

ARID LANDS OF SUB-SAHARAN AFRICA

Staff Final Report
July 1974—December 1974



NATIONAL ACADEMY OF SCIENCES
WASHINGTON, D.C. 1975

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ARID LANDS OF SUB-SAHARAN AFRICA

2
Staff Final Report

on an Advisory Panel

of the

3
Board on Science and Technology for International Development

Commission on International Relations

National Academy of Sciences - National Research Council

July 1974 - December 1974

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Washington, D.C.

This Advisory Panel on Arid Lands of sub-Saharan Africa under the Board on Science and Technology for International Development, Commission on International Relations, National Academy of Sciences - National Research Council, was supported by the Bureau for Africa, Agency for International Development, Washington, D.C., under Contract No. AID/csd-2584, Task Order No. 12.

NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL

2101 Constitution Avenue Washington, D.C. 20418

COMMISSION ON INTERNATIONAL RELATIONS

May 1, 1975

Dr. George S. Hammond
Foreign Secretary
National Academy of Sciences

Re: Report of NAS Advisory Panel
on Arid Lands of sub-Saharan
Africa

Dear George:

The following is the report of the Board's Panel on Arid Lands of sub-Saharan Africa which deals with problems of the long-term development of the Sahel. This letter summarizes and reports the principal conclusions and recommendations arrived at by the panel. The staff summary reports of the panel's meetings and appendices comprising working papers and minutes of these meetings have been compiled for transmission to AID as required by our contract with the Africa Bureau.

The NAS at the request of AID appointed BOSTID's Advisory Panel on Arid Lands of sub-Saharan Africa late in 1973 to "advise AID with respect to the critical medium- and long-term natural resource management problems of the drought-stricken region of West Africa, and to provide assistance in the design and implementation of U.S. participation in an international collaborative scientific effort being organized to address the emergency situation."

Over the past 12 months the panel (the list of members is appended) met formally five times and held special meetings to consider particular topics, such as the future climate of the Sahel region. In late October 1974 a group of panelists met with other international scientists and planners familiar with the Sahel at the Rockefeller Foundation Study and Conference Center at Bellagio, Italy to discuss strategies for the long-term development of the Sahel region. Individually, panel members met with a wide group of people knowledgeable about the Sahel, and visited the area during the period covered by the panel's report.

Rehabilitation and long-term development of the Sahel is a very large, complex and intractable set of social, economic and political, as well as technical, problems which the panel would be presumptuous to expect to treat in depth using the approach of intermittent short meetings. In addition the pace of events in the Sahel, where a large number of bilateral and international organizations are moving ahead rapidly with relief and rehabilitation operations, outstrips the capacity

of even a full-time operational agency such as AID to monitor successfully. The value of the panel lay in the overview it provided to AID in reviewing some of its proposals, in responding to questions raised within AID, and in helping AID conceptualize strategies that will assist the Sahel countries in ultimately achieving economic self-sufficiency.

The highlights and conclusions of the panel's work are:

1. A discussion of AID's mid-term (1974-75) program of activities for the Sahel countries which enabled AID officials to reassess the problems associated with some of the large proposals such as tsetse fly clearance and provision of large areas of grazing reserve. AID has now reallocated its resources with respect to these problems in line with the panel's suggestions.
2. A critique of the draft report of the group at MIT with which AID contracted to produce alternative strategies for the long-term development of the Sahel. Since the decision to undertake the MIT study antedated the establishment of the NAS panel, and since the conclusions and recommendations of the final report by MIT were not available to the NAS panel before it completed its work, a critical review was not possible. Panelists concerns about the methodology of the study, however, were conveyed to AID and MIT representatives and perhaps contributed to a revised approach to the study. The final MIT report is being distributed to panelists for individual comment.
3. A special meeting on the future climate of the Sahel convened by the panel, chaired by Dr. Thomas Malone, which brought together a large group broadly representative of U.S. climatology. Opinion was divided as to the atmospheric conditions which cause severe drought, and as to man's ability to predict when they would occur, and whether or not future droughts will be more frequent and severe than those of the past. More information is necessary to improve our ability to predict drought, and attention is being given to this problem. Drought is unfortunately an inescapable feature of the Sahel region and planning must take into account and cope with the severe droughts which may be expected to occur periodically.
4. An international meeting held in collaboration with the Rockefeller Foundation at the Foundation's Study and Conference Center at Bellagio comprising a group of NAS panelists, scientists and administrators from Africa, Europe and international agencies in order to discuss strategies for the long-term development of the Sahel region. This meeting provided a unique opportunity for participants to exchange viewpoints and perceptions of drought-related problems. The panel's report of the Bellagio meeting and a Bellagio Working Paper prepared by the Rockefeller Foundation will be circulated widely to disseminate the conclusions and recommendations on opportunities for long-term Sahelian

development. We hope these will be used as a basis for programs of bilateral and international donor agencies. The conclusions and recommendations emphasized: a) the need for a systems approach to the utilization of available resources, and b) the need for an institutional mechanism in the region (a "Sahel institute") which would provide systems research and development to support the long-term development effort. Within these contexts efforts should be undertaken to:

- . upgrade the nomadic-pastoral livestock system;
- . improve the predictive capacity of meteorological services;
- . improve the supply of information on soil and water resource development to farmers on a farm scale;
- . accelerate food production, both crop and livestock, as the basis for food security for the region which will permit and support long-range economic diversification including such things as small scale agro-industry;
- . improve understanding of the economics of marketing at the farm-level, within and between countries;
- . improve infrastructure, roads and communications, in the area;
- . ensure that in developing large-scale water resource projects in the great river basins of the area, opportunities for small-scale water resource development (such as described in BOSTID's More Water for Arid Lands) are not neglected; and
- . above all, improve the level of education of the peoples of the region, adults as well as children, by all means (formal and otherwise) as the main basis on which long-term change can be effected in the area and on which all other development activities will depend.

At the panel's final meeting in December, members felt that the original mandate of the panel had been accomplished and it was agreed that therefore the panel as presently constituted should be dissolved. However, it was also agreed that a number of important tasks should be undertaken which might require a different panel or other mechanisms.

Accordingly the panel recommends to BOSTID that the following tasks be undertaken in consultation with AID and other agencies and organizations:

1. Collecting, collating, and analyzing the recent drought experience. A great deal of information has been derived from the recent drought, which should be systematically collected before it is irretrievable and analyzed for the lessons which should be preserved to reduce the impact of the next drought.
2. Providing a focus for U.S. scientific and technological inputs for problems of long-term self-sufficiency in arid lands around the world, particularly in Africa.

Dr. George S. Hammond
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3. Implementing the ideas outlined in the Bellagio report, summarized above. To do this AID should consider establishing working groups to address the specific problem areas, e.g., upgrading the nomadic-pastoral livestock system. These working groups should not undertake studies of the problems per se but rather design projects and programs for donor agency financing and implementation to remove the critical constraints towards progress in development. Each working group should of course include African participants from the Sahel countries; certain of them, e.g., to consider a systems approach to development planning, small-scale water resources, etc., may be suitable topics for NAS participation following the recent BOSTID studies of these topics.

On behalf of the panel, I would like to convey to you how much my colleagues and I have appreciated working together in this important and challenging area. We greatly appreciated the service and expertise of your staff in the conceptualization and implementation of the program. If individually or collectively we can be of service to BOSTID and the NAS in the future, please feel free to call on us to do so.

With warm wishes,

Sincerely,

John J. McKelvey, Jr.

ADVISORY PANEL ON ARID LANDS OF SUB-SAHARAN AFRICA

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PREFACE

The Advisory Panel on Arid Lands of Sub-Saharan Africa of the Board on Science and Technology for International Development (BOSTID) was appointed by the National Academy of Sciences in late 1973 in response to a request from the Agency for International Development (AID).

The work of the panel up to June 1974 has been recorded in a staff progress report. These earlier activities led to the planning of an international conference to review the situation in the Sahel, and discuss long-term development opportunities.

The international conference was held at the Rockefeller Foundation Conference and Study Center at Bellagio, Italy in October 1974. A meeting of the panel was held in September 1974 to discuss the plans for the Bellagio conference, and a final meeting of the panel took place in December 1974 to review the outcome of the Bellagio conference and the conclusions reached by the panel from its discussions.

This final report contains a summary of the two formal meetings of the panel, and a staff-prepared report of the Bellagio conference. A separate volume of appendices comprises the minutes of these meetings and working papers contributed to the Bellagio conference. The Table of Contents of the appendices volume is included as page v of this volume.

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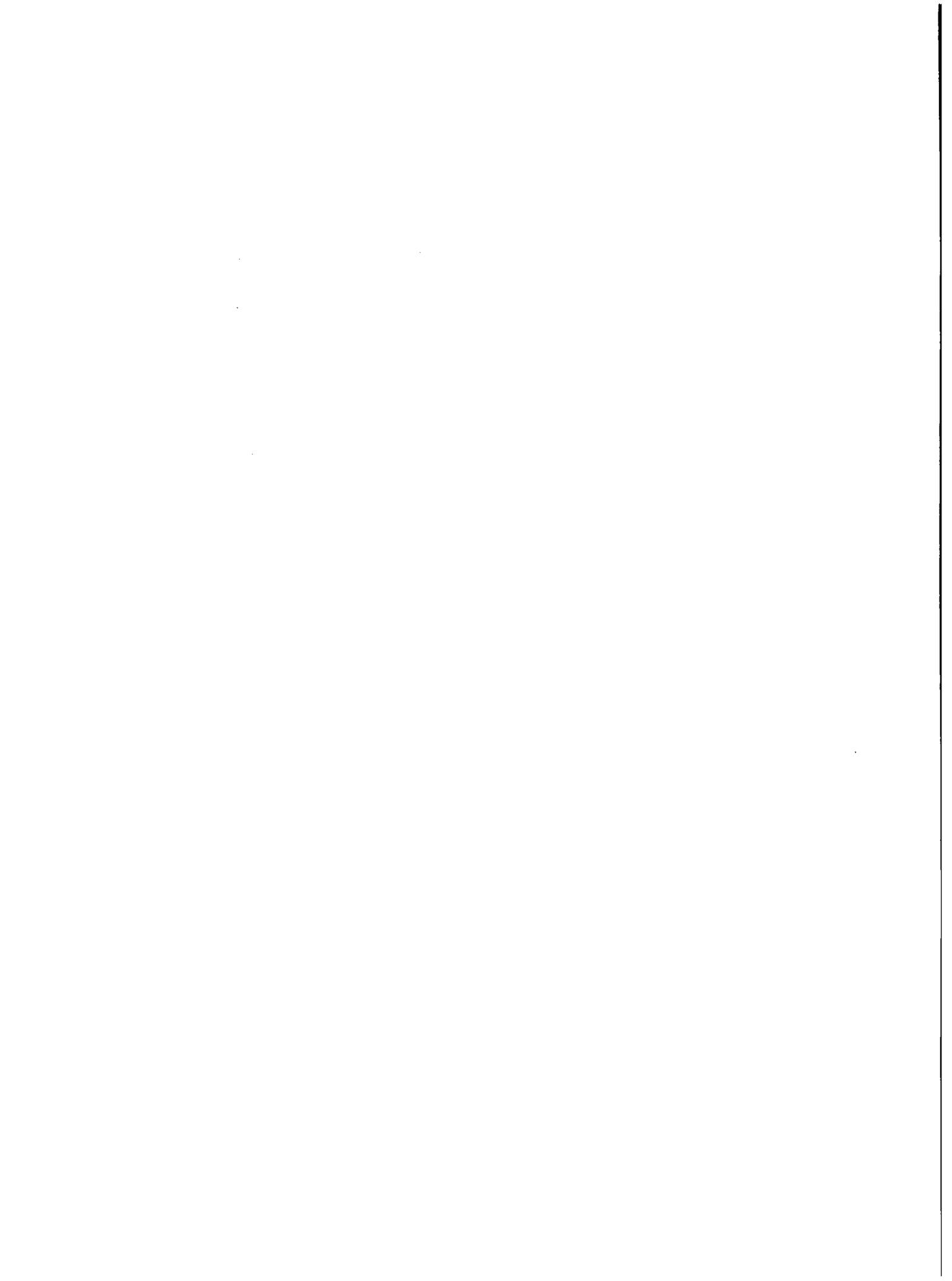
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Summary Report

Fourth Panel Meeting, 23 September 1974

The purpose of the meeting was to discuss plans for an international meeting on development strategies for the Sahel to be held under the auspices of the NAS panel and the Rockefeller Foundation later in 1974.

The Foundation was able to make available the Villa Serbelloni Study and Conference Center in Bellagio, Italy to accommodate up to 20 participants, but the only time available was a period of 5 days in late October.

Dr. Lyman reviewed AID project planning since the spring of 1974.

Dr. McKelvey reviewed the prospective participation and objectives of the Bellagio conference.

Dr. McLoughlin reported on a lengthy visit he had recently made to the Sahel and the conclusions he had reached in an 18-volume report.

Among the conclusions were:

- . the psycholinguistic difficulties of development discussions are a significant problem in the Sahel countries;

- . the absorptive capacity of the Sahel countries, to which assistance must be geared, is severely limited;

- . the whole area of the economy served by the private sector is being neglected.

The afternoon session was devoted to a discussion of the agenda for the Bellagio conference. A working draft agenda which had been prepared for discussion was discarded, and instead a list of questions was com-

piled which was designed to assist in the definition (and thereby resolution) of the main issues. These questions were distributed to participants in the Bellagio conference as a basis for discussion:

Climate/Weather

1. What are the realistic prospects for the climate of the Sahel over the next 20-30 years? What are the implications of this for large- or small-scale project development planning?
2. What research is required?

The Ecosystem

1. What is the capacity of the Sahel to support people and animals? How can the limits of this be determined? What are the development implications for the next 20-30 years?
2. What changes are taking place? Are they inevitable? What are the major facets of interrelations of change in climate, population, agricultural production, land use, and environmental quality? Specifically, where is the energy to come from for development, for fertilizer, for transportation, etc.?

The Peoples and Institutions

1. What are the psychological impacts of the drought? Are they more profound and permanent among agricultural or pastoral peoples?
2. How can the process of identifying local wants, needs, and priorities be assisted and related to donor objectives? How can governments be assisted to increase absorptive capacity for projects? How can maintenance, monitoring, and evaluation of projects be assured?

3. How are the most favorable conditions for rural development created?

4. How can rationalizing productivity and ecological use of resources be reconciled? What would be the effect of this on employment and subsistence? For example, are there realistic ways of continuing to encourage and modernize pastoralism as an ecologically adaptive system for the low productivity environment, without eliminating the overall life and livelihood system?

5. How do the heretofore rather neglected sectors (e.g., manufacturing and mining) become incorporated into efforts to develop these economies?

Staff Report^{*}

CONFERENCE ON INTERNATIONAL DEVELOPMENT PROBLEMS IN THE SAHEL

Bellagio, Italy, 24 - 29 October 1974

Rockefeller Foundation Conference and Study Center, Villa Serbelloni

Participants

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* The Rockefeller Foundation has prepared a separate set of working papers on the Conference, published May 1975 and available directly from the Foundation.

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SUMMARY

The Bellagio conference was organized in an attempt to draw together the main lines of long-term development thinking represented by individuals from a variety of countries and institutions with different perspectives united by a deep concern for the future security and well-being of the peoples of the Sahelian countries. Underlying the discussions of the component parts of integrated development strategies was the question of how the region would be better equipped to face the next drought.

The discussions were designed to improve the articulation of the main development issues and narrow the focus to practical approaches to solutions to these problems. These main development issues include problems of equity--how development strategies can help nomads, farmers, and city-dwellers to achieve reasonable levels of food security, employment, education and other services with some measure of equity. In the case of the nomadic pastoralist this is particularly acute where efforts to increase the productivity of grazing may destroy the traditional way of life. Equity is also an issue in terms of the level and time-scale on which development activities are organized, where the long-term impact of investments in large water resource development projects is contrasted with immediate returns from small investments in many projects.

A second major issue is the provision of appropriately trained manpower as well as increasing the general level of education through formal and non-formal means to assist the management and implementation of development.

A third issue is the development of adequate infrastructure to sustain long-term economic and social development, including the natural drainage basins, transportation and communications, and modification of the economic-marketing system within countries and integration of the economic system in the whole West African region.

The fourth main issue concerns the creation of regional applied research, development and extension capabilities to support the development system for the whole region, recognizing the interrelationships of its components, and simultaneously strengthening national resources.

The discussions were frank. Given the very complex nature of the issues and the varying perspectives of the participants, unanimity on each point was neither sought nor attained, although a fair degree of consensus was evident in the conclusions and recommendations.

Certain issues could not be resolved: the question of equity could not be discussed directly as some participants felt strongly that it was an internal political matter for the Sahelian countries. Others maintained it remains central to long-term stable economic development, particularly as it affects the pastoralists.

Major conclusions on which the recommendations are based were:

1. The present weather pattern in the Sahel suggests no catastrophic event but implies that severe drought cycles will continue in the years ahead, and therefore severe drought will continue to be a major factor which the long-term development system for the Sahel must accommodate, through flexibility, mobility of people, goods and services, and adequate reserves.

2. Food security is a key factor in the future stability of the Sahel system and to the successful adaptations of the present subsistence system.

3. The magnitude of educational requirements in the rural areas and the rate at which traditional, formal instruction is given are severe impediments to the delivery of educational opportunity which is the crucial element in successful organization of all of the parts of the system.

4. The present transport and communications system in the Sahel is inadequate to support necessary movement of goods and services, or emergency relief supplies.

It was also recognized that the success of long-term development strategies will depend on the extent to which they can balance the requirements imposed by the interrelationships of the elements of the system. It is, therefore, difficult to order priorities; however, there are several key areas in which an early start can be made. These include the following:

1. Improved education services, which more than any other single sector can contribute to achievement of the essential popular involvement in the development process, the adoption and adaptation of new agricultural practices, planning and coordination of all the implementation activities, must break from past practice and be made available simultaneously at the adult primary and secondary levels through a variety of means. Linked to this is the establishment of an institute for the Sahel which, through research and development, will support the educational effort.

2. Food production must be increased to provide the security for the system. This is linked to better utilization and management of soils and water resources in both dryland and irrigated agriculture. Recognizing that large-scale irrigation schemes associated with new big dams will take years to complete, increased emphasis should be given to the variety of small-scale techniques which can increase the amount of available moisture at comparatively low cost. Health services have a particularly important task in facing the endemic infectious diseases, controlling hazards in new large and small water schemes, and improving work potential.

3. The animal production and management system must be improved, through incentives (health, nutritional, educational, marketing), and through greater reliance on the natural complementarity of the Sahelian Zone with other ecological zones.

4. Improved transportation and communication networks are essential and a systems approach should be taken to implement an area-wide plan.

A Strategy for Long-term Development of the Sahel

I. Introduction

The recent disastrous drought in sub-Saharan Africa, extending over six years, brought such widespread devastation and resulted in human suffering on such a scale that world attention was drawn to that area. As the severity of the drought increased and the threat of mass famine spread, many international efforts were mounted to rush food and emergency supplies to the six West African nations most severely affected. Immediate relief needs properly were given priority attention but basic problems of climate and water, food and population, and of ecology and resource management also demand world attention. Responsible officials in the Sahel and in international agencies recognize the need for a regional long-term development plan and sustained actions to bring greater food security and an improved standard of living to the predominantly rural peoples of the area. The importance of planning now to identify promising long-term solutions to problems of drought-prone West Africa led the U.S. National Academy of Sciences, with support from the U.S. Agency for International Development, and the Rockefeller Foundation, to call an international conference for projecting a long-term development strategy in the Sahel.

Fifteen scientists and administrators knowledgeable and concerned about the Sahel met 24 - 29 October 1974 at the Rockefeller Conference and Study Center in Bellagio, Italy to explore the dimensions and options for a development strategy in the Sahel. The underlying theme was "What happened as a result of the drought, and what will happen when the rains fail the next time?" Two broad categories of questions were addressed:

. What scientific, technical and managerial tools are available to speed recovery from the recent drought and reduce the impact of future drought cycles?

. What institutional mechanisms exist, or may be created by the Sahelian countries working with international donors, to seek economically, politically, and ecologically acceptable and equitable solutions to long-term problems of the area?

Conference participants had long experience in sub-Saharan Africa or in other arid regions; they represented a wide spectrum of scientific disciplines and of managerial expertise for development in such specialties as soils, dry-land and irrigated agriculture, plant and animal production, climatology, water resources utilization, anthropology, pastoralism, agricultural research and extension, economics and marketing systems. The meeting was organized as an opportunity to discuss drought and its consequences for the long term in a unified, systems manner. Participants were seeking development strategies tuned to ecological-cultural traditions, avoiding massive technological interventions, and realistically focused upon a rural, predominantly agricultural economy. The discussions unfolded in the context of:

. New perspectives of the physical and natural resources of the region with particular concern for food systems and water availability;

. Human resources for development recognizing the population as a productive force as well as a consumer of resources;

. Infrastructure limitations to long-term problem solving in the Sahel with emphasis upon natural drainage basins, transport and communica-

tions, and modification of the economic-marketing system within individual countries and integration with Sudanian Zone countries of the broader, West African geographical region; and

. Institutional imperatives for development which were proposed in terms of creating regional applied research capabilities and simultaneously strengthening appropriate local research and development resources.

The report summarizes the five days of discussions at the conference in Bellagio. It highlights positive actions which participants recommended and reflects a hopeful vision for the future. That vision is one that sees as a practical and attainable goal a more secure and improved standard and quality of life for the Sahelian peoples.

II. New Perspectives of Natural Resource Utilization

A. Introduction

A prerequisite in the preparation of a comprehensive systems strategy for long-term development of the Sahel is an understanding of its physical and natural resources. From such an understanding insights arise into problems and solutions that are ecologically sound and economically attainable. To these considerations the human resource dimension provides the vital force participating in all steps of planning, analysis, decision making, and program implementation.

The harmonization of human goals and of physical resources then provides the foundation upon which all other aspects of Sahelian development planning may rest. This section of the Bellagio conference report singles out the physical (or natural) resource constraints and needs, and is followed by another section on human factors. In the analysis of the

physical resources aspect of a strategy for Sahelian development, the conference participants were particularly concerned with climate, water-soil relationships and their implications for food production.

B. Climate

Controversy exists among meteorologists and other atmospheric scientists concerning future global weather trends. In the absence of demonstrable evidence to support a theory of radical climatic change, however, the Bellagio conference participants concluded that the present uncontrollable weather pattern in the Sahel suggests no catastrophic event, but implies that severe drought cycles will continue in the years ahead. Drought will continue to be the major factor determining the nature of the Sahel system. One cannot predict when a drought will occur; past experience suggests serious episodes at least once each decade. Although predictive drought forecasting is not yet possible, important advances in atmospheric sciences and related disciplines are being made. It is imperative that lessons learned elsewhere be related and interpreted in ways useful to the Sahelian region. A specific example is the conclusion that weather modification experiments (through cloud seeding) are not warranted in the Sahel. Positive actions which could be undertaken, however, include the following:

. Linking weather information needs of the rural people with knowledge the meteorologist can offer. Collection of meteorological data as an "end in itself" must be avoided; it should fulfill needs of farmers and herdsmen.

. Collecting and assembling data to improve weather predictive

capacity and services in the Sahel in the immediate future. This demands a careful use of existing knowledge of short-term drought cycles to maximize weather forecasting possibilities.

. Studying effects of drought and of high temperatures on grass species grown in the Sahel.

. Linking a comprehensive knowledge of the Sahel to knowledge of similar arid areas elsewhere to draw comparisons for mutual benefit.

C. Water-Soil Interactions: Basic Relationships

The Sahel is not a homogeneous region in terms of water and soils. In general there are three to four great soil type systems and two underground water systems which characterize the region. Interactions between soil and water systems dictate in large part the potential for crop and animal production.

The primary need is an ecosystem approach toward understanding and managing Sahelian soil and water resources. The hydrodynamic properties of soils must be understood and related to their productivity. Depth of water tables and underground flow patterns must be known. Perennial river basin and lake reservoir use and management must be exploited for complementary irrigation to a far greater extent than is currently the case. Soil and water scientists can only gain the information required from field measurements which must then be interpreted and expressed in terms useful to sedentary farmers and to itinerant herdsmen who have little formal schooling but much practical knowledge. The goal of soil and water scientists working together is not to elucidate physical phenomena to their peers, but to relate the observations of soil-water interactions in simple and practical ways to the rural peoples of the Sahel and to their development planners.

D. Food Production Systems

Perhaps the most complex topic dealt with by the participants at Bellagio is the interdependence of crop and animal production in the Sahel. Given the fragile ecosystem, agricultural and livestock practices that have evolved over the years have been tuned to the vagaries of climate and limitations imposed by meager soil endowments. Livestock husbandry among the nomadic peoples is deeply ingrained in the social fabric of the area. In recent years the traditional balance has been shifted to accommodate an increasing human and animal population and to meet rising expectations for goods which could only be imported by partially converting from subsistence agriculture to cash crops and exporting livestock. Thus, the most recent drought disaster occurred when there were greater numbers of people to be fed, larger herds on the land, and relatively less food in storage than in the past. To help redress this imbalance, a variety of measures must be considered. Fortunately, there exists in the region a network of crop and animal research stations with an accumulation of knowledge and experience, some of which is applicable to the natural and normal husbandry conditions of the Sahel and which, if wisely applied, would enable Sahelian farmers and herdsman to increase their productivity significantly.

Among the possibilities discussed and endorsed at Bellagio were:

1. Increased emphasis on food crops to improve yields with known methods. Food security is the key to future survival and to adaptations of the present subsistence system. Special attention must be given to marketing efficiency and the mix of food and cash crops. (The participants were cognizant that fertilizer and pesticide costs have increased

dramatically and that these economic constraints must be dealt with in order to meet higher food production goals.)

2. Better utilization and management of water resources for dry-land farming within the limits imposed by available natural rainfall.

3. Improvement in the animal production and management system through greater reliance upon the natural complementarity of the Sahelian Zone with the Sudanian and Guinean Zones of West Africa.

4. Improvement of the pattern of cattle movement (transhumance) and the introduction of marketing livestock at a younger age.

5. A planned system of incentives for pastoral and farming peoples in terms of (a) better health and nutrition services, (b) availability of basic and special education, (c) better communication between researchers and rural peoples, (d) alternative employment opportunities, and (e) marketing of crops and livestock and better off-farm sales prices.

III. Human Resources for Development

A. Introduction

Between 80 and 90 percent of the Sahelian people derive their living from agriculture; therefore, changes in land and water management which by necessity imply changes in traditional living patterns, demand wide and popular participation. Thus a prerequisite for long-term development is involvement of local people in planning, problem analysis, decision making and program implementation. Popular democracy will not be easily achieved but is essential to effect changes in the traditional life of farmers and herdsmen. Two of the more promising program areas in which to begin are education and health care services. Both improved access to education and to health services must overcome:

- . Inadequate numbers of trained teachers and medical specialists,
- . Meager economic resources to train needed leaders and to extend their services into the remotest rural areas,
- . Low general literacy rates,
- . Mobility of large segments of the population to be served,
- . High incidence of parasitic diseases,
- . Tradition-bound practices in education and in primary health care that impede change.

B. Education

Bellagio conference participants recognized that the magnitude of the educational services needed in the rural regions and the rate with which traditional, formal instruction is given are severe impediments to the delivery of education opportunity. Therefore, improved services must break from past practices and be made available simultaneously at several levels:

- . At the level of adults, rural cooperatives offer possibilities to impart new skills, particularly in business education, on a wide and practical basis. The effective techniques of animation rurale merit wider application. Also, use should be made of local leaders as one means to reinforce the traditional custom of palaver in village and tribal decision making. Mass media have a particularly important role in both formal and nonformal education and should be given much greater emphasis. However, psycholinguistic barriers to understanding exist between planners and rural people; these must be addressed if educational techniques are to be more effective.

. At the level of primary schools, local languages should be the medium of instruction, particularly for the initial cycle (1 - 3 years). Curricula need to be completely reoriented away from a classical system to one that emphasized local knowledge about the environment, health and sanitation, nutrition, care of animals, use of simple tools, and other aspects of rural life.

. The secondary cycle requires drastic revision to provide training in vocational skills which are oriented to rural and service occupations. In general the present system encourages breaking of family ties and emigration to regional towns and cities in the expectation of obtaining scarce white collar employment.

. Continued diligence must be exhibited in discovery, motivation and training of especially talented youth for leadership roles in the Sahel. The region needs highly qualified and well-trained citizens for leadership in agriculture, commerce, industry, and government. This requires strengthening of the formal education system simultaneously with efforts to extend educational opportunities by innovative, nonformal means.

C. Health Care Services

Sufficient resources do not exist to institute a modern public health care system after the patterns of more industrialized countries but incremental improvements in present practices, including folk medicine, can be made to reduce infant mortality, childhood diseases, and common bacterial infections. A health care program may begin with supervised paramedical services with built-in provisions for upgrading skills of those delivering primary care. In conjunction with special adult educa-

tion and more traditional schools, inclusion of instruction on basic hygiene and sanitation, nutrition and health, and first aid should be widely taught.

Several systems of rural health care delivery are being introduced on a trial basis in developing countries. From a review of these programs much may be learned that would be applicable and rather quickly adapted to the Sahel. For example, the use of teams presently assigned to malaria eradication could be utilized in the wider function of health education. These teams are soon to be joined by personnel combating river blindness and sleeping sickness. Add-on efforts seem eminently reasonable in the Sahel and are within the potential of local-international resource availabilities.

IV. Infrastructure for Development

A. Introduction

The lack of adequate physical infrastructure in the Sahel in terms of river-drainage basin development for water management, a modern transport network and communications system are serious deterrents to both emergency relief measures and long-term economic development. Since independence, capital investment funds to build needed regional and national infrastructural elements have been unavailable to Sahelian countries. A second major constraint has been the shortage of operating funds to maintain the national and regional infrastructure, and these are likely to continue to be critically short in the future.

Related to the needed investments in physical infrastructure is a parallel need to change traditional marketing practices. In part, marketing in the region reflects the lack of easy mobility of goods.

Another factor is the tradition of nomadic peoples to view animals on-the-hoof as wealth and security. Since the custom of optimizing production and marketing of cattle does not exist, little or no reliance is placed upon a money and banking system. If a more market-oriented economy, with food security and regular availability of services, existed and was accepted by the nomadic peoples, movement of surplus livestock from rangelands of the Sahel in normal years to the south and west where higher demand exists for meat would bring higher returns for the cattle. It must be appreciated, however, that subsistence frequently dictates that pastoralists raise different qualities and types of livestock from those sought by the southern markets. Although there was a gradual trend toward a market economy prior to the disastrous drought years, positive steps need to be taken by the Sahelian governments to encourage modern marketing of livestock and other agricultural goods as far as is possible without affecting food security. It was not the purpose of the Bellagio conference to examine in detail the social-political implications in converting to a market-oriented economy; however, the participants did note the importance of social and political decisions on economic and technical changes, particularly in the context of integrated economic development involving flows of goods and services across national boundaries from north and south.

Infrastructure investments affect not only the agricultural sector but also the nascent industrial sector in the Sahel. To provide more employment opportunities, to enhance agricultural products intended for local and export markets, to produce domestic consumer goods which are now imported, to meet rising foreign exchange demands for development

purposes, and to broaden the economic base of the Sahelian countries, development programs must give greater attention to minerals exploitation and strengthening the manufacturing sector. With assured water resources and electrical energy plus an improved transportation-communications network the pace of industrial development, as well as agricultural development, can be greatly enhanced.

B. River and Drainage Basin Development

Within the Sahel and adjacent areas are four great river systems--the Gambia, Niger, Senegal, and Volta--and one lake system--the Chad. None is fully utilized, but if each were more systematically developed and managed, reliance on rainfall and dry-land agriculture could be greatly reduced. However, this would affect relatively limited numbers of people, and participants in the conference recognized that full utilization could not make the region agriculturally self-sufficient, particularly when population growth rates are considered, but the potential increase in agricultural output plus the parallel benefits of electrical energy generation and river transport and associated enhancement of water management are of crucial importance for the social-economic development of the region.

Problems which must be overcome before river and drainage basin development can be realized are:

. Negotiation of water use and distribution agreements among the several Sahelian countries,

. Raising significant financial resources on favorable terms through international lending agencies,

. Overcoming health problems such as schistosomiasis and trypanosomiasis associated with water basin development in tropical and semi-tropical zones, and

. Planning for the integration of irrigated and dry-land agriculture with respect to optimum complementarity and questions of equity.

Construction of large-scale dam projects will take time. Equal, if not greater, emphasis should also be given to all kinds of small-scale water conservation techniques which can provide immediate improvements in the availability of moisture for crops, livestock and people. Much experience has been gained around the world on both large- and small-scale water management systems, and should be studied and made available to the Sahel.

C. Transportation and Communications

The present transportation and communications network in the Sahel is inadequate; it failed to provide a reliable basis for prompt national and international response in the most recent drought-relief operations. Indeed, the absence of a modern land transport-communications system exacerbated relief operations by delaying shipments of critical foodstuffs, by increasing severity of suffering in many remote locations, and by requiring costly air transport.

To improve transport and communications, an area-wide plan is needed using a systems approach for its implementation. A first priority is a reliable telecommunications network linked to the outside world. Such a network is both technologically feasible and economically possible.

A second priority is a regional transportation network plan that includes, where appropriate, (a) primary and secondary roads, (b) rail-road links, (c) river transport, and (d) air transport. In making cost/benefit estimates for such a comprehensive system attention should be given to multiple uses of roads for transport, river and drainage basin improvement, and access for other development purposes (forestation, mining, tourism, etc.). The huge cost for emergency relief transport during the recent drought disaster serves as an important social cost/benefit reference point in helping to justify a major investment in an area-wide transportation system.

V. Institutional Imperatives

A. Introduction

A wide range of local institutions exist in the six nations of the Sahel to study crop and animal improvement, to promote various aspects of water resources development and to exploit particular mineral resources. There is, however, no overall multidisciplinary institution to originate and coordinate research and development in the Sahel over the long term. A critical need for such a coordinating institution has come to be described as the institutional imperative for an accelerated program of technical and economic development in the Sahel.

B. The Sahelian Institute

The identification of the need for a research and development management organization dealing with a broad range of Sahelian problems was first suggested by the Permanent Interstate Committee on Drought Control in the Sahel (CILSS), an official intergovernmental organization of the six West African countries. At the Bellagio conference the

assembled participants endorsed the CILSS call for a Sahelian institute and suggested that its functions include the following:

- . Strengthening research and development programs in existing national laboratories within the Sahelian countries and better coordination of efforts throughout that geographic area. This function implies sustained and adequate funding plus wide access to the world scientific community.

- . Collecting and disseminating from all appropriate sources information on research and development programs that are applicable to Sahelian problems.

- . Participating in ongoing research, particularly of the type needed to transfer and/or adapt technologies from relevant programs outside the Sahel.

- . Training research and development personnel.

- . Performing central services of data collection, information and bibliographic reference, computation, and liaison with international organizations.

- . Serving in an advisory capacity to individual governments, to CILSS, and to international organizations when requested to do so.

- . Adopting an extension function, assisting with implementation of research in the region.

The Bellagio conference participants also recommended that a comprehensive Sahelian institute requires a "feasibility study phase" prior to its creation to outline its role and its scope of activities, to define its relationship to other research and development institutions in the

six West African nations, to suggest its institutional structure, and to explore sources of financing. Very significant resources over a realistic period (10 years) must be pledged by the Sahelian governments and by international donors to enable a new institute to be created and function effectively. The ultimate goal should be the creation of a self-sustaining, indigenous capacity for scientific-technical problem analysis, evaluation and solution in the Sahel to reduce its dependence upon technical assistance from outside the area.

Summary Report

Fifth Panel Meeting, 18 December 1974

The agenda for this meeting included the following items:

- . review of the MIT draft final report;
- . review of the NAS - BOSTID study More Water for Arid Lands:

Promising Technologies and Research Opportunities;

- . review of the Bellagio conference and the background paper prepared for it by George Van Dyne, "Long-term Development Strategies in Relation to Environmental Management in the Sahel";
- . discussion of the report of the Bellagio conference; and
- . future role of the NAS Advisory Panel.

MIT Draft Report

Panelists pointed out that it was difficult to review the report critically as the section of conclusions had been omitted, and it was only possible to infer the conclusions and to critique the methodology. There was criticism of the lack of coordination between the various sections, which led to great unevenness in quality and style and much duplication. The agricultural section is perhaps the strongest, but others, while containing useful ideas, may be of more use to people not well acquainted with the situation in the Sahel. As a result of discussions with AID officials, the authors are now planning to publish an overall summary volume capturing the essence of the study and the volume on agriculture which is most elaborately worked out in terms of alternatives. Panelists' individual comments and suggestions will be sent to AID.

More Water for Arid Lands: Promising Technologies and Research

Opportunities*

(This report is a compendium of promising but little-known techniques for the utilization and conservation of scarce water resources in arid regions, compiled by a panel of the NAS Board on Science and Technology for International Development.)

In response to a request to comment on the utility of this report for the Sahel region, panelists said they found it useful and interesting. Several made the point that the emphasis on the contribution small-scale techniques could make was particularly welcome. Dr. Peterson, who was chairman of the study panel, commented that there was no implication that these techniques should be a substitute for large-scale capital development activities. While they can save a great deal of water and make useful contribution to individual or small community situations, the large-scale projects are needed for large increases in energy and food production. Equally, the report purposely did not deal with increasing the efficiency of conventional on-farm water management, another area in which tremendous savings in water could be made.

AID representatives thought the selection of techniques would be very useful for their field staff in the Sahel in designing projects above and beyond the large dam schemes, and expressed concern over the potential for increase in pest breeding created by numerous small-scale water development projects. Dr. Peterson indicated there was a companion volume in the series of studies which dealt with mosquito control. The majority of techniques in any case are designed to reduce the amount of free-standing water and the evaporation losses to which it is subject.

Panelists felt that there was much experience with these techniques which should be brought to bear on the problems of the small farmer in

* Special Report No.14, Commission on International Relations, National

the Sahel, and that the necessary longer-term research and adaptation of these methods to the needs of the Sahel could be appropriately conducted by the proposed Sahel institute discussed at the Bellagio conference.

The Bellagio Conference Background Paper

Introducing this topic, Dr. McKelvey asked Dr. Van Dyne to make a short presentation on the background report he prepared for the Bellagio conference. Dr. Van Dyne said his report was based on the outline study he developed for the panel previously ("Problems of Contemporary Man in a Fragile Ecosystem--the Changing Sahel") and he had reviewed the available literature to prepare a condensation of the various development viewpoints, which he then reviewed and drew some personal conclusions.

In the review of the literature, he had identified three "feedback loops" (to which the MIT draft report referred as "vicious circles") which condition development planning. These result from

- . the physical characteristics of the region--recurrent drought (whether cyclical or secular);

- . the social behavior of the people--the importance of livestock in their lives, and the pressure to increase livestock numbers, leading to overgrazing, deforestation;

- . recent introduction of technology--large number of permanent water points, allowing people to remain longer in dry areas than was possible historically; reduction in infant mortality through health programs--which has led to large population increase.

These factors have had the effect of increasing the overgrazing and deforestation of the region, destruction of the plant communities, erosion, and desertification.

On the economic side, the area is characterized by low production capacity, low output, mass-elite gap, limited opportunities for saving, credit and investment, and limited employment, education and other social amenities, complicated by rural-urban migration due to population increase and the weakened rural resource base.

The first major conclusion which may be drawn from this is that it is impossible to deal with single factors in isolation, and the system must be viewed as a whole. This leads to the concept of the requirement for an organization to do the systems analysis study and planning; there are suggestions it could be located either outside or inside the region. The latter might be more politically acceptable and provide more substantial long-term development capabilities in the region.

A second conclusion is that to develop self-sufficiency over a short period will require a great increase in the technological capability of the population to capitalize on the human and natural resources available. This will require a three-pronged attack--mass education efforts to reach the grass-roots (variously thought of as "bush schools," self-help projects, or "actions de masse"); efforts to increase as far as possible the numbers of technically trained personnel in a variety of fields and to develop an institutional framework in which they can be more effectively deployed; and a longer range reform of the educational system linked to the logical development of the agricultural, agricultural-industrial, industrial and mining sectors.

A third conclusion is that one of the largest natural resources of the area at present is the grazing land resource. The only major export for most of the countries is livestock, and there are massive areas of arid land with vegetation resources which can only be harvested through animals. This leads to the concept of using grazing as an entry point for achieving a more efficient use of resources--by improving the north-south movement of animals, linked to improved rangeland management and utilization, and also linked to development of dryland and irrigated crop systems, new land use schemes, agro-industrial and industrialization, in an integrated manner which would on the one hand facilitate movement of animals raised in the north southwards, through fattening and finishing areas to slaughter and export, and simultaneously on the other hand be accompanied by complementary movement of supplies and services from the south to the north. This will require rather major changes in institutional structures, land holdings, transportation, credit and banking. The system must be looked at as a whole in order to make sound long-term improvements through clear identification of the interaction of the parts of the system. There is probably inadequate trained manpower, technology and organization in the region to undertake this integrated development, hence the concept of an international institute.

Ensuing discussion, while generally accepting the conclusions of Dr. Van Dyne's paper, brought out the following points:

. The need to "sophisticate nomadism" as a means of capitalizing on the area's major resource is complicated by the variety of types of animal which are presently raised and may be required for different

purposes--the hardy milk and meat producing animals (required by nomads for their life-style) differ in genetic and production characteristics from the heavier high-quality meat producing animals required for more sophisticated external markets. A whole spectrum of animal types is required to meet the wide variety of needs.

. The great emphasis placed in development plans on marketing of cattle should not permit them to overlook the numbers and types of animals on which nomads rely--for their daily needs, for security in hard times, for improvement in their living standards. Market capacity must be carefully balanced against these other needs if security is to be preserved.

. For these reasons the key element in improving and stabilizing the system appears to be security for the nomads in attempting to bring their livestock into balanced production for export. If the "improved" system does not provide security of services as they perceive them, they will return to the traditional system.

This line of reasoning also supports the conclusion that the inter-relationships of the parts of a long-term development system are very sensitive and must be dealt with as a whole. High variability in conditions calls for flexibility and mobility on the part of the people and production elements and for provision of adequate storage of reserves against worse periods. Recurrent drought can be thought of in systems planning as the driving force determining, in large measure, the nature of the system.

It was also realized that some of the Sahel countries are already moving to set up this type of system and there is experience from other

dry areas (the Sudan, Maghreb, and Middle East for example) which is relevant to the Sahel situation and should be studied.

The Bellagio Conference

Dr. McKelvey summarized the discussions which took place at Bellagio.

The Conference on International Development Problems in the Sahel was organized by the NAS panel and the Rockefeller Foundation to gather ideas and wisdom from a broad spectrum of experience and interest provided by the participants. Much has been said and written about the various aspects of the many problems relating to the drought. The conference was an effort to focus on these problems and their interrelationships as viewed from a variety of perspectives, and to identify broad areas of agreement or disagreement regarding long-term development strategies or opportunities.

Climate

Dr. Malone and Dr. Bunting gave excellent presentations on this topic. The discussions led to the conclusion that one must accept the fact of climatic variability over which man has no control. Weather modification is unlikely to contribute to a solution to the problem of inadequate rainfall in the foreseeable future. In the short term, methods can be developed to improve the accuracy of prediction about climate and to get vital information to farmers and herders to enable them to react more effectively to drought-prone situations.

Food Production

Dr. Adams and others made a strong case for improved food production, both animal and plant, as the necessary security for survival; this was agreed to by all.

Pastoralism

The Bellagio conference discussed pastoralism and nomadic life in detail and came to similar conclusions to those reached at the present meeting. The nomadic system can be improved and helped if it is well understood. The special role of animal production in long-term development was presented by Dr. Van Dyne, and Dr. Pagot's experience contributed greatly to our understanding of this aspect of the problem.

Human Resources

A very fundamental revision of the educational system was recommended by Dr. Kane. He was particularly concerned with nonformal education, including things such as teaching practical business skills to nomads and taking advantage of the oral tradition. An expansion of university level education is also required for long-term self-sufficiency.

Health

Infectious diseases were of most concern--trypanosomiasis in cattle and human beings, onchocerciasis (river blindness), malaria, and schistosomiasis. These diseases were considered mainly with respect to water resource development.

Infrastructure

Much discussion took place on drainage basin development, transport, communications, and changes in economic systems. The five great drainage systems--the Niger, Senegal, Gambia, and Volta rivers and the Chad basin--were discussed as potential resources for improved water resource management in agriculture, transport, power generation, industrial requirements, human settlement, etc.

Institutional Development

Dr. Doo Kingue of the United Nations Development Program made a presentation on institutional development, including particularly the need for an institution such as a Sahel institute with research, development, and extension functions.

A draft staff report of the Bellagio conference was circulated. Dr. McKelvey explained that minutes of the conference were also being used as the basis of a report to be prepared by the Rockefeller Foundation.

In discussion of the draft report panelists called for sharper focus on the main topics of the Bellagio discussions--food security, infrastructure, increased participation of local people, long-term development. A central question raised at Bellagio was, "What will happen when the rains fail again?" Much discussion, therefore, focused on whether the Sahel will be better prepared next time, concluding that

- . food production, storage, and marketing should emphasize security even at the expense of marketing efficiency;
- . systems of improving animal production must be developed without destroying the adaptiveness of the system;
- . river basin planning, coupled with human resource integration, requires consideration of sequence and timing of dams based upon extrapolation of experience from elsewhere;
- . human participation requires modification of the educational system; and
- . mass communication requires increased emphasis (radio, television, vernacular languages, etc.).

Other suggestions for improvement of the report stressed: the need to order priorities and also to indicate the perspective of the time frame of large project development (in river basin development results will be seen only after a decade or so--what happens in the interim); the interrelationship of the economies of the Sahelian countries with those in the Sudanian Zone.

To the question of what new insights had been gained, several members suggested the integration of ideas expressed at Bellagio was new--the notion that there is a need to proceed on a variety of different, interrelated things in order to accomplish a series of tasks--some immediate, some longer-range. This is the systems approach. However, there is a danger in this--that because one cannot do everything, one does nothing. Thus it is essential to identify and highlight two or three priorities.

Future Role of an NAS Panel

Dr. Lyman expressed his agency's need to continue receiving advice from an advisory body and offered the suggestions that it might be organized to look at the problems of aridity on wider basis, perhaps including East Africa. It might also have a sharper focus to suggest to AID and be more directly integrated with AID's activities to assist with major decisions which have to be made by AID.

Panelists had discussed this item at the Bellagio conference and concluded that the panel had discharged its responsibility as conceived in the original terms of reference and should not continue as a committee. However, there were important things to be done--to catalyze the develop-

ment of a Sahelian institute and to assemble the experience of the drought. The first should be a truly international effort, and there may be need for a U.S. group to assist AID's participation in it. The second is an opportunity to record the major, natural, living experiment of the drought experience so that the next drought will not have to be faced without this memory.

There is as yet no systematic attempt to collect and record observations: on drought experience of varieties of plants and animals; on water resources and management systems; on one of the most expensive relief operations in history; on the effects on the macro-economies of the countries; on the movement of pastoralists from the grazing areas to camps. There should be an international effort launched to undertake this over the next 2-3 years in which the NAS might participate.

It was therefore recommended:

. a conference should be held to bring the drought experience into focus;

. a panel, to provide scientific advice to AID, that would have a different composition from the present panel, should exist to be concerned with arid land development problems, perhaps focused on Africa rather than solely on the Sahel; and

. the NAS follow up the Bellagio conference with respect particularly to the creation of a Sahel institute.

It was agreed these recommendations be made to BOSTID, which could undertake the necessary actions in consultation with AID and other agencies.