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EFFECTIVE RESOURCE INVENTORY IN THE SAHEL: PLANNING IMPLEMENTATION AND UTILIZATION

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INTRODUCTION

This Issues paper is prepared as an introduction and problem definition for a workshop sponsored by USAID on "... Sahel Resource Inventory and Mapping Coordination..." The workshop is planned for Bamako, Mali, in the period May 20-25, 1982. This paper identifies the present situation and major constraints or problems in:

a. The possible development of guidelines for the standardization/compatibility of inventory techniques and mapping work across the region;

b. Measures that will improve utilization of project outputs and their periodic updating.

The paper is based on interviews with concerned persons in agencies doing resource inventory work in the Sahel, with Mali Government personnel and on personal experience and knowledge of factors involved in performing natural resource inventories and effecting their use by the developing nations. It is the intention of the organizers that this paper will be used together with a case study, the Mali Land Use Inventory Project (688-0205), and with other project reports given at the workshop as

points of departure for deliberations by the conference. The workshop will be expected to come up with a set of guidelines for improving the effectiveness of natural resources inventory in the Sahelian region.

It is emphasized that the improvement of effectiveness of inventory projects must concern preplanning, planning, implementation and use of results. The scope of work statement uses the expression: "... guidelines for the standardization of inventory techniques." This writer seriously doubts that rigorous standardization of techniques at this time will achieve what USAID has in mind.

The real issue should be comparability or compatibility of data from survey to survey within countries and within the Sahelian region. Especially relevant to comparability of data and project output, resources are not uniform all across the Sahel. To avoid cumbersome legends it may be necessary to slightly modify the way different zones are treated as one moves across the region. In any event, the goal of legend development and thus of the inventory should be to picture the natural characteristics of the landscape, to detect the kinds of relatively homogeneous things that are in fact repeated in space, map and identify them so others can readily benefit from the discoveries. The maps should show and the legends make clear the natural groupings of vegetation and the soil taxa (classes) and depict where possible the natural or real relationships that are consistent between landforms, soils and vegetation. To the extent these goals are achieved, separate inventories should be easily comparable and their results compatible.

Where inventories are done by different contractors working through different donor nations and to service different purposes, it is simply not feasible initially to engage in the rounds of negotiation that would ensure that each and every map define the same things at their borders of juxtaposition, that legend categories and mapping intensities be identical, that identical systems of symbolization be used and that the separate maps be immediately and completely intelligible without studying

their legends to resolve the similarities and differences and to understand the reasons why the two efforts may have treated similar landscape conditions differently.

If, on the other hand, it is essential that total uniformity be achieved throughout an area of concern -- for example in national level land use planning -- then it would appear a far wiser course for one international agency, one donor or a consortium of donors to fund one unified project to produce the desired result. It would appear that a recognition of this kind of need is the reason why USAID has funded the Mali Land Use Inventory as a single unified project, why FAO/UNEP through the GEMS project has undertaken the rangeland ecosystem monitoring project which Dr. Van Pratt will report at the forthcoming workshop, and why IEMVT has undertaken the projection of small scale atlases of the forage resources of the Sahelian region. Desirable as it would be to unify all resource analysis work in a similar manner, development and management projects are conceived from time to time which require additional information over and above what is available. It seems, therefore, that resource surveys conducted by a multiplicity of donors and agents will continue to be a fact of life. The options are simple. We either stop and agree on a uniform methodology or strive instead to do what this writer perceives as the major contribution of the forthcoming workshop in May 1982. That is to identify and address the issues and to agree on a set of guidelines which, until such time as unified methodologies, can be agreed upon, will result in a substantially higher degree of compatibility and easier comparability among the various resource inventory, analysis and monitoring projects that will be moving ahead in the Sahelian region. The group assembled at the May workshop should be able to make major progress toward a set of guidelines which, if reasonably adhered to, would make results more compatible among surveys and contribute substantially to greater effectiveness of resource inventories in meeting the information needs of the host government, in serving the requirements of natural resources development and management projects, and which should also insure the most effective and continued use of results by ministry personnel within the host governments.

The needs of this paper are, therefore, to define the problem and the issues which should be addressed by the conference. In the interest of working efficiency, the paper will also make some suggestions and provide a work flow diagram from which to approach the consideration of essential guidelines by the workshop participants.

GOALS AND PURPOSE

The focus of the U.S. Agency for International Development is to help improve life's situation for the poorest of the poor in the developing nations of the world. Among other things this implies an improvement of the relationship between a people and the renewable natural resource base that sustains their life. It also implies improved effectiveness in the use of both the renewable and nonrenewable resources which provide the possibility of general economic improvement and strengthening within the country. Implicit in this goal is the need to evaluate natural resources in terms of kinds, amounts, location and potential for higher or more effective use and development. It is equally important to determine the constraints or limitations which the character of the resources themselves place on development or management activity. Thus, all international assistance organizations are faced with a concern about the assessment or inventory and monitoring of natural resources. The degree to which human activity is compatibly matched with the potentials and limitations of the natural resources determines not only the base level of health, subsistence and happiness of the populace but also their potential for economic and social advancement as a people and a nation. If a compatible matching of people and environment is to be achieved, natural resource assessment in relation to human activity, current and potential, is an essential first step in almost all development projects.

One might propose that resource development and management projects can move to implementation on the basis of existing information and without additional effort in resource inventory and analysis. In some limited instances this is true; but unfortunately, in most lesser developed

nations, fully adequate and integrated assessments of soil, vegetation, water, human resources and infrastructure do not usually exist for the whole country, except at very small scales in a national atlas. It is even unusual for such information to be available for an entire ecological province within the country. In the Sahelian region there are maps of geology, soil or vegetation, animal breeds/kinds and distribution, transhumance movements, etc., that contain useful information. In many instances, only one or two themes is treated per project and in a relatively limited area. The data are available in some cases at highly generalized scales and in some at as large scale as 1:25,000. Without performing a complete inventory but drawing on available works of others, it appears that well under half of the Sahel has been covered by these kinds of treatments at medium to large scales. Rarely do the examples this writer has seen provide a comprehensive treatment of the whole ecosystem in a coordinated way. Having reviewed the GRM/TAMS Mali Land Use Inventory Project (688-0205), however, the writer believes it to be an outstanding example of a comprehensive resource inventory done close to the right way with full potential utility for its intended purposes. Other donors and UN organizations are, for example, already finding preliminary results from the project useful in their deliberations about future programs. It will be an excellent case study on which to focus attention in the May 1982 workshop.

Whenever an area of national need for resource development or management is first perceived, the question arises, "Where within the country should the problem be implemented?" The proper answer to this question usually requires a low intensity nationwide assessment of resource potentials and limitations under a uniform system and scale of treatment so that the best candidate areas can be selected on a factual and rational rather than a purely political or emotional basis. Once a project area has been selected, rational planning for development usually requires more detailed or additional kinds of information than was necessary for the nationwide or province-wide evaluation. Thus, a second stage, or planning/management level of resource analysis becomes

necessary. While the first step should always be to assemble and evaluate available information, practically every nation is faced with the initial tasks of providing a comprehensive resource assessment for the country or for a specific project area. In the absence of nationwide analyses like the Mali Land Use Project, decisions about specific areas to develop where best to spend available financial and technical manpower resources are not as likely to be made in the best long-term interest of the country. Thus, some level of resource inventory and evaluation is a universal concern; and, if lacking, can be omitted only with grave consequences.

This is always an important concern because the initial goal of all natural resource development projects should be:

> To insure a rational allocation of the host country's natural resources that is:
>
> a. consistent with the resource potential, and
>
> b. within the ecological constraints and limitations which these resources inherently place on the activities of man.

If these goals are achieved, ordinarily the highest level of economic activity that the resource can sustain in perpetuity may also be achieved as a succeeding goal because development funds and energy will be expended in the most promising areas. Some might argue that certain kinds of development projects can be sited without a comprehensive resource inventory. Granted this is possible. For example, an irrigation project is sited first of all on the basis of the availability of water; but having reached this decision on a possible site, a project becomes feasible only if the soils are adaptable, water quality is adequate, and existing or new infrastructure can result in effective integration of the project into the economy.

A concomitant and equal concern should be to achieve, as soon as possible, total transfer of technological capability to design and manage their own affairs to the host countries; and, in the meantime, to engage in such activities and projects as will strengthen the country economically, improve the status of its people and place the country eventually in a position to absorb the cost of resource development and management. It would appear that most western nations engaged in technical assistance subscribe to this goal. It is philosophically identical to the often quoted expression, "Give a man a fish and you feed him a day; but teach him to fish and you feed him for a lifetime."

PROBLEMS AND SITUATION

USAID has been rather heavily involved in the support of resource inventory and analysis projects in the Sahel since the early to mid-1970's. The intention of this activity has been to support AID programs for strengthening of crop and animal agriculture in the host countries as well as to provide information which Ministry staff people would use:

a. In formulating their own resource development policies;

b. In setting national and regional goals and objectives to improve resource utilization and management; and

c. In the preparation of more rational land use plans for the allocation and development of renewable natural resources.

The majority of these resource analysis projects have been carried out at a reconnaissance intensity with mapped results reported at scales ranging from 1:1,000,000 to 1:200,000. Some projects have been reported at scales as large as 1:50,000 but with intensity of examination still appropriate to regional application and prioritization of "most likely" development areas rather than to the needs of specific project design

and resource management planning. Remote sensing in consort with appropriate ground observation has been the modus operandi. The primary remote sensing medium used has been multispectral Landsat imagery, dominantly processed by visual interpretation. In some projects, aerial photography has been used either as the primary medium of analysis or in support of the interpretation of the Landsat images. In some cases computer analysis of multispectral scanner data has been used as the primary analytical approach. A multiplicity of contractors have been used to implement both operational projects and certain entirely experimental projects. The latter have focused particularly on tests of the capability of satellite data to provide information needed in the development, management and monitoring of vegetation, soil and water resources.

In spite of all the work that has been done, there is universal concern both within USAID and among all performing contractors that the results or products from a high proportion of the resource inventory projects are not being used with full effectiveness. Host government personnel do not seem generally to acquire the capability or skill, during the course of their participation in a single inventory project, to independently take the next step in the effective use of the information without further guidance and help. The lack of effective use of results from inventory projects is perhaps the single most important problem to be addressed by the workshop. If this problem alone is solved, the workshop can be considered successful.

In addition, USAID has joined with other donors in funding the establishment of a Remote Sensing Center in Ouagadougou, Upper Volta with the expectation that it would greatly facilitate the application and transfer of remote sensing technology throughout the Sahelian region. Making this facility an effective link in the total system of resource inventory and monitoring as well as training and technology transfer is a serious concern of USAID as well as other donors and Sahelian governments.

ISSUES

The central thrust of this paper was to be the identification of issues which the workshop should address. The expectation is that with such a starting point more progress and accomplishment could be expected from the conference. The Issues paper should provide an organizational framework and point of departure so that conferees will have something into which they can "sink their teeth" as they begin deliberations. With these thoughts in mind, it is suggested that each participant give advance thought to each issue and formulate his own opinion. The issues are each prefaced by a situation statement to set the stage for consideration followed by a few key questions. The purpose of this is to focus initial attention. Participants may or may not agree with the preamble statements or even that the questions asked are the right ones -- so much the better. Perhaps then each will do his own thinking and a higher value of the workshop will be assured.

Those persons in USAID who conceived the workshop on "Sahel Resource Inventory and Mapping Coordination" proposed the two broad issues which were stated in the introduction. Perhaps it would be helpful to bring these back into focus at this point by restating the basic concerns as questions which workshop participants should contemplate ahead of the workshop and be prepared to address both in their formal presentations, if appropriate, and in their extemporaneous contribution to the deliberations of the conference. One of these issues surfaced in all of the writer's interviews as being of greatest and of universal concern. As AID perceived, there is a strong concensus that the host governments are not making anticipated use of the results from resource surveys -- reports, and maps and tabular data. In fact, the small cross-section of Mali Government personnel to whom the writer talked expressed similar concerns and were seeking solutions most of which appeared outside their control. This issue resolves itself into two questions, perhaps the most important this workshop will address:

- Why is the level of practical use by the countries so low, and

- What must be done to insure higher utility and use of new resource information by host governments?

Unless the basic causes of this dilemma are correctly identified and a workable answer found for the "What must be done....?" question that can be implemented almost immediately, concern with the remaining question, "What guidelines?", may be purely academic and of little immediate relevancy -- unless, of course, part of the cause of nonuse lies in the way resource inventory work is being done. Correcting or improving such procedural matters by establishing effective guidelines may facilitate use of the data. It seems unlikely, however, that the solution to the fundamental issue is so simple. The guidelines and "standardization" question is so complex and intimately tied to procedural details of inventory that its introduction is deferred to the last section of this paper.

Why is the Level of Information Use Low?

It follows from the above discussion that the first priority concern should address those issues that directly relate to actual use of resource inventory data. The identification of these issues is found in the causes of the lack of follow through to beneficial use. Which of the following are, in your judgement and experience, most likely to hold a key to solution? What additional causes can you identify? Which one or two should receive corrective action first?

- Host country does not see need and, does not understand relation between inventory and development/management.

- Users do not know how to relate information to specific problems and decisions.

- Philosophies, attitudes or procedures of USAID may contribute to (be a part of) the problem.

- Failure to provide project follow through or a phase out period of continuing technical assistance after the inventory is completed.

- Failure to interpret data and show applications examples as a part of the inventory project.

- Host country lacks critical mass of trained resource analysis and planner-managers.

- Lack of host country involvement in and commitment to the work of inventory and interpretation.

- Lack of motivation and interest on part of potential users.

- Organization within host country government for integrated resource planning, development and management often cumbersome, overly segmented, understaffed and underfinanced.

- Need within country for development projects that will more quickly feed the hungry, create a higher product and stimulate cash flow.

- Impatience and political urgency to get on higher visibility than use of resource inventory data.

- Intensity and scale of inventory did not match the specific information needs of the most urgent problems to be solved.

In preparation for your participation in the workshop, "X" out the above concerns you feel have an inconsequential effect, asterisk the two most important causes that should receive first attention and add in the margin any causal factors you believe were overlooked.

Project Follow Through

It is interesting that practically every consulting firm contacted in the interviews listed the lack of project follow through as the primary reason for lack of use of inventory data. In addition, a number of AID personnel were cognizant of this aspect of the problem and expressed the view that some form of more effective follow through after completion of the actual inventory was essential. Any inventory that is well done has a latent value in its products but effective use is the "developer" that translates that latent value into a visible image of real benefits that can be translated into a cost/benefit statement. This writer has always contended that renewable natural resources inventory is not completed until both the inventory and its interpretation are done.

The inventory is the mere accounting of the kinds, amounts and locations of the various resources together with a description of each of the kinds of things inventoried. The presentation of results traditionally takes the form of maps, tables, narrative and appropriate sketches, figures or photographs to make clear the nature and characteristics of the things mapped. These tables, narrative and illustrations are often referred to as the descriptive legend. A completed inventory should go one step further to the preparation of interpretive maps, tables or narratives that relate each kind of mapping unit to the kinds of questions being asked of the inventory, in so far as they can be anticipated and stated in the project plan. These interpretations include such things as land use suitabilities, relative qualities of each kind of land and resource for various specified uses, suitabilities of soils for various crops (where appropriate at the survey intensity and scale), hazards and risks of development in certain kinds of resource areas, present ecological condition of the resources in relation to what the potential is judged to be, and many other kinds of data reduction and summarization which are addressed to a specified problem or to a decision that must be made. These might be referred to as interpretive legends, tables, overlays or supplemental maps. They represent the kinds of products that have to be

produced in relation to a particular application of the inventory data. It should be obvious that every possible need cannot be anticipated at the outset of a project and further that people as knowledgeable of the inventory as those who did the work are best qualified to make these kinds of interpretations. This is where follow through becomes critical to beneficial, imaginative and full use of inventory data -- critical to the only real value of the inventory project.

It takes far more years of experience, training and guidance to make sound interpretations of inventory data than merely to assemble the raw data. The person who starts his first contact with renewable resource inventory as a counterpart-trainee on an operations project rarely if ever reaches this higher level of competence by the time the basic inventory is completed. Yet, by the same logic, he is the country representative who is best qualified to go on, with demonstration, encouragement, guidance, and assistance when needed to reach this higher level of competence where the payoff really starts. Experience is apparently showing that this is not being achieved under present policies and modus operandi.

Even in the United States with its much higher renewable resource management technology, inventory information is not always effectively used in the planning process. In those instances, where the resource analyst continues to work closely with the planners and managers, programs are much more successful and knowledge developed in the inventory always contributes in a major way to the right decision, often redirecting away from a less favorable option. We should, of course, recognize that other factors than resource characteristics, best and highest use, and resource suitabilities often figure dominantly in the ultimate decision. These are most frequently short-term economic advantage and political expediency; but if good resource information and sound interpretation of the consequences of alternatives are considered in the socioeconomic or political decision, then one can at least feel confident that what may have been best from the resource point of view -- and possibly from the

long-term sociopolitical point of view -- "had its day in court" and was heard before the decision was made. When these kinds of complications arise in an advanced, developed nation, it is inconceivable that we should expect personnel from a developing nation to effectively use inventory data without the same kind of follow through relationship between the resource analyst and the manager/decision maker. Rarely is proper follow through provided on USAID resource analysis projects. It would be most appropriate for the workshop to find and recommend a workable solution to the problem of follow through as it relates to information use. Perhaps questions like the following should be pursued:

- Why has USAID generally terminated resource inventory contracts with the survey phase or with survey plus limited land use capability/suitability interpretations?

- Under allowable working procedures, is it possible to modify and extend a contract that lacks a follow through phase to include a stepwise, phase out program of essential continuing assistance?

- What problems or complications do you see, if any, in writing resource analysis projects to include a follow through aspect that would phase out in say three years? How could any disadvantages to this procedure be mitigated?

- If the concept of follow through were to be included in future resource analysis projects sponsored by USAID, where in the planning process would it have to be initiated? How can you assure it will happen?

- Are there generalizations and recommendations that can be drawn from the above questions or is the answer to each question country specific?

- Do you currently have a resource inventory project on-going in your country? If so, what steps have been taken to provide follow through and to insure use of the data? If the answer is none, should the project be modified immediately or discontinued?

Education and Training

The challenge of education and training of African nationals to be self-sufficient and eventually to take over from expatriates and foreign contractors in high technology areas has many facets. Some feel that it is moving all together too slowly in relation to need and importance. This writer has said that the best assurance that host countries would use resource analysis data lies in training a cadre of their people to do the inventory work for themselves, with experts available to help and guide only when needed. Obviously, this has limitations where it is urgent that resource development and management projects move ahead fast. It may not be a practical solution. Education takes time! Available people with the requisite education is one of the major problems in finding and assigning counterparts to projects and in organizing the staff required to take over and continue when expatriates and contractors pull out. It is the primary deterrent to lasting progress. If the workshop addresses the following questions, some recommendations for improvement in the education training area may be developed.

- Can resource analyst technicians be selected and trained on the job, given that they start with a secondary education, or is a college degree prerequisite?

- Can African institutions (in or outside the Sahel) play a stronger role in training people for resource analysis work at all levels?

- Has the AID practice of writing training components into resource analysis projects that require only limited participation or observation of the project and a few seminars by the contract staff been effective?

- Are operational projects the place to train technicians and lead analysts? If so, from what level of starting background and at what required level of work activity on the project?

- For Africans trained abroad, should donor agencies require that they be allowed to work out thesis problems in their home country and make it possible for major professors to visit the study site to work with and guide the trainee?

- Is it feasible to set up more college-level, two-year, non-degree institutions in Africa and should this be given higher priority in AID programs?

Host Country Involvement

There are many ramifications of host country commitment, and it is directly related to whether or how they will use the results of resource inventories. There are three areas where the host country commitment should not be taken lightly by either the donor or the host, and all three should be evaluated and considered at the outset of any development/management program. The first is Pre-project Involvement and Commitment. A serious host country commitment to a project prior to its initiation is essential. Host country involvement should begin at the conception of the project idea -- or better yet, they should be the conceivers! In this pre-project stage of resource analysis, three of the important roles of the host country are:

1. To contribute to the problem analysis and specification of information need;

2. To participate in determining the appropriate scale and intensity of analysis;

3. To participate in deciding whether the project is to be a single phase of a multiphase effort.

With involvement in these three determinations, the host country will have a much better understanding of what the final products will be and unfortunate surprises will be minimum. The government should be party to setting the priorities that finally give the project the go ahead. Once this point is reached, the second area, Project Operations Involvement of the host country, is essential for both training and effective use of the data. At this point, it is equally important that ministries like planning and finance, clearly realize that their commitments to the project, its operation and use of results must be real and forthcoming. All too frequently host governments can promise performance during the planning and negotiation stage only to find that they do not have the staff or resources to produce when the critical time arrives. These failures can have a severe impact on contractor performance to say nothing of the value of the total effort to the country. The third area of critical commitment is Post-project. Here it is important for host governments to realize that once they accept a project, they take on a commitment that extends beyond the life of the initial effort if it is going to prove a wise investment for both country and donor. Financial commitments of the country will almost certainly increase upon conclusion of any resource inventory if trained people are to remain with the program and begin to realize new accomplishments and benefits because of the information and understanding then available. As a result of the continuing quest for donor assistance, these kinds of post-project commitments to maintain a working level can exceed the nation's capacity and available cash flow with which to meet the commitment, to say nothing

of available personnel. It is imperative that an objective analysis of areas two and three be made while engaged in pre-project considerations. If the answer appears to be negative on significant commitment and involvement in both areas two and three, then perhaps the project itself is not feasible. This writer feels that failure to think these three areas through at the outset is one of the major reasons why host countries do not involve themselves more in the use of project data and why project continuation or maintenance beyond donor involvement is often uncertain.

Another important aspect of country involvement concerns the matter of interministry understanding of projects for which they are not directly responsible, as well as collaboration in areas of common interest. Inventories done in the interdisciplinary context of all USAID-supported projects have many potential uses, often beyond the authority of the sponsoring ministry. Sometimes we see different ministries supporting or asking for closely comparable projects without coordination, and on some occasions, seeming to "protect" project results as though they were proprietary. Realistic liaison among agencies of the government should also be worked out in the pre-project stage if maximum benefit in relation to cost is to be realized.

- Do these kinds of problems arise in relation to your project(s)? How serious are they and what should donor nation attitude be toward these matters?

- When the recipient nation is on its own with natural resources evaluation, is it likely they will be able to absorb the recurrent costs of salaries, equipment maintenance and replacement and project operations?

- If we encourage developing nations to become fully capable to do their own resource analysis and monitoring, are we asking them to "grab a tiger by the tail" in terms of their likely

capability to meet the financial burden in the next ten to twenty years? Perhaps they would be better advised to put their scarce technical man power on direct wealth producing projects?

Who Should Do Resource Analysis Projects?

In addition to some questions of international and multi-donor coordination and implementation which are beyond the scope of this workshop to address, there are four options that are appropriately within the concern of this conference. These relate to the contractor-host country relationship in the conduct of resource inventories.

The first option is that the contractor works entirely alone. He completes the inventory and interpretation and turns it over to the government as a finished job. This alternative is poorest of the four, greatly diminishes benefit to the host country and makes a follow through period mandatory if the survey is to be effectively used.

The second and third alternatives involve the contractor working with host country counterparts a) in a quazi trainee-observer mode, or b) in a full working counterpart-trainee mode. Of these two a) is little better than option one because the observers rarely learn enough to do the work themselves or to thoroughly understand the project to the point of effectively using the data. Option b) can represent the best of both worlds in which effective training is accomplished, the project is thoroughly understood by government personnel and the likelihood of some use of the data is enhanced -- but probably not assured without a phase out, follow through period of additional help and training in how to plan.

Option four is idealistically preferred but hardest to achieve except in the more educationally advanced of the developing nations. That is to train country personnel to do the work entirely themselves but to have well qualified experts standing by or readily available to help or suggest, only when needed, and to perform the few highest technology tasks for which present in-country capability is inadequate. This latter approach practically insures application of results, provided some follow through liaison between analysts and decision makers is provided, until it is confirmed by performance that the data users can make their own interpretations of the inventory data as needed. The writer has seen option four tried and work with complete success in two cases but in each instance the initial training level of the host country personnel was substantially higher than average.

- Into which of the four categories do projects fall with which you are familiar, and do your observations confirm or refute the above?

- Would you prioritize the four approaches with respect to the preference USAID should work for in a contractor-host government relationship?

- If you are currently involved with a project that does not fall under option three or four, how could it be changed to embody more of the features of these options? If it cannot be changed should it be discontinued?

Need for Inventory: Is It Real?

We have assumed that resource inventories and monitoring are necessary. Before going further perhaps we should ask the obvious question, "Are they, when and when not?" The facts do seem to bear out that generally across the Sahel population pressure on the land and food needs are

increasing. Cropping is making inroads on grazing lands in many areas and rangelands are generally deteriorating. Woodland production is being exploited beyond sustained yield capacity. Therefore, we must strive to create a better balance between man and these resources; are we taking the right steps?

- Are we right in saying you cannot wisely allocate resources and improve, manage, and maintain ecosystems that you do not reasonably well understand and that, therefore, renewable natural resource assessment must continue? Is a formal inventory an essential step in that understanding?

- Are we giving sufficient attention to investigation of traditional systems of management, to customs, attitudes and existing social systems in the quest for understanding?

- In view of the difficulty of influencing people to change, i.e., the likelihood of really improving resource use and management, could inventory dollars be better utilized in other areas? If so, where?

Use of Work by Other Donors

The French have accumulated a wealth of knowledge about West Africa. Their scientists, for instance, have done many good studies of the plant ecology of the region; and the Dutch, as a further example, have done considerable work on productivity of rangelands. Specific agencies, IEMVT, OSTOM, IGN, ITC, et al., have worked on many aspects of natural resources and produced numerous maps of the resources of the Sahel. There are national atlases that contain useful small-scale maps and other typical geographic information. Access to some of this work is difficult and available only in France or the donor country. Consolidation of all this information to make it readily available in a depository, either in each country or in a regional center, would be a great asset

to the countries and to the region. It would also greatly simplify the work of contractors, and for certain purposes, could replace the need for a full blown inventory, enabling one to get by with merely a survey to update existing information. Some questions should be answerable and decisions possible by merely drawing together, integrating and analyzing already available data at considerable savings. Landsat mosaics at a scale of 1:1,000,000 provide an excellent base on which to draw together, integrate and interpret such data. The writer knows of one instance where this approach was used successfully. Under present circumstances this is difficult to do. Also, in this writer's experience, project funding does not always allow for doing a good job of consolidation and analysis; and we sometimes even find a reluctance on the part of the European depository to release information to non-European contractors without specific country clearances and other cost generating bureaucratic requirements. These sometimes rule out a fair and objective consideration of information known to exist. These are frustrating circumstances. Some have expressed the view that existing information is so inadequate that new inventories are necessary, even though available data does contribute to legend development and related functions.

- What has been your experience in these areas and what light can you shed on ways to improve the situation?

- Have USAID and contractors working for the agency tried hard enough in each instance to really become familiar with and to use existing material in lieu of making their own new survey?

- Is AID willing to fund thorough reviews and attempts to integrate the work of other agencies and donors? This does take time!

- Have contractors been remiss in not including funds to do this important work in their proposals? Is the problem and need generally recognized in RFP's?

Selection of Appropriate Remote Sensing Technology

This writer views remote sensing technology as consisting of a family of technologies from aerial photography to multispectral aircraft scanners with ultraviolet and heat sensors, to microwave or radar systems, and satellite systems such as Landsat, the meteorological satellites, and Landsat-D and SPOT which will be available by mid-decade. Because of its unique capability to fill a developing world need, there is a strong tendency to focus attention around Landsat alone. Some things Landsat does well, but for some applications, it is totally inadequate. In many instances, it can be best used in a multistage mode with one or more scales of aircraft photography and ground or overflight sampling. The temporal flexibility of Landsat, flaunted in the early days as one of its tremendous advantages, has all but disappeared with cloud cover problems, tape recorder malfunctions, etc. At the same time visual interpretations of highest quality, state-of-the-art Landsat images can develop large amounts of information about terrestrial ecosystems, geological features, and even about water bodies with special processing. For maps and data to be presented at scales of 1:100,000 and smaller, Landsat is hard to beat as a remote sensing medium. Used in the hands of a skilled digital data analyst who is also a highly knowledgeable earth or resource scientist, Landsat provides the only practical means of looking at each and every 0.4 hectares of a landscape and classifying it according to specified criteria. With digital processing, it is often possible -- although rarely done -- to classify an area at the same information intensity as one might analyze some of its features from aerial photography at a scale of 1:24,000.

- Considering the above, have we overemphasized Landsat as a working tool? Where we have used it, have we gotten the best out of the system? Should we be using more aerial photography as a part of the remote sensing system?

- If you were to act most wisely, should you be withholding activity on new small scale projects until Landsat-D or SPOT files with their higher resolution systems?

- With a receiving station in Ouagadougou, maximum use of temporal capability could become feasible for the whole Sahelian region. For your applications, how important is the temporal repeatability of satellite imaging systems?

- For what kinds of projects would you use aerial photography exclusively?

Uniformity/Comparability of Products

In the terms of reference to this writer, this was one of the particular concerns raised by USAID. Resource surveys are traditionally done at different scales for different purposes. If they are single-use or single-purpose oriented, the legend is more likely to be utilitarian rather than to approximate a natural system. If the inventory is multipurpose or eocological in nature, it is much easier to devise a common legend or classification based on ecological principles. Utilitarian legends are hard if not impossible to compare or relate one to another. For example, surveys done for forestry applications are more likely to have a forest product bias and to ignore features not important in forest management, even though they are vital to range or agriculture. We do not generally expect the inventory maps to be totally comparable between scales because they are providing different information, but it would be highly desirable if the work were done so that the larger scale, more intensive treatments could be readily recognized as a subset of the smaller scale, more generalized work. Unfortunately this is not often the case but it could be if one insisted that all inventory legends must be ecologically based rather than utilitarian, and provided we could agree on classification concept -- something which even the soil scientists, in spite of substantial progress, have not yet achieved on an international scale.

For work at a given scale or intensity of examination, uniformity might imply identity of: legend format and mapping procedures, features examined, classification concepts, and even of presentation. On the other hand, comparability of results could be achieved as long as the same features of the landscape are examined under reasonably uniform mapping guidelines and following the same or compatible classification concepts. Incidentally, even two analysts on the same project will rarely map the same landscapes in exactly the same way throughout even when following the same criteria. Edge matching is always a problem that must be addressed. This is because any man or machine-generated map is a generalization or simplification of the diversity that really exists on the landscape. Generalization and simplification are judgmental processes in which complete uniformity and consistency cannot be expected. Thus, a total resolution of AID's interest in achieving uniformity among projects is not realistic. Higher comparability should, however, be possible if good guidelines can be agreed upon.

It is important to be aware that achievement of total uniformity leads to rigidity that restricts analyst ingenuity in adapting to unique project requirements or resource conditions and, more seriously, tends to restrict advancements and improvement in resource analysis technology. A more flexible approach, on the other hand, that provides reasonable comparability allows advancement to take place in the technology. The achievement of a reasonable compromise in the latter framework is the challenge.

- Is nonuniformity among surveys of comparable scale intensity of examination really a substantial problem? Why? How does this situation impact your accomplishments or those of your host country?

- In your experience again, exactly how and to what extent does non-comparability among surveys conducted at <u>different</u> scales and intensities impact utility of the data and its effective use.

- Actually, does not the most successful solution to these kinds of problems reside in your doing a good job of analyzing and specifying your information needs? If not, how can you achieve a satisfactory solution?

Standardization of Classification Schemes

While USAID has organized some international expert teams, they more commonly tend to bring in their own national contractors to perform projects or provide expert advise. These groups or individuals tend, in turn, to bring along their own technologies and classification concepts -- with which they obviously are most familiar. This can result in confusion to host country personnel when they observe unfamiliar classification being interpreted where prior work may have established European concept. For example, U.S. workers generally use the new USDA/SCS Soils Classification Scheme and, similarly, the SCS system of land use capability assessment. The former system requires laboratory soils data for assignment in many classes and these data are sometimes impossible to obtain within the time and funds allowed, thus, assignment of a soil to a class may be questioned. The latter system is biased toward a single land use, cropland agriculture, in contrast to a procedure that would evaluate all potential land uses on the same capability/suitability scale so that comparisons of the consequences among land use alternatives can be more fairly done. European thinking has had a strong influence on U.S. vegetation classification concepts, so perhaps the problem is less critical here; but even so, U.S. workers are sometimes slow to make use of French investigations of the vegetation of the Sahelian region. The manner in which vegetation classes are established and described could benefit from standardization. In all cases, it would be highly desirable to agree on hierarchical classification schemes so that more refined, larger scale work could clearly be recognized as subsets of the more generalized reconnaissance surveys. Standardization may, however, be achieved at the expense of methodological progress.

- Do you perceive a real need for standardized classification schemes for soils, vegetation, landforms, etc.? Should USAID, for example, insist that contractors follow a particular scheme? If so, which should it be?

- Should the scheme already in use in the region or country be the controlling factor in this decision? Even if a better system exists?

- Is the greater progress in improving on classification schemes and concepts, that should result from an open approach and analyst ingenuity, worth the inconvenience of diversity in classification and legends?

- How frequently do differencs between surveys have to be resolved? Really, is standardization in this area essential and worth the time and effort to achieve it short of an arbitrary decision? Under what specific circumstances is standardization mandatory?

- Should standardization in the mandatory areas be worked out internationally or limited to the areas of USAID's direct interest?

Regional Environmental Monitoring

At the height of the Sahelian drought and again during the push of the Desertification Conference, there was considerable pressure to develop projects to monitor environmental conditions in the Sahel and elsewhere. Various projects were proposed and some are currently being implemented. These include the FAO/UNEP project now under way in Senegal and a CILSS sponsored, region-wide project being considered by USAID.

There are two important options in monitoring the condition and the trends in condition of natural resources. One is to take the regional approach and document sample point data throughout the region, and the other is to document the changes that result from project level implementations designed to improve management and correct resource abuse. The latter is essential for fine tuning and occasional redirection of the management program. Monitoring on a regional basis is likely to be quite expensive in relation to measurable benefits, unless remote sensing plays a major role and highly efficient sampling schemes are worked out for ground documentation and verification. Monitoring on a regional basis merely provides information useful for policy decisions, setting regional funding priorities, and public awareness campaigns. Monitoring on a project level, on the other hand, charts improvements from positive management interventions, detects negative side effects, enables the fine tuning of good management programs, and supports project redirection when needed, even discontinuation when advisable. If well designed they are cost effective in the cost/benefit context.

- Should monitoring expenditures be project specific rather than nationwide or region-wide? Are both truly necessary?

- Assuming regional monitoring projects are desirable, should there be more than one in the Sahel?

- How can coordination of planning and implementation of regional monitoring actions among the UN Agencies, CILSS and multilateral and unilateral donors be assured so that projects will be of highest quality and unnecessary duplication avoided?

- Is regional monitoring of resource condition and trends a logical role of the Regional Remote Sensing Centers? If so, what should their role be and how should the work be funded?

- Should this kind of activity be left entirely to UN initiative?

- What should USAID's role in environmental monitoring be?

Surveys Update and Monitoring

The more rapid are anticipated changes, either natural or management induced, the more important inventory updates and monitoring becomes. When decisions are expected to produce irreversible changes or side effects it is important that the decision be based on the best possible current information. When important consequences of management or development cannot be accurately predicted, monitoring information for fine tuning the management program becomes particularly critical. If on the other hand, implementation of management is slow to bring about and/or the effects on the resource are subtle, monitoring and inventory update can be an unwise expenditure of funds and manpower. Considering these factors....

- Is it possible to indicate frequencies at which you expect Sahelian governments would need to update the renewable natural resource inventories being produced by your project?

- Considering realistic levels in the intensity of management that is possible on rangelands, croplands and woodlands and the rates of change in land use practices, how frequently do you perceive the need for monitoring Sahelian resources?

- Should the monitoring be done on a project by project basis or on a regional level?

- When all is considered along with competition for financial and technical manpower resources is there really any need to be concerned about monitoring and inventory updates at this time?

Effective Land Use Planning

Perhaps in Europe people have learned better to harmonize their activity with the resources; but in the United States, with a ~~very few~~ few notable exceptions, a poor job is being done in land use planning in spite of reams of information on resources and the consequences of ill-advised development. Each year enough prime agricultural land is buried under concrete and houses to feed a number of African cities and villages. Having knowledge of resources and consequences is no assurance that the right decisions on resource allocation will be made.

- How can such errors be avoided in development of the Sahel? Should inventory follow through with the decision makers help to get the problem done?

- What has to be done to be reasonably confident that, "when all the facts are in, the facts, and not politics or short-term economics will make the decision" and that it will favor optimum use of lands in relation to their capacity to meet the needs of the greatest number of people?

- Will structuring and organization of the planning agency help? Is planning effective when isolated in a planning agency or should it be done within units of government that also have the authority of implementation decisions and action, i.e., within a management oriented agency?

Value of Resource Inventory and Monitoring

First, may we assume agreement on the concept that something can have value without producing a directly measurable benefit in the strict economic sense? If so, then the following logic may also be acceptable. The principle of value received for service rendered should -- with the

cost/benefit concept as only one standard of measure -- function strongly in guiding future policy regarding resource analysis in the Sahel. Let us expand on this idea from the assumption that a completed resource analysis has inherent value or real potential value but that measurable benefits are totally dependent on use and application. Until use is realized, the potential value is still there, but there are no benefits. Cost/benefit ratios are easy to calculate where a project yields real economic goods that, in themselves, have a value in the market place. Resource analysis activities are, however, in the category that this writer calls facilitating actions. They are essential to getting the job done but not directly contributory. They produce results which are not measurable in the market place -- their real value depends on what is done with the results. In addition, there is another problem in attempting cost/benefit analyses with this and perhaps any other kind of essential facilitating actions. They have side benefits which are not possible to anticipate. Some may come immediately and some years after the work is done so they cannot possibly be factored into a cost/benefit analysis. This writer has had two such outstanding examples in his own experience. In one case inventory information developed for grazing management discovered a land use infraction which, when settled, more than paid the full cost of the inventory. In the other instance a solution was offered for an entirely unrelated problem, chemical waste disposal, because of things discovered in the inventory. So it often goes with any good resource analysis where a sincere attempt is made and a little imagination applied to use the data in decision making. In resource analysis, however, many of the benefits are intangible or difficult to measure even when results are fully used.

Where does this leave the resource analysis program in the Sahel. If what people are saying is true; that is, use is not generally being made of the results of these kinds of projects, then it goes without calculating that the cost/benefit ratio is infinitely large and unprofitable (megabucks divided by zero). The obvious conclusion is that the program should be slowed, terminated forthright, or positive corrective action taken immediately. Hopefully the latter option will be exercised.

- What is your judgement of the probable cost/benefit ratio in these programs, < 1.0, about 1.0, or > 1.0?

- Is it possible that there are instances of real value received, unanticipated, hidden benefits, that people have not appreciated? Can you help, through your contributions to the workshop to precisely document these cases?

- If the cost/benefit ratio is substantially greater than 1.0, what are the immediate steps that can be taken to correct the situation even with already completed projects?

- If these steps are not taken, or if they should not be effective in moving into a use mode, what is the obvious conclusion?

- Do the intangible and obscure values of resource analysis invalidate the cost/benefit ratio as an evaluation standard for resource analysis -- assuming of course that results are effectively used?

Appropriate Levels of Remote Sensing Sophistication

Remote sensing technology, especially as it relates to satellite systems, microwave, and multispectral airborne systems, is very high technology on the leading edge of development. When one considers the role of the computer in processing and manipulating these kinds of data to generate information, the sophistication level is even higher with an increased number of alternatives. The question of how much of this is appropriate to conditions in the Sahel is exceedingly important and should be answered in great wisdom. This writer presumes that we can all agree on a few guiding principles. Those parts of the technology transferred to or used in the Sahel should be the proven elements, not the untested or highly experimental; they should be appropriate and

efficient in performance of the task or meeting the need; they should be realistically usable in the local environment; and, within these constraints, the local technicians should have the highest state-of-the-art working materials and procedures that they can be trained to use in a technically and cost effective manner.

- Thinking particularly of satellite systems, what are the most appropriate and useful elements of remote sensing technology that should be utilized or encouraged among Sahelian workers?

- Considering aircraft and aerial photography, what guidelines would be appropriate?

- What guidelines are necessary to assure that the highest appropriate and efficient technology is provided without creating an overkill?

Regional Center Involvement

There is much interest in the role of the Regional Remote Sensing Center at Ouagadougou, Upper Volta, in Sahelian country programs and in resource analysis and monitoring. Substantial sums have been expended by USAID and other governments to establish this Center and more sophisticated plans are on the drawing board. To make these investments contribute appropriately to the betterment of the region, the following questions need to be addressed?

- How can the Center best serve the needs of the region as you perceive them?

  - Training -- can or should it function in a broader spectrum than remote sensing; i.e., soils, vegetation, geology, etc.?

- User assistance -- technical help and laboratory support at the Center or in the country for users of remote sensing?

- Project implementation -- should the Center do work for Sahelian countries on a cost recovery or other basis?

- Providing real-time, state-of-the-art satellite images?

- Providing or advising in aerial photography applications, e.g., assist in design of aerial photo missions and do contract interpretations?

- Providing a digital analysis service laboratory?

- Providing high quality cartographic services?

- How can the Center be Africanized with functioning assured -- how can African nations eventually handle the cost?

- What have your experiences been in working with the Center that may provide guidelines for improvement and strengthening?

- Should regional monitoring be done by or through the Center?

GUIDELINES FOR PROJECT DESIGN AND IMPLEMENTATION

This issue falls into the category of specific guidelines for successful inventories. Two of the important concerns are what kinds of guidelines are <u>really</u> necessary, and how can they be written so as not to function as rigid controls that inhibit methodological progress? The

main reasons for guideline statements are to insure that important steps or issues will not be overlooked, that the efficiency and effectiveness of inventory monitoring projects will be maximum, and that the results will be compatible and comparable among resource analysis projects to the extent this goal is feasibl to achieve.

In considering guidelines one should evaluate the need and applicability across the full spectrum of project operations in resource analysis.

- Problem Analysis and Specification of Information Needs
- Project Design and Planning
- Project Implementation
- Project Follow Through and Information Interpretation
- Action Plan for Development/Management and Implementation
- Monitor and Fine Tune Action Plan

In the above spectrum of activities only the Action Plan for Development/ Management and Implementation is outside the concern of the resource inventory workshop. It is included in the sequence to reinforce the relationship of resource inventory and monitoring to the important work that makes it all worthwhile, implementation of effective development and management projects.

In the time available for this workshop it is not realistic to expect that a set of guidelines can actually be developed. If it is considered a necessary step by the workshop participants, it could be most efficiently done by a small working group of individuals who have had substantial experience in the conduct and use of resource inventories in developing countries. It is desirable, however, that the workshop consider some of the more general questions relating to guidelines, provide some guidance and suggestions to a subsequent working group, and possibly to suggest a terms of reference or scope of work statement to the working group.

To help guide the deliberations of the workshop, a series of flow diagrams is included as Appendix A to this issues paper. These in effect will expand on the above spectrum of project operations. With respect to the normal work flow, it would seem appropriate for the conference to consider the following questions:

- Exactly who is or should be the audience to whom guidelines need to be addressed?

- As a general or universal objective, what should a set of guidelines accomplish?

- What are the most common omissions in conceiving, planning, implementing and following through on resource analysis projects where a set of guidelines would be helpful?

- At what points in the work flow are there methodological alternatives for which guidelines are needed?

- If there are such, identify the specific areas in the work flow where guidelines should take the form of directives that would specify exactly how or under precisely what concepts the work would be done.

EFFECTIVE RESOURCE ANALYSIS IN DECISION MAKING

The role of resource analysis and monitoring in the decision process is dependent on five factors, with far-reaching consequences, that are often overlooked in project planning. One of the major reasons why users experience difficulty or need special help in applying the results of inventory is that one or more of the following was not carefully evaluated as the map scale, examination intensity, legend design and sampling or ground verification methods were decided:

- The administrative-management or executive organizational level that will use the information;

- Resource development or management objectives to be attained;

- Anticipated intensity of managemnt to be applied;

- Consequences of error in data developed by or from the inventory; or conversely, precision and accuracy levels <u>really</u> required; and

- Flexibility of subsequent action plans in terms of fine tuning redirection, or reversal.

If these five factors are not considered during inventory project design and planning, it can result in a poor match between information provided and decisions to be made.

There are three broad areas of decision making in resource development and management. Each of these three areas has its unique and different information requirements, but the main difference is in the scale and intensity, or refinement, of examination at which the information is presented. These three broad areas are:

- Legislation, policy and broad goal setting, the executive level of planning;

- Resource allocation as to use or combinations of uses; and

- Resource development and management.

Each of these three broad functional areas are multilevel in character. A unique information output is required for the decisions made in each of the separate functions and at each level within. The executive level of planning can be done at national, regional, or local levels. Resource

allocation can provide for single use, or multiple use and for control mechanisms in land use planning and development. In the latter area, resource development and management, one can be concerned with custodial, extensive or intensive management, and with development programs that change the nature and productivity of the natural ecosystem. These four levels progressively require more detailed and accurate information for decision making. The sequence of decisions, if planning is sound and thorough, almost always starts with executive level decisions of the type indicated and proceeds next to the question of resource allocation, and finally to development and management details. This sequence needs to be kept in mind because it has an impact on the design of inventory projects -- particularly as regard to map scale, intensity of examination and whether or not the work is done in single or multiple phases.

The scale of imagery used or the scale of the final maps determines the amount of detailed information that can be provided. The executive level of decision usually requires small-scale or broadly generalized information elements (1:2,000,000 to 1:100,000) at national and regional levels; but executives may require information at scales as large as 1:30,000 to 1:10,000 for local level decisions. The resource allocation decisions generally require information appropriate to scales of 1:250,000 and larger, but some initial allocations can be accommodated at scales of 1:1,000.000. Final and detailed resource allocations that involve expensive development projects may, on the other hand, require information at scales of 1:30,000 to 1:10,000 with some engineering aspects of development requiring even larger scales. Similarly, in the management area custodial and extensive management decisions may be comfortably made from information and maps at intermediate scales, but intensive management and ecosystem manipulation or modification may require inventory or monitoring information derivable only from imagery at scales of 1:3,000 to 1:600 plus ample amounts of ground measurement. One of the major reasons why some have been dissatisfied with inventory results or have failed fully to use them is that these kinds of considerations -- that is, relating scale to information level and in turn to decision level and need -- were not made in the planning stages. A most common

problem is doing work at a small-scale and high level of generalization and then trying to extend it too far into the detailed decision making process where it was never intended to be adequate. It is particularly important for the resource analyst to know the function(s) and level(s) for which he is to provide information. Failing to do this, his work may confuse the issue with unnecessary detail or fall short of providing all of the critical elements for a rational decision -- at which point bias, emotion and political expediency rule the decision making process.

Assuming that the above kinds of information are available and are evaluated in the preplanning phases of resource surveys, and knowledgeable resource specialist or interdisciplinary team should be able to follow through a logical work flow such as Appendix A and design a sound and potentially successful inventory project. In situations where many different teams are working in a given region, the question of comparability of results does arise and may be an important concern. Thus this workshop, concerned especially with the Sahelian region, should evaluate the need for guidelines that will:

- Insure better planning, implementation and follow through of resource inventory and monitoring project; and

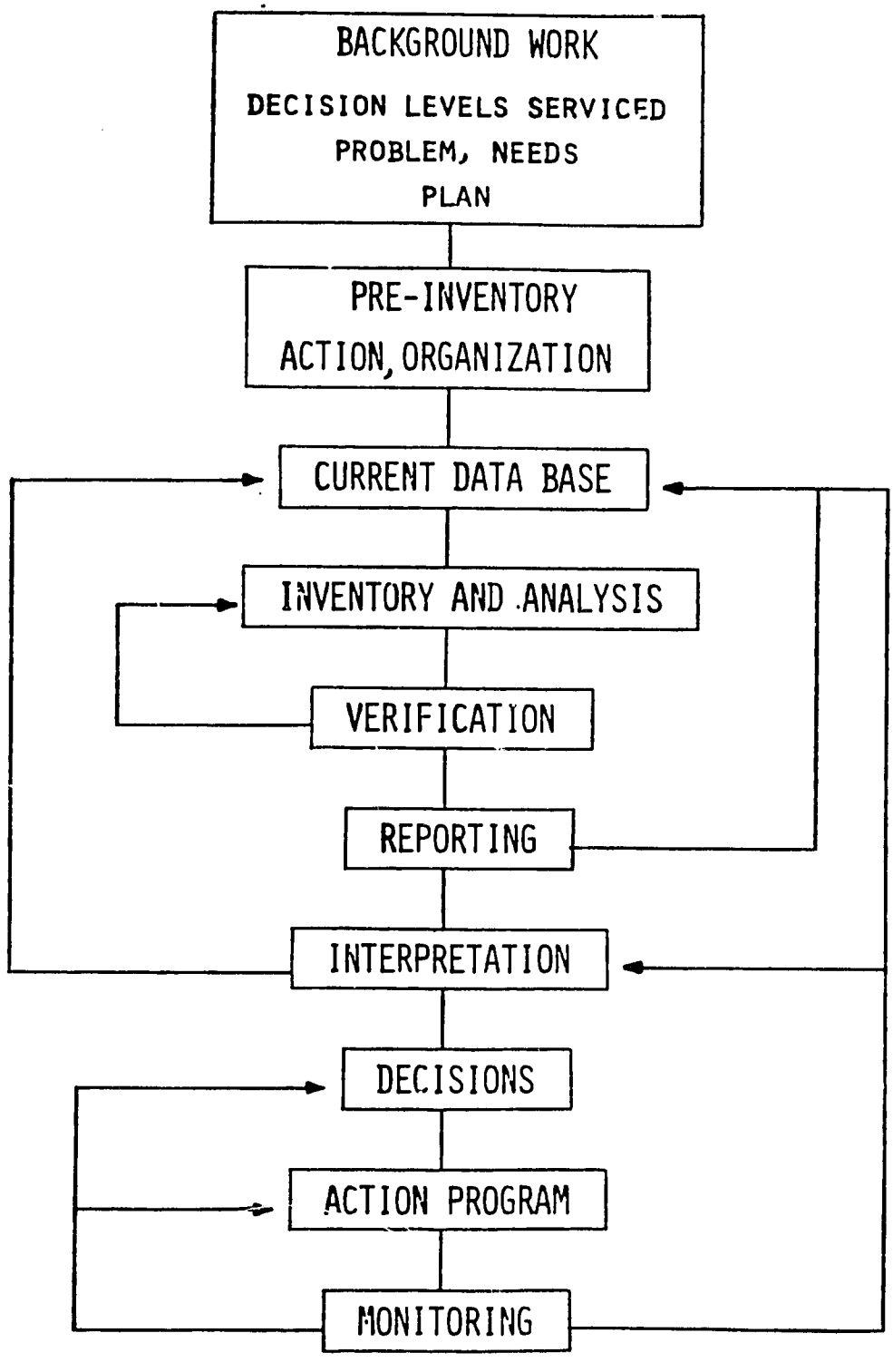
- Achieve a reasonable level of comparability among surveys where this is important.

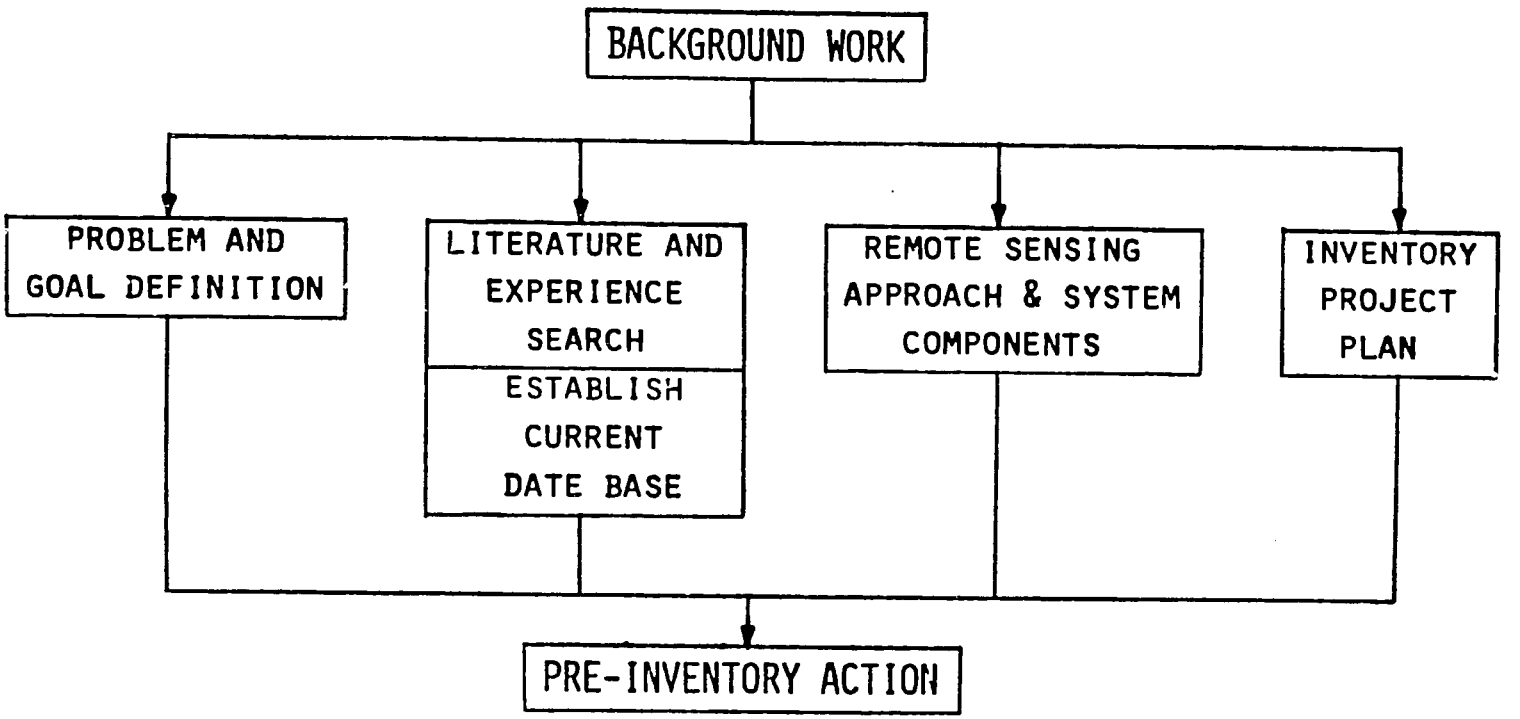
This should be possible by considering the issue statement, "Guidelines for Project Design and Implementation" together with the above suggestions and the flow diagram in Appendix A. As the work proceeds it might be well to remember that the assurance of good cooking is not in the recipe but in the hands of the chef and the proof is in the eating! So it is with resource analysis and monitoring.

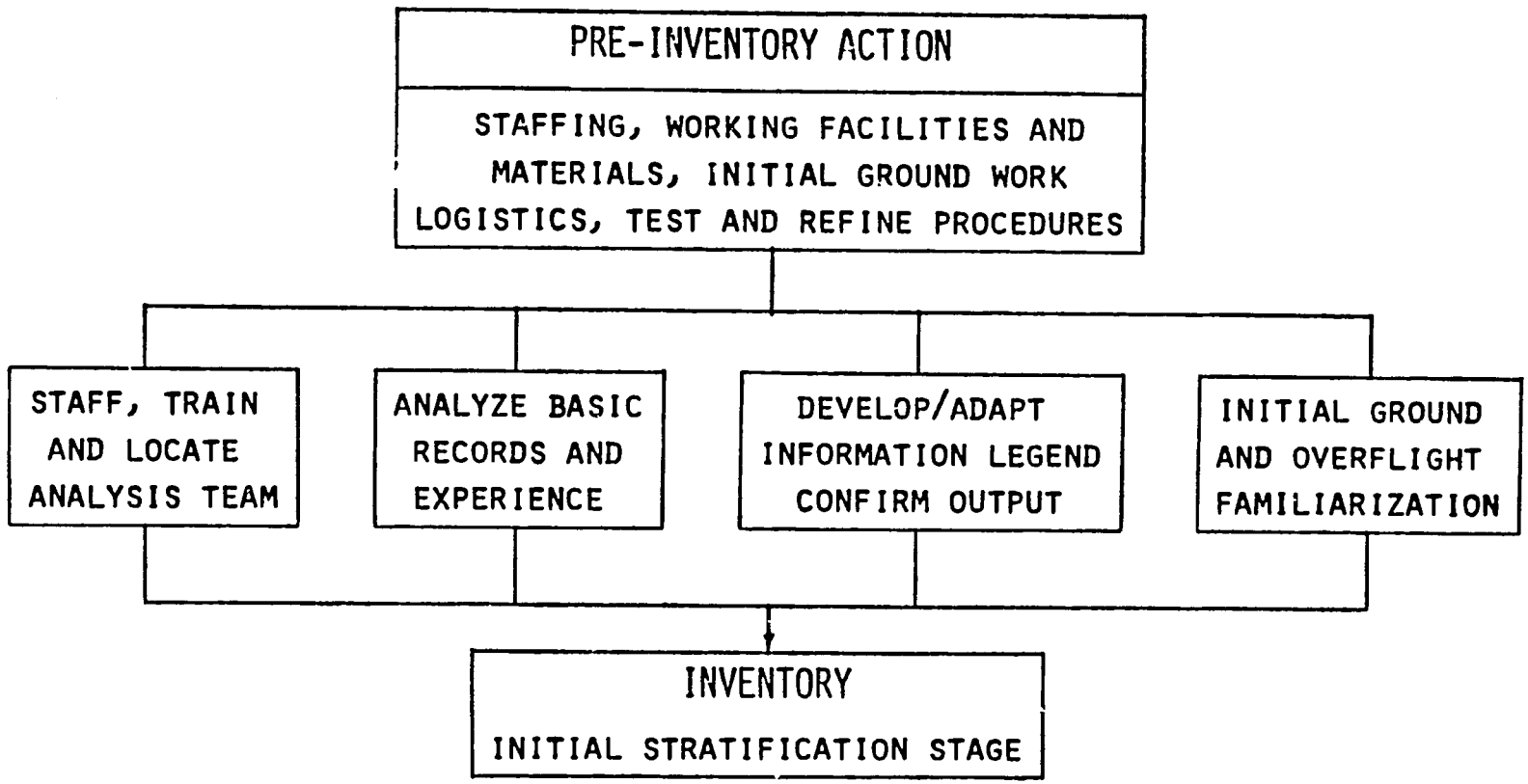
APPENDIX A

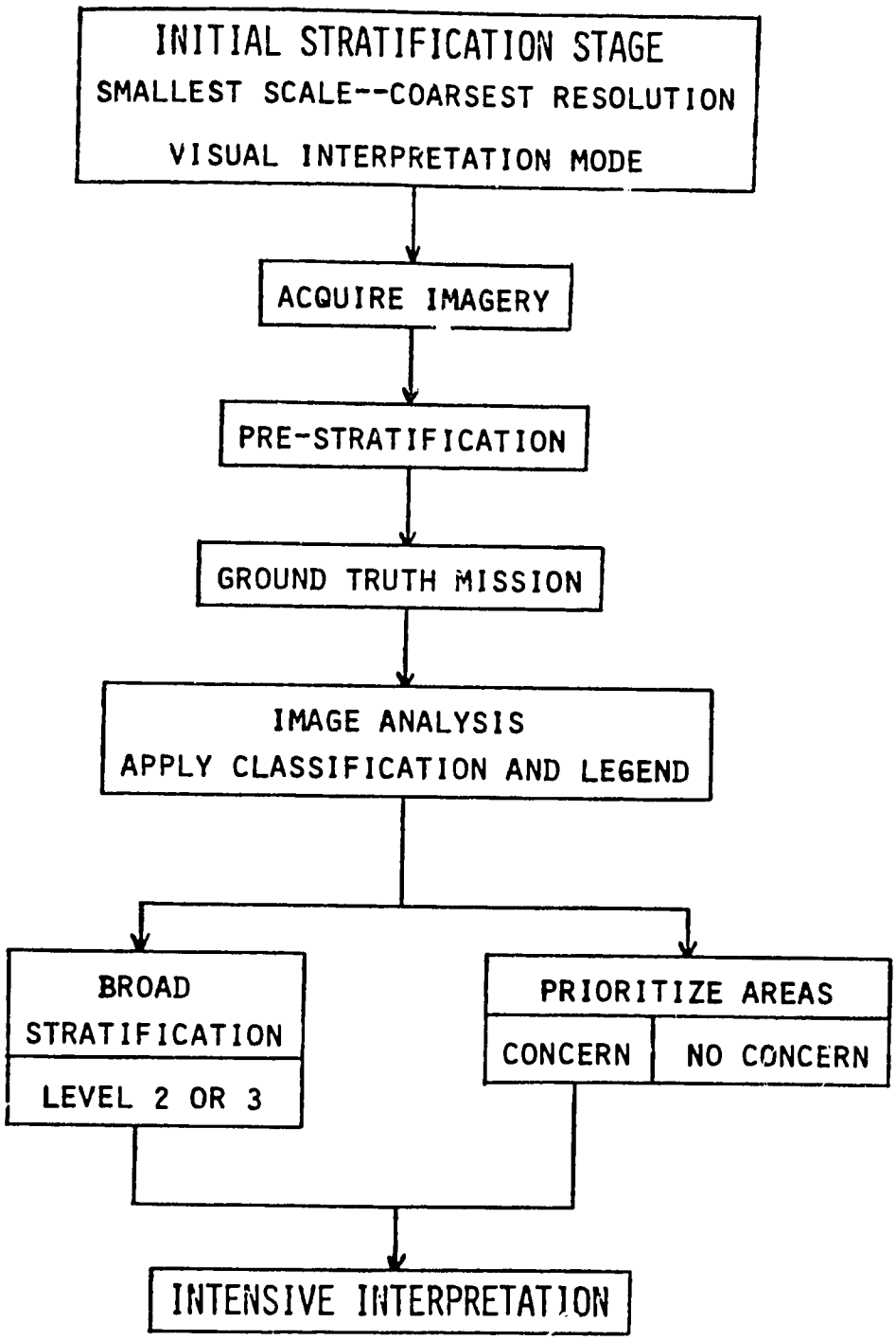
A TYPICAL WORK FLOW DIAGRAM FOR THE PLANNING, IMPLEMENTATION AND USE OF RENEWABLE NATURAL RESOURCES INVENTORIES AND MONITORING THAT MAKES APPROPRIATE USE OF REMOTE SENSING TECHNOLOGY TO MINIMIZE THE COST OF GROUND OR FIELD WORK

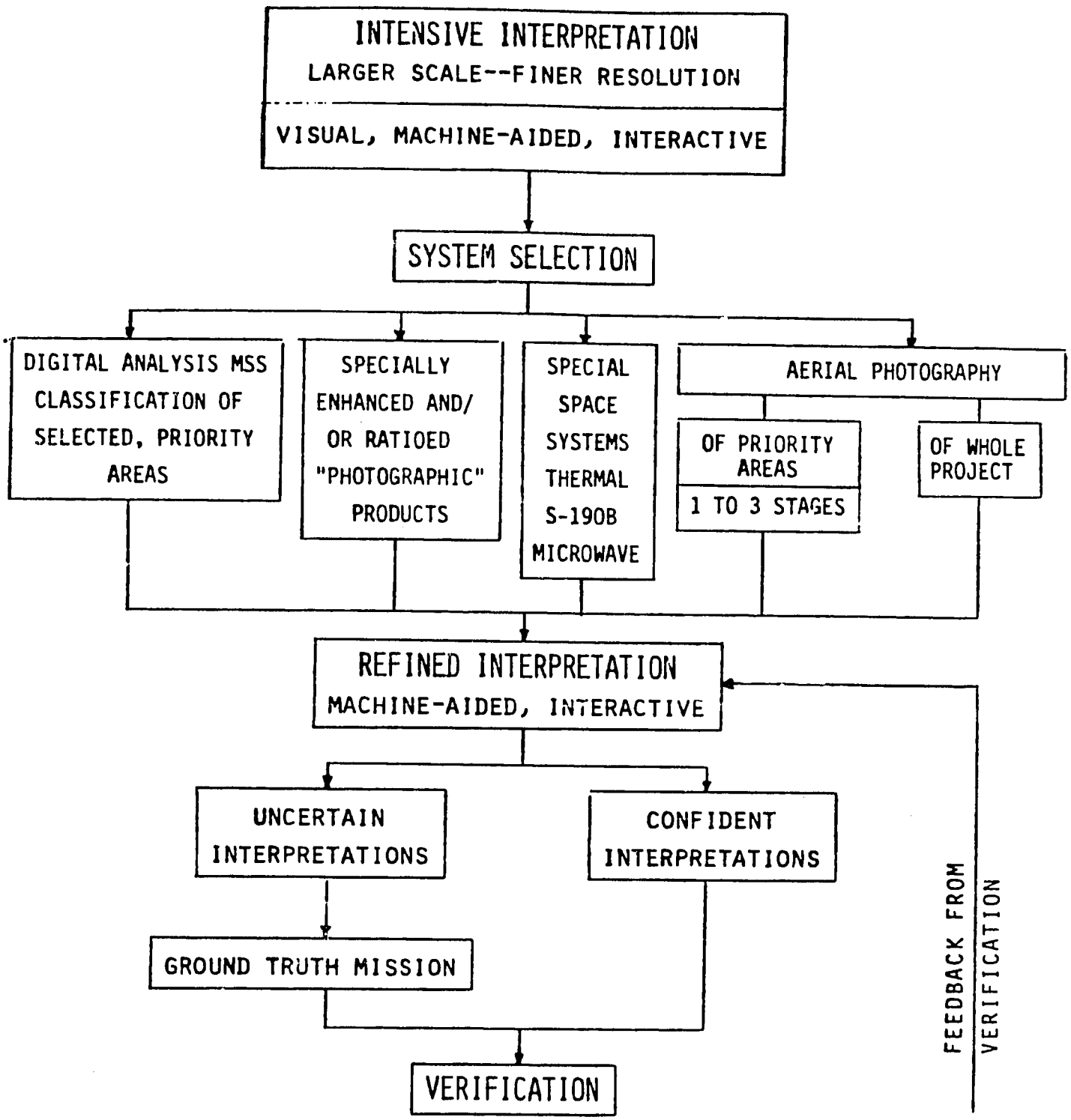
MAJOR STEPS IN EFFECTIVE
USE OF REMOTE SENSING



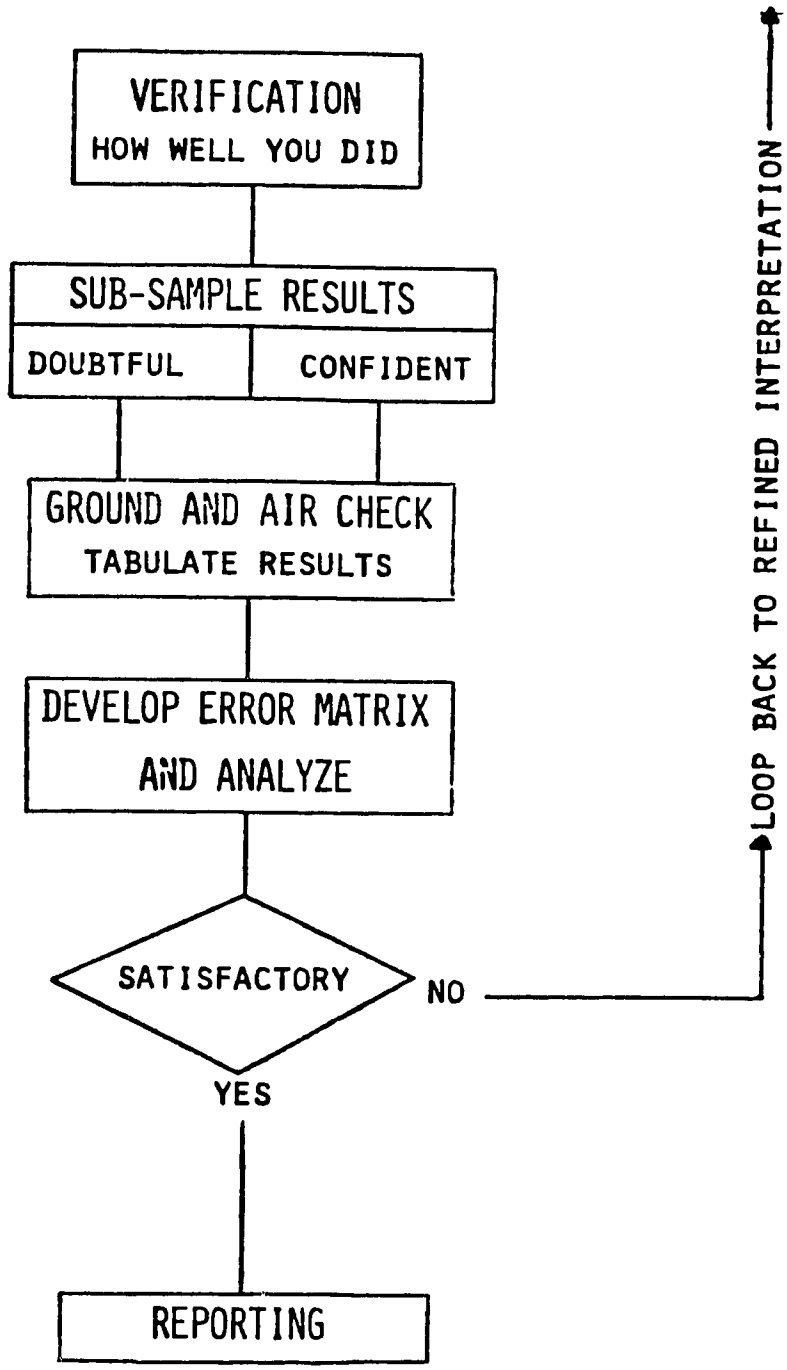

BACKGROUND WORK
PROBLEM AND GOAL DEFINITION
LITERATURE AND EXPERIENCE SEARCH
ESTABLISH CURRENT DATE BASE
REMOTE SENSING APPROACH & SYSTEM COMPONENTS
INVENTORY PROJECT PLAN
PRE-INVENTORY ACTION

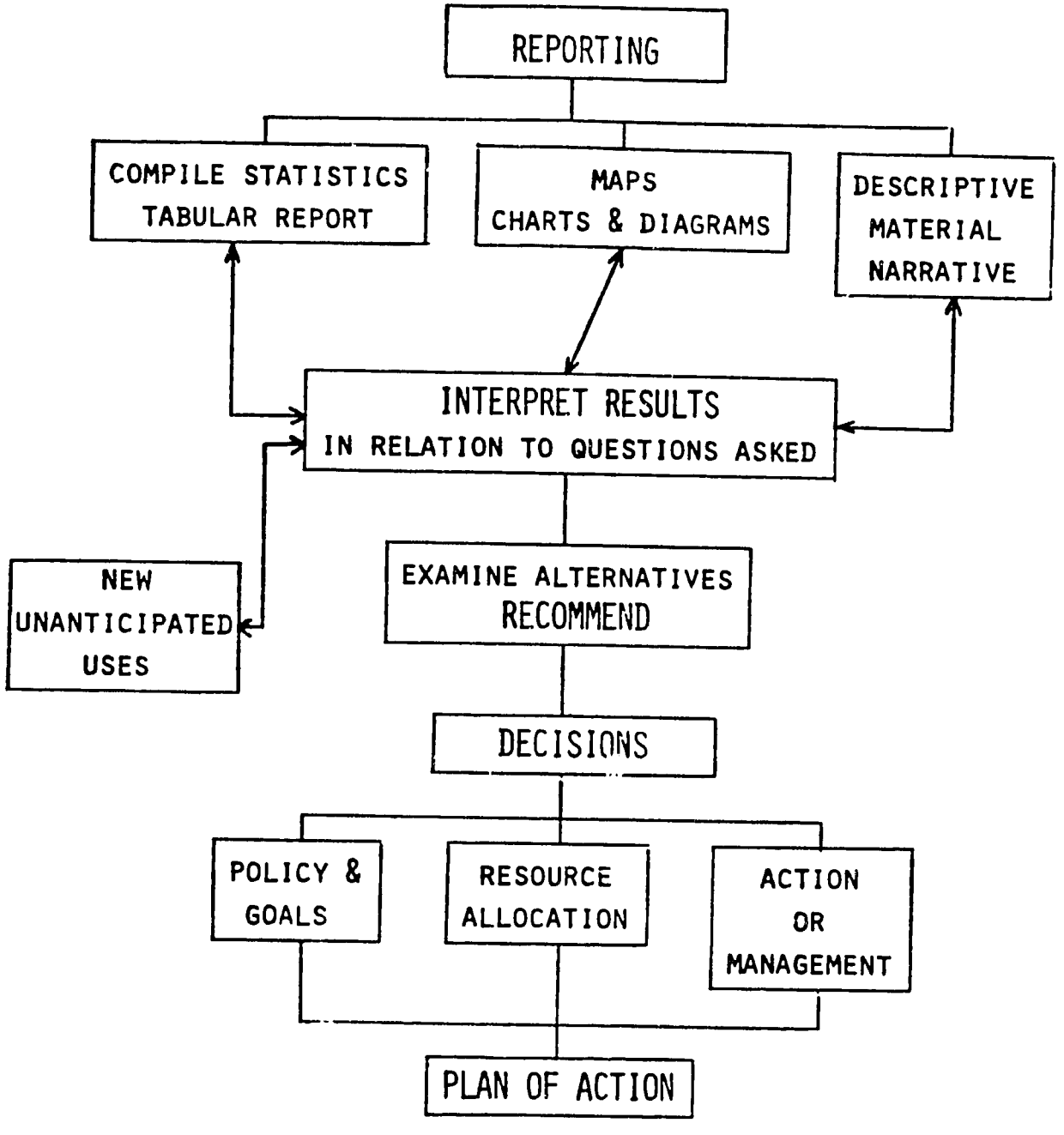

PRE-INVENTORY ACTION
STAFFING, WORKING FACILITIES AND MATERIALS, INITIAL GROUND WORK LOGISTICS, TEST AND REFINE PROCEDURES
STAFF, TRAIN AND LOCATE ANALYSIS TEAM
ANALYZE BASIC RECORDS AND EXPERIENCE
DEVELOP/ADAPT INFORMATION LEGEND CONFIRM OUTPUT
INITIAL GROUND AND OVERFLIGHT FAMILIARIZATION
INVENTORY
INITIAL STRATIFICATION STAGE

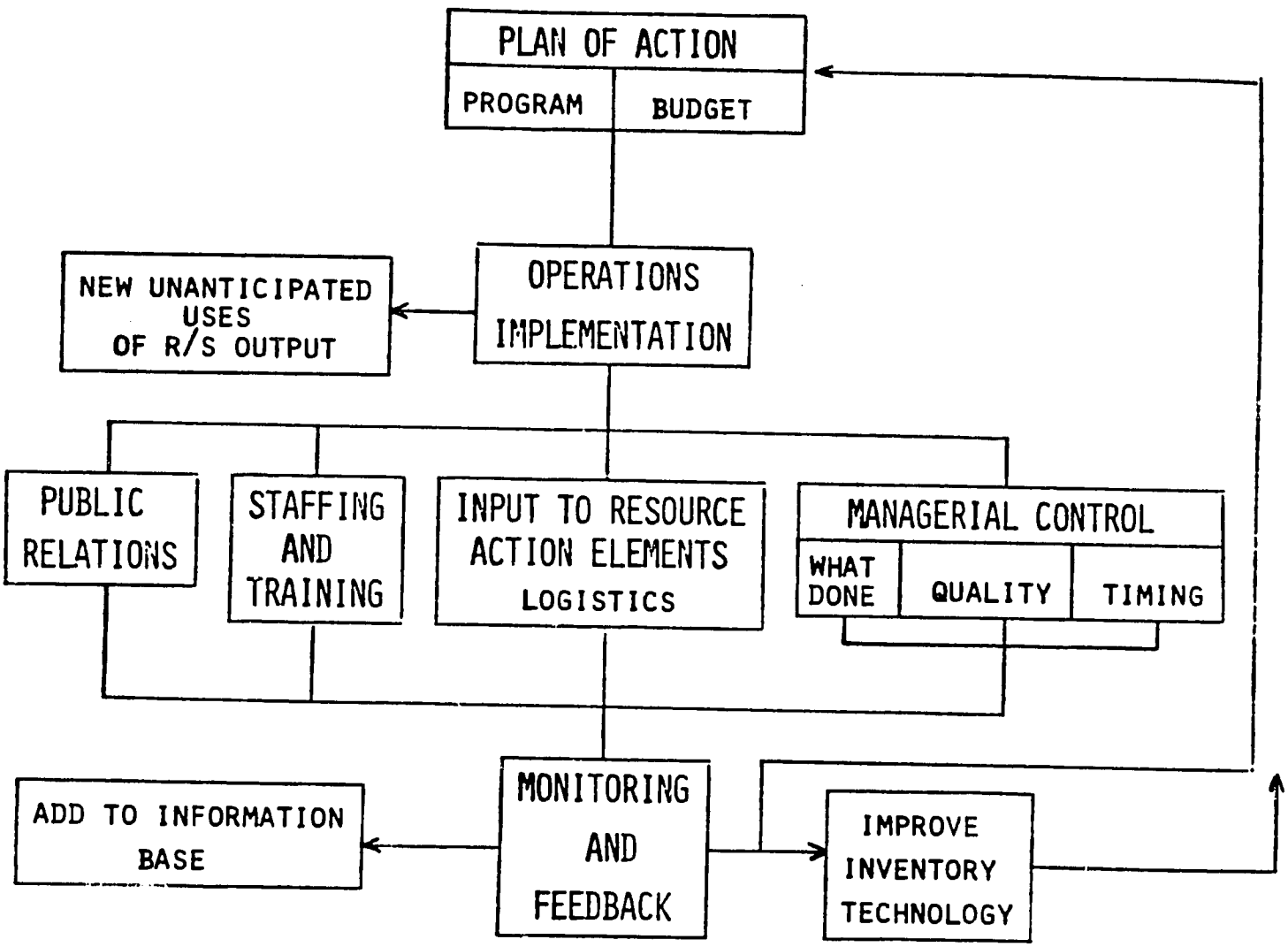
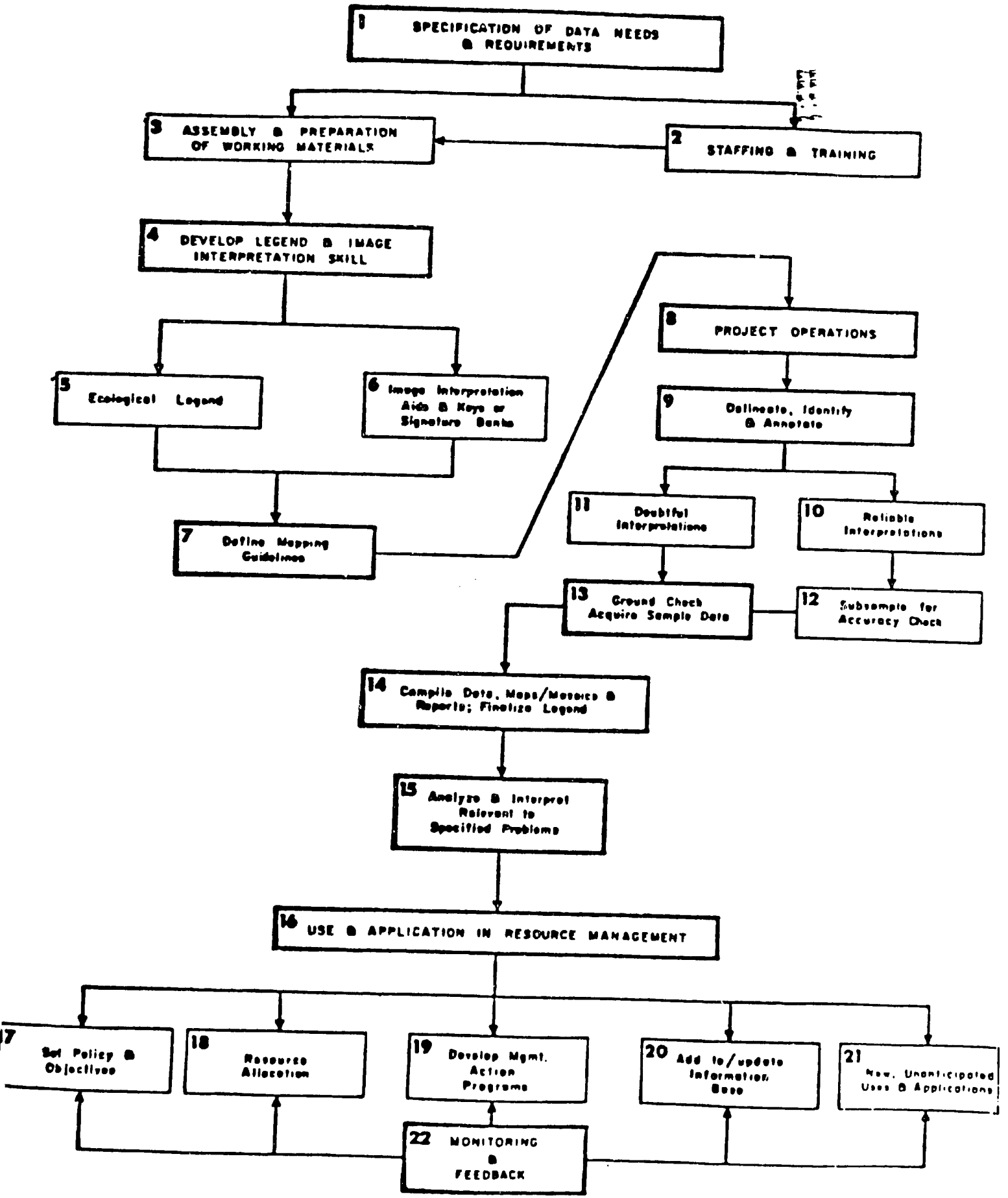

INITIAL STRATIFICATION STAGE
SMALLEST SCALE--COARSEST RESOLUTION
VISUAL INTERPRETATION MODE
ACQUIRE IMAGERY
PRE-STRATIFICATION
GROUND TRUTH MISSION
IMAGE ANALYSIS
APPLY CLASSIFICATION AND LEGEND
BROAD STRATIFICATION
LEVEL 2 OR 3
PRIORITIZE AREAS
CONCERN
NO CONCERN
INTENSIVE INTERPRETATION


INTENSIVE INTERPRETATION
LARGER SCALE--FINER RESOLUTION
VISUAL, MACHINE-AIDED, INTERACTIVE
SYSTEM SELECTION
DIGITAL ANALYSIS MSS CLASSIFICATION OF SELECTED, PRIORITY AREAS
SPECIALLY ENHANCED AND/ OR RATIOED "PHOTOGRAPHIC" PRODUCTS
SPECIAL SPACE SYSTEMS THERMAL S-190B MICROWAVE
AERIAL PHOTOGRAPHY
OF PRIORITY AREAS
1 TO 3 STAGES
OF WHOLE PROJECT
REFINED INTERPRETATION
MACHINE-AIDED, INTERACTIVE
UNCERTAIN INTERPRETATIONS
CONFIDENT INTERPRETATIONS
GROUND TRUTH MISSION
VERIFICATION
FEEDBACK FROM VERIFICATION

45


VERIFICATION
HOW WELL YOU DID
SUB-SAMPLE RESULTS
DOUBTFUL
CONFIDENT
GROUND AND AIR CHECK
TABULATE RESULTS
DEVELOP ERROR MATRIX
AND ANALYZE
SATISFACTORY
NO
YES
REPORTING
LOOP BACK TO REFINED INTERPRETATION


REPORTING
COMPILE STATISTICS
TABULAR REPORT
MAPS
CHARTS & DIAGRAMS
DESCRIPTIVE
MATERIAL
NARRATIVE
INTERPRET RESULTS
IN RELATION TO QUESTIONS ASKED
NEW
UNANTICIPATED
USES
EXAMINE ALTERNATIVES
RECOMMEND
DECISIONS
POLICY &
GOALS
RESOURCE
ALLOCATION
ACTION
OR
MANAGEMENT
PLAN OF ACTION


PLAN OF ACTION
PROGRAM
BUDGET
OPERATIONS IMPLEMENTATION
NEW UNANTICIPATED USES OF R/S OUTPUT
PUBLIC RELATIONS
STAFFING AND TRAINING
INPUT TO RESOURCE ACTION ELEMENTS
LOGISTICS
MANAGERIAL CONTROL
WHAT DONE
QUALITY
TIMING
MONITORING AND FEEDBACK
ADD TO INFORMATION BASE
IMPROVE INVENTORY TECHNOLOGY

WORK FLOW & SCHEME FOR RESOURCE INVENTORY, ANALYSIS, & MANAGEMENT