Niamey
9-15 March
1974

18

Unesco

MAB

Programme on Man and the Biosphere (MAB)

Regional meeting on integrated ecological research and training needs in the Sahelian region

Organized jointly by Unesco and UNEP

Final Report

MAB report series No. 18

Niamey
9-15 March
1974

Programme on Man and the Biosphere (MAB)

Regional meeting on integrated ecological research and training needs in the Sahelian region

Organized jointly by Unesco and UNEP

Final Report

Unesco

Previous reports in this series :

1. *International Co-ordinating Council of the Programme on Man and the Biosphere. First session. Paris, 9-19 November, 1971.*

2. *Expert panel on the rôle of systems analysis and modelling approaches in the Man and the Biosphere Programme (MAB). Paris, 18-20 April, 1972.*

3. *Expert panel on Project 1 : Ecological effects of increasing human activities on tropical and subtropical forest ecosystems. Paris, 16-18 May, 1972.*

4. *Expert panel on Project 12 : Interactions between environmental transformations and genetic and demographic changes. Paris, 23-25 May, 1972.*

5. *Expert panel on Project 5 : Ecological effects of human activities on the value and resources of lakes, marshes, rivers, deltas, estuaries and coastal zones. London, 19-22 September, 1972.*

6. *Expert panel on Project 3 : Impact of human activities and land use practices on grazing lands : savanna, grassland (from temperate to arid areas). Montpellier, 2-7 October, 1972.*

7. *Expert panel on educational activities under the Man and Biosphere Programme (MAB). Paris, 5-8 December, 1972.*

8. *Expert panel on Project 6 : Impact of human activities on mountain ecosystems. Salzburg, 29 January-4 February, 1973.*

9. *Expert panel on Project 13 : Perception of environmental quality. Paris, 26-29 March, 1973.*

10. *International Co-ordinating Council of the Programme on Man and the Biosphere. Second session. Paris, 10-19 April, 1973.*

11. *Expert panel on Project 7 : Ecology and rational use of island ecosystems. Paris, 26-28 June, 1973.*

12. *Expert panel on Project 8 : Conservation of natural areas and of the genetic material they contain. Morges, 25-27 September, 1973.*

13. *Expert panel on Project 11 : Ecological aspects of energy utilization in urban and industrial systems. Bad Nauheim, 16-19 October, 1973.*

14. *Working group on Project 6 ; Impact of human activities on mountain and toundra ecosystems. Lillehammer, 20-23 November, 1973.*

15. *Consultative group on Project 9 : Ecological assessment of pest management and fertilizer use on terrestrial and aquatic ecosystems. Part on Fertilizers. Rome, 7-9 January, 1974.*

16. *Working group on Project 1 : Ecological effects of increasing human activities on tropical and sub-tropical forest ecosystems. Rio de Janeiro, 11-15 February, 1974.*

17. *Task Force on the contribution of the social sciences to the MAB Programme. Paris, 28 February-2 March, 1974.*

SC.74/Conf.670/
Paris, 5 January 1975
Original : French

TABLE OF CONTENTS

		page
	Synopsis	6
1.	Introduction	8
2.	Problems of the Sahelian zone	10
	2.1 Characteristics and delimitation of the region	10
	2.2 Background of the present situation	11
	2.3 Past failures and future orientations	13
3.	General objectives and approaches	15
4.	Integrated pilot projects and their problems for study ...	18
	4.1 Main focus of pilot projects	19
	4.2 Criteria for siting of pilot projects	19
	4.3 Outline of research fields	20
5.	Inventory and survey of natural resources	23
6.	Conservation and regeneration of pasture areas in the Sahelian zone	26
	6.1 Extensive surveys of areas and of their genetic resources	26
	6.2 Studies of the regeneration of degraded Sahelian ecosystems	28
	6.3 Conservation and utilization of wild animals in extremely dry areas, particularly near the Sahel/Sahara zone	30
	6.4 Establishment of biosphere reserves in the Sahelian region	31
7.	Education and training	32
	7.1 Primary and secondary education	32
	7.2 Training of specialists	33
	7.3 Information for decision-makers	34

page

8. Suggestions for implementation 35

8.1 Mechanisms for information exchange 35

8.2 Mechanisms for co-ordination and stimulation of integrated research projects 35

ANNEX 1 List of participants 37

ANNEX 2 MAB Technical Note No. 1 :"The Sahel : Ecological approaches to land use" - Table of contents 42

ANNEX 3 Centre for Integrated Studies of Development in the Sahel : suggestions on responsibilities and phasing of work 43

S Y N O P S I S

The central problem of the Sahelian zone concerns the management of grazing lands under marginal and fluctuating climatic conditions in a particular social, economic and cultural context. In order to effectively improve the relationship between man and his environment in the Sahel, it is necessary to understand more fully the complex and dynamic interactions within natural ecosystems and between natural ecosystems and socio-economic processes.

The general objective of research and training activities of MAB Project 3 in the Sahelian zone is to help the governments of this region organize a long term drought relief programme by improving methods and types of management of semi-arid lands within the framework of the socio-economic policies of these governments. Much valuable research has been undertaken. There have been, however, both insufficient co-ordination between disciplines and inadequate attention paid to the impacts and feedbacks of technological interventions and to the problem of implementing results. This situation calls for the application of already existing knowledge to specific development schemes, the promotion of a broadly based, integrated approach to research and training, and co-operation between the countries concerned.

Three broad categories of activities can be identified which correspond to different needs and objectives and entail different scales and intensities of effort. These categories are :

1. *integrated pilot projects, which focus on an interdisciplinary approach to the intensive study of man's interactions with Sahelian ecosystems (including not only extensive grazing land areas which are marginal for agriculture, but also zones of contact between extensive grazing lands and cultivated or irrigable areas) ;*

2. *inventory and survey of natural resources, including use of modern remote sensing techniques as well as more conventional tools of resource analysis ;*

3. *conservation and regeneration of pasture areas, including extensive surveys of plant genetic resources, studies aimed at the recovery of degraded pastures, and conservation and use of wildlife in extremely dry areas.*

The problems of development and management of natural resources can only be overcome through education and training of local personnel within the countries themselves. Major efforts are required at all levels, from primary and secondary education to training of specialists and sensitization of decision-makers.

A number of logistic problems require urgent attention if the necessary programmes of research and training are to be successfully launched. A "centre for integrated studies applied to development in the Sahelian region" is one suggested mechanism. A steering committee, comprising personnel involved in integrated projects in the region, could provide the basis of an advisory group for this centre and a liaison between the overall international co-ordination of MAB Project 3 on grazing lands and individual research projects in the Sahelian zone. The publication of a MAB Technical Note entitled "The Sahel : Ecological approaches to land use" should provide a useful summary of the present state of knowledge on certain aspects of the region. The next step is to elaborate and develop bilateral and multilateral agreements leading to applied research and training activities in the region.

1. INTRODUCTION

Recent widespread droughts and famine have drawn world-wide attention to the problems of the Sahelian zone of West Africa. Drought is not a new phenomenon in this area. It has occurred often in the Sahel, and will doubtless continue to do so. What is new, however, is the extent and severity of the consequences of the recent period. World concern for the problems of the area has focused, quite naturally, on the immediate and urgent problems of famine relief. This concern, however, has also led to recognition that long-term solutions to the problems caused by drought must be based on sound integrated methods for the management of the semi-arid lands of this region. New management strategies must be sought within the framework of the socio-economic goals defined by governments of the region, and must be based on the needs and aspirations of the local population.

This is,briefly, the background of a regional meeting on integrated ecological research and training needs in the Sahelian region. This document is the final report of that meeting held on the invitation of the Government of Niger, in Niamey, Niger, from 11 to 15 March 1974. The main purpose of the meeting was to explore the ways and means of developing in the Sahelian zone (considered as a geographical entity) integrated ecological research and training projects which would respond to real needs and in which countries of the region would agree to participate.

The meeting was organized by Unesco within the framework of its intergovernmental and interdisciplinary programme on Man and the Biosphere (MAB) and with the support and financial assistance of the United Nations Environment Programme (UNEP). It was convened in collaboration with the African Institute for Economic Development and Planning (IDEP) and FAO and in consultation with WHO, WMO, UNDP and IUCN. Participants included some 50 experts representing within the region Chad, Mali, Mauritania, Niger, Nigeria, Senegal, Sudan and Upper Volta ; and outside the region Canada, France, Federal Republic of Germany, United Kingdom and United States of America. The full list of participants is provided in Annex 1 of this report. Professor Abdou Moumouni from the University of Niger, Niamey, Niger, was elected president and Mr. Jean Djigui Keita, Ingénieur-Agronome, of Bamako, Mali, and Dr. Mohammed Yousif Sukkar, of Khartoum, Sudan, were elected vice-president.

Problems of arid lands, including desertification in the Sahel, have been given priority within the work programme of UNEP. In the context of the MAB Programme, the focus of the regional meeting relates directly to MAB Project 3, which is concerned with the impact of human activities and land use practices on grazing lands, including those of arid and semi-arid areas. It is also related to MAB Project 4 which deals with the impact of human activities on the dynamics of arid and semi-arid zones ecosystems, with particular attention to the effects of irrigation. One of the main research themes defined by the expert panel for MAB Project 3 (see MAB Report Series No. 6) concerns the formulation of management strategies for maximum sustained use of areas which are marginal for crop production. This is clearly the case for much of the Sahel zone.

The regional meeting represented a first step in translating the recommendations of MAB Project 3 into operational field projects at the regional level. In addition to considering the planning of co-operative research and training projects in the region, the meeting also dealt with the need for synthesis of present knowledge and formulation of management strategies based on this knowledge. Reviews of the present state of knowledge on various biogeographical aspects of the Sahel were prepared as background documents for the regional meeting. These reviews were revised after discussion and examination during the regional meeting, and have been published as a MAB Technical Note. The table of contents of this technical note is included in Annex 2 of this report.

2. PROBLEMS OF THE SAHELIAN ZONE

2.1 Characteristics and delimitation of the region

"Sahel" is basically a climatic term, and thus the general area of the Sahel can be defined according to the classifications of aridity. In broad terms, the Sahelian Zone is situated to the south of the Sahara between the two isohyetals of 100 and 600 mm mean annual rainfall, with a fluctuation coefficient of about 30 %. It can be subdivided into the Saharo-Sahelian (100-200 mm), Sahelian (200-400 mm) and Sudano-Sahelian (400-600 mm) zones.

The "natural" vegetation follows the east-west trend belts of both climate and soils. It is essentially composed of a low herbaceous layer and of scattered Acacia, with sharp species and biomass change partly in response to rainfall and partly in response to local soil and water conditions.

Although the areas of thornbush savannas east of Chad in Sudan and Ethiopia are not strictu sensu part of the Sahelian Zone, they have more or less the same environmental characteristics as the actual Sahelian Zone and face very similar management problems. For this reason and for the development of co-operative activities at the regional level within the Man and the Biosphere Programme, the Sahelian Zone is considered in a broad sense as extending from the Atlantic Ocean to the Red Sea and Indian Ocean.

Long-term average climatic conditions of the Sahel and resulting low productivity impose strong limits on the exploitation of these zones. In areas which normally have an annual rainfall of more than 250-300 mm dry-farming of some crops is still possible. However, poor soils and soil erosion limit these activities.

Since the resources are considered insufficient to be used agriculturally, nomadic animal husbandry has been the main human occupation within the Sahelian Zone. In fact, so far it has proved to be the only mechanism for productive resource development in the Sahel.

The savannas of the Sudan Zone are found south of the Sahel. This zone, inhabited predominantly by sedentary agriculturalists, plays an essential

role in the development of pastoral nomadism in the Sahel. While pastoral nomadism represents an adaptation to the agriculturally marginal conditions of the Sahel, it is not a self-sufficient way of life. Interactions with settled agricultural communities are necessary to assist agricultural productivity as well as to provide basic food support for the nomadic population. In fact, the twc ways of life are interdependent ; nomads receive most of their grain from settled agriculturalists while farmers depend on the nomadic community for animal products.

2.2 Background of the present situation

At first, the current serious problems of the Sahelian Zone seem to be unique historically due to the unusually severe drought of recent years. Yet everything known about the climate of the Sahel suggests that drought conditions have occurred in the past, although it may be necessary to search as far back as 1910-1914 to find an analogous situation. It is precisely to both seasonal and randomly cyclical patterns of moisture deficit that pastoral nomadism is adapted.

Why then the disastrous consequences of the recent years' drought ? The answer lies in the impact of various innovations and the socio-economic changes in the region combined with traditional perceptions of the environmental and economic risks. As nomads often exist close to the margin of subsistence and since a minimum number of animals is required by each family in order to guarantee survival, maximizing herd size has traditionally been a deeply engrained cultural trait, particularly in response to a threatening drought and as a symbol of prestige. Changes from outside the pastoral system which tend to increase human population, reduce the available grazing land, and animal disease , increase water supply,and release control mechanisms established in the traditional system to maintain an equilibrium between availability and consumption of resources.

In the past, hygiene and health problems constituted the bottleneck to the development of livestock breeding and animal productivity in Sahelian countries. Periodic epizootic diseases and endemic parasites regularly decimated the herds. In recent years these problems have been partly resolved, and their limiting influence on development of livestock production has been reduced. At the same time, African veterinarians have been trained

in large, if not sufficient, numbers. This has resulted in considerable improvement of the health status of herds, a marked increase in livestock numbers and, consequently, a proportional increase in the pressure imposed on grazing lands. Unfortunately disease prevention has often been used as an isolated measure without consideration of pasture improvement or marketing. Such technical assistance has even been used at times to prevent natural selection through disease. In addition, a hydro-pastoral policy has been followed in the countries concerned, a policy which essentially consists of creating numerous watering points and deep bore-holes.

Thus to a certain extent the problems of animal health and watering have been resolved. However, the solution of these problems has provoked a third problem, that of hunger. Increase in herds, their tendency to flock together, and their concentration around water points have resulted in large scale degradation of pasture, such that about 30 % or more of the total cattle stock has died during the recent five-year drought period, generally from hunger, rather than thirst or disease.

From this it can be concluded that the priority problem regarding livestock in the Sahel is that of the productivity and management of pasture lands (for grazing and other purposes) and of forage reserves.

The destruction of the basic pastoral forage and fodder resources by over-exploitation, already serious before the recent drought period, has led to catastrophic consequences during years with rainfall significantly below the median level. The disruption of the extensive grazing lands of the Saharo-Sahelian areas is increased as humans and cattle migrate to the already heavily populated Sudano-Sahelian region, where agricultural and sedentary activities as well as more intensive grazing activities are also severely affected and where there is not always sufficient consideration of ecological problems in development planning. Consequently, long-term drought relief can only be achieved through a comprehensive resource management policy which takes all these factors into account. The central problem of the Sahelian Zone thus involves management of grazing lands under marginal and fluctuating climatic conditions in a particular social, economic and cultural context.

2.3 Past failures and future orientations

Pastoral research and development in the Sahel have not achieved the results hoped for. There are reasons for these failures. Development schemes have often ignored traditional grazing practices, resulting in severe deterioration around newly created watering places. Survey and research activities in the region have often brought little or no benefit to the local population and governments concerned. There has been a lack of sustained training and research efforts ; permanent administrative and research infrastructure in the region are generally lacking. Adequate links have not been established between research, training and development activities. There has been little attempt to present the available information to decision-makers in a form which is both concise and easily assimilated.

Perhaps most important, however, is the fact that insufficient attention and importance have been given to the socio-economic and ethno-cultural context of local populations. These populations have an intimate knowledge of the environment and a wealth of experience which we have not always fully appreciated or used. Given the need in any successful developmental action for active participation of local populations (thus excluding the imposition of ill-adapted exterior models) and given the disorganization of the pastoral system after a period of drought, it is recommended that :

- all research and developmental operations take into account the socio-economic context of local populations ;

- the "ecological" and zootechnical experience and knowledge of the local populations be considered the point of departure for studies which precede and prepare development projects ;

- all research and development actions be accompanied by educational action so that local populations recognize their responsibilities in the use and exploitation of their environment (see section 7) ;

- in the context of the current drought, a detailed evaluation of the real potentials of the Sahelian Zone be undertaken, as well as an examination of the behaviour of local populations during the period prior to the present situations.

In order to achieve more rational management and improvement of the man/natural environment relationship in the Sahelian Zone, it is necessary to fully understand the complex and dynamic interactions within "natural" ecosystems and among these ecosystems, socio-economic processes and technological and scientific innovations.

In particular, planners and decision-makers must be familiar with and able to predict the impact of changes in human populations, life style patterns and technology on the future viability of these systems. However, lack of knowledge and of specialists, particularly those trained in integrated approaches, is one of the fundamental bottlenecks in assimilating and applying medium- and long-term concepts of the rational planning and utilization of the development potentialities of the Sahelian region. Decision-makers lack guidelines for evaluating the consequences of their decisions, particularly as regards the future condition of Sahelian ecosystems.

3. GENERAL OBJECTIVES AND APPROACHES

The meeting defined the general objectives of research and training activities of MAB Project 3 in the Sahelian Zone as follows : to assist the Governments of this region in their efforts to organize long-term drought relief by using improved methods and types of management of semi-arid lands within the context of the socio-economic development aims defined by these Governments. The ultimate objective must be to define the carrying capacity of the region and to maintain the human population in its traditional habitat, to improve its standard and quality of life and to integrate it in the national and, if the Governments so wish, international economic circuit.

The means proposed at the Niamey meeting to achieve these objectives are "to secure, quantify, synthesize, distribute and apply information on natural and social science research" on Sahelian ecosystems.

Much valuable research has been undertaken. There have been, however, both insufficient co-ordination between disciplines and inadequate attention paid to the impacts and feedbacks of technological intervention and to the problems of implementing results. This situation calls for the application of already existing knowledge to specific development schemes ; the promotion of a broadly based, integrated approach to research and training ; and co-operation between the countries concerned.

The meeting highlighted the necessity of integrated and holistic approaches as well as regional co-operation, co-ordination and harmonization of all research and training action in the Sahel region concerned with rationalizing and improving man/natural resources relationship under particular environmental constraints. It welcomed the development of bilateral and multilateral agreements for integrated research and training activities between Sahelian and other countries.

Three broad categories of activities (including surveys) were identified and recommended by the meeting, categories which correspond to different needs and objectives and which require different levels and intensities of effort. These are :

- integrated pilot projects,which focus on an interdisciplinary approach to the intensive study of man's interactions with Sahelian ecosystems (including not only extensive grazing land areas which are marginal for agriculture, but also zones of contact between extensive grazing lands and cultivated or irrigable areas) ;

- inventory and survey of natural resources, including use of modern remote sensing techniques as well as more conventional tools of research analysis ;

- conservation and regeneration of pasture areas, including extensive surveys of plant genetic resources, studies aimed at the recovery of degraded pastures, and conservation and use of wildlife in extremely dry areas.

These themes are elaborated in sections 4-6 of this report. The meeting insisted that multidisciplinary and integrated ecological research can best be carried out within the framework of pilot projects and recommended that priority be given to the development of this type of research. The meeting also stressed the necessity of combining research and training functions in implementing each of these activities. The training of personnel should be an integral and important component of any field research project. Some broad approaches and methodological principles for research are outlined in the report of the expert panel on MAB Project 3 (see MAB Report Series No. 6).

The meeting also recommended that all research and training activities undertaken in the Sahelian zone within the framework of MAB should :

- be planned and implemented in conjunction with the national priorities and problems of the countries concerned ;

- be undertaken with the support and co-operation of the people likely to be affected by them ;

- be based on consideration of the needs and traditional socio-economic practices of local populations ;

- take advantage, when possible, of planned and on-going development schemes ;

- be focused on well-defined areas which, for ecological and socio-economic reasons, can be treated as units suitable for overall development planning (thus facilitating the application of research findings to development needs).

4. INTEGRATED PILOT PROJECTS AND THEIR PROBLEMS FOR STUDY

The Sahelian environment can, in a global sense, be considered an ecosystem characterized by

- a short rainy season (2-3 months) ;
- high variability of rainfall in time and space ;
- predominantly sandy soils ;
- plant cover of annual grasses with thorny shrubs and trees (Acacias) interspersed at various densities ;
- low and extremely variable production from an area suitable for grazing only ;
- a carrying capacity in animals (and consequently in humans) which is very low and extremely variable in space and time, leading to the development of nomadic societies which represent man's way of adapting to this harsh environment.

Accordingly, research must be concerned with all the components of this "system", and include all the disciplines dealing with them. However, the framework and the dimension of this research must be defined so that disciplines constitute the links of a chain, which collectively focus on the complex inter-relationships within the natural ecosystems and between man and the natural environment.

This systems approach to studies and research in the Sahel should be carried out in carefully selected pilot projects which distinguish between the short term objective of contributing to the survival of the pastoralists after the recent disastrous drought and the medium and long term objective of their being increasingly integrated into an exchange economy.

4.1 Main focus of pilot projects

It is considered that pilot projects should focus on two main types of socio-economic and "ecological" situations in the Sahel zone.

In the first typically Sahelian situation, land is marginal for agriculture and the main land use is, and is likely to remain, livestock breeding on a nomadic pattern. The objective of pilot projects in these areas would be to assess the situation and provide management guidelines for the ecological potential of marginal lands used on a multiple-resource basis by nomads and pastoralists. These projects should result in determination of types and forms of land use and resource management which would be most appropriate from ecological, economic and social points of view. They should also examine the possibilities and consequences of a fundamental reorganization of life in rural areas, including fundamental changes in life style such as from nomadic pastoralism to sedentary pastoralism and farming.

The second situation concerns zones of contact between extensive grazing lands and cultivated areas, either in the proximity of a major river or near the Sahel-Sudano border zone. In these contact zones, the main emphasis of pilot studies should be to help develop mutually beneficial socio-economic relationships between nomadic pastoralists, agriculturalists and agricultural stock-breeders.

It is recommended that pilot projects be organized in East, Central and West Africa. In each of these geographical regions one project should be initiated in a typically Sahelian zone and another in a contact zone.

4.2 Criteria for siting of pilot projects

In considering possible locations for the siting of pilot projects, the following factors should be taken into account :

- critical nature of the problem ;
- representativity of the area, including consideration of geographical and climatic criteria (e.g. possibilities of access, amount of rainfall, availability of water) ;

- complementary fodder resources ;

- ethnic and socio-cultural homogeneity ;

- possibilities for assuming a major role in education and training in the area ;

- possibility of contributing directly to proposed development schemes ;

- possibility of supporting existing research activities and institutions.

4.3 Outline of research fields

The definition of the work programme for a pilot project will of course depend on the precise objectives of the project, the nature of the problem under review and the financial and manpower resources available. Nevertheless, it might be useful to outline here some of the research areas that could comprise individual pilot projects.

4.3.1 Abiotic factors and physical environment

In integrated pilot projects, special attention should be given to

- relations between surface and ground water resources and the quality and quantity of plant biomass and productivity, including field trials on optimal use of run-off waters ;

- optimal distribution of watering points for livestock ;

- possibilities of exploiting solar and wind energy, particularly in relation to low-cost extraction of ground water ;

- effects of construction of regulating dams and wells on ecosystem structure and dynamics and on the local populations concerned, particularly as regards their effects on the socio-economic strategies adopted by these local populations ;

- rate of recharge of ground water.

4.3.2 Vegetation/soil inter-relations

Some of the basic needs for survey and inventory of the plant resources of the Sahelian zone have been discussed in earlier sections of this report. This extensive surveying of the condition and structure of the plant ecosystem must clearly be linked to more intensive, pilot project studies on the actual and potential performance of the vegetation, and to its response to various abiotic and biotic stresses and manipulations (e.g. drought, over-grazing).

In particular, attention should be given to the structure and composition and the functioning and dynamics of plant formations. Delimitation and description of the structure and composition of plant formations should be undertaken to identify plant indicators of ecosystem condition which can be tested and applied on an extensive scale and to achieve multi-purpose use of vegetation resources. As regards functioning and dynamics, emphasis should be given to analyses of seasonal and yearly variations in quantity and quality of primary production, especially in relation to factors such as edaphic conditions, incoming solar radiation, water availability, rate of nutrient cycling, frequency and severity of fire, grazing and trampling pressure, introduction of new plant species, etc.

4.3.3 Interactions between large herbivore and the environment

Research on this problem should be focused on determining the most desirable structure (species, age, sex, etc.) of large herbivore populations. The socio-economic strategies and needs of local human populations as regards livestock, the requirements of large herbivores for forage, and their reciprocal relations with other components of the arid and semi-arid ecosystems of the Sahelian zone must be taken into account. In particular, attention should be accorded to

- analysis of consequences of traditional selection of livestock, including adaptation to the Sahelian zone and studies of the potential of local strains ;

- zootechnical studies and research on the reproductive problems of herds and the raising of calves, including specific nourishment needs, reaction to potential parasites, etc. ;

- zootechnical and socio-economic studies of the management of herds, including herd structure, off-take movement of immatures for growing out and finishing, marketing, optimum age for marketing, problem of "running-out" of stock, etc. ;

- research in veterinary medicine, including control of disease, physiology of the Sahelian herds, physiology of animal nutrition in relation to the Sahelian environment ;

- research on specific animal fodder at the Sahel-Sudanian border, including problems of fodder cultivation and supply, conservation of fodder resources, condition and siting of pasture lands, etc.

4.3.4 Resource-use strategies of local populations

Special attention should be focused on the drought-avoiding (or drought-mitigating) strategies developed by local populations as short- and long-term responses to an environment having generally low, but nevertheless fluctuating, levels of rainfall, and consequent primary and secondary productivity. This work should include description and analysis of the following processes and characteristics :

- structure and change in the social system, including demographic structure of population, stratification system, inheritance structure, kinship relations, social correlates of economic structure, etc. ;

- labour and management practices, including attitudes of local populations to innovation and development, availability of labour in different seasons, etc. ;

- relations between local community and outside societies, including drift to urban centres, economic interactions between nomads and agriculturalists, etc. ;

- legal basis for land use, including ability to transform or use land for desired activities, accessibility to watering points, control of local populations over land and water resources, etc.

5. INVENTORY AND SURVEY OF NATURAL RESOURCES

Inventory, survey and mapping of natural resources are vital for planning the future optimum use of the resources of the Sahel. Collectively these resources are considerable, but they are spread thinly over a wide area. Although much information on natural resources is available, most of it is a "one time" assessment of a single resource. Most inventories do not cover the whole area and much of the information that is available is site specific, but we know that the Sahel is a dynamic zone with changing patterns of rainfall and vegetation.

The major needs for survey and inventory in the region include

- regular assessment of the spatial and temporal pattern of distribution of precipitation, with a view to providing an early warning system of the state of resources (either abundancy or scarcity) ;

- inventory of surface and underground water resources, including mapping of the distribution and importance of wells ;

- assessment of solar and wind energy resources ;

- preparation of soil capability maps indicating soil texture, depth and water regime ;

- monitoring of the extent of plant cover, as a basis for evaluation of trends in desertification processes ;

- mapping of the density of the tree layer ;

- inventory of forage resources, and mapping of the major types of pasture areas (see the following section of this report) ;

- inventory of herding and cropping intensity in relation to available resources of vegetation, water, soils and populations ;

- location and inventory (on a seasonal as well as annual basis) of human populations in relation to vegetation, soils and water resources.

The meeting also concluded that water is not the only limiting resource for the Sahel region and that inventory and survey efforts should not concentrate exclusively on surface and underground water resources. However, an increase in irrigated land could be one way to partially alleviate the climatic hazards of the Sahelian region on a medium and long term basis and to assure the alimentary needs of the human populations by increasing and intensifying cultivation. Furthermore, sufficient water points will always be one basic prerequisite for improvements in animal herding. Multiplication of these water points should, however, be carefully controlled in order to avoid overgrazing of pastures and consequent soil deterioration and erosion.

Surveys and research on water resources should take advantage of and collaborate with the Inter-African Committee on Hydraulic Studies and Unesco's International Hydrological Programme. Both can be particularly helpful in matters regarding a larger diffusion of information on hydraulic resources.

The meeting gave considerable attention to solar energy and, to a lesser extent wind energy, as possible sources of thermic and mechanical energy. Solar energy is an important and permanent resource of the entire Sahel region. Wind energy is a non-negligible resource in certain parts of the region. Research concerning the practical and small-scale application of solar and wind energy for pumping underground water and, in the case of solar energy, for domestic uses, needs strengthening. This situation has to be taken into consideration particularly as regards the need for firewood, which is one of the principal causes of the extensive cutting-down of trees throughout the Sahel, especially in proximity to urban areas.

Two suggestions can be made for carrying out the recommended inventories and surveys. First, maximum use should be made of remote sensing techniques, such as earth observing satellites and aerial photography, as well as more conventional tools of resource analysis. It is essential that this work be done in conjunction with people using these resources. Second, in order to

develop for the regular assessment and survey of resources mechanisms adapted to the needs of the countries themselves and closely co-ordinated with related research, training and development activities, it is necessary to establish permanent structures in the region itself. The proposed "Centre for Integrated Studies on the Sahel" (see section 8) could provide one such mechanism.

6. CONSERVATION AND REGENERATION OF PASTURE AREAS IN THE SAHELIAN ZONE

In the fragile ecosystems of the Sahelian zone, man's activities, which are frequently compounded by climate fluctuations have contributed to the accelerated degradation of "natural" ecosystems. The growth of human and animal populations has resulted in over-utilization of the renewable natural resources of the region. The marginal region bordering the true desert is particularly susceptible to degradation. Here the precipitation fluctuations from year to year and decade to decade are the highest in the region. When rainfall is abundant, livestock numbers increase and grazing lands are ploughed up. During drought years, which are common characteristic features of the area, the land is subjected to pressures from which it cannot recover, and is vulnerable to the degradation which accompanies short-sighted policies and actions. At the present time, these areas are thus suffering their greatest deterioration. To stop the ecological decline which has led to this degradation of the Sahelian zone, it is of utmost importance that research programmes, based on long-term considerations rather than the sometimes more urgent immediate needs, be undertaken in order to develop methods which conserve and regenerate the natural resource base. The following programmes of conservation and regeneration are recommended.

6.1 Extensive surveys of areas and of their genetic resources

Surveys and inventories are necessary to determine the nature and extent of biotic communities. Many areas are still essentially unknown botanically, making detailed classification and mapping necessary. Particular emphasis should be given to endangered species of plants and to important "pioneer" species in invasion of desert areas and in regeneration of degraded areas, to particularly well adapted species with low water requirements, high energy conversion efficiency, and maximum fodder generation capability ; and to plants utilized by local cultures for either food or medicinal purposes. Aerial and satellite imagery now available, could be useful in identifying areas suitable for conservation.

A useful and immediately productive approach to understanding changes in plant communities in time and space might be organized as follows :

- identification (and, if necessary, synthesis of results) of previous surveys (e.g. made 5-15 years ago) of the structure and composition of plant communities, undertaken along well defined transects with clearly identified sampling locations ;

- repetition of survey along the same transect and in the same locations (using similar, as well as improved methods as in the earlier survey) and evaluation of the scale and magnitude of change over time (i.e. between surveys) ;

- comparison of satellite images or serial photographs, synchronized in space and time with the results of ground measurements ;

- evaluation of the applicability of the results of site surveys to a broader area through remote sensing of extensive tracts of land ;

- elaboration and development of procedures for the regular assessment of the condition and trend of Sahelian ecosystems, including assessments of such processes as desertification and erosion and such indications of ecosystem condition as density of total plant cover, of tree canopy cover, etc.

In addition to information obtained from the type of approach outlined above, much valuable information already exists and can be obtained from specialists. Survey activities should be carried out in co-ordination with specialists in forestry and wildlife conservation departments in the countries concerned and with botanists and at herbaria containing important collections of African plants. In Africa these would include the Herbarium at University College in Addis Ababa, Ethiopia, the East African Herbarium in Nairobi, Kenya, and the "Institut Fondamental d'Afrique Noire" in Dakar, Senegal ; and in other countries, the Herbarium and Library of the Royal Botanic Gardens in Kew, Surrey, the "Herbarium Universitatis Florentinae" of the "Istituto Botanico" in Florence, the "Museum National d'Histoire Naturelle" (Laboratoire de Phanérogamie et d'Ethnobotanique) in Paris, the Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux, Service d'Agrostologie,

Paris, the Smithsonian Institute, Washington D.C.

Consideration should be given to the support and improvement of herbaria and collections in or near the Sahelian zone.

6.2 Studies of the regeneration of degraded Sahelian ecosystems

The objective of these studies would be to determine the mechanism of recovery of flora, fauna and soils in the Sahelian region and to use this information in planning and implementation of projects for the regeneration of semi-arid zone ecosystems. Especially important would be further studies of the role of Acacia tortilis in the ecology of sub-desert areas.

The semi-arid tropics of Africa contain numerous species of high forage value that could be utilized to create sown pastures where the natural pasture has been degraded or destroyed, through over-exploitation or cultivation. Many of these species (grasses, legumes, shrubs, trees) could also be cultivated as forage crops in rotation with cereal crops in order to establish buffer fodder reserves, as well as provide for other needs of the human populations in the region.

To date there have been few studies which have linked detailed and comparative surveys of plant species adapted to drought conditions to research on the ecology of these species, particularly as regards their plasticity and adaptation to environmental stress conditions. Also, there has been little attempt to combine the study of exotic plant species which may be particularly useful for ecosystem recovery with the study and improvement of grazing resources by simple and inexpensive techniques of natural regeneration ol plant species.

Research which could be useful in developing schemes for the regeneration of degraded pasture areas include :

- study of the dynamics of herbaceous vegetation under the impact of total exclusion of livestock and other ungulates, grazing in the rainy season, and grazing in the dry season ;

- study of the dynamics of the regeneration of woody vegetation under the effect of total protection and various means of exploitation (see Boudet, MAB Technical Note No. 1) ;

- study of the possibilities of reseeding grazing areas through use of autochthonous and exotic species, annuals and perennials, herbaceous and woody species ;

- use of run-off waters and river over-flows for establishment of belts of vegetation such as Acacia, Atriplex, etc. ;

- domestication and multiplication of woody forage species such as Gadaba glandulosa and Maerua crassifolia ;

- domestication of "spontaneously" growing species for fixation of dunes, such as Panicum turgidum, Cyperus jeminicus, and others. On the other hand, Leptadenia pyrotechnica could generally be used in sandy areas as a windbreaking hedge.

In translating these broad research themes into action-oriented field projects, emphasis might be directed to the problems of conservation and evaluation of forage species, in order to improve pastures and increase present carrying capacities. The scope of such projects would be to

- collect and cultivate promising forage species from the area (from Sudan to Mauritania) ;

- evaluate their production potential under various ecological conditions of rainfall, soils, etc. ;

- study their biological performance (phenology, germination rates, growth rates, etc.) ;

- assess their fodder value at various stages of their biological cycle ;

- multiply seeds for species or ecotypes which appear best suited in terms of ecological adaptation, productivity and multiplication potential ;

- introduce, evaluate and multiply other species or ecotypes or cultivars from other areas having more or less similar ecological conditions (East Africa, southern Africa, Australia, India, Latin America, Pakistan).

- produce seeds of the best species to be tested in research stations in the region as well as in development projects.

6.3 Conservation and utilization of wild animals in extremely dry areas, particularly near the Sahel/Sahara border

The ability of a number of desert animals, such as the addax (Addax nasomaculatus), the scimitar-horned oryx (Oryx tao) and several species of gazelles (Gazella) to convert scant desert vegetation into high quality protein make their potential value exceed by far that of any domestic species under comparable conditions. But many of these species are now endangered, and means to conserve these valuable genetic resources for future use, including the restocking of depleted areas, are urgently needed. Thorough surveys to determine the status of these desert species should be conducted. The surveys should also identify areas which could be established as reserves for their preservation and for research on the species and its habitats. Remnants of desert antelope populations are found especially in Chad, Mali, Mauritania and Niger. Areas such as the mountain massifs Aïr in Niger and Tibesti in Chad have been recommended as significant natural habitats worthy of international support for conservation of desert species. In addition to establishing reserves, plans should be made for regional co-operation in establishing and enforcing hunting regulations.

As mentioned above, the productive potential of many of these wild desert animal species can exceed that of domestic animals under comparable circumstances. A number of pilot operations on game cropping and on ranching and harvesting of wild ungulates have been conducted in East Africa. Some of the experience and information from these activities would be useful in developing plans for pilot studies and operations in the Sahel region.

Such studies and operations in the Sahel could include the following activities :

- studies of animal species adaptation to desert conditions, including food habits and metabolism of desert mammals, to determine the most suitable species for restocking areas ;

- studies of plant and animal relationships, including the role of animal species in the germination and dissemination of important pioneer plants and in the regeneration of natural areas ;

- establishment of a series of enclosures for experimentation in reintroduction of plant and animal species and the regeneration of the area ;

- experiments to determine practical means of harvesting and utilization of wild animal species and of storing meat.

6.4 Establishment of biosphere reserves in the Sahelian region

To facilitate implementation of the various research themes outlined above, high priority should be given to establishing reserves for conservation and research over a long period. The biosphere reserves of the MAB Programme include categories and criteria which would allow managers to use a wide range of techniques for conservation and restoration of natural areas (see MAB Report Series No. 22). The purpose of these reserves in this zone would be to help achieve and co-ordinate conservation, research, and regeneration efforts on a regional basis. Reserves which meet the criteria for biosphere reserves would also participate on a regional basis in a global system of research, monitoring, and exchange of information.

It is suggested that a biosphere reserve network should be developed in the Sahelian region which would include a range of natural and modified ecosystems. The relatively undisturbed natural areas would serve for long-term conservation and research and could be compared with modified areas. The specific objectives of protection and research in modified areas would be to permit recovery from past human impacts and to generate new knowledge for rehabilitation and management of other modified areas.

Some suggested areas for future reserves in the Sahelian zone are outlined in Conservation of Vegetation in Africa South of the Sahara (Hedberg and Hedberg, ed. Uppsala, 1968).

7. EDUCATION AND TRAINING

In the long run, the serious problems of natural resources development and management in the semi-arid lands of the Sahelian zone can be overcome only through education and training of local personnel in the countries concerned. Training needs in regard to implementing the various research and conservation projects should be identified as soon as possible. Training should then be accomplished according to a planned programme which includes on-site training, specialized programmes and courses, fellowships and exchanges. Wherever feasible this training should be carried out in co-operation with local institutions and educational systems.

7.1 Primary and secondary education

The meeting emphasized the absolute necessity of assuring an efficient elementary education, particularly in respect to functional literacy, in all parts of the Sahelian region. Particularly in rural areas, educational systems should be conceived in accordance with the needs and ways of life of local populations. Education should not provoke dissatisfaction with these ways of life or with "manual labour", but should rather be designed to allow members of pastoral groups to assume greater responsibility for their own administration and well-being. There is also a need for innovative and flexible schemes of education adapted to the nomadic movements of pastoral societies. In certain areas, groups such as youth movements and unions could be stimulated and mobilized to undertake specific educational and action programmes in relation to the environment. Ecology or science clubs could be formed within the formal school structure.

The meeting recalled that Unesco had already launched several projects aimed at improving general and technical pre-university training, such as a pilot project for the improvement of biology teaching in Africa. Further use should be made of the national study groups already existing in the framework of this project. In particular, these groups should be transformed into permanent committees concerned with multidisciplinary pedagogical renovation. These committees should be a liaison between

the countries of the region and Unesco in order to allow these countries to take full advantage of Unesco's assistance in the field of educational renovation and scientific popularization. These same committees should be invited to regroup themselves on a bio-geographical basis in order to co-ordinate their actions and to establish a sufficiently large market for the circulation of teaching materials. In this respect, a re-assessment should be made of the various basic education projects launched by Unesco in what was formerly French West Africa.

7.2 Training of specialists

An important aspect of the problems of the Sahelian zone is that most countries of the region do not possess infrastructures which are specifically responsible for the study and management of the grazing lands of the region, and that the number of African specialists in this field is negligible in comparison to the enormity of the problems to be solved. The training of qualified personnel, as well as the establishment of relevant administrative structures, constitute an absolute priority for the development of the region, a priority without which the problems mentioned in earlier sections of this report cannot be satisfactorily resolved on a long-term basis.

Solution to the severe problems of the region requires that the people of the Sahel define and carry out for themselves studies and research needed for the wise management of their natural resources. The training of specialists from the region should be a practical training, aimed at acquiring real knowledge of the environment by systematic studies of concrete problems in the areas where they occur.

To this end, the regional meeting recommended that

- education and training programmes at the university level be based on the needs and aspirations of the peoples of the regions ;

- post-graduate training courses be organized at the regional level, aimed at promoting an integrated and multidisciplinary approach to research on the natural resources of the region ;

- fellowships and other means for exchange of personnel between projects in different countries (within and outside of the region) be made available, in order to provide research workers from individual Sahelian countries with the opportunity of learning and mastering new techniques and approaches ;

- national and regional structures for training and research linked to development needs and priorities be developed by the countries of the region.

7.3 Information for decision-makers

The rational exploitation and management of the environment depend, in the end, on decision-makers. The results of survey and research should be made available in a form useable by decision-makers. This is one important task for any programme such as MAB.

The regional meeting recommended that governments increase their efforts to provide high level administrators and others responsible for the socio-economic development of the region with ecological information. To this end, the meeting recommended convening short-term seminars and workshops on integrated environmental management and welcomed the intention of Unesco to organize the first such seminar for decision-makers in West Africa in early 1975 in Dakar, Senegal.

The meeting also supported Unesco's present efforts to incorporate environmental considerations and perspectives in the training of engineers, architects, secondary school teachers and other professional groups whose activities can have major influence on the environment.

8. SUGGESTIONS FOR IMPLEMENTATION

8.1 Mechanisms for information exchange

A significant research effort has already been carried out in the Sahel. However, the results of this research have not always been widely available. In a number of cases, documentation on the Sahel, and collections of plants, animals and soil samples taken from the Sahel, are not available within the region itself. It is of great importance, therefore, to develop within the region basic information and documentation centres which are intimately linked to research and training activities.

In addition, the regional meeting made the following recommendations :

- recommended the development of mechanisms for the regular exchange of scientific information between research workers within the Sahel region and research workers of different regions with similar ecological zones and comparable problems ;

- suggested compiling a systematic record of research workers, institutions, libraries and documentation centres concerned with the Sahel and distributing periodic information bulletins on research projects undertaken in the region and their results ;

- supported the preparation and publication by Unesco of a state of knowledge report on tropical grasslands (to include the Sahel region) and of a MAB Technical Note entitled "The Sahel : Ecological Approaches to Land use" (see Annex 2) ;

- requested the MAB Programme to encourage and support regular seminars between research workers of the region, which focus on information exchange, research methodologies and data synthesis linked to precise problems.

8.2 Mechanisms for co-ordination and stimulation of integrated research projects

As implicit in earlier sections of this report, there are at least two major requirements which need to be met for the promotion of integrated research in the region.

The first requirement concerns the development of structures in the region to assist the governments of the Sahelian zone in their efforts to organize a lasting drought relief by improved methods and types of management of semi-arid lands within the socio-economic aims defined by these governments. Analysis of available information up-dating the more important social and economic data on resources, and integrated studies for planning and management purposes, will be the means to achieve these long-range objectives. The regional meeting considered that these tasks could be accomplished through the establishment of a "Centre for integrated studies of development in the Sahel". The regional meeting recommended that Unesco elaborate the modus operandi of this proposed centre, and explore the means for its establishment with various international and national funding agencies. Since the regional meeting several consultations have taken place within the United Nations system and in particular in co-operation with the Inter-state Committee for the Fight against Drought in the Sahel (CILSS) to develop a master plan for the proposed centre. Some preliminary Unesco suggestions on the responsibilities and functioning of this centre are given in Annex 3 of this report. In addition, at the request of the Committee on Science and Technology for Development of the Economic and Social Council of the United Nations, Unesco has prepared an interagency report on the obstacles to development for arid and semi-arid zones.

The second requirement concerns the development of mechanisms for co-ordination of integrated research projects within the Sahelian zone. For this purpose the regional meeting recommended that a steering committee be formed within the framework of MAB, comprising personnel involved in integrated projects within the region. Such a committee could provide the basis of an advisory committee for the "Centre for integrated studies of development in the Sahel", as well as the link between the overall international co-ordination of MAB Project 3 on grazing lands, and the individual research projects contributing to this MAB project within the Sahelian zone.

ANNEX 1

LIST OF PARTICIPANTS

1. Specialists from the region

CHAD

Mr. NGAKOUTOU
Maître Assistant à l'Université du Tchad
Directeur de l'Institut Pédagogique National
Directeur de l'Institut National Tchadien pour les sciences humaines
B.P. 503
Ndjamena

MALI

Mr. Jean Djigui KEITA
Directeur des Eaux et Forêts
Bamako

Dr. N'golo TRAORE
Docteur Vétérinaire
Directeur de l'Institut d'Economie Rurale
Bamako

MAURITANIA

Dr. Oumar BA
Centre National d'Elevage et de Recherches Vétérinaires (C.N.E.R.V.)
B.P. 175
Nouakchott

Mr. Amadou B. BARO
Chef, Division Recherches Agronomiques
Direction Agriculture
Nouakchott

NIGER

Mr. Pierre GRANIER
Service Agrobiologie
Laboratoire de l'Elevage
B.P. 485
Niamey

Mr. Diouldé LAYA
Directeur
Centre National de Recherches en Sciences Humaines (C.N.R.S.H.)
Niamey

Dr. Abdou MOUMOUNI
Professeur Agrégé de Physique
Office du Niger pour l'Energie Solaire (ONERSOL)
Niamey

NIGERIA

Dr. A.A. ADEMOSUN
Department of Animal Science
University of Ife
Ile - Ife

Mr. T.A. AFOLAYAN
Kainji Lake Research Project
P.M.B. 666
Newbussa - Kwara State

Dr. F.O. OLUBAJO
Department of Animal Science
University of Ibadan
Ibadan

SENEGAL

Mr. S. DIARRA
Département de Géographie
Université de Dakar
Dakar

Mr. Sidy Lamine GUEYE
Département de Biologie Végétale
Université de Dakar
Dakar

Mr. Simon PEREIRA BARRETO
Délégation Générale à la Recherche Scientifique et Technique
Dakar

SUDAN

Dr. Mohammed Obeid MUBARAK
Department of Botany
University of Khartoum
Khartoum

Dr. Mohamed Yousif SUKKAR
Department of Physiology
University of Khartoum
Khartoum

UPPER VOLTA

Mr. Ouétian BOGNOUNOU
Centre Voltaïque de la Recherche Scientifique
Département de Botanique
B.P. 7047
Ouagadougou

Mr. Ahmadou CIRE-BA
Section Agrostologie et Aménagement des Pâturages
Direction des Services de l'Elevage
B.P. 7026
Ouagadougou

Mme Elise DIALLO
Sage-Femme d'Etat
Protection Maternelle et Infantile
Dopoya
Ouagadougou

Mr. Idrissa YAYA
Directeur de l'Hydraulique (H.E.R.)
B.P. 330
Ouagadougou

2. Specialists from outside the region

CANADA

Mr. Gilles LESSARD
Centre de Recherches pour le Développement International
Pavillon Comtois
Ch. 4318
Université Laval
Québec, P.Q.

FRANCE

Dr. J.C. BILLE
ORSTOM
24 rue Bayard
75008 Paris

Prof. F. BOURLIERE
Faculté de Médecine
45 rue des Saints Pères
75006 Paris

Dr. R. FAUCK
ORSTOM
24 rue Bayard
75008 Paris

FEDERAL REPUBLIC OF GERMANY

Prof. Horst S.H. SEIFERT
Department of Tropical Animal Hygiene
University of Göttingen
34 Göttingen
Oskar Kellnerweg 6

UNITED KINGDOM

Mr. A. BLAIR RAINS
Land Resources Division
Overseas Development Administration
Tolworth Tower
Surbiton, Surrey

UNITED STATES OF AMERICA

Mr. Norman MACLEOD
Department of Biology
Centre for Earth Resources and Environmental Studies
The American University
Washington, D.C. 20016

Dr. Brien E. NORTON
Ecology Center
Utah State University
Logan, Utah 84322

3. Observers

Mr. Ch. BOCOUM
Institut Polytechnique Rural
Katibougou
MALI

Mr. P.C. CHAMARD
Géomorphologue
Université de Niamey
B.P. 237
Niamey
NIGER

Mr. J.C. DELWAULLE
Directeur du Centre Technique
Forestier Tropical
B.P. 225
Niamey
NIGER

Mr. I. MAZOU
s/c Service de l'Elevage
Niamey
NIGER

Mr. O. NIANGADO
Institut Polytechnique Rural
Katibougou
MALI

Mr. N.A. SOW
Institut Polytechnique Rural
Katibougou
MALI

Mr. P.T. TRAORE
Direction Nationale des Eaux et Forêts
Bamako
MALI

4. Representatives of International Organizations

Food and Agriculture Organization (FAO)	Mr. A. NAEGELE FAO Représentation Permanente du PNUD B.P. 620 Nouakchott MAURITANIA
World Health Organization (WHO)	Dr. R. CARIC Bureau Régional OMS B.P. 739 Niamey NIGER
International Union for the Conservation of Nature and Natural Resources (IUCN)	Dr. Hugh F. LAMPREY P.O. Box 21472 Nairobi KENYA

5. Representatives of regional offices and organizations

Comité Inter-Africain d'Etudes Hydrauliques (CIEH)	Mr. André BENAMOUR B.P. 369 Ouagadougou UPPER VOLTA
Institut du Développement Economique et Planification (IDEP)	Mr. Sékou Oumar BA IDEP Dakar SENEGAL

Unesco Regional Office for Education in Africa (BREDA)

Mr. Olivier LEBRUN
BREDA
B.P. 3311
Dakar
SENEGAL

Mr. André SALIFOU
BREDA
B.P. 3311
Dakar
SENEGAL

6. Unesco consultants for the meeting

Mr. L. BERRY
Department of Geography
Clark University
Worcester, Massachusetts 01610
U.S.A.

Mr. Edmond BERNUS
Géographe ORSTOM
15 rue Malebranche
75005 Paris
FRANCE

Mr. G. BOUDET
Maître de Recherche ORSTOM
Chef du Service Agrostologie
Institut d'Elevage et de Médecine
Vétérinaire des Pays Tropicaux
10 rue Pierre Curie
94700 Maisons-Alfort
FRANCE

Mr. Hubert GILLET
Maître de Conférences
Museum d'Histoire Naturelle
Laboratoire d'Agriculture
57 rue Cuvier
75005 Paris
FRANCE

Mr. D.L. JOHNSON
Graduate School of Geography
Clark University
Worcester, Massachusetts 01610
U.S.A.

Mr. R.N. KAUL
Institute for Applied Research
on Natural Resources
P.O. Box 2048
Baghdad
IRAQ

Mr. X. PIERRE
Directeur du Centre de Documentation
et d'Analyse de la Commission
du Fleuve Niger
B.P. 933
Niamey
NIGER

7. Secretariat of the meeting

Mr. Francesco di CASTRI	Secretary, International Co-ordinating Council of the MAB Programme, Unesco, Paris
Mr. H.N. LE HOUEROU	Co-ordinator, MAB Project 3 FAO Crop and Grass Production Service Via delle Terme di Caracalla Rome
Mr. Gisbert GLASER	Programme specialist, Division of Ecological Sciences, Unesco, Paris

Mr. Albert SASSON

Consultant, Division of Ecological Sciences and Division of Pre-University Science and Technology Education, Unesco, Paris

ANNEX 2

MAB TECHNICAL NOTE No. 1 :
THE SAHEL : ECOLOGICAL APPROACHES TO LAND USE

TABLE OF CONTENTS

Introduction

The Sahel : Climate and Soils, by L. Berry

Remote sensing potentials for ecological research and training in the Sahel, by N.H. Mac Leod

Plant cover and pastures of the Sahel, by H. Gillet

Pastures and livestock in the Sahel, by G. Boudet

The improvement of pastoral economy in the Sahel : Research trends, by G. Boudet and H. Gillet

The role of the forester in land use management in the Sahel,CTFT

Animal production and health in the Sahelian zone, by H.S.F. Seifert

Studies on pastoral nomadism in the Sahelian zone : A bibliographic review, by E. Bernus

Human geography in the Sahelian zone, by E. Bernus

The status of pastoral nomadism in the Sahelian zone, by D.L. Johnson

Improvement of pasture and livestock exploitation in the Sahel : Proposals for management and land use, by G. Boudet

Publications of the United Nations Sahelian Office.

ANNEX 3

CENTRE FOR INTEGRATED STUDIES OF DEVELOPMENT IN THE SAHEL : SUGGESTIONS ON RESPONSIBILITIES AND PHASING OF WORK

As mentioned in section 8.2 of this report, the regional meeting accorded general agreement to the idea of a centre located in the Sahelian zone, which would assist the governments of the region in developing lasting drought relief measures in the region. Some provisional ideas on the responsibilities and phasing of work of such a centre are outlined in the following paragraphs.

Responsibilities of the Centre

The responsibilities of the proposed centre might include :

- collection of the available knowledge and experience ;
- inventories and surveys of natural resources, energy resources and animal and human resources ;
- evaluation of the existing resources, mainly for soil and water resources and grazing lands, in socio-economic and socio-cultural terms ;
- interdisciplinary pilot research in fields where the gaps in knowledge are most considerable, in particular in the field of inter-relationships between various ecosystem components ;
- identification at an early stage of the effects of particular development programmes on human and natural systems, and promotion of respective research ;
- co-ordination and harmonization of all ongoing and planned research and training activities ;
- presentation of survey, evaluation and research results and related information to decision-making bodies ;
- advice, upon request, to decision-making bodies ;
- training of high and medium level specialists to carry out all the above-mentioned functions.

The centre would not necessarily undertake all these activities itself, especially as far as inventories, surveys and sectorial research are concerned, whenever other institutions with potential to carry them out already exist in the region. The responsibility of the centre would be to act as a catalyst for research dealing with already well-identified priorities and which would be identified as a result of the evaluation of the situation in the Sahel, ensuring that the necessary surveys and research are carried out,

and itself undertaking research involving various types of interactions on problems within its competence.

For disciplinary research, the centre will need to establish relations with, and profit from, the current and growing strength of other research institutes within the region. An important function of the centre should be to engage other institutions and/or individuals to carry out specific research tasks.

An important prerequisite for success of the centre will be intimate and continuous co-operation between planners, decision-makers, surveyors and research workers in the region and those involved in project design and execution.

Preparatory Period

The project should be carried out in two phases : a preparatory period of one year, followed by four years of project implementation. This phasing is necessary because of the innovative nature of the project. The initial staff will be responsible for :

- drawing up a detailed work and research programme for the centre, considering also the possibility of encouraging and sub-contracting specific studies at sectoral national or regional research institutions ;

- defining an effective organizational and operational structure for the centre, keeping in mind the centre's role in providing information and guidelines to decision-making bodies ;

- defining more clearly what equipment is necessary, both for the centre and for other associate existing institutions ;

- drafting at the end of the preparatory period a master plan for the establishment of the centre based on the work programme and structure mentioned above and taking into account the need for regular evaluation of the project by the governments, funding bodies concerned and the executing agency ;

- beginning the work of gathering data, literature and information, training specialists or technicians, and carrying out research work in a special field of integrated studies to be defined at a later time.

Unesco maintains close contacts with UNDP, FAO and UNEP for the implementation of this project.

A stylized "ankh", the ancient Egyptian sign for life, has been incorporated into the symbol of the Programme on Man and the Biosphere (MAB).