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ARID LANDS - ECONOMIC, SOCIAL AND
ECOLOGICAL MONITORING

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ABSTRACT

Population pressure in the arid and semi-arid lands of Kenya is increasing, largely due to rapid population growth and outmigration from the higher potential areas. More intensive use of the arid lands for traditional agricultural and pastoral activities is causing imbalances in the ecology of these areas which result in soil erosion and environmental degradation.

In order to plan the development of arid regions and to alleviate the stress experienced by their inhabitants, information is needed on the social, economic and ecological systems of these areas and their interaction. Such information should then be translated into policies and programmes relating to local conditions, problems and development potential.

Problems become acute when the carrying capacity of the land is overstepped. It is difficult to assess objectively the point at which this occurs, as the carrying capacity can only be defined according to the values of local people. However, in many semi-arid regions of Kenya we know the maximum capacity has been reached, as an increasing cattle population has resulted in overgrazing, causing soil erosion and environmental degradation. This situation is often aggravated by the expansion of agriculture into more marginal lands, thus depriving the pastoralists of some of their better grazing lands and increasing the vulnerability of the farmers to famines caused by drought.

Several solutions to these problems were suggested during a Workshop on Arid Lands held at the Institute for Development Studies on 28 - 29 June 1976. Some of these solutions would involve major changes in pastoral activities, particularly the control of grazing, institutional arrangements to curtail or prevent overgrazing, and the encouragement of cattle sales through the activities of an extensive marketing system. It was noted that planners should take advantage of the pastoralists' keen awareness of their environment and of the complex, flexible land-use systems they have developed.

The collection and analysis of relevant data regarding both the ecology and the production systems of the dry-land areas was seen to be an essential first step in the formulation of appropriate strategies for the development of these areas. These regions have generally been neglected by data gathering

agencies, and their remoteness makes data collection difficult and expensive.

A variety of information gathering techniques was reviewed, operating at different scales. It was stressed that surveys should be low cost, and should use, as far as possible, existing agencies and institutions to provide the necessary basic, minimum monitoring. Remote sensing satellite technology was discussed as a means of obtaining general overviews of large and often remote geographic areas. This should be allied to detailed studies of specific areas and continuous observation of 'critical indices' in order to provide planners with timely information on changes in environmental and economic systems.

Problems associated with the ethical and practical aspects of data gathering were also discussed. The need to clear monitoring activities at all levels of the administrative structure and to explain their purpose to local populations was stressed. This process should allow the values and priorities of these people to be incorporated into the formulation of development strategies. Despite these ethical problems and others of a more practical nature regarding the measurement of environmental processes, e.g., soil erosion, the urgency of the situation facing the people of these regions makes it imperative that action be taken swiftly to prevent famine and loss of life.

Participants in the seminar outlined their ongoing research into problems of semi-arid areas. These included the following projects:-

1. The UNEP Desertification Conference. Professor Haq and Dr. Rosenov.
2. Activities of the Kenya Government's Central Bureau of Statistics.
Mr. Casley.
3. UNDP/FAO Kenya Habitat Utilisation Project. Dr. Gwynne and Dr. Croze.
4. The Ecology of Northern Kenya: Problems of Data Collection. Dr. Kamau.
5. Ecological and Human Problems of Northern Kenya. Dr. Mbithi.
6. Project to Test the Concept of Human Carrying Capacity. Dr. Bernard.
7. Rangeland Ecology Monitory Unit.
8. UNEP Worldwide Monitoring Programme. Dr. Francesco.
9. A Botanical and Anthropological Study of Mbere, Eastern Kenya.
Dr. Brokensha.
10. An Anthropological Study of Fertility. Dr. Reining.
11. A Study of Family Planning in Meru. Mr. Greeley.
12. Local Planning and Participation: Baringo District. Mr. Kinyanjui
and Mr. Ng'ethe.

The Workshop on Arid Lands was organised by Dr. Peter N. Hopcraft, Acting Director of the Institute for Development Studies and Dr. Priscilla Reining, a research associate at I.D.S. from the American Association for the Advancement of Science. The Workshop agenda and the list of participants are given as appendices to this report. The Workshop consisted of four sessions, the mornings and afternoons of 28 and 29 June 1976. Dr. Hopcraft chaired the first session, Professor Israr Ul Haq of the United Nations Environment Programme the second, Dr. Reining the third, and Dr. Hopcraft the final session.

OPENING REMARKS -- DR. PETER HOPCRAFT

We are here today because we are all conscious of the severe human and ecological problems in the arid areas of Kenya, and because we recognise that the situation is rapidly getting worse. We are also acutely concerned that not enough is known about these areas. A good deal is known about the theory and process of land degradation, thanks, in large part, to a number of people in this room, but we urgently need more information about the arid zones, and we need a mechanism for providing a flow of relevant information. I am glad that we have with us representatives from the Kenya Central Bureau of Statistics. This is certainly one of the best statistical data-gathering institutions in this part of Africa and the staff of the Bureau have interesting and important plans for improving their activities. But, like the rest of us here today, they do not know, and currently have no mechanism for finding out, what is happening in the arid areas, especially with regard to the human populations, their productive systems, their resource base and their welfare.

The principal focus of this Workshop will be on the question of information and data gathering. In other words, what do we need to know on a continuing basis from these areas and what feasible methods are there for finding out?

Some of us here are ecologists and some are social scientists. I hope one of the reasons we are here is that we do recognise that we are dealing with human societies and human social systems, and with the ecological consequences of these systems. We need a broad definition of ecology which focusses on the people living in these areas, considering both human activities which cause ecological change and also the effects of changes in the ecology on the human population. Information is needed on the whole question of the incentive systems, the food production systems and the behaviour patterns of these societies, and finally on the most fundamental of all these processes, that of human population growth and its determinants.

Let me briefly outline the logic of this Workshop. First we shall discuss what is happening in the arid areas and try to arrive at some understanding of present trends and problems, as a basis for identifying those factors which should be monitored. We shall consider pastoral areas and also the arid agricultural areas where equally severe problems are developing. In fact, a clear distinction cannot always be made because, as we can see in many parts of Kenya, agriculturalists are increasingly encroaching on areas which should be defined as strictly pastoral, with very severe consequences for the accelerating process of desert creation.

Next we shall discuss the very complicated question of monitoring welfare and the human condition. Then we shall look at different data-gathering techniques in more detail, ranging from satellite photography at one end of the spectrum to detailed anthropological studies at the other. Finally a number of people will discuss specific studies which are going on in these areas.

The United Nations Environment Programme is sponsoring an important conference on desertification in 1977. A description of their thinking on these issues should provide one element of background to our discussion here.

The UNEP Desertification Conference - - Dr. Boris Rosenov

The purpose of this Conference is to draw up a common plan of action to combat desertification. A small secretariat is currently preparing for the Conference in close cooperation with various U.N. agencies, and a draft plan of action has been written which is being circulated among international agencies and national governments. Suggestions for the plan of action will also be gathered at four or five regional conferences which will take place before the main conference to be held in Nairobi in August 1977.

Desertification is a phenomenon which is occurring on every continent, but, though we can describe the process, we do not have enough information to gauge its extent. We need to know which countries are experiencing desertification, what geographic areas are affected, what populations are affected and what are the economic consequences. To help fill out our knowledge, case studies are being prepared by U.N. agencies in India, Pakistan, Iraq, Niger, Tunisia and Chad and by the national governments of the United States, China, Israel and Australia.

To control the process of desertification the greatest stress must be put on proper land use. This includes agricultural practises and the correct management of rangeland. The social and economic conditions of the people living in arid areas are the most important, and perhaps the most

difficult, factors to consider in trying to bring about change. The technocrats who are studying these issues may be tempted to think of solutions in terms of advanced technology, but care must be taken to consider what solutions are actually appropriate or feasible in terms of the socio-economic conditions of the people living in these areas.

FIRST DISCUSSION SESSION: WHAT ARE THE CRITICAL PROBLEMS
IN ARID AND SEMI-ARID AREAS ?

Factors Which Bring About Environmental Deterioration

Dr. Leslie Brown opened the discussion by reminding the Workshop participants that ecological problems are caused by human beings. Human behaviour is creating deserts, so human behaviour must be changed, but this can be done in a relatively short period of time, compared to climatic or topographical features which only change very slowly.

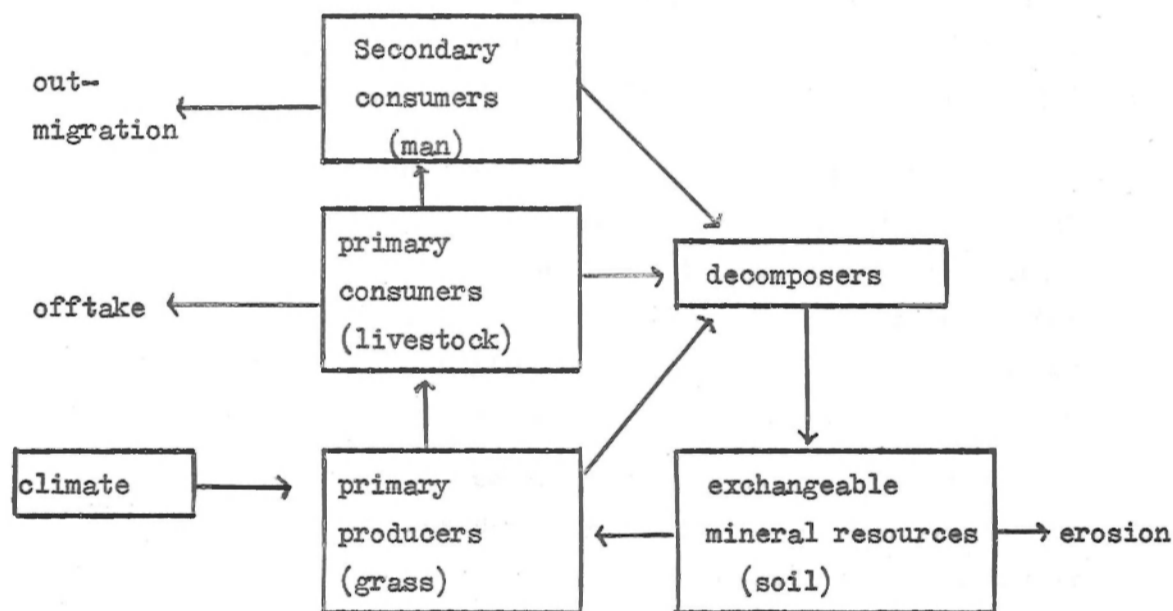
He emphasised that these problems are urgent and solutions must be found quickly. Short-term measures must be undertaken right away on the basis of existing knowledge and information, rather than postponing any action until more information is available. In addition to interim measures, there is an urgent need to monitor the whole process of land misuse. It is also vital that the interim measures themselves should be adequately monitored.

Desertification is caused by bad land use which can be observed in many countries, developed as well as developing. Bad land use can be the result of sheer stupidity, ignorance or a lack of technical knowledge. In many arid areas people are aware that soil erosion is taking place but do not realise that it is caused by their own activities. It is also possible that deserts may be created by major changes in climatic conditions, but scientists who attended an F.A.O. conference in 1974 at the time of the Sahel disaster rejected the notion that there had been any major change in the climate of that region.

Much remains to be learned about proper land use in the semi-arid areas. For example, the desirability of traditional grass burning, or of the newly introduced group ranching schemes, is still being debated. However, simple and effective soil conservation measures were developed some time ago, and sound livestock management practises have been worked out for these areas. Yet while these measures were enforced by government and widely practised in Kenya in the past, implementation systems have now largely broken down and it is urgent that new means be found to put them back into practise today.

What Is an Ecosystem ?

Dr. Harvey Croze presented a diagram demonstrating the various components of an ecosystem and their interrelationship. In a pastoral area the primary producers of nutrients are the grasses which depend for their growth on the climate and the soil. The primary consumers are the grazing animals, and the secondary consumers are the pastoralists who consume animal products. Either of these consumers may leave the ecosystem, bringing about a loss. The plants, animals and people who remain produce organic wastes which, with the action of the decomposers, are returned to the soil. If soil erosion occurs, this is also a net loss to the system.



Dr. Hopcraft contended that the loss from animal offtake and human migration was relatively insignificant. The overwhelming problem was excessive livestock, removal of the grass cover, pulverisation and overheating of the soil, inability to retain moisture and massive erosion. Carefully managed production systems that include animal offtake are, for most of these areas, part of the solution to the main problem of erosion and ecological breakdown rather than a significant contribution to it.

Population Pressure and Carrying Capacity

There is some maximum human carrying capacity for each ecological zone and many dry zones in Kenya have reached their capacity. When these areas must support too many people, the result is overgrazing, soil erosion and desertification. In the Sahelian region prior to the famine of the early

1970s, the population increased, the agriculturalists pushed into marginal lands to a greater and greater extent and the pastoralists were pushed back and confined to the dryer areas so that a much greater pressure was put on the land.

In eastern Kenya also, a large number of agriculturalists have migrated into marginal areas during a series of good years because of population pressure elsewhere, and as a result when there is a bad year a much larger section of the population is subject to famine. This process has been accelerated, perhaps, by the development of drought-resistant and drought-evading crops, such as Katumani maize, which have enabled people to cultivate areas in good years which in fact ought not to be cultivated at all.

In the pastoral areas, especially where milk is the principal subsistence food, the dietary needs of a growing population require an increased number of livestock, while at the same time the land available for grazing is shrinking. Rotational grazing, leaving the land to rest for sufficient periods to regenerate its productivity, becomes impossible. Removal of the vegetative cover and soil erosion reduce the carrying capacity of the land, which in turn reduces the productivity of the livestock. The response of the pastoralists is frequently to increase their herds to maintain subsistence supplies.

Added to this is a tenure pattern in which the land is communally owned but the livestock are owned individually. Since the individual pastoralist receives all the benefits from his animals and cannot exclude others from access to his grazing land, he has a strong economic incentive to maximise his herd so that his animals use up the last blade of grass rather than allowing it to go to animals belonging to someone else. This is the classic economic problem of the overuse of a common property, leading, in this case, to a cycle of overstocking, land degradation and environmental destruction. There are already a number of recently productive areas in Kenya which are so exhausted and eroded that it would be uneconomic to undertake the measures necessary to regenerate them.

The pastoralist has a similar short-term economic incentive for increasing the size of his family. If there are a number of herders in the family, the herd can be broken down into small units to exploit the range resource more fully. This practice is particularly important in times of drought, and the size of livestock herds can be observed to change according to the amount of rainfall.

A number of other factors which lead to the deterioration of the arid areas were also mentioned. The removal of trees for firewood and charcoal has led to a disastrous loss of vegetative cover in some areas. The widespread decimation of wild animal populations has reached crisis proportions. These species are far better adapted to, and make far more productive use of the rangelands than do domestic livestock. At the same time, they retain a sound ecological balance with the various species of vegetation and preserve the productivity of the land.

Dr. Bernard pointed out that the concept of population pressure is extremely complex and little understood. On the one hand, little is known about the ecological potential of the areas under discussion. For example, there is little water balance information and only scattered soil surveys. On the other hand, the concept of human carrying capacity is much more complex than the mere notion of providing a minimum level of nutrition. The acceptable standard of living of the people in question must be taken into account, along with the level of technology of their food production systems. There is an urgent need for more information on all these questions, and the information must be made available to the people responsible for the development of these areas and not merely taken out of the country as part of someone's Ph.D. thesis.

Land Consolidation and Group Ranching

Land consolidation and registration are being extended throughout rural Kenya as a government policy and Dr. Leslie Brown stressed that land consolidation is essential as it is physically impossible to farm properly on fragmented land. Dr. Celia Kamau, however, pointed out that Dr. Brown's examples of land consolidation were taken from high-potential farming areas and that the merits of land consolidation are much less obvious in arid regions. The concept of group ranches was devised in the 1960s as the form of land consolidation most appropriate for pastoral areas. However, Dr. Kamau has found that in Samburu, group ranch boundaries are based on social units, and insufficient consideration has been given to climatic and ecological factors. There is a danger that the migratory patterns of the pastoralists, which have been a primary feature of their adaptability in the past, will be disrupted, and they will be confined to units of land which are, in fact, sub-economic.

According to Dr. Michael Gwynne, it should be possible to demarcate viable group ranches on the basis of traditional migratory patterns and ecological conditions. If one carefully follows the movements of a pastoralist

group, one will find that they move their different types of stock within a natural region with fairly definite boundaries. In drier areas these regions are usually larger, and everywhere groups tend to have reciprocal arrangements with others so that they can move onto other people's land when climatic conditions make it necessary. These natural boundaries could be made the basis for the development of group ranches.

Mr. Sidney Meadows, whose experience has principally been with the Maasai, agreed that group ranch boundaries should be set with full consideration of ecological factors and that ranches must be large enough to support their members without putting too much stress on the land. He felt that land consolidation has an important role to play in teaching nomadic people that their grazing resources are finite and must be properly husbanded. Dr. Hopcraft agreed that basically land consolidation is meant to make it clear that a group of people will depend indefinitely on a specific piece of land so that they will take the responsibility for ensuring its long-term viability. However, since a group ranch is still owned communally, while the animals are owned individually, the economic incentive described earlier for an individual to enlarge his herds is still operative, even though it is in the interest of the group to restrict livestock populations and preserve the productivity of the land.

In addition, the group ranch model has been imposed in some instances among groups where it is completely inappropriate. Local pastoralists, who may in fact not form any stable grouping, may come together to form a group ranch simply as a means of qualifying for a government loan. To a great extent these loans have been used for disease control and water development, further contributing to increased stock numbers and greater pressure on the land. In some places these developments have undermined the entire environment in a few years and the population has survived only on famine relief. So far there is little evidence that marketing arrangements and group ranch management structures have been effective in limiting or reducing stock numbers and reversing this trend.

Dr. Leslie Brown pointed out that settled ranching, either on an individual or a group basis, is only possible where rainfall approaches 20" a year. In drier areas at somewhere between 15" and 20" of rainfall a year, only nomadism is possible.

For example, a group of Galla people inhabit the arid region around the Tana River where rainfall is probably 10" or less. The only way they are able to live there is by having access to the Tana River delta where there are seasonal floods. From the point of view of central government there are certain disadvantages to nomadism, such as administrative difficulties and the problem of keeping children in school, but it must be recognised that in an area such as this, if people are not allowed to migrate, they will not be able to survive.

Marketing and Management to Control Stock Numbers

Dr. Hopcraft suggested that any long-term solution to the problem of overstocking would have to include the introduction of a reliable marketing system to enable pastoralists to sell beef and purchase other foods conveniently. Present marketing practises and attitudes towards marketing, along with the accompanying changes in dietary patterns, are important areas of investigation where much more needs to be known. Marketing behaviour and dietary patterns should be major components of any monitoring system, and the provision of the necessary facilities and incentives are prime areas for government activity. Mr. Meadows responded that where markets are available, pastoralists have shown themselves willing to sell their cattle, though at least initially they prefer to sell males and older females and keep their breeding stock. In fact, a number of group ranches are producing higher quality animals and selling them directly to the Kenya Meat Commission.

Dr. Brown agreed that pastoralists are willing to sell their stock where markets are accessible, but in much of northern Kenya the animals are far away from the nearest agricultural area with surplus foodstuffs. Government measures which would be necessary to facilitate trade, such as building a railway from El Wak to Isiolo, could not be justified economically in view of the low total productivity of the area.

Selling cattle from an area does constitute a net loss to the local ecosystem, and Dr. Croze suggested that perhaps sales should be restricted for that reason. However, Dr. Hopcraft and Dr. Kamau argued that the destruction of the environment due to erosion caused by overgrazing is much more significant than any net loss caused by the offtake of cattle. Dr. Brown added that a commercial beef ranch on the average removes about 1,000 lbs. liveweight of stock a year per 25 acres, and these animals are about 82 per cent water. But if an area is overgrazed and eroded as much as 100 tons of soil per acre can be lost in a year. There is also a continuous renewal of the soil by weathering of the underlying rock, so that a certain rate of offtake can be maintained while keeping the system in balance.

Dr. Croze commented that we need to know more about all aspects of the ecosystem: for example, at present very little is known about the decomposers who play an essential role in the renewal of the soil.

In summarising this portion of the discussion it was pointed out that a development strategy for rangeland areas involves changing from a traditional subsistence system based on milk to a modern marketing system. The transition is complex and must be approached with a package of development measures. These include the development of marketing systems and, most important, effective range management involving the control of livestock numbers. Only in that context should measures that tend to increase the pressure of livestock on the land, such as disease control and water development, be considered.

Approaches to Change

It was stressed that pastoralists generally know their environment very well and exploit every opportunity to ensure their survival. Different groups have developed their own food production systems and have made other adaptations to their specific environments. These systems demonstrate great intelligence and flexibility. For instance, most pastoralists grow crops to some extent when they have the chance or enter into trading relationships with farmers. The Turkana not only cultivate sorghum, but they have actually developed two of the fastest growing sorghum varieties in the world.

Pastoralists have adapted continuously and rapidly to social, political and ecological change, according to some of the Workshop participants. For example, the size, sex and age structure of herds and the types of animals included all vary widely and change rapidly in response to environmental factors. Also, when the opportunity becomes available to secure government loans, a number of pastoralist peoples are quick to join together to form group ranches. When they are settled in high-potential farming areas, they very quickly take up the cultivation of new crops.

Because the pastoralists themselves know better than anyone else how to survive in arid areas, any measures to improve their living conditions should be based on what they are already doing, rather than imposing totally new practises from outside. Such measures should also be tailored to specific groups because the opportunities and constraints of each group are to some extent unique.

In many countries there has been a widespread virtual rejection of pastoralists by central governments, and the pastoralists themselves are keenly aware that their own interests may not coincide with government policies and

programmes. For example, their views on the optimal condition of livestock may not coincide with those of outsiders since they may use the animals primarily as a source of milk and blood rather than of meat. Also, in the past some governments and international agencies have insisted that pastoralists become sedentary, and in many cases this has greatly reduced the effectiveness and reliability of their traditional food production systems. Governments have not given priority attention to pastoralists. With the expansion of agriculture their rangelands have become smaller, and their relative numbers are also diminishing given the even higher population growth rates in high potential areas. Some have also moved into agriculture or wage employment in search of greater economic security.

It may not seem justifiable to make large investments in areas where the economic potential will always be relatively low, yet without appropriate development efforts the entire arid region is likely to become a worse and worse deficit area and governments will have to spend more and more just to keep people alive. As food production systems become less viable due to population increases, environmental stress and government neglect, increasing numbers of people will be forced to rely on famine relief. This situation creates very serious problems. When groups of people begin receiving food they tend to become dependent on relief and expect that they will be given food indefinitely, but countries at the early stages of economic growth cannot afford to have whole sections of their populations dependent on relief. Yet, given proper management, the arid lands do have production systems capable of producing substantial incomes from domestic animals and wildlife. There is no reason why they should become an economic burden on the rest of society.

Data Collection in the Arid Areas

Mr. Dennis Casley of the Central Bureau of Statistics commented that very little data have been collected by the Kenya government in the arid areas, partly because of the problems and expense involved and partly because these regions have suffered from a general neglect. A national rural survey was initiated in 1975, but it does not include pastoralist areas. The national sample basically covers the six more densely populated provinces - Central, Eastern, Coast, Rift Valley, Western and Nyanza - and, though the great majority of the national population is included, nearly all the pastoralists are left out.

It is very difficult and expensive to carry out surveys in these regions. The methodological, and even the physical problems are great. Lack of manpower and financial resources is an important constraint, and often collecting data proves to be physically dangerous due to the misapprehensions and hostility of nomadic people. Dr. Leslie Brown pointed out that the investigations of the

Maasai area where the Kaputiei Group Ranching Scheme was developed cost around £50,000, and only covered an area of 827,500 acres. This works out to a cost of about £1 per 16 acres, and if the 180,000 square miles of northern Kenya are to be studied, the level of expenditure is totally infeasible. Drs. Hopcraft and Reining suggested that the most effective and inexpensive way to collect data would probably involve a combination of satellite scanning, aerial sample surveys and micro-anthropological investigations. Agencies and institutions already serving these areas in such fields as health and range management should also be used for periodic monitoring of key variables.

Mr. Casley added that in the past there has been an emphasis on large surveys which require considerable time to carry out and analyse before the results are made available. These methods are appropriate for variables which change slowly, but in other cases the situation changes so rapidly that information provided after a considerable delay may be of only historic interest. At present an increasing share of the limited resources available for data gathering is being directed towards monitoring current trends, such as maize production and nutritional status, with information made available immediately.

Professor Haq concluded the morning's session by emphasising that an expansion of monitoring and data collection activities will require simultaneously an expansion in training at all levels to provide the necessary skilled manpower.

SECOND DISCUSSION SESSION: MONITORING THE HUMAN CONDITION

Professor Haq and other members of the United Nations Desertification Secretariat have developed a tentative list of criteria for monitoring the human condition which was presented to the Workshop participants for discussion.

Criteria for Monitoring the Human Condition (State of Well-Being)

1. Human Health
 - (a) Incidence of malnutrition (overall picture; in rural and urban areas; and among the vulnerable groups, viz., pre-school children, nursing and expectant mothers, and the old and invalids)
 - (b) Incidence of disease (parasitic, infectious and deficiency diseases)
 - (c) Mortality rates (overall rate; rates in rural and urban areas; and rates according to age)
 - (d) Average weight and height (according to age and sex groups)
2. Food
 - (a) Average availability of food (calories; and essential food factors - balance sheets)
 - (b) Eating habits and food taboos

(c) Nutrition education status (among the educated and the masses)

3. Human Settlements

- (a) Availability per family (kind; design; and number of kitchens, toilets and bath-rooms)
- (b) Supply of drinking water and disposal of sewerage and household refuse
- (c) Overall sanitation (with special reference to the location of animal habitations)

4. Educational Status

- (a) Literacy rate (according to age, sex and rural-urban categories)
- (b) Educational level: number and percentage of citizens trained in informal (vocational or short-course levels) and formal (primary, secondary, and tertiary/professional) systems of education, vis-a-vis national trained man-power needs and output of existing educational institutions
- (c) State of extension activities (number of extension agents and availability of extension facilities in major sectors of economy, e.g., livestock production, range management and crop husbandry)

5. Socio-cultural Patterns

- (a) Population (by category)
- (b) Income and standard of living (professions, G.D.P., per capita income, and cost of living indices)
- (c) Social impediments to advance (value systems, role of women in society, traditions versus traditionalism, and incentives and innovations)
- (d) Extent, magnitude and impact of social welfare activities (government, private, international).

The UNEP Desertification Secretariat is soliciting opinions on the appropriateness of the criteria themselves and on ways in which they can actually be monitored in the field. They hope that the case studies which are being carried out in preparation for the Desertification Conference, and possibly any studies which will be carried out during the same period in Kenya, will provide a means of pretesting these criteria so that they can be further developed and refined before the 1977 Conference.

What Information Should Be Gathered ? - Baseline Information and Special Studies

It was stressed that if the problems of the arid areas are to be dealt with effectively, two types of information are needed: detailed studies of specific communities, and a small number of objective indices which can be monitored for large populations quickly and without a great expenditure of resources.

Detailed baseline studies should be made of particular areas, taking into account the great diversity which exists within the arid zone. The focus of these studies should be the people's production systems which must be maintained and enhanced if their social systems and their wellbeing are to be preserved. More information is needed on such environmental factors as soil types, water table levels and climatic conditions which result in major changes in production patterns over very short distances.

In addition, inventories should be made of the services which are available, such as the number of roads, health services, boreholes, educational facilities and the amount of research being aimed specifically at the arid zones. The quality and relevance of these services must also be assessed, such as the usefulness of the education being offered or the relevance of the research. Dr. Maleche was asked to comment on the appropriateness of education for people in arid areas, as formal education status was one of the criteria for human welfare listed by the Desertification Secretariat. In his view, education should not be imposed on a people from outside, but must be based on their needs and measured in terms of its usefulness to them. Most learning in these areas takes place outside the formal school system and we need to know a great deal more about it.

The values and priorities of the people living in arid areas must also be ascertained so that the notions of human welfare on which monitoring and development activities are based correspond to their own notions and not others imposed on them from outside. This is extremely important because the people living in these areas understand their environment, their needs, their opportunities and their constraints much better than anyone else. All those in government and other agencies whose decisions affect the arid regions must be made aware of the viewpoint of the people who live there so that development efforts are not useless or counter-productive. Dr. Krystall pointed out, for example, that Kenya has about 20,000 extension workers in the field, and in order to help rural people effectively these workers need tools and skills, as well as indices of the people's felt needs and goals, so that they can make their services as useful and relevant as possible.

Also, if the wellbeing of local people is to be improved significantly, the major effort and resources will have to come from the people themselves. The arid areas are so vast, even in Kenya alone, that the national government and donor agencies could not begin to make a large enough input to have, by itself, any significant effect on the wellbeing of all the people involved.

The local people's own aspirations and their own efforts form the only adequate basis for any significant development, and these people are unlikely to accept the criteria of outsiders.

By contrast, the discussion pointed out many items on the list of criteria proposed by the Desertification Secretariat which appear to be measures of modernisation or westernisation, rather than of human welfare as assessed by the people themselves. For example, the list suggests that traditional value systems are an impediment to progress, but in fact where traditional value systems are abandoned the result is not necessarily progress.

In order to find out the goals and priorities of a group of people, a qualified anthropologist or sociologist could be called in to try to capture their world view and determine what things are important to them. However, this may not be necessary. It has been Dr. Brokensha's experience dealing with a farming community in a semi-arid area, and Dr. McLoughlin's experience dealing with nomads, that people often have very clear ideas about what they want, and need only to be asked. This information can be obtained fairly easily for each area, but there is no universal solution appropriate to every community. Each group of people has an implicit list of its own needs and priorities which in some instances may coincide closely with the views of development planners and in other cases may be quite different from the list which government planners would devise for them. Work should begin from the local people's own list of priorities, identifying what is feasible, what can be achieved in a different way, and what must be ruled out.

Dr. McLoughlin pointed out that pastoral peoples generally have a clear perception of their idealised life-style based on living conditions prior to the cumulative pressures of the last few decades. Clearly, with increased population density in these areas, nomads cannot be restored exactly to their past conditions, but by working with them and starting from their own views of the ideal life, we can learn how to measure and possibly improve their welfare, as they themselves would define it, using modern means.

In addition to information about the current situation in each area and an assessment of the local people's needs and aspirations, the need to estimate long-term social trends was discussed. These would include population growth rates, fertility patterns and the patterns of nomadic movements. It is also possible to measure people's wellbeing and the performance of their production systems without cultural bias by concentrating on physical indicators such as the condition of the grazing lands and the nutritional status of both livestock and people. Dr. Mbithi suggested that the Desertification Secretariat was probably primarily interested in developing criteria of wellbeing which

are comparable from one given area to another, but this consideration should definitely be secondary to the aim of developing measurements which are relevant to each particular community.

Indicators to be Monitored

Mr. Casley suggested that several criteria of welfare listed by the Desertification Secretariat were irrelevant in arid areas and would be impossible to measure in any case. For example, how can one measure income, under item five of the Secretariat's list, among a people who do not participate in the cash economy? The question of feasibility also relates to other items which would be technically possible to measure, but which, given limited resources, cannot feasibly be monitored by existing government machinery on a regular basis. The list presented by the Desertification Secretariat contains a complex variety of indicators, some of which measure human welfare only indirectly, such as sanitation and sewerage which presumably are an indirect measure of health. By contrast, what is needed is a certain minimum list of crucial indicators, such as the availability of food, incidence of childhood malnutrition and mortality rates, which the government can realistically be expected to monitor on a very wide scale.

The purpose of a monitoring programme must be kept in mind. Monitoring is meant to pick up change, especially change for the worse, and quickly, so that action can be taken to alleviate a situation before it becomes disastrous. Unlike an academic research project, monitoring must also cover a very large population, which means that the operation must be carried out by low-level staff with very limited resources. Dr. Mbithi added that it is important to clearly specify the population being monitored.

Some important indicators do not change very rapidly over time, so that information gathered through normal government operations is probably fairly accurate and monitoring per se is not necessary. Factors which change very slowly and therefore do not require continuous monitoring include education and literacy levels and the level of extension activities and other infrastructure. Only direct indicators of human welfare which change quickly need to be monitored with a more mobile and more rapid data gathering system.

The goals of any monitoring operation should be to produce a state of continuous sensitivity to the factors which determine human welfare. Perhaps the first indicator to be considered is the simple issue of survival. One must know the mortality rates and the most important causes of death, which are frequently droughts and epidemics. Further, the health and nutrition status of a population must be measured in terms of their own understanding of

health and illness. Various types of malnutrition should be differentiated so that specific dietary deficiencies can be determined. The patterns of incidence of various diseases should be monitored, and the correlation of specific diseases with poor nutritional status and other factors should be determined. Further, it has been observed in Kenya that groups of people experiencing stress tend to move, so that patterns of mobility are another important indication of human welfare. Population movements can also indicate the likely level of soil erosion and other forms of environmental stress, and the dislocation of social institutions as a result of mobility could also be studied. Crop yield estimates and projections need to be carefully monitored so that food shortages can be predicted. Up until now this information has been supplied by local chiefs who have no training in how to make estimates and who may well be motivated to submit inaccurate figures for a variety of reasons. Finally, household surveys need to be carried out and ownership patterns determined in a disaggregated form so that, for example, figures on average cattle ownership do not mask the very real stress of a number of pastoralists who own no cattle at all. All of these measures can be thought of as providing an index of stress.

Monitoring Techniques

Data gathering techniques were discussed in more detail during the morning session of 29 July, but during this session Dr. Michael Gwynne of UNDP/FAO described the three-tiered monitoring system which has been developed for wildlife studies in East Africa and suggested how it could be used to monitor the human condition in arid regions. The demarcation of natural, fairly self-contained ecological zones can be carried out from data collected by satellite and high-altitude aerial surveys. Quantifiable information on different types of housing and other structures, whether they are presently occupied or have been abandoned, on livestock numbers and movements, on roads and cattle trails, on the location of wells and other watering places, on cropping patterns and the advance and retreat of cultivation, and on erosion can be obtained by repeated, systematic fly-overs with small airplanes. Additional information which cannot be gathered from the air can be collected by visits on the ground. This would include such information as the sex and age ratios of livestock, the height of vegetation and sociological data. The advantage of relying to some extent on aerial monitoring is its low cost and the speed with which one can gather reliable data from a large area. The operational costs of aerial monitoring work out to U.S. \$50 per 1,000 square kilometres, which is very much cheaper than the cost of gathering the same information on the ground. Because of the low cost, frequent sampling also

becomes feasible.

Dr. Priscilla Reining described the research techniques used by the Communicable Disease Control Centre in Atlanta, U.S.A., working in Niger in 1973. This group worked out a very sophisticated sampling frame to measure changes in the height and weight of 500 carefully selected children throughout the Sahel over an extended period. The project was then set up so that local field workers could carry out the measurements very simply with a minimum of equipment. Trends in growth rates could be monitored easily and areas experiencing stress quickly identified.

Dr. Hopcraft concluded the afternoon session by briefly describing the operation of the Early Warning System in Ethiopia. The unit which is responsible for the system is small, has minimal staffing and gathers virtually no data itself. Instead, it identifies the major information gaps that exist and provides additional resources to existing government agencies in the areas concerned to gather information. The unit sees its role as making sure that other government operations use their capacity to gather data as fully as possible and then pass the information on to this one unit for analysis. This institutionalised capacity to digest and analyse information from a number of sources and identify problems before they reach disastrous proportions is clearly a vital step in any serious attempt to monitor, or do anything about the arid areas.

During the afternoon session some concrete ideas were generated on just what indicators should be monitored and also some ideas about what techniques of data collection would be appropriate and feasible. The next step should be an actual experimental project to try out some of these ideas and see how they work.

THIRD AND FOURTH DISCUSSION SESSIONS: METHODOLOGIES FOR DATA GATHERING AND SPECIFIC STUDIES CURRENTLY UNDERWAY

Monitoring Techniques Developed by the UNDP/FAO Kenya Habitat Utilisation Project

Dr. Michael Gwynne and Dr. Harvey Croze described in some detail the techniques for monitoring and data collection which they and their colleagues have developed for studying wildlife in East Africa. They also suggested ways in which these techniques could be applied to the problems of monitoring the human condition in arid areas, particularly among pastoralists. Little is known about these areas because of the enormous difficulty and expense of collecting information in traditional ways and because they have not received

priority attention from the central government. Most data collection activities in the past, and even today, have concentrated on the high potential areas.

Systematic and repeated monitoring over entire areas is extremely important because informal observation at a few points can be very misleading. For example, when officials of the Ministry of Tourism and Wildlife were flown over the Garissa area where the boundaries of a national park are to be determined, they were impressed by concentrations of game in a few locations and felt these should be included in the proposed national park. However, if they had visited the area one week earlier or one week later, the animals might have been in entirely different locations. Only systematic monitoring over a period of time can determine the complete pattern of animal movements necessary to draw the boundaries of a viable national park. Other sorts of informal observations can also be put into perspective if information is available from broad-scale systematic surveys.

When an area is selected for study, an initial investigation is undertaken to determine the patterns of vegetation and the major topographical features, such as rivers, lake shores and mountains, which would limit the movements of large mammals or pastoralists. This information is collected by aerial reconnaissance flights at around 2,000 feet and by satellite, and it is used to ascertain the boundaries of fairly self-contained ecological zones. Satellite imagery, rather than taped data, is used to complement and supplement maps, to identify major landmarks and to give a picture of the rainfall pattern on a continuous basis as it is reflected in the patterns of vegetation.

Once these zones are determined, low-altitude aerial monitoring can be initiated. This is basically a systematic sampling technique. The zone is divided into squares ten kilometres long by ten kilometres wide, and these are further divided into sub-units of five kilometres by five kilometres. The aircraft then flies up and down the middle of these sub-units at an altitude of 300 feet. Two trained observers sit in the back seats and look at the ground on either side through markers fixed to the struts of the aircraft. These markers are placed at a certain width so that at an altitude of 300 feet the angle produced covers a strip of land 250 metres wide. With one strip of land sampled on either side of the aircraft, a one-half kilometre sample is obtained out of a unit five kilometres wide. Thus the proportion of land observed can be calculated fairly exactly, and the number of features observed can be expanded to produce reasonable estimates for the total area.

The observers record what they see on tapes, and these observations are subsequently coded for analysis by computer. The observers can also take photographs with hand-held cameras to record features which need to be checked on the ground. One obvious example is large groups of animals, and an effort is made to photograph any group of over twenty. Using these methods researchers can produce reasonably accurate soil, vegetation and drainage maps, indices of use by large herbivores such as cattle trails, estimates of the area available for grazing and browsing, of green biomass and of available water. These techniques can be used for describing the state of an area at one particular time or for monitoring change. They can be used for projects designed to record different sorts of data for different purposes: for example they were used recently to estimate the dugong population in Kenya's coastal waters. If the process of desertification is to be monitored, then special attention needs to be directed to the primary producers in the ecosystem, the grasses, and the primary consumers, the herbivores. Information is needed on the present state of an area, on the changes which are occurring, and on the range of variation, often very large, which is possible before the system becomes non-viable. All this information can be gathered by this type of aerial monitoring at the very low cost of about \$50 per 1,000 square kilometres.

A number of other aerial monitoring techniques have been tested, some involving the use of videotapes or greater reliance on photography. However, the costs of these alternatives have proven to be prohibitive, especially if repeated sampling is desired over an extended area.

When applied in pastoral and semi-arid agricultural zones, these aerial monitoring techniques can provide a great deal of useful information to planners quickly and at low cost. They can show how the land is being used, what is the seasonal pattern of land use, where overuse is causing ecological stress and where more intensive use would be possible. They can produce extremely valuable information on the pastoralists' grazing and management patterns which is necessary for planning viable development for an area. For example, aerial surveys have been used in Lamu and southern Narissa to determine which areas should be developed for ranching and which should be designated as a national park. In Kajiado the government agreed to pay local farmers to allow wild animals to use their land, and an aerial survey was used to measure how many animals were grazing on particular farms in order to determine how much compensation each farmer should be paid.

In addition to aerial monitoring, a great deal of important information can only be gathered on the ground. Systematic ground-level observations can be carried out by establishing a number of observation sites which are visited at regular intervals or by travelling across the area according to a series of monitoring transects in much the same way that one monitors from the air. Observation sites are chosen at different altitudes which are typical of different zones of the region under study, and at each of these a rain gauge should be installed. With either type of ground-level monitoring, the depth of soil moisture should be checked, along with the species of grasses and woody vegetation available and its nutrient composition. The sex ratio of animals can only be determined from the ground, and a few specimens can be slaughtered to determine their health and nutritional status. The level of stress experienced by the livestock is a good indication of the level of stress which the human population is likely to be experiencing.

In addition of course, sociological studies of the local people are carried out on the ground. There is a great deal of important information about human populations which cannot be gathered by aerial monitoring, so that this technique would have to be supplemented by more monitoring and detailed studies on the ground than would be the case with studies of wildlife. Yet aerial monitoring can provide a great deal of reliable information about people quickly and cheaply. In designing a monitoring programme, some sort of balance has to be drawn among a number of factors: the type of information desired; the level of reliability required; the speed with which the information is needed; and the limited manpower and financial resources available. A further consideration is that ideally the whole data gathering process should also be aimed at enlisting the support of the local people, even though this may be very difficult, since they know more about their environment than anyone else and since they will have to make the major input in carrying out any process of change or development.

Ethical Problems of Data Collection among Human Populations

The ethics of aerial monitoring, and of statistical data collection in general, were discussed in some detail. No monitoring flight is ever undertaken without the full cooperation of the administration, right down to the district officers who have agreed to contact officers at the locational and sublocational level. However, there is no guarantee that the individual pastoralist or farmer has actually been informed. Whenever possible, the purpose of the study should be explained to the entire population of the area in some detail, and their cooperation and assistance should be solicited. However, it is often extremely expensive and time-consuming to reach these

people on the ground, which is one of the main justifications for aerial studies in the first place. Further, unless a researcher or government worker has spent years with a particular group learning about them and gaining their trust, it is unlikely that he could get very reliable or complete information from them, given their long-standing suspicion of the central government. The pastoralists usually suspect - and not without some justification - that any information they give to outsiders will be used to increase their taxes or in some way to their detriment, rather than to bring them any tangible benefits.

Mr. Casley of the Central Bureau of Statistics pointed out that any survey involves an invasion of privacy and thus gives rise to ethical questions whether it takes place on the ground or from the air. In Kenya people are required by law to provide information for government surveys, and orthodox survey techniques always involve some element of compulsion. It may be that cattle are delayed in reaching a watering place so that each one can be counted and marked, or it may be that a household selected as part of a sample has a large number painted on the door. In both cases people might legitimately be expected to object, and in fact among pastoralists the enumerators are often driven off so that they have to fabricate their figures.

Dr. Hopcraft stressed that, although there are ethical problems involved in any data gathering or monitoring operation, the present situation is even more disturbing: people in the arid regions will soon be starving or already are starving, and very little is known about them or their problems, very little is being found out, and very little is being done that improves their welfare or alleviates the ecological problems in their areas. Some techniques must be found to gather information about these areas quickly and inexpensively so that relevant and effective assistance and development programmes can be initiated. Ignoring the production, the welfare and the ecological problems of arid and pastoral areas and peoples raises even more severe ethical and moral questions.

Monitoring Activities of the Central Bureau of Statistics

Staff members of the Central Bureau of Statistics described a number of their data gathering activities. The Bureau has been conducting standard government statistics operations for many years on such subjects as population, education, labour, prices and crop production. In addition, over the past ten years they have carried out a number of special surveys, including budget surveys, income surveys and small-farm censuses. Then at the end of 1974, the Bureau initiated a continuous programme of survey activity in the rural as well

as the urban areas based on a three-stage national sample of households which covers about 80 per cent of the national population, but leaves out the arid regions almost entirely.

The National Sample. The sample is taken from six of Kenya's provinces - Western, Nyanza, Rift Valley, Central, Eastern and Coast. These are divided into sample areas, and two sampling clusters are identified in each area, except in Coast Province where there is one cluster in each area. There are 120 of these clusters in all, and surveys are carried out by 120 enumerators, half of whom are permanent, with 30 field supervisors. In fact, to give more accurate estimates there should be about 300 clusters, with 10 or 12 respondents in each, instead of 20 respondents in each cluster as there are at present.

A very small number of these clusters border on the arid regions -- one at Taita, one at Tana River, one or two in Machakos and one in Elgeyo Marakwet -- and this is the extent to which these regions are included. In fact, the pastoral areas are explicitly left out of the national sample as it stands at present because it is designed as a three-stage sample with the household as the final unit, and this is not applicable in pastoral areas. In the present sample, households are listed and are considered fairly static, so that they can be visited over a period of time as often as required. Obviously this could not be done in the same way among pastoralists. There are at present no plans to include the pastoral areas in the national sample, at least up to 1978. The Bureau might be able to respond to a specific request for a pilot project or a case study in this region, but such a study would almost certainly require new data collection techniques.

Present Surveys. The national sample is the vehicle into which various surveys can be introduced. At present an Integrated Rural Survey (I.R.S.) is being conducted which began in 1975 and covers questions of crop production, labour input, crop disposal, income and expenditure, combined in a questionnaire which is administered by the enumerators. The enumerators also carry out physical measurements, for example of areas under certain crops. Starting with this rural survey, the Bureau intends to build up a system of social measurements and indicators which will help to assess the quality of human life. The format of the rural questionnaire has been redesigned with this purpose in view and includes a number of questions which should give a fairly complete picture of the quality of life on rural subsistence farms. Questions are included on the availability of water, the use of modern health facilities and traditional medicine, and means of

sewerage disposal. A number of modules can be fitted into the questionnaire on a regular basis, starting with a marketing module and a simple literacy module to determine whether the respondents can read and write a letter, read a newspaper or a small book in their mother tongue, in Kiswahili or in English. A malnutrition module based on weight-for-height measurements will be included with the World Fertility Survey which will be carried out in Kenya in 1977. A more detailed module on drop-outs from the formal education system will also be added later.

Among other activities, the Bureau has designed a vital health system in collaboration with the Ministry of Health. Also a labour force survey, including information on incomes, employment, education, migration and vocational training, is being conducted in the same 120 clusters.

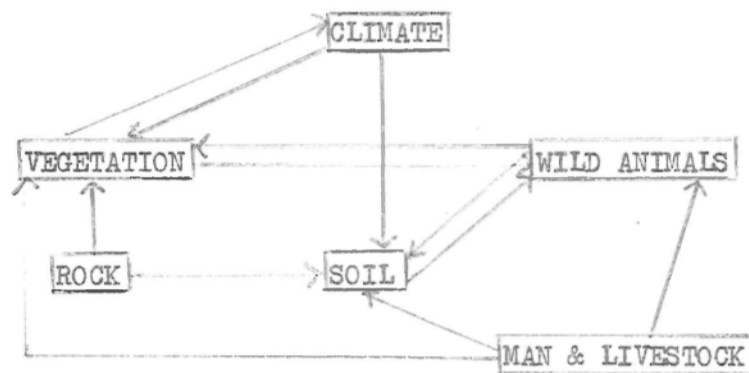
During the year, 10,000 households will be visited 2 times and 2,000 will be visited 12 times for the labour force survey alone. There is an increased danger of respondent fatigue when numerous visits are made to the same households, so that great care must be taken to create a good rapport between the respondents and the enumerators to ensure a high level of cooperation. Before a survey is initiated, the local government officers are contacted, and when necessary a baraza (public meeting) is held to explain what will take place. The bureau has enjoyed a very high degree of cooperation in these farming areas, in contrast to the lack of cooperation frequently experienced among pastoralists. In 1975, only 18 households were lost out of 1,670 through non-cooperation, which included death and disappearance, so that actual refusal to cooperate was negligible. In some pastoral areas, by contrast, there has been 100 per cent refusal to cooperate.

Once the first tabulations are produced from these I.R.S. surveys, the staff of the Bureau will study them to determine what additions and changes should be made in the future. At this stage they plan to consult with the ministries, appropriate departments and institutes of the University of Nairobi and other groups in the country who rely heavily on their data, to help determine what directions future information gathering operations should take.

The Ecology of Northern Kenya: Problems of Data Collection

Dr. Celia Kamau, a geographer at Kenyatta University College, stressed the need to understand the ecology of northern Kenya more fully and to measure more accurately the physical variables which determine the primary production of nutrients. A great deal more information needs to be collected on all the elements of the ecosystem.

The complex interrelationships among these elements are depicted in the diagram. The main agent through which the different elements influence each other is water, either directly in the form of rainfall or groundwater, or indirectly through the presence of vegetation.



Each of these elements is changing constantly, both independently and in interrelation with the others. Looking at the climate for example, there is a long-term trend in East Africa of warming and drying which goes back to about 15,000 years ago. There also seems to have been a significant decrease in rainfall over the past sixty years, and a further decrease during the past five years. Local people are aware of this decrease in rainfall, and this makes it more difficult to convince them that their own activities are also having an unfavourable impact on the environment. For example, in one locality of northern Kenya a stream has dried up, but since the people realise that rainfall has diminished they are not ready to accept the fact that the water has disappeared in part because their goats have removed all the vegetation from the catchment area.

Rainfall and Climatic Conditions. Data on climatic conditions are incomplete and not always accurate. Most missions and district offices keep rainfall statistics, but these vary widely in quality and even if accurate figures are collected they may not be representative of the entire region because missions and government headquarters tend to be located in places favoured with relatively high rainfall. Records of temperature are not widely available, and statistics on evaporation and wind conditions are rare.

Dr. Kamau was asked whether there is any evidence that a decrease in vegetation actually leads to a reduced amount of rainfall. She replied that there is no evidence that rainfall itself is influenced by the amount of vegetation in an area, but the effective moisture in the upper levels of the soil and the temperature of the soil are determined to a very great extent by the presence of vegetation.

Ground Water Supplies and Boreholes. Very little is known about the ground water supply in Kenya, and yet larger and larger quantities of ground water are being removed through an increasing number of boreholes. We do not know at what rate this valuable resource is being depleted or at what rate it is recharged. Techniques must be developed to trace ground water and measure the rate of recharge so that its use can be intelligently planned.

In addition to the depletion of ground water supplies, a number of other problems are associated with the construction of boreholes. For one thing, as boreholes replace traditional methods of collecting water, population groups may become totally dependent on this type of government intervention. Further, the siting and operation of boreholes must be planned carefully to coordinate with the availability of grazing, and this has often not been the case in the past. If a borehole is operated as a permanent source of water, increasing numbers of livestock will be kept permanently in the vicinity leading to serious overgrazing and destruction of the vegetation. This situation could be alleviated if dams or reservoirs were constructed which fill up with rainfall and empty on a natural basis so that pastoralists and their livestock can only stay in the area for limited periods of time. The same effect could be achieved with boreholes if they could be turned off whenever the area surrounding them is in danger of overgrazing. This would force the people to move, but there are numerous problems involved. For one thing, the local people would never accept any limitation on the use of a source of water voluntarily. This could be overcome if boreholes were operated with mobile generators which could be moved away, but there still remains the technical problem that a borehole must be used at least every month or so to maintain its viability.

Surface Water and Sub-surface Seepage. There are serious problems in measuring the rate of discharge of surface water, particularly in northern Kenya. In that area many rivers and streams remain dry most of the year and then flow heavily perhaps for as short a period as one week, with extremely destructive large boulders carried by the water. Under these conditions normal methods of gauging the flow of rivers are not appropriate, and there is a further problem that the little weirs, particularly if they contain metal, tend to be removed and recycled into spears. During the dry season when these rivers are dry beds of sand, there is sub-surface seepage through the deep sand which is an important source of water, both for people and their livestock and for wild animals. This discharge or sub-surface run-off in a sand river bed is something we are not able to gauge at all. However, the Ministry of Agriculture has successfully constructed a number of

sub-surface dams which increase the storage of water in these river beds.

Soil Erosion. Everyone knows that improper cultivation and overgrazing lead to soil erosion, but in fact the rate of soil erosion is very difficult to measure. One must look both at the place where the material is removed and at the place where it is deposited, but a measuring device placed on a slope under heavy use is likely to be damaged or destroyed. It is also difficult to judge whether an area which appears eroded is the result of present-day erosion or was created long ago. Particularly in arid areas, a feature such as a gully may appear unchanged for a number of years and then suddenly undergo intensive erosion when a rare catastrophic event occurs, such as a very heavy rainfall or flash flood.

In addition to the loss of soil, erosion can also contribute to a loss of surface water. When the catchment area of a river or stream is heavily cultivated or denuded by overgrazing, the water no longer percolates slowly through the soil and rock, but rather comes to the surface and rushes off. If the soil has been compacted or if it is very dry, it absorbs less still, and most of the water passing over it runs off. The Israelis in some arid areas have deliberately removed soil from ridges so that the rate of run-off increases and the valleys below receive more water for irrigated agriculture. This strategy can be successful as long as the water and the soil carried in the water are not lost completely. In fact, in Kenya a great deal is lost through run-off into the sea.

Studies in Northern Kenya

Dr. Mbithi described a series of studies on ecological and human problems in northern Kenya which is currently being carried out by a team of researchers, largely from the University of Nairobi. In northern Kenya people have suffered from a number of natural calamities such as drought and famine, and development efforts in the region were disrupted by the so-called Shifta Wars. The area has also experienced a certain degree of neglect, since the allocation of national resources has been focussed on the high potential agricultural areas, largely because little was known about possible development strategies for arid areas. The role of developing this region was passed over largely to voluntary agencies, but no one in or out of government had a very clear idea of what should be done. Inevitably in such a situation, a number of mistakes were made: feeding programmes offered diets which were not nutritionally adequate and seemed to create permanent dependence, boreholes and irrigation schemes created more ecological problems than they solved, dams were built across rivers which were destroyed in minutes by seasonal flash floods. So the organisations involved

in these development efforts asked the University of Nairobi to study their problems, find out why many of their projects had failed and help design more appropriate projects for the area. Studies were started as far back as 1965, and at present are being undertaken in Marsabit, Turkana, Wajir, Garissa, Tana River, Mandera, Isiolo and to a certain extent Samburu. The project is supported by the National Christian Council of Kenya and the National Environmental Secretariat.

The study has started with baseline surveys and evaluations of existing projects and also, where possible, baseline surveys of local economic systems. An effort has also been made to classify different ecological zones within the region in terms of their resource combinations. Since the area is so large, no formal system of sampling is feasible. Rather, the research projects are being carried out in the form of case studies.

Information is being collected on such demographic factors as the size and structure of the population and patterns of population movement. Careful geological studies are also being made, noting the wide geological variation within the region, looking at soil and water in particular, and identifying areas with especially high development potential. Economic studies of agricultural production in the irrigated and dry-land farming areas and of livestock production in the pastoral areas with particular stress on the goat, along with the camel, are being undertaken. Finally the technical and economic potential of irrigation is being investigated, taking into account such problems as increased salinity.

These studies are being carried out with very simple methods because what is needed is not precise statistical data, but rather some educated guesses which can be arrived at fairly quickly and which can be made the basis for further planning in the region. It is hoped that the results of these studies, and information about other projects and studies of arid areas throughout the world, will be shared more widely than has been the case in the past. A number of groups are gathering information and trying to work out strategies for the development of these regions in Kenya, in Sudan, in the Sahel and elsewhere - and perhaps some sort of international data bank could be set up to help them learn about each other's work and better coordinate their efforts.

A Project to Test the Concept of Human Carrying Capacity

Dr. Frank Bernard, a geographer then at Kenyatta University College, described a baseline survey he is carrying out in three areas to try to determine whether the notion of human carrying capacity has any real meaning and to identify useful indices and techniques to measure levels of population pressure. This survey is being conducted in upper Machakos, in parts of Kiambu and parts of Kisii District, all of which are high-potential agricultural areas, but the methodology which is being developed is also applicable to semi-arid and arid areas under permanent habitation. It is hoped that this methodology will be simple and inexpensive enough to eventually be incorporated into the Central Bureau of Statistics' national sampling system.

During the colonial period very crude estimates of carrying capacity were made in Kenya according to ecological zone. The Kenya Soil Survey has also derived estimates of carrying capacity based on soil types, but so far this only covers a very small portion of the country. The Department of Agriculture developed carrying capacity estimates twenty years ago, but these are fraught with problems.

Estimates of carrying capacity should start with the identification of ecological zones as described by Dr. Gwynne earlier in the Workshop. Human carrying capacity, of course, cannot be a simple estimate of the amount of vegetation a given unit of land can produce, as might be the case for wildlife, but rather it depends on a number of human variables. These should include the land use system and level of agricultural technology being applied in a particular ecological zone, but the relationship between carrying capacity and the level of technology employed is a complex one. Technology includes a whole range of factors such as the implements and form of mechanisation used for cultivation, the application of inputs such as fertiliser and pesticides, and the whole system of farm management employed. The Kenya Soil Survey has developed three categories of agricultural technology - traditional, intermediate and advanced - and some simplified system of stratification of this sort will be used in this study.

Another factor which must be considered in determining the level of human carrying capacity is the movement of external resources into an area, which is an increasingly significant phenomenon in Kenya as outside income is sent back to the rural areas and invested in farmsteads. Finally, the yield levels which are being achieved for various crops must be taken into account. These considerations produce a rough estimate of carrying capacity which can then be compared with the actual density of population.

Dr. Bernard is also following a second approach to the problem of determining carrying capacity, which involves identifying a number of indices of population pressure. These are quantified as much as possible for specific areas and then compared with the rough estimates of carrying capacity already made, in order to produce a much more accurate and refined carrying capacity model. The indices of population pressure which will be measured are such things as water quality, soil status and the degree of soil degradation, the use of marginal land such as steep slopes and rocky or swampy areas, changes in the vegetative cover and the extent of deforestation, changes in cropping patterns from crops requiring soils which are rich in nutrients to others which will yield with poorer soils, reduction of the amount of land left under fallow through the cultivation of leys and pastures, declining crop yields, the nutritional status of the population, patterns of land use such as fragmentation of plots and the incidence of land disputes, and finally demographic indicators such as outmigration and the number of squatters. A small number of these indicators which are significant and correlate with others can be isolated to become the basis of measurements carried out over wide areas.

Sampling in the three districts will be undertaken on the basis of a grid system. The actual size of squares in the grid will vary according to population density so that every household in the area has a one in a hundred chance of being sampled. In other words, the sample will be stratified by density classes. A number of the indices of population pressure can be measured using aerial photographs taken in March 1976 and comparing these with aerial photographs of the same areas taken during the 1960s. Information can be gathered from photographs on such variables as vegetation cover, fragmentation of land, the use of marginal lands, rate of deforestation and the areas still under forest, changing cropping patterns, the extent of cultivation of areas originally set aside as pastures and leys, and some measure of soil erosion. Further information can be gathered by observation and measurement on the ground, by sampling such variables as the soil, and by surveying the households in the selected areas using a field questionnaire. This should produce information on cropping patterns, migration, and some measure of landlessness or pressure on the land in terms of the number of people in each farmstead and the number needing land. Finally, some use will be made of photographs and computer compatible tapes from the satellite system as supporting material. This should provide information on forested areas, types of vegetation and the accessibility and quality of water, and should suggest which areas are under stress and should be studied in more detail.

The preliminary work for this study began in early 1975 and should be completed by September 1976. The ground-level survey will be carried out during the period from October 1976 to June 1977, and then the data will be analysed and a report prepared which should be available by August 1978.

Some of those who have considered the question of human carrying capacity have postulated that the relationship between population pressure and technological development is dynamic in that increased population leads people to improve their technology in order to raise their productivity. Others believe that increased population leads to a degradation of the environment and diminished resources for investment so that technology stagnates and productivity decreases. This survey will not provide any information on the possible results of changes in population density, however. It is a baseline survey at one point in time aimed at formulating a measure or an index of human carrying capacity and revealing whether the concept has any real significance. It is hoped that this study will be only a beginning and others in the future will develop more precise measures and more accurate models of human carrying capacity.

The Rangeland Ecology Monitoring Unit

A Rangeland Ecology Monitoring Unit has recently been established in Kenya as part of the Ministry of Agriculture's Phase II Livestock Development Programme sponsored by the World Bank. The team is attached officially to the Ministry of Agriculture and funded by the Canadian International Development Agency (CIDA) for a period of four years. A three-tiered monitoring programme will be carried out using the techniques developed by the UNDP/FAO Kenya Habitat Utilisation Project and described earlier in the Workshop. Monitoring will begin in the southern part of the country in Kajiado, Narok and Taita, will move north along the coast and within three or four years will move inland through northern Kenya so that it embraces the entire rangeland area, which is about 500,000 square kilometres out of a total of about 585,000 in the country. The total cost of the project will be £5 million, including a large proportion of capital costs at the outset, and this will be covered by £1.5 from the Kenya Government and the rest from CIDA, half in the form of grants and half as loans.

The Unit is directly responsible to a steering committee composed of the Director of the Central Bureau of Statistics, members from the Ministries of Agriculture, Tourism and Wildlife, and Finance and Planning, and representatives from a small number of other organisations. The steering committee will govern what information is gathered and what techniques are used. In addition, a larger umbrella committee will be established with representatives from a whole

range of interested organisations and agencies, including the University of Nairobi, which will be able to obtain specific data on request if it is practicable to collect it. Finally, an advisory group will be established from which the unit can draw additional expertise.

Data will be available in raw and tabulated form to all government departments and approved users. Also the data will be analysed in an attempt to develop over time simulation models for particular areas which can be used for management purposes.

UNEP's World-wide Monitoring Programme

Dr. Francesco Sella of UNEP described the ecological monitoring being carried out by the United Nations Environment Programme. On a world-wide basis, changes in atmospheric turbidity, carbon dioxide levels and other changes which affect climatic conditions are being monitored. Soil degradation is also being studied in connection with the preparation of a world map of soils. It is hoped that by early 1977 soil maps for the Middle East and Africa north of the Sahara will be completed. Also a pilot project is being undertaken to monitor the forest cover in the tropical region of Togo, Benin, Nigeria and Cameroun using satellite and radar data collection techniques. It is hoped to extend this project to the adjacent rangelands and beyond to the arid regions, but at present all plans are being held in abeyance due to financial constraints.

In addition to the monitoring projects being carried out by UNEP itself, the organisation plays a role in stimulating, coordinating and to some extent funding the monitoring activities of other United Nations agencies and national governments.

A Botanical and Anthropological Study of Mbere, Eastern Kenya

Dr. David Brokensha, Research Associate at the Institute for Development Studies, described a botanical and anthropological study he and his associates are carrying out in Mbere, a largely semi-arid agricultural district in eastern Kenya, focussing on plants as a means of viewing people's relationship with their environment and how this is changing over time. The area covers about 600 square miles and can be roughly divided into three zones on the basis of altitude, with very distinct patterns of soil, vegetation and rainfall. The zones descend from an altitude of nearly 4,500 feet near Mount Kenya to 2,000 feet on the Tana River, and much of the area receives below 500 mm of rainfall a year. In the lowest zone there are food shortages every three or four years and a famine, which requires considerable outside assistance, about every ten years. There

is also some evidence that this cycle may be accelerating. The Kenya Soil Survey has recently completed a survey of the area from which it was concluded that a very large proportion is not suitable for cultivation at all.

Dr. Brokensha worked in the area for fifteen months during 1970-71 as part of the Special Rural Development Programme, again for six months in 1974, and now plans to be in the field for twelve months. He and his associates are staying at Siakago and are visiting four sites which were selected as fairly representative of different ecological zones. They are using the classical anthropological methods of walking around the area and talking with the people in a fairly intuitive, informal manner. In this way they will study a sample of about 200 people very intensively, and they may also obtain less detailed information on another 2,000 through Kenyan student Research Assistants who work with them, particularly during the school holidays. They will also collect and identify plants in the area, consult the local government archives, and make use to some extent of satellite imagery.

By this very intensive study of a small area they hope to obtain a complete picture of the local people's detailed knowledge of their environment and the ways in which they have adjusted to it. This is important because this knowledge is rapidly disappearing and it should be a valuable basis for any development planning in the area. The role of an academic is to record the local people's extensive knowledge and make it available to government officials who are responsible for the welfare and the development of the area.

Dr. Brokensha and his associates are asking the local people for information on about 200 wild and domestic plants, whether they are common or rare and whether they were common or rare in their fathers' and grandfathers' time. They are asking both men and women because they have learned that men and women are familiar with and use quite different varieties of plants. In this way they hope to learn about the full range of plants in the area and how this has been changing.

In fact, the ecology of the area is changing very rapidly due to a number of factors. For one thing, with land adjudication and increasing population pressure, a great deal of land is passing from communal to individual ownership and is being cleared for agriculture. Also trees are being cut down at an accelerated rate because of increased demand for charcoal and firewood. The removal of trees also becomes more widespread as people need a source of cash income to pay school fees, since they can earn small amounts of money quickly by manufacturing and selling charcoal. A third factor is that the cultivation of maize is increasingly replacing millet. This has an interesting

sociological implication in that young women no longer spend a great deal of time grinding millet by hand for their mothers-in-law, but rather the maize is ground in small local mills. A fourth change which has taken place is that thatch roofs are increasingly being replaced by corrugated iron. One implication of this is that young men are forced to leave the area to earn the cash necessary to buy a metal roof.

By concentrating on the changing incidence and use of plants, the researchers hope to arrive at a fairly complete picture of the interaction between a growing human population and a semi-arid environment characterised by diminishing natural resources. The conclusions derived from this intensive study of a small area can be generalised to a certain extent to other similar areas and useful comparisons can be drawn. Studies on very different scales, ranging from this intensive study of a small local area to the world-wide surveys being carried out by the United Nations Environment Programme, are mutually reinforcing and all contribute to our understanding of man and his environment.

An Anthropological Study of Fertility

Dr. Priscilla Reining of the American Association for the Advancement of Science described an anthropological study of fertility which she was carrying out in one village in a high-potential area of Kenya's Central Province. This particular village was selected for the study because it was investigated in detail by another anthropologist twenty years before, so that it is possible to draw a fairly complete picture of the changes which have occurred over this period of time. A complete re-census of this village of about 3,000 people is being undertaken using the Core Questionnaire of the World Fertility Survey. Present demographic trends and geneological patterns are also being investigated. In addition to the single village study, area frame sampling is being employed.

Similar studies of the change which particular societies undergo over time could be conducted with about six pastoral groups in northern Kenya who were the subjects of detailed anthropological studies in the past.

A Study of the Family Planning Programme in Meru

Dr. Edward Greeley, then an associate of the University of Nairobi's Bureau of Educational Research, described briefly a study he had conducted of the Kenya Family Planning Programme as it has been implemented among the Meru of eastern Kenya. He chose specifically a community in which the Family Planning Programme has been relatively successful so that his study might generate some ideas as to how a successful programme might be implemented

in other areas. The people who live in this high-potential agricultural area are involved to a great extent in the production of cash crops. The population of the area is extremely dense, the size of holdings is small, and the people are increasingly aware that land is a finite resource and that they will not be able to pass on farms of a viable size to a large number of children. Thus they tend to be willing to limit the size of their families.

The experience of the Family Planning Programme suggests that perhaps there is some sort of built-in ecological balancing mechanism so that when it is clear to people that their land is extremely limited they are willing to reduce the size of their families. Population growth in pastoral areas might also be reduced if people could be made sufficiently aware of the limited availability of land.

Local Planning and Participation: Baringo District

The Kenya Government has recently undertaken the decentralisation of development planning to the district level so that plans can more accurately reflect the specific needs and priorities of each local area. Mr. Kabiru Kinyanjui and Mr. Njuguna Ng'ethe of the Institute for Development Studies have carried out a study in Baringo District of Rift Valley Province for the Ministry of Housing and Social Services. This study focusses on the district planners' need for relevant information which can be translated into effective development programmes and policies. They were specifically asked to evaluate a multi-purpose training centre in the district, but they soon realised that they could not evaluate the role of training without collecting information on many other aspects of rural development, such as health, education and land use.

A district such as Baringo contains a wide range of ecological zones, ranging from a high-potential zone in the former 'white highlands' to an arid region in the lowlands, some parts of which can be described as an ecological disaster area. These different ecological zones are inhabited by a variety of markedly different people. Government officers are forced to plan for a number of different communities largely on the basis of records kept at district headquarters, which are incomplete and often inaccurate. They have almost no information at all about conditions in some of the more remote parts of the district.

Detailed information is needed about the food production systems in all these areas, about the ecological potential and about emerging problems, before any sensible planning can take place. And this information is needed quickly, especially since the hardships experienced by some groups in the arid areas are becoming more acute every day. This information must be

relevant to the practical needs of the planners and it must be effectively and clearly communicated to them. Finally, any understanding of the way local people use their resources, even in the more remote areas, must take into account the impact of the central economy and influences from outside.

As part of this study, an inventory was made of the information available in Baringo District, and data were found on such factors as livestock movement, soil erosion, agriculture, health and mortality. However, a great deal more was learned from intensive interviews with community leaders throughout the district. These people had a clear notion of their own development needs and priorities, but in many cases their requests had been ignored or distorted by government officers. For example, women in one area identified the high incidence of malaria as the most serious problem in their community and sent a request to the district level for a health centre in their area. However, this request was dismissed by the District Development Committee on the grounds that there were already a number of health centres in the district, although none of these was accessible to the people in this particular area.

A dilemma faces the local people in many arid and semi-arid areas: since they lack the necessary political power or influence, they cannot secure an adequate share of national resources or ensure that their needs will actually be considered. One goal of district-level planning has been to facilitate the participation of the local population in the development process. However, unless local people are given access to resources, their participation in the planning process amounts to little more than an exercise in co-optation. Also one must specify just which local people will in fact take part. If a district does not have the capacity for truly broad-based participation, any new resources which are introduced may well come under the control of a local elite, exacerbating the process of rural stratification and inequitable development.

In Baringo, for instance, a disproportionate share of national resources, such as extension services, is still directed to the high-potential area. Given an acute lack of resources, people in the arid areas have very few alternatives for survival in their harsh environment. They keep livestock in numbers which are destroying the ecology of the area, but until they have some alternative means of livelihood it will be impossible to convince them to reduce the size of their herds. The present situation leads to serious ecological consequences such as soil erosion on the ridges and increasing silt deposits in Lake Baringo. If drastic measures are not taken quickly, much of the district may well be desert within ten years.

CONCLUDING REMARKS

It appears that there is increasing human population pressure in the arid and semi-arid regions of Kenya, largely due to rapid population growth and substantial outmigration from the high potential areas. Dry lands are being used more intensively for traditional farming and livestock keeping, causing severe soil erosion and environmental degradation in many areas. Under increasing pressure from these types of land use, the normal ecological balancing mechanisms in these regions are breaking down.

Those who are planning the development of these arid regions, or designing measures to alleviate the stress experienced by the human population, need information on the ecology of specific areas, on the welfare of the people who live there, on the functioning of local food production systems and on the impact of projects which have already been carried out. Information on a variety of factors needs to be gathered and analysed so that it can be translated into policies and programmes which make sense in terms of local conditions, problems and development potential.

The information collecting facilities of existing government institutions in these regions must be exploited more fully and new data gathering activities must be initiated. A combination of techniques, many of which have been discussed at this Workshop, will be necessary to monitor a small number of crucial indicators throughout the region and at the same time study a few specific areas in more detail. In view of rapidly deteriorating human and environmental conditions, the need to collect information very quickly and translate it without delay into appropriate government action was stressed by many Workshop participants.

A great deal of useful information is available through existing government institutions and must be brought together for continuous monitoring and translation into action programmes. This includes records from hospitals on the incidence of specific diseases and types of malnutrition. It also includes information on the marketing of livestock, prevailing prices and the volume of sales. A sudden increase in the sale or slaughter of cattle is a good indication that the population in the pastoral areas is experiencing a heightened degree of stress which may develop into famine conditions in a fairly short time. Meteorological data are also important, and an effort should be made to collect more accurate and complete information on climatic conditions and trends.

New data gathering activities in the arid and semi-arid regions should probably include systematic aerial monitoring with supporting information gathered by satellite. Information gathering on the ground is slower and more costly than aerial surveys and may be less accurate in some respects, particularly when informants are not cooperative. However, many important types of information, particularly concerning the knowledge, attitudes and aspirations of the local people, can only be collected in this way. In the agricultural areas, the Central Bureau of Statistics is developing sensitive and rapid data gathering techniques, and they have encountered a remarkably high degree of cooperation. In the pastoral areas, greater reliance will probably have to be placed on aerial monitoring, but in addition teams of enumerators and researchers could move around on the ground, perhaps following particular groups of nomads, interviewing people as they come to watering places (though this has not always proved successful in the past), or making random information-gathering walks with camels. For the 1979 census an attempt will be made to reach every person in the country.

The discussions which took place at this Workshop are only the first step in a process of information sharing which we hope will continue on a regular basis. The projects described here, with their very different approaches and scales, must be brought together so that the relevance of each is made clear and the various types of information which have been collected become mutually reinforcing. A number of techniques for data gathering have been discussed, and the next step should be to actually test the effectiveness of these techniques on an experimental basis. Further testing and discussion should lead to a valuable contribution to the Desertification Conference which will be held in Nairobi in 1977.

APPENDIX I: AGENDA FOR THE WORKSHOP28 June, 9.00 a.m.

Chairman: Dr. Peter Hopcraft (I.D.S.)

What are the Critical Problems in Arid and Semi-arid Areas ? Tentative Questions for Discussion

1. Is there a vicious circle of desertification ?
 - a. Among pastoralists, increased human and animal population and inappropriate range management systems lead to overgrazing, loss of vegetative cover, increased soil temperature, decreased moisture retention, permanent soil loss and erosion of the resource base. How is this cycle characterised ? What are the economic and social determinants and what are the consequences ?
 - b. Among farmers, movement into arid lands is accompanied by clearing of indigenous vegetation, soil loss through wind and water erosion, and pressure on soil fertility through cropping. What are the determinants and what is the extent of this process ?
2. Desertification causes and responses
 - a. To what extent do traditional production systems and patterns of behaviour cause desertification ? Does desertification cause changes in those systems ?
 - b. What are population growth rates and what are the fertility responses to population pressure on fragile, depleting resources ? What are the determinants of fertility behaviour ?
 - c. What changes are occurring and what are called for in the patterns of land and livestock ownership ? Are existing ownership and management institutions responsible for mismanagement of the resource base ?
3. Productivity and human welfare implications
 - a. What are the principal income-earning alternatives and what measures hold out promise for increasing the productivity of these areas ?

- b. What are the effects of current changes on nutrition and health patterns ? Are exogenously produced foods replacing traditional diets ? What exchange possibilities, relationships and marketing systems exist to support these innovations ?

28 June, 2.00 p.m.

Chairman: Dr. Israr ul Haq

Monitoring the 'Human Condition'

1. Data requirements for assessing the human condition:
 - Health
 - Nutrition
 - Housing and settlements
 - Education
 - Economic
 - Social and political (endogenous and exogenous)
 - Demographic
 - Other
2. Methodologies for data gathering to assess the human condition

29 June, 9.00 a.m.

Chairman: Dr. Priscilla Reining

Data gathering techniques, their limitations and applicability

1. Satellite and aerial surveys
2. Sample surveys: Integrated rural surveys
 - Health, demographic and fertility surveys
3. Agriculture, livestock and wildlife surveys
4. Soil, topographic and geological surveys
5. Cartographic surveys
6. Others

29 June, 2.00 p.m.

Chairman: Dr. Peter Hopcraft

Specific Case Studies

Central Bureau of Statistics Surveys

Northern Kenya Study

Carrying Capacity Study

Rangeland Ecological Monitoring Unit

Decentralised Development Planning, Baringo Case Study

Others

Concluding Remarks

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