to monitor natural resources. Once this is operationally possible, management and planning of natural resource development can become a reality and sustainable development an achievable goal.

The proposed RBMS represents a practical, but modest, step on this road. Phase I of the proposal is a five year endeavor. The principle objective of the first phase is to establish a systematic process whereby it is possible to establish a sustainable RBMS. At the end of Phase I, one would expect the following objectives to be achieved:

1) An awareness will be created of the utility of a RBMS among decision-makers in the public and private sectors.

2) Selected components of the RBMS will be functional.

3) The final design of the RBMS will be determined.

4) Recipient country nationals will be trained in the operations and use of the RBMS.

The RBMS will build upon existing work with early warning systems (such as FEWS in Sudan) and data bases developed through existing recipient country and donor projects. However, the RBMS is a new concept, both to recipients and, in many regards, to donors. Therefore, implementation will, by necessity, lean toward a learn-by-doing approach, with key decision points built into the implementation strategy.

The implementation strategy follows a dual, but mutually reinforcing, approach. First, up to three resource centers, which are essentially facilities having a data base and analysis capability, will be established early in the project. This will provide the capacity to solve relevant problems and, hopefully, attract the attention of and develop the awareness of key decision makers regarding the utility of the potential RBMS. At least two additional resource centers will be established during Phase I. Studies utilizing the new resource centers will be funded as a means of providing practical training and experience to all concerned decision makers and

resource center staff,thus encouraging, by stages, the awareness, skills and relationships on which the RBMS will be based.

The second track involves the design of the entire RBMS, and the placement of the Core Center, which will be the central support for the RBMS. This track will be the more complex and will take considerable time to implement. Core center functions include computer systems planning, training and interfacing with decision-makers, developing standards and screening data, managing data bases, digitizing and cataloging data, creating outputs and maintaining equipment. By the end of Phase I, the following core functions would be expected to be operational: training, guidelines for operation, and basic maintenance. During Phase I the Core Center will begin as a Technical Advisory Committee composed of Sudanese and other personnel involved in the System, and heavily supported by outside technical assistance and guidance provided through an international support center. The essential shape and composition of the RBMS Center will be determined by the Sudanese, and will be one of the outputs of Phase I. A major decision point will be the mid-point of the project when a major evaluation and workshop will be held for the purpose of evaluating the outputs of Phase I, determining if project objectives can be met and whether the capital costs of establishing the initial Core Center facility are warranted. The merit of a dual implementation strategy is that, first, it

quickly produces data and studies so that decision makers can benefit from the utility of the system and, second, it enables Sudanese to learn-by-doing while designing their own RBMS.

It is anticipated that the principal implementing agency during Phase I will be the National Council for Research (NCR). The NCR has the desired requisites in terms of mandate and functions and could serve as the eventual institutional base for the Core Center.

Project resources would be used to fund long and short-term technical assistance, commodities, including computers and micro computers, training and other relevant direct costs.

Although this proposal was developed with Sudan in mind, most of those involved believe, over and above direct benefits to Sudan were it to be implemented, that a reasonably successful effort would have an enormous potential for suggesting a pattern or prototype for other developing countries, especially in Africa, which have an equally urgent need for a resource base monitoring system. Thus, the question of why Sudan is germane and the reasons useful. There are essentially three. First, the state of degradation of Sudan's natural resources is appalling, and the rapidity with which it is taking place is even more alarming. At the same time, moreover, there is a developing groundswell of understanding that something must be done. In other words, the need has become self-evident. Second, the Sudanese themselves, at least at the technical level, are beginning to understand the utility and benefits of technology/information systems and their application to development problems. This experience has come mainly from project work, such as sand dune deposits on proposed roadway tracks, and the Sudan Emergency

Recovery and Information Surveillance System work in evaluating drought conditions and estimating agricultural production, where Sudan has developed area sample frames and methodologies more advanced than elsewhere in Africa. Third, there is a fortunate convergence of interest on the part of trained and knowledgeable Sudanese technicians, the Remote Sensing Facility of the Centre for Surveying, Mapping and Remote Sensing in Nairobi, which has established a close and tested working relationship with Sudan, and donors who have developed a keen interest and considerable experience with remote sensing and geographic information systems in Sudan.

III. PROPOSAL DESCRIPTION

A. Perceived Problem

A.1 Background

Sudan is a vast country undergoing rapid changes. Severe problems such as land degradation, inadequate food security, breakdown of economic structures, poor health conditions, and excessive population growth are plaguing the country. These problems affect Sudan's ability to stabilize and fully utilize its human and physical resources. To solve these problems, policies must be responsive to this changing resource base. The ability to create and implement effective policies in this dynamic environment is dependent on quick and thorough analyses of current resource assets, limitations, and changes. For example, actions to combat land degradation in the west require answers to questions such as: where are lands degrading; what processes are causing the degradation; what happens if no action is taken; what remedial actions at what costs could be employed to reduce the degradation; and what would be the benefits of remedial actions. To answer these questions, information derived from data on population habits, water availability, current land use, land tenure, soil potential, erosion hazards, transportation, changes in land cover, and other

sources must be consulted. The data must be located, merged and analyzed, with information and output in the form that a decision maker can understand. Without such information, effective policies and implementation plans will be difficult, if not impossible, to create.

Some data on resources are currently available. However, the data are dispersed among many agencies, cannot quickly be compiled for multi-sectoral, problem-oriented analysis and cannot possibly be current. In addition, data often are not disaggregated to show the impact of changes on the status of women and other important population sub-groups. As a result, the ability of technicians to provide a timely response to the information needs of decision makers is limited. Yet the use of resource information is critical to the effective creation and implementation of plans and policies.

Numerous inter-dependent physical and behavioral factors complicate the formulation of effective plans and policies. Thus, data from these different sectors must be integrated to successfully analyze the problems. A sound understanding of the complex interactions of these variables must be in hand to understand the intervening factors which influence resource problems and to predict the resultant effects of implementing new policy. Continuous monitoring must follow to measure results of policy changes and permit adjustment of policies as necessary to reach the desired effects.

When information needed to better understand and evaluate problems is lacking, the cost of devising and implementing solutions to those problems is great. The decentralized data for Sudan is costly to both the Government and the donor community. If data are not on hand to provide quick and easy information, inefficient and poorly timed solutions are likely to result. For example, by not having ready access to information, donors were not able to respond quickly to the 1984/86 famine situation. As a result, millions of additional dollars were spent to transport food to the west than would have been necessary if a system to provide information to decision makers had been in place.

It would seem clear that expenditure to develop a system that could save considerable resources would be well-spent. By integrating data from various related sectors and using these data for multiple purposes, the costs of the original data collection will be amortized over a variety of projects. Such a system also would reduce the duplication of effort that commonly occurs when one is unaware of data that have been gathered to address an identified problem. The savings gained by having timely data and by minimizing the duplication of effort allow decision makers to more effectively target and support other projects which will help develop resources and reduce human suffering. Sudan has a fragile environment, very limited resources and any wasteful duplication of effort should be

avoided at all costs.

In the last five years, one bilateral donor alone provided almost $500 million of support. This sum does not include food assistance, assistance from centrally-funded projects, or local currency contributions. Even a small increase in efficiency could result in substantial savings.

A.2 Specification of the Problem and Underlying Assumptions

Sudanese capacity to utilize and manage its human and natural resources is limited. Improving decision making capabilities to respond to a rapidly changing environment is required to address this problem. Underlying this issue is the assumption that if better information is available to the decision maker, better plans and policies will result. Further, implementation of better policies will contribute to growth and development through more effective management and utilization of resources. This improved decision making capability is essential if Sudan is to have the capability to assure food security, maintain and conserve its natural resource base, reduce famine emergencies, create economic stability, adequately provide for the health of its population, and address other problems.

A.3 Mechanism to Solve the Problem

To address the problem of inadequate utilization and

management of resources, the process of using information in the decision making process must be instilled within the operating procedures and structure of a country, especially the government. This will be successful only if the capability exists to provide information to decision makers on a timely basis through analyses of multi-sectoral data. A Resource Based Monitoring System (RBMS) can provide the necessary mechanism. The utilization of such a system should lead to improved decision making, which, in turn, should generate more effective policies, and ultimately would contribute to improving many of the difficult situations facing Sudan.

Some of the rudiments of an RBMS already exist to a greater extent than in many other African countries. Sudan has a base of relevant data (although terribly scattered and not easily integrated), and a reasonably well-trained pool of experts who are scattered just as the data are scattered. Sudan also participates, perhaps more extensively than other countries, in the Famine Early Warning System (FEWS); and FEWS has pioneered the kind of information system methodologies designed into this proposal.

FEWS, an Agricultural Planning and Statistics project (APS), and the Sudan Emergency Recovery and Information Surveillance System (SERISS), have already begun to demonstrate that developing country decision

makers are interested and able to take advantage of information systems. In 1987, the agricultural production estimates generated by SERISS were of such value to decision makers that they formed the basis for a parliamentary debate on food security.

A.4 Definition of RBMS

The concept of an RBMS is a new one to Sudan, as it is to many developing countries. Most decision makers recognize the problems which exist, and realize they need information to solve these problems. But, it will take a good deal of education and training to describe what is meant by the system that the RBMS proposes and how it can be utilized in problem solving. The RBMS described in this paper is an information system which uses geobased data to assist in making informed decisions based on the information provided by analysis of multi-sectoral data.

In order to avoid confusion, the following is a list of basic terms used.

Analysis: The function of manipulating data to provide information (i.e. analytical, spatial, statistical, etc.).

Data: An observation or measurement of a place or thing. Its form could be a statistic or map.

Decision makers: Users whose responsibilities include policy decisions and resource management and utilization.

Geobased data: Data that are linked to geographic coordinates, and can be analyzed and displayed in a spatial context.

Geographic information system: A system to merge, analyze, and output geobased spatial and tabular data.

Information: Products derived from the interpretation of data.

Informed decisions: Decisions which use increased and enhanced information derived from analysis of available data.

Multi-sectoral data: Data gathered from different disciplines (e.g. agriculture, health, nutrition, meteorology, etc..)

Resources: All human, natural and physical assets.

Users: Those who have an impact on resource management and utilization.

A.5 Benefits of Using a RBMS

A RBMS has the potential to provide the mechanism to make informed decisions. These decisions will effect policies for the utilization and management of human and natural resources. The RBMS is designed to:

* Create awareness and acceptance for using the best available information in the decision making process;

* make resource information available on a timely basis in response to decision maker needs;

* encourage interministerial cooperation in problem solving;

* create incentives for technicians to cooperative in problem solving;

* provide the capability to examine the potential effects of alternative policies;

* merge multi-sectoral data for integrated problem-oriented analysis;

* make the optimum use of available data;

* promote data sharing;

* employ microcomputer methods as appropriate technology;

* identify data gaps for establishing priorities for new data collection;

* provide output in a form for effective communication between resource technicians and decision makers;

* establish base-line data to monitor changes in the resource base.

A.6 Components of a RBMS

The RBMS proposed is composed of a Coordinator(s), Resource Centers, a Chief Executive, and a Core (including a Technical Advisory Committee), International Support Center(s), and decision makers. While all of these components must be present in some

capacity in the early stages of the project, they will only achieve their definition and full capabilities as the process develops.

The Coordinator(s) is an organization(s) that provides the links which tie the system together. The Coordinator needs to have good connections in both the technical and governmental dimensions. The Coordinator will identify Decision Makers, identify working groups for the Resource Centers, work with the Technical Advisory Committee and define incentives necessary to encourage participation among all components. Two types of Coordinators are envisioned. One is to act as an Interim Coordinator to conduct phase one of the project. One or more will act as a Study Broker(s) who will formulate projects for the Resource Centers and assist in creating awareness among decision makers.

The Resource Centers are the facilities for the key working groups of the system. The Resource Center is a facility having a data base and analysis capability. A team of specialists with expertise in disciplines necessary to study a problem use the Resource Center as an organizational structure to study their problem. These specialists will be identified by the Study Broker for a particular activity, and will often come from many different agencies. Initially, each Resource Center will

address only one problem or study. As the process evolves each Resource Center may host multiple studies. A Team Leader for a study will be identified by the Study Broker. The function of the Resource Center will be to manage specific data bases and to coordinate with the Core on the management of the data bases. This includes data gathering, analysis, statistical reporting, simple spatial display and distribution of the data. These Centers can be located in Ministries, regional governments, quasi-governmental agencies, and the private sector. Resource Centers are envisioned to have basic microcomputer capability, including the ability to spatially display data and conduct statistical analyses. Sophisticated analyses, beyond the capability of the Resource Centers, will be conducted in collaboration with the Core Center Facility (or International Support Centers). This approach will hold down costs of expensive equipment while providing advanced capabilities to the individual Resource Centers, which should concentrate on practical work and not on computer maintenance. At later stages, existing Sudanese capabilities, such as the Gezira Board Management Information System, Agricultural Planning and Statistics project, the Forestry Department's planned system, and others, which are currently oriented to single sector objectives, can be considered Resource Centers which will eventually network into the RBMS system.

The Chief Executive is the manager of the complete system. This person will be the interface with key Sudanese and donor participants and will coordinate policy approval. This person will be the non-voting Chair of the Technical Advisory Committee. It is the responsibility of the Chief Executive to raise awareness of the RBMS and promote its use. It will also be this person's responsibility to coordinate the preparation of and obtain approvals for the next phase of implementation design.

The Core Center is the central support of the RBMS. It should be established in an environment that provides the needed visibility and support. The Core Center will begin as a Technical Advisory Committee that is assembled by the Chief Executive of the RBMS and the Interim Coordinator, and will provide technical and management direction for the process. The Committee will be composed of delegates from the benefitting ministries and organizations, the Resource Center chiefs, and the donor community. Initially, much of the technical back-up will be provided by outside consultants and International Support Centers. Eventually, the Core Center must be developed to include the core data base, computers and geographic information system. The fully developed Core Center will have the following functions:

Managing computer systems, planning, training, interfacing with decision-makers, developing standards and screening data, managing data bases, digitizing data, cataloging data, creating sophisticated outputs, and maintaining equipment. The fully developed Core Center will not be in place by the end of the initial phase of the project. Given the newness of the concept, and need for a gestation period, the pace of full implementation is not expected to accelerate until after the first phase. The Core Center will also interface with other Sudanese centers of excellence, such as the National Remote Sensing Center, National Archives, and National Documentation Center.

The International Support Center(s) are sub-regional or regional specialized technology centers outside of Sudan which will provide technical support for all components of the RBMS. Such Centers would provide technical assistance necessary for the design and implementation of RBMS. These Centers will be heavily involved in the initial phases of the process, but their involvement will diminish as the Core Center develops capabilities.

Decision makers are those who control and manage resources. Specific decision makers who are working on critical issues will be targeted by the RBMS

for their involvement. Their interface with the RBMS will be through the Chief Executive, Coordinator(s), Technical Advisory Committee and the Team Leaders of the Resource Centers. Decision makers are the targeted audience to achieve the overall project goal.

A.7 Functions of RBMS

A.7.1 Identification of Problems, Information Requirements, and Interpretation Frameworks

~~Identification of Problems, Information Requirements, and Interpretation Frameworks~~

One of the essential functions of the RBMS is the identification of problems whose analysis will benefit from multi-sectoral data. RBMS will interface with decision makers and ask questions to identify those problems which they plan to take action on in the near future. RBMS will then identify the information necessary for addressing these problems and develop models for interpreting information from available data. Information often requires analysis of many types of data. Interpretation frameworks define the types of data and data characteristics necessary and describe the methods of combining and analyzing data. For example, grouping persons in the labor force by occupational code categories represents a simple interpretation framework to derive desired information. A more complex framework

is to then determine the employment status of the particular occupation. If data are available to define employment opportunities, one could then determine where shortages or surplus labor is available. The method of combining or analyzing the various pieces of data is the interpretation framework.

A.7.2 Identification of Necessary Data

~~Identification of Necessary Data~~

Identifying the needed data is the next step. The basic building blocks of the RBMS are the data. In Sudan, some resource data are available, but not readily accessible. Thus, one of the primary activities in building the RBMS is the creation of the data base. Once the data needs for a particular activity have been defined, an inventory will identify the available data to determine how much of the needed information already exists. These data will be compared to the defined information needs in order to identify data gaps. Data bases will be created from existing data and priorities will be established for collecting data that are missing.

A.7.3 Creation of Standard Operating Procedures

~~Creation of~~

The development of system operating procedures and guidelines is an important component in the management of the system. Multi-sectoral participation is a key to

the success of the RBMS and requires careful policy guidance and planning. Effective policies and plans will encourage technical participation by organizational units, promote cross-sectoral cooperation, promote system visibility and acceptance, and assure adequate system resources.

The Sudanese must develop their own operating policies if they will be expected to follow them. Indicative of policies and procedures which must be defined are, for example, who has priority on system use; how will a fee be structured to sustain the system; how does one define new activities; how does one target decision makers; does one distribute data from a central facility or from individual Ministries; and many other questions.

A.7.4 Establishment of Data Standards and Guidelines ~~Establishment of Data Standards and Guidelines~~

Some of the most important policies are related to the standards and guidelines for the data in the RBMS. The standards and guidelines for data are especially important because the data will be derived from multiple sources. General guidelines and standards, consistent with regional and international standards, need to be

established which specify the quality and characteristics of the data. A source and reliability statement that discusses data standards (describing the framework and methods of collection, target population, sample design, etc..) should accompany all data sets. The standards and guidelines are necessary to insure that data will have utility and reliability for multiple purposes, are consistent for comparability and that data sets can be efficiently processed. For example, if studies in separate district councils of a province measured literacy, a useful provincial estimate could not be obtained by combining these data unless some uniformity in the definition of, and calculation of, literacy estimates were used.

A.7.5 Development of the Data Base

Development of the data base is key to the success of providing a quick response to decision maker inquiries. Data will be screened to conform to the RBMS standards and guidelines. The data will be map registered for storage by geographic coordinates. Since all data will be registered to a map base, they will consequently be registered to each other for retrieval and analysis.

Thus, for example, by having separate date on soils

and land use registered to a map base, these data can be overlaid and more information would be available from each map separately. Determining where agricultural intensification could occur in a locality requires knowing where soils are suitable for use as agriculture land and which lands are now being used in agriculture. The remaining areas could then be further developed. Both types of data have to be consulted to provide the information, and the data have to be geographically registered.

A.7.6 Management of the System ~~Management of the System~~

The RBMS is an activity that is based on rapidly evolving technologies, and is, therefore, conceived as an evolutionary process. Development of a RBMS requires a flexible implementation strategy to assure the system is available and capable of providing information quickly at times when various needs are critical for decision makers. The managers of the RBMS will know where the process begins, and roughly what the expected outcomes are, but the path between the two may not be clear. However, certain parts can be determined ahead of time and management will need tools to guide system evolution. Specific recommendations will need to be made for many of the parts of the RBMS system, with the

understanding that alterations to the system design will occur during the definition and implementation of the process. This sort of implementation strategy will place an added responsibility on the management of the RBMS. The managers of the RBMS will need the technical competence and experience to recognize opportunities and to avoid pitfalls as advanced satellite and monitoring systems and international data storage and distribution networks are put in place over the next several years. This will be a key issue during implementation.

The RBMS will also require the acquisition and maintenance of computer equipment. The maintenance function of the computers will be determined by the specifications of the equipment, but, in addressing the maintenance needs, Sudanese will be trained to perform basic computer system maintenance. Whenever possible, both software and hardware choices will be standardized, thus simplifying the maintenance requirements. The increased capabilities of microcomputers for use in information systems permits the use of the kinds of modern, efficient software necessary to operate the RBMS.

A.7.7 Staff Development~~Staff Development~~

Training will be necessary to ensure the

Sudanization of the RBMS, and serve as an incentive to ensure that motivated Sudanese participate in the RBMS. Many of the concepts which are basic to the process, as well as the skills needed to run the systems, are new. Training will be required throughout the process in areas such as decision maker awareness, digitizing and mapping techniques, computer operation, statistical analyses, image processing, and equipment maintenance.

B. Goal and Purpose

B.1 Goal

The goal of the Resource Based Monitoring System is to improve capacity for effective utilization and management of human, natural and physical resources. The many challenges facing Sudan demand an increased capacity for developing effective policies for the utilization and management of the country's resource base. The absence of a system hampers the country's ability to manage and effectively utilize its resources.

Achievement of the goal requires implementing a process to rapidly link information to decision making. The assumption is that better information will lead to better planning. The process of developing an

RBMS will develop numerous strengths in the areas of data management, analysis, presentation, and use. Analytical capabilities should also be greatly enhanced.

The system must facilitate the use of integrated multi-sectoral data to address complex problems dealing with maintenance and conservation of the resource base, addressing human resource needs, increasing economic stability, and related development issues. Historic data are often the only data that are available to decision makers on a timely basis. In addition, these data provide a base-line of information necessary to assess change in the condition of a resource. Establishing an integrated data system will provide useful information to decision makers and improve the capacity of the country to effectively utilize and manage its resources.

B.2 Purpose

The purpose of the proposal is to establish the basis for a sustainable Resource Based Monitoring System. The activity described is the first phase of a longer process. It will establish an initial RBMS as a prototype for evaluation and subsequent design of a sustainable system. Since the complete concept has not been tested in other developing countries, no lessons

learned can be used in the initial design. Activities to reach the desired goal are scheduled in phases to allow periodic evaluations. These evaluations should establish a) if the type of technology being transferred is being effectively used, b) if Sudan is accepting the concept of using resource information in the decision making process, and c) if Sudan is developing the approach of information sharing for multi-sector analysis. This phased implementation strategy will reduce the risk in making capital investments necessary to test the concept of implementing the full system.

C. Expected Achievements and Accomplishments

C.1 Awareness Established

There are two direct indicators which would illustrate that an appropriate level of awareness has been generated by the project. The first will be evident if, upon completion of the initial phase, the Government requests continuation of the RBMS development process. The second indication is the utilization of the RBMS by decision makers.

Since this activity would represent the initial phase of an evolutionary process, one of the key achievements required is that the awareness of the

utility of an RBMS is established among decision makers in both the public and private sectors. Such awareness will be realized only through the cooperative efforts of all involved in the system. During the term of Phase I an indirect measure of success achieved will be reflected in the extent to which decision makers facilitate the continued operation of the RBMS.

C.2 Implementation Design Determined

By the conclusion of the first phase, the RBMS design will be documented. Crucial components of the system will have been identified or established. A Technical Advisory Committee will be established and functional. This Committee will define RBMS operating policies and be composed of Sudanese and donor organizations utilizing the system.

Another aspect of the final system design that will evolve over the course of the first phase will be the establishment of the relationships and incentives required between the various functional components of the RBMS. These relationships determine the functional capability of the system. For example, data sharing, multi-sectoral analyses, and the adoption of standardized data functions are dependent on establishing the many relationships between the Resource

Centers, the Core Center Facility, the Coordinators and the Technical Advisory Committee.

Finally, an expected accomplishment included in the final design will be the specification of the institutional linkages of the system. This covers the inter-relationships between the various ministries and non-governmental organizations. The procedures for data sharing and dissemination and the introduction of new activities and Resource Centers will have been determined.

C.3 Selected RBMS Components Functional

The fully developed RBMS system will not be operational until subsequent phases of the process are completed. At the end of Phase I, a minimum of five (5) Resource Centers will be operational. Limited functions of the Core will have been established. These functions are expected to include training, guidelines for operation and basic maintenance.

The core data base for the RBMS will have been partially established. Standard data, such as the Sudan Survey Department 1:1,000,000 base maps, will have been entered. The data base will include data as developed and used by the Resource Centers. Also included will

be selected data from various ministries and other government and non-governmental organizations. The data included in the data base will have been screened for conformity to standards and guidelines developed through the Technical Advisory Committee.

C.3.1 Link to Early Warning and Development

Early warning and development projects rely on similar types of data and analysis procedures that will be implemented in the RBMS. The RBMS will provide a critical function by archiving base-line data from which information relevant to early warning and development, such as the existence, location, extent, and status of resources, can be derived. With this information, resource potentials and limitations can be identified and sites or sectors targeted which are under-utilized, and may be candidates for development, or over-utilized, and, thus, vulnerable to degradation and human suffering. The RBMS will provide a mechanism to understand the processes involved in the complex interactions which affect the design of early warning and development projects.

Early warning systems rely on the use of indicators and measures to monitor changes in conditions. These indicators are especially monitored within targeted

vulnerable areas. For example, the Sudan Emergency Recovery and Information Surveillance System (SERISS) estimates the amount of current agricultural production and nutritional condition of the vulnerable traditional agricultural areas in western Sudan. The Famine Early Warning System (FEWS), as presently implemented across the Sahel, is not a primary data collection effort, and, therefore, must rely on existing data, such as data produced by SERISS. The RBMS will provide a mechanism to promote standardization and to merge the SERISS data with other types of data. This will provide an archive of base line data against which changes can be monitored and assessed. Therefore, direct links between monitoring programs, such as SERISS, which provide input for FEWS, and the RBMS will provide a method to use historic data to assess changes and target populations at risk, and will continue to build the archive through input of reliable data.

Development projects must assess the potential and limitations of resources to define appropriate inputs which could bring about desired changes. The RBMS can serve development projects by providing an archive of existing data for analysis and for defining targets of opportunity for development. The system also will provide a means of assessing the impact of resource-related development projects. The integrated data base

of the RBMS will provide the capability to accomplish these tasks on a multi-sectoral basis. Development projects, in turn, will serve the RBMS by providing additional baseline data to the archive for enhancing the understanding of the country's resources. The incentive to each group is they both receive benefits by cooperation.

C.3.2 Data System Improved

Improvements will be realized with respect to data standardization, use, archiving, cost, and interpretation. The Technical Advisory Committee will define guidelines regarding the types, quality, and formats of data which will be accepted for entry into the core data base. Related to this activity, procedures for the archiving, cataloging, and sharing of data among the various users and Resource Centers will be established. Data transfer through networking will be defined to accomplish data entry, archiving, sharing, and distribution.

The RBMS will provide cost-effective data for use in a variety of resource policy issues. Since data are expensive to collect, it is important to derive as much information as possible from the data. By merging and aggregating available data across project studies,

subsequent data collection costs will be reduced. Decision maker requests for new information for a region may, in some cases, be met by locating and analyzing existing data which are site-specific, but which can be aggregated with other site-specific data for regional studies. This not only decreases the cost of regional studies, but allows amortized costs of the original site-specific data.

The value of interpretations from any one data source will be increased since the RBMS will provide a mechanism of integrated analysis of these data with other interacting variables or data layers. Thus, interpretations provide information that is of more direct value to the decision makers.

The systematic archive will provide a method to determine where data gaps exist. As decision makers assign priorities to the types of information required, a rapid analysis of the data base will allow determination of the limitations of the information available. A decision can be made as to whether or not to take an action given these limitations or to acquire more data to complete the information required before taking any action.

C.4 Sudanese Trained

Sudanese technicians and decision makers will receive training through short and long term training both in-country and abroad. To assure the long-term viability of the project, the training function could be integrated into the university system. Intensive training by outside consultants would be provided to faculty at the University of Khartoum. They, in turn, would provide both short-term training and integrate the RBMS concepts into the educational process. In addition, the University would benefit from active participation in RBMS in terms of faculty incentives through access to sophisticated technology for general education purposes. Initially, this training will emphasize the use and maintenance of computer systems, and analysis techniques. Other training, such as the more technical aspects of developing a geographic information system, will be developed. Training covering the use and maintenance of the RBMS will occur throughout implementation. In addition, decision makers will be made aware of RBMS through in-country workshops which will underline the relationship between information and policy decisions.

D. Proposal Outline

D.1 Implementation

Establishing RBMS will require a lengthy gestation period. Therefore, establishing a RBMS should be considered a long-term process, with this activity being the first phase. Establishing a RBMS will involve not only constructing a sophisticated system, but also changing ingrained habits of thinking and methodology.

In Phase I, the objectives are to create awareness, initiate all the elements of the systems, create a series of incentives to assure participation, gain operating experience, and use the experience to formulate a final system design. In Phase I, the emphasis is on the projects in the Resource Centers. The Resource Centers must become operational and have an impact on decision making. Initially, the attention given to the Core Center is relatively small, and basically only sufficient to bring coherence and support to the system as a whole. In Phase II, emphasis will shift to enhancing the capabilities of the Core Center, in particular making it more independent from the International Support Center(s), and establishing a routine mechanism for introducing new activities and Resource Centers. Subsequent phases would involve completing the evolution of the system elements, and adjusting the design to take advantage of lessons learned while operating the system.

Throughout the process the system will be progressively integrated into the Sudanese decision-making process. In Phase I, this amounts to creating awareness and incentives to participate; in Phase II to increasing the system's capacity and expanding its use to a larger pool of users. Subsequent phases will emphasize using the RBMS on a routine basis to improve the incorporation of information into the decision making process, as well as cooperating with other regional and international data systems.

D.2 Phase I

The duration of Phase I is expected to be five (5) years. The approach of Phase I in implementing the process is designed to generate awareness of the capabilities of RBMS among decision makers and to nurture the embryonic elements of the complete system, thus creating sustainable demand for its continued growth. The difficulty in constructing the implementation strategy is that this is a prototype system, and the experience to evaluate tradeoffs is lacking. Thus, the most appropriate strategy appears to be a sequence of "small steps" that allow each step to benefit from the experience gained in previous steps. However, from the beginning, RBMS will need to satisfy

all essential functions that range across the system elements.

A key design issue is the institutional siting of the Core Center facility. In the end, the investment in the Core Center facility will be the single largest expense. Several locations for the facility have been considered and the main contenders reduced to four. The alternatives are: The Institute of Environmental Studies (IES, University of Khartoum), the Ministry of Agriculture and Natural Resources (MANR), the National Council for Research (NCR) and the private sector.

While each of the potential sites have particular strengths, each, unfortunately, has at least one significant weakness. The IES has the advantages of already being familiar with multi-disciplinary analysis methods and having a proven record of conducting quality resource-related research. The major limitation of the IES is the absence of a strong and direct link between the IES and high level policy decision makers which works. The MANR has the advantages of being able to collect related data, well-trained staff, a good relationship with donors, and influence within the Government of Sudan. Major drawbacks to locating the facility in the MANR are its single sectoral interest, the absence of a logical

department in the MANR to site the facility, and poor interdepartmental and ministerial cooperation. The NCR advantages include its close connection to the Prime Minister, its functional neutrality, and a mandate which cuts across ministries and regional governments, thus allowing for significant interaction between data suppliers and information users. The principle disadvantage is that it may not currently be a sufficiently dynamic institution to fully implement the activity. Finally, the private sector has the advantages of profit potential and the incentive to provide a sustainable system through the assessment of user fees. A major disadvantage is that the private sector is not integrated with the governments decision making process. On balance, one is inclined to recommend the National Council of Research as the site of the Core Center facility. In the end, however, the Sudanese should decide where the facility will be ultimately be located. If they can come to a sound decision, the various sectors will be more likely to use the shared facility. Thus, a premature decision should be avoided--in which case the final selection may be delayed and, in the meantime, an Interim Coordinator be designated.

Since there is little direct experience to evaluate the importance of each of the weaknesses

discussed above, a strategy has been formulated which would delay the determination of the location of the Core Center facility, while, at the same time, initiating the Core functions. The virtue of delaying the selection of the location of the facility is that it will allow the postponement of large capital investments until later in the process when more information will be available and, presumably, a more confident decision can be made. Notwithstanding, the need to establish Core Center functions at the outset was equally evident by the recognition that guidance and coordination of the RBMS was vital to the expected achievements of Phase I.

Three design alternatives were considered. The first alternative considered locating the Core Center facility at the outset (at the recommended site--NCR) and also initiating the functions of the core at the NCR. This alternative was rejected due to the undesirability of fixing the location of the Core Center facility prematurely. The second option considered delaying the choice of the site of the Core Center facility, as well as delaying the policy and guidance functions of the Core. This option was unattractive because of the lack of any real, early guidance for the system. It also appeared weak in its ability to promote multi-sectoral analysis and data sharing. The third

alternative proposed to delay selecting the location of the Core Center facility while starting selected functions of the Core (particularly the guidance function) at the outset. This alternative was preferred for two reasons. First, there was a consensus among those most familiar with Sudan that an activity like this could not get started without sufficient high level influence at the outset. Second, it provides a compromise between the first two options in terms of guidance. Delaying the selection of the site for the Core Center facility also has the benefit of delaying setting up the expensive infrastructure until more system experience is available.

D.3 Implementation Strategy

As illustrated in Figure 1, implementation is envisioned as being carried out along two parallel, but mutually reinforcing tracks. One track develops the Resource Centers.

The other establishes the nexus of project elements that is the Core Center. This track is termed the RBMS Design Track. The implementation plan will, it is hoped, contribute to awareness of the utility of a RBMS through the demonstration of the performance of the pilot Resource Center activities. At the same time, development of the Core Center will begin in a way that

provides a sufficient level of visibility to make the activity viable, and provide the requisite overall guidance and support. The middle portion of the plan (see Figure 1) is devoted to the Sudanese developing experience in informed decision-making, multi-sectoral analysis, data sharing, and the acceptance of a system of guidelines.

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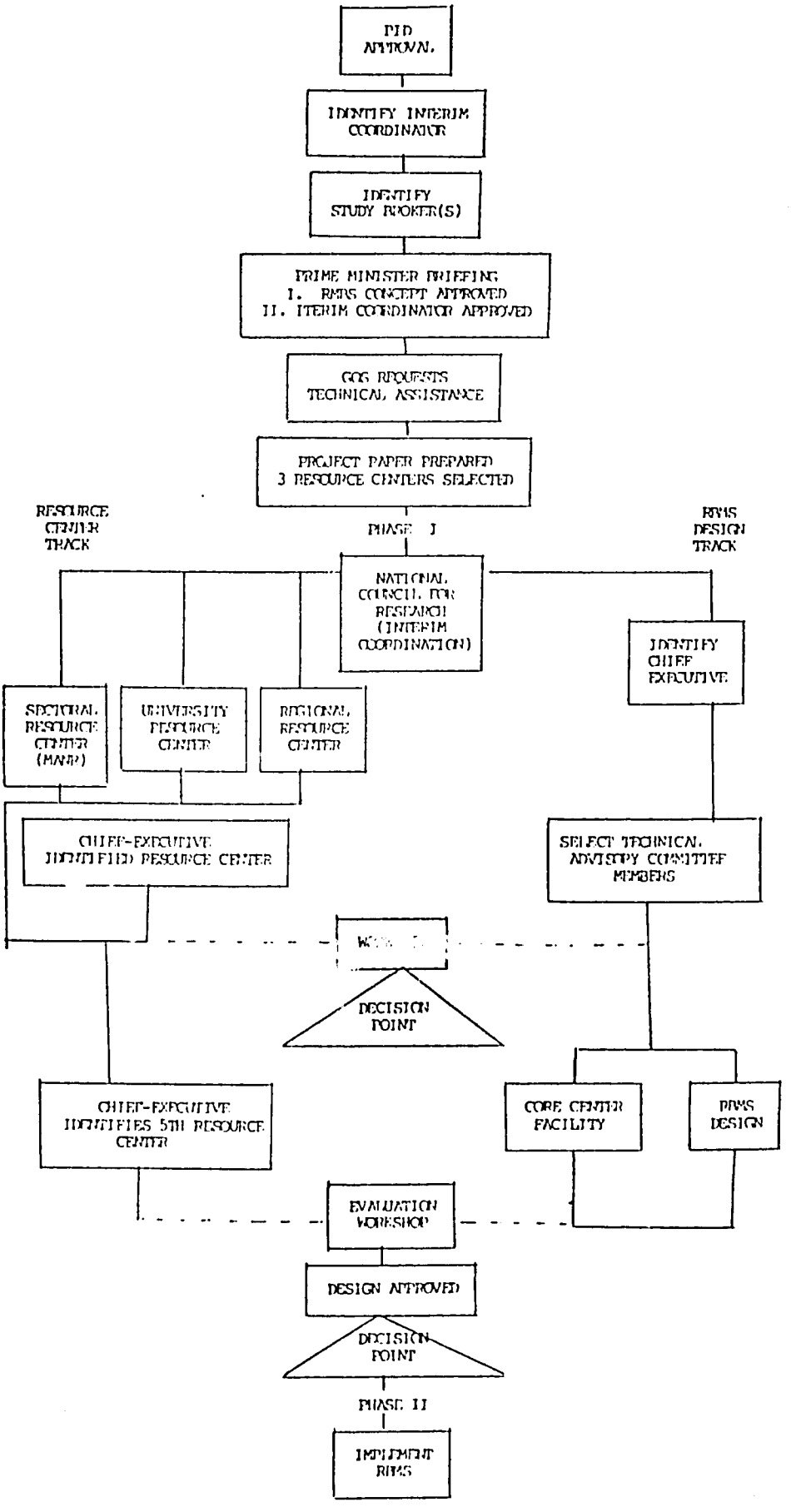
FIGURE 3. ~~PERT CHART~~



(Fig. 1 goes here)

Implementation involves the transfer of modern technology, but in a phased approach staying within the bounds of sophistication to assure the technology is appropriate for transfer and manageable by Sudanese. Information system capabilities are rapidly migrating to microcomputers. Many functioning microcomputers are already in use throughout Sudan. The early stages will use microcomputers before establishing a more sophisticated system in the Core Center Facility. This should provide experience in maintaining systems prior to implementing more complex technology. In addition, the RBMS is designed to concentrate system maintenance within the Core Center staff, so that trained staff can self service routine maintenance throughout the system.

D.3.1 Resource Centers

The early emphasis of effort will be on the Resource Centers (see Figure 1). During this stage, choosing locations and activities will be based on the identification of Decision Makers with the skills and personality to establish a good working relationship with the activity, and who can bring visibility to the system.

It has been suggested that there would be additional benefits to the system if at least one Decision-Maker were involved in regional government, and if another were at the most senior levels of the central government. After the decision-makers are chosen, the pilot activities have to be chosen. The Study Brokers will assist in the selection and design of the activities. The selection criteria should be that the underlying problem is amenable to multi-sectoral analysis, germane to the Decision Maker's basic responsibilities, and will provide demonstrable results by the time of the first workshop. The final step is to physically locate the system and arrange for the analysis team. It is recommended that one Resource Center be located in Kordofan province, and one in the Ministry of Agriculture. Another Resource Center will be established at the beginning of project implementation. This Resource Center will be in the University of Khartoum, Geography Department, and will provide short and long term benefits. In the short term, it could be used to produce people skilled in using a Geographic Information System (GIS) and could provide basic services and increased system capability to the other Resource Centers. In the long term, it could introduce potential future decision makers to the concepts underlying a RBMS. A fourth system will be chosen by the Chief Executive (CE) in the early stages of implementation. The purpose

is to provide some incentive to the CE, but, more importantly, to provide on-the-job training in setting up systems.

Subsequently, the fifth Resource Center will be established during Phase I. This will occur after the Core establishes a permanent mechanism for introducing new projects/centers, and, thus, permit testing of that mechanism.

Finally, after significant results are available from the pilot activities (mid-term of Phase I), a decision-maker workshop, professionally organized by the activity, will be held to promote awareness. The performance of the pilot activities should be used as the vehicle to stimulate the interests of the attendees. Hopefully, the workshop will provide sufficient interest to act as the springboard to setting up the Core Center facility. This will be a major decision point. It must be determined, inter alia, if there is sufficient interest to warrant the expenditure for setting up the facility and continuing with the RBMS.

D.4.2 Core System Design

The efficient functioning of the Core Center is fundamental for sustaining the RBMS and reaching the

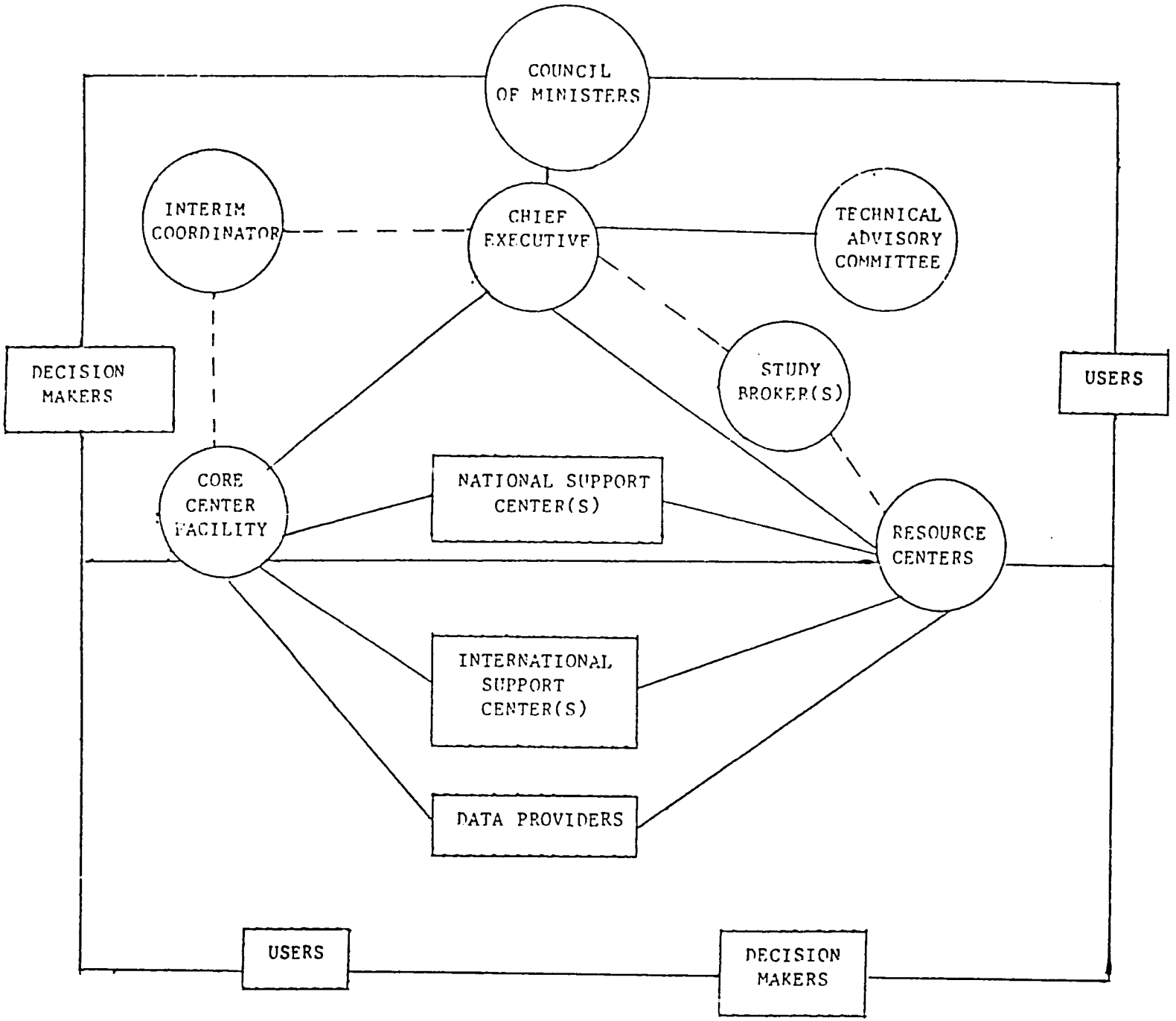


FIGURE 2. RELATIONSHIP OF COMPONENTS OF RRMS

overall goals. Therefore, selection of its location is critical and should be pursued with caution. It is recommended that the Technical Advisory Committee report via its Chief Executive directly to the Council of Ministers (Figure 2). The contingency is for the Chief Executive to report to a neutral, but visible organization. If the contingency plan requires implementation, it is recommended this organization be the National Council for Research. Early political interest and support from the government would be a decided advantage for providing visibility to the RBMS and to the design of a useful and sustainable system. Therefore, a visit with the Head of Government will be requested after initial approval of the proposal, but before the final activity design is undertaken.

(Figure 2 goes here)

The meeting will serve multiple purposes. The concept for RBMS will be presented using GIS briefing materials which are available for Sudan. The strategy for implementing the RBMS, including the need for selecting an appropriate Chief Executive and site for the Core Center, will be discussed. The initiation of a request for technical assistance from the Government will be established. The use of the National Council for Research as the Interim Coordinator for the first

phase will be suggested for approval. A request for direct participation of one Sudanese staff (most probably from NCR) in preparing the final design will be made in order to assure that the RBMS is designed to be responsive to Sudan's most critical problems. The actual naming of a Chief Executive will not be requested at this time. However, the Head of Government should be briefed that this individual is a key person in the RBMS and that personal skills of the Chief Executive will be critical to the success of the project. The Chief Executive should be a dynamic individual capable of spearheading the awareness campaign, managing the system, creating incentives for participating in the RBMS and understanding the system from the technical perspective.

One of the first RBMS activities will be to select Study Brokers. The Study Brokers' concept is modeled after an approach developed by the Institute of Environmental Studies at the University of Khartoum. Study Brokers will assemble activity specific multi-disciplinary teams of highly skilled technical experts from the University, government, and the private sector. They will also pull together data bases for activities. Among the first tasks of the Study Brokers will be to staff the pilot activities. A potential Study Broker identified is the Institute of Environmental Studies.

The Core will be established from the outset, but will begin as a Committee and evolve into an operational center. Managing the maturation of the Core and siting the Core Center Facility will be one of the most difficult aspects of the proposal. While one must recognize when the Core Center can bring functions on-line, and when functions can be executed reliably, RBMS management must assure that the emphasis of Phase I remains to provide awareness and must not allow the Core activities to become weighted such that progress of the Resource Centers is impaired.

To avoid wasteful mis-steps, provision should be made for the option of short term technical assistance to help manage the activity of the Technical Advisory Committee. Although the Committee members will be well-qualified within their field of expertise, it would be reasonable to expect them to be relatively uninformed about the exigencies of operating a GIS. Therefore, it may be advisable to help the Committee structure or formulate the issues to be resolved. It may also be useful to have managerial expertise available to help craft a sequence of Committee meeting agendas designed to formulate issues, encourage active participation, and maximize productivity.

Rounding out the Core will be its use of the International Support Center(s). Any functions that cannot be handled by the Technical Committee will need to be contracted to facilities, most likely outside of Sudan, capable of providing those functions to the Resource Centers. The contracts should be flexible in terms of level of effort so that it can decrease as the Core matures.

Once a suitable level of awareness is achieved, the Core Center facility should be established. After this step, all the elements of the entire RBMS will exist. At the conclusion of Phase I, the experience gained from operating the entire system should be used to make the long-term system design. The last step in the activity will be to gain approval of the design so that it can be used in Phase II.

IV. OTHER FACTORS

A. Social Considerations

A.1 Socio-cultural Feasibility

The proposed RBMS will form the basis for a sustainable Resource Based Monitoring System to assist

decision makers in their capability to respond to resource-related problems. Such a system should prove beneficial through the assumption that a better information system leads to more effective policies, and that more effective policies improve the physical and social conditions of the country. Since data considered for the system will be selected based on the identification of problems in the areas of human, natural and physical resources, those segments of the population and environment most in need should derive the most benefit from the system.

One issue to consider in determining feasibility is whether or not there exists sufficient willingness between the relevant resource disciplines to cooperate with each other toward resolving problems through sharing data and information. Currently, interdisciplinary coordination of effort and cooperation appears minimal. The potential high visibility of the proposed project that will result from the inclusion of a Chief Executive and Technical Advisory Committee, who will report to the Head of Government through tne Council of Ministers, should contribute toward reducing existing barriers to cooperate. Furthermore, as the implementation of the RBMS gets underway, the better products made available by the system to decision makers are expected to promote data sharing.

A.2 Impact

By improving the data system and thereby improving decision making capabilities, the project will benefit decision makers. The resulting policies formulated by decision makers should have a positive impact upon those physical and human resource groups targeted as specific problem areas. Over the course of the entire process, a fully operational RBMS will have the potential to impact on the entire spectrum of resource-related problems. As more and more data pertinent to the system are incorporated, the cost required to provide input into resolving problems will be reduced.

The country will also derive benefits associated with the development of trained personnel. By training Sudanese in the use, operation, maintenance, and management of RBMS, both current and future generations of decision makers will be available to further the ability of the country to effectively deal with many serious resource problems.

A.3 Sustainability and Spread

The potential sustainability of the system will

be increased as the achievements of the project are realized. For example, the level of awareness of the RBMS created during Phase I will be directly related to the system's sustainability. Whether or not the Resource Centers are able to begin linking their information by the end of Phase I also will be important with respect to system sustainability. Other achievements in the areas of training and transferring technology are vital to sustain the system. The system also must develop methods to provide for the loss of trained personnel to foreign employment opportunities if the RBMS is to be sustainable.

The spread of the RBMS is, in part, a function of the success of the Study Brokers, the Chief Executive, the Resource Center Decision Makers, the coordinator(s), and other human RBMS components in promoting awareness of the utility of the RBMS. The actual use of RBMS information by Resource Center Decision Makers to help resolve resource-related problems is another important factor affecting the spread of the RBMS. If Decision Makers outside of the Resource Centers are able to observe the success of the Resource Centers, and if those decision makers have problems and data that can be spatially-linked to resources, then they will presumably want their area to be considered as a new Resource Center, or at least to have access to the RBMS

information.

A.4 Women in Development

One of the key human resource issues facing developing countries is the role of women and the impact of development projects on their well-being. The RBMS can have a significant impact on issues related to women.

By setting guidelines for the screening and archiving of data, the RBMS will be able to include gender-specific data in the system. Furthermore, by identifying data gaps, the RBMS will be able to help in the design of questionnaires and data collection tools which will allow disaggregation of data by gender. These data can then be analyzed.to determine the impact of development activities on women. Where possible, the RBMS also will have the ability to gather and perform analyses of existing data which may provide information on gender-related issues. It is these kinds of analyses that will provide the information needed to assess outcomes of current projects and to successfully design future projects.

B. Economic Considerations

The proposed project is seeking to create an

institution and to transfer technology in the form of analytical skills through formal and on-the-job training. In these cases, traditional economic evaluation techniques are often inappropriate tools to evaluate the activity's value to society. The economic review, therefore, considered what appear's to be necessary preconditions for project success. Key among these preconditions are a commitment on part of the Government to see such a system not only institutionalized, but also to be effectively utilized; the availability of data that could be utilized in such a system; and the availability of trained human resources, as there is a high turnover of skilled individuals, either through emigration or through movement to more lucrative employment within the country.

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B.1 Costs of the Proposed System. The overall costs of the system will depend upon a number of factors, but the most important would be related to:

a) Determination and location of the number of Resource Centers. If a Resource Center is located in an institution which already has some information system capabilities, then the capital costs could be reduced by adding on to the existing system. This will not only be in the area of hardware, but also in training of staff.

An example of such an instance could be the existing activities of the Ministry of Agriculture and the World Bank financed Management Information System which has been designed for the Gezira scheme. Similarly, location of system components (in distance) away from the Core Center functions would influence costs.

b) The type of technology utilized and the training program required for use of the technology. The RBMS, if implemented successfully, would represent a major jump in the type of both hardware and software that is currently being utilized. A determination would need to be made if a similar type of technology would be made available to all Resource Centers, or if the technology utilized would be specific to each Resource Center. There are costs and benefits to each approach. Utilizing a common technology base makes training easier, and also generates the capacity to replicate and makes human resources more mobile. But, the cost could be a loss of specificity in task. Similarly, while the technology used in the Resource Centers could be less intensive, and of a lower level than that used at the Cores, the Core Center technology should be easily utilized by those from the Resource Centers.

c) Time period for phase-in of the Resource Centers and establishment of the Core Center.

Local currency costs could easily escalate due to inflation pressures. This would be especially true if the Resource Centers are located in regions where transport costs are very high, e.g. Kordofan.

d) Types of data to be used in the system. If the RBMS is to emphasize the use of existing data, then it is important to identify the Resource Centers and the data available at these Centers. This will place limits on the data to be in the system and make the costs reasonable, as well as the system manageable.

B.2 Appropriateness of Investing in RBMS delete extra line

Currently, a number of government and donor activities exist which are dependent on data collection and analysis. However, there is no unique activity which attempts to synthesize existing data and make them available to policy makers in a decision-making real time environment. The RBMS is a proposal for such a system. As such, it is very difficult to quantify the value of such a system. Its value is dependent upon the type of decisions that it is used to influence. For example, timely information on crop conditions and decisions related to release of sorghum stocks for food distribution or export could only be valued at the time of the event. This system could also be viewed as being

used to prevent incorrect decisions or decisions made without a data base. Hence, in value terms, it is quite difficult to value the stream of benefits from the system.

However, the system (RBMS) could be evaluated in terms of what would costs be to the country if the system was not available to influence specific policy decisions, e.g. loss of foreign exchange earnings, loss of crop production, etc.. In evaluating the economics of the system, the analysis should take into account various alternatives where the alternatives are related to the composition of the Resource Centers and the Core Center. For example, alternative I could be of 2 resource centers in Western Sudan and a core center in Khartoum while alternative could be 1 resource center in Western Sudan, 1 in the Gezira scheme and a core center in Khartoum.

V. Conclusions

(To be completed)

VI. References

1. Mathews, Jessica Tuchman. "Redefining Security", Foreign Affairs, Spring 1989. Pages 162-177.

2. Gore, Albert Jr. "Our Global Eco-Blindness", The Washington Past, May 14, 1989, Outlook, Commentary and Opinion.

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5. Thacher, Peter S. Address entitled "The Environmental Crisis: The Role of New Communications Services". 1989 Conference of the International Institute of Communications, Paris, France, September 7, 1989.

6. Time, June 5, 1989. "Taking the Earth's Vital Signs". Pages 72-74.

7. Humphlett, Hanrahan, Fletcher and Smith

Satellite Technology and World Food Security. Congressional Research Service Report for Congress, October 10, 1989.

8. The concept for the RBMS proposal was developed initially in Sudan in collaboration with, inter alia, Jonathan Alsson, Donald Moore, Hassam M. Hassam, Eric Rodenburg, Thomas Loveland, Nancy Mock and Linda Usdin to whom the author, who was the USAID Mission Director at the time, acknowledges with appreciation their contribution.

TUFTS UNIVERSITY
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Note

Dear Ray:

Herewith a draft copy of a paper I propose to submit to ERIM's 23rd Symposium on Remote Sensing of Environment to be held this April. For the time being I am calling it "Prototype for a Resourse Base Monitoring System", but let's hope someone can come up with a better title.

I would very much appreciate your taking the time to read this dratt, and return any critical comments and suggestions you have to me so that I can incorporate them in the final version.

Many thanks in advance.

Best regards.

Sincerely yours,

John W. Koehring
Diplomat-in-Residence

Medford, Massachusetts 02155
617 628-7010

FAX: 617-628-5508

14-

TUFTS UNIVERSITY
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January 11, 1990

Mr. Allan K. Parker
ERIM
P. O. Box 8618
Ann Arbor, MI 48107-8618

Dear Mr. Parker:

I am pleased to acknowledge your letter inviting me to serve as one of the co-chairmen of the Plenary Session "Solutions to the Technology Transfer Problem" at the 23rd International Symposium on Remote Sensing of Environment, to be held in Bangkok, Thailand, April 18th through April 25, 1990 and wish to confirm that I accept your kind invitation.

In this capacity, I understand that I can invite three papers in the subject area. The persons I wish to invite to present papers are as follows:

Hassan M. Hassan, Environment Department
The World Bank
1818 8th St., NW
Washington, DC 20433.

Dr. Hassan's paper will deal with the organizational options open to the international community in managing the resource base and environmental information networks that exist and are being developed.

Robert A. Bisson, Chairman of the Board
BCI Geonetics, Inc.
Airport Road
P. O. Box 529
Laconia, NH 30247

Mr. Bissen's paper will deal with the practical application of remote sensing as it relates to exploration for water in fractured bedrock.

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Allan Falconer, Principal Scientist
c/o TGS Technology, Inc.
EROS Data Center
Sioux Falls, SD, 57918

Mr. Falconer's paper will discuss recent practical applications of remote sensing and geographic information systems in preparing land resource inventories as well as several of the constraints inherent in developing national capabilities for resourse base monitoring.

I understand that ERIM will contact each of these gentlemen and provide them with information that they require to participate in the Symposium. If further information or action is required of me, please let me know.

You might wish to send a copy of this letter to Dr. Forester. As soon as I will have an opportunity, I will be writing to him and will forward a copy in any case.

A colleague of yours at ERIM, Tom Wagner, recently forwarded me a copy of a paper by Jefferson Fox entitled "Spatial Information for Resource Management in Asia: A Review of Institutional and Organizational Issues". It is a good paper, which brings out some of the same points which I am trying to take into account in the paper I'm preparing on national resourse base monitoring systems in less developed countries. The paper would be a useful contribution to the Symposium. How does one go about soliciting a paper such as this, and is there room on the agenda to accommodate an additional paper or presentation?

If you have any questions, please feel free to contact me at the Fletcher School, telephone number 617-628-7010, Ext. 2706.

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