



Policy and Research Paper N°10

Population and Environment in Arid Regions
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ISBN 2-87108-057-7
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Introduction

Policy & Research Papers are primarily directed to policy makers at all levels. They should also be of interest to the educated public and to the academic community. The policy monographs give, in simple non-technical language, a synthetic overview of the main policy implications identified by the Committees and Working Groups. The contents are therefore strictly based on the papers and discussions of these seminars. For ease of reading no specific references to individual papers is given in the text. However the programme of the seminar and a listing of all the papers presented is given at the end of the monograph.

This policy monograph is based on the conference on 'Population and Environment in Arid Regions' organised by the IUSSP Scientific Committee on Population and Environment, The International Geographical Union Committee on Population Geography and UNESCO, held at the University of Jordan, Amman, from 24th-27th October 1994.

Summary of Main Points

1. The impact of increased aridity and environmental degradation in arid lands is not limited to the populations of arid areas.
2. Population policy makers working in arid environments do so in an atmosphere of considerable uncertainty. There is a lack of high quality demographic and environmental indicators from which to formulate policy decisions.
3. Policy makers need to recognize more fully the complexity of meaningful evaluations of population-environment interactions. Desertification is not only associated with a shift in physical environmental systems towards increased aridity, but may also be a function of the way in which changing population-livelihood systems are (mis)managed.
4. Aggregate macro-scale analysis can result in what is termed the ecological fallacy. In-depth process-based research is required to establish meaningful understanding of the two-way relationships which interconnect demographic and environmental regimes.
5. Environmental and demographic systems are dynamic and constantly changing. Traditional responses to drought have become more difficult both in the current context of economic and societal change and in relation to the rigidities associated with the political organisation of territory by states.
6. Policy makers need to be especially aware that vulnerability in times of crisis is unevenly distributed amongst the populations of arid areas. Vulnerability is associated time and again with those who are in an economically marginal position relative to the national economy, those who are politically least able to represent their own interests and those such as women, children and ethnic minority groups who find themselves weakly located relative to the dominant power relationships of society.

1. The impact of increased aridity and environmental degradation in arid lands is not limited to the populations arid areas.

The purpose of this publication is to draw out the policy issues and implications of demographic and physical environmental change in arid lands and to consider why some population groups are more vulnerable than others and merit special attention from policy makers.

The first and most obvious point is that a large proportion of the world's population lives in arid environments. Hyper-arid, arid and semi-arid zones cover 37 per cent of the land surface of the globe.

| Box 1: Population Distribution in Arid Lands by Continental Grouping | | |
|---|---|--|
| | Estimated Population 1994 (Millions) | Proportion Living in Arid Regions (%) |
| Africa | 237 | 34 |
| America | 102 | 13 |
| Asia | 484 | 14 |
| Europe | 16 | 2 |
| Australasia | 2 | 11 |
| World | 841 | 15 |

These lands are home to some 15 per cent of the world's population, but many more people than this are affected by changing people-environment interactions in arid lands. This is true on at least three counts (see Box 1 for distribution of this population over the five continents).

- First, arid regions form parts of larger states and consequently the populations of these states are involved in the resource and population policies of their governments towards the arid regions.
- Second, crises in arid regions often spill over into other regions, whether in the form of requests for financial/material assistance during times of drought or in the form of refugee flows.
- Third, international economic relations, which influence the exchange value of goods and labour, directly affect the livelihoods of the populations of both arid and non-arid areas and consequently shape both inter-regional migration and trading relationships.

2. Population policy makers working in arid environments do so in an atmosphere of considerable uncertainty. There is a lack of high quality demographic and environmental indicators from which to formulate policy decisions.

Many key indicators of demographic change are ambiguous or contested, while measures of the extent of environmental change such as levels of desertification are widely contested. At least three sources of uncertainty face the policy maker;

- First the lack of agreement over how aridity should be measured and over an integrated and coherent monitoring system for evaluating environmental change;
- Second there have been very great difficulties in measuring population numbers and characteristics in arid environments; and
- Third there exists no agreed conceptual model which maps the expected interactions between population and environment in arid areas.

There are difficulties raised by the definition of aridity and desertification (see Box 2). Differences exist even between one United Nations organisation and another in the baseline definition of aridity, as for example between UNESCO and UNEP.

This makes difficult analysis of the relationship between demographic systems and environmental change. Recent technological advances, such as those facilitated by remote sensing, have facilitated monitoring of the

extent of desertification and promise to ease the problem of measuring environmental change. The fruits of such advances have yet to feed through to policy makers by providing an agreed matrix of indicators of the speed and extent of environmental change in arid regions. Furthermore the type of data sets emerging from remote sensing, valuable as they are, will remain limited, not being able to go beyond visual analysis of surface land-use types and permitting only limited process statements to be made about desertification.

Box 2: Definitions of Aridity

What area of the earth's surface is defined as arid? There are variations between authors over the definition of aridity and the boundaries of arid regions. Aridity is measured in terms of the ratio of rainfall to potential evapotranspiration. Aridity is usually taken as a situation in which rainfall is less than half the value of potential evapotranspiration. At a global level estimates of the spatial extent of aridity range between 45 and 48 million square kilometres. Such global figures are of little assistance in the present context. Indeed definitional problems increase considerably both in the attempts to put boundaries round areas described as arid and to categorise areas by degrees of aridity. Distinctions have been made between the categories hyper-arid, arid, semi-arid and dry sub-humid.

Case Example from Egypt

One of the major issues facing the Egyptian government is the reclamation of desert areas to ease population pressure in the 3 per cent of the country which contains 97 per cent of the population. Special emphasis has been placed on the Western Mediterranean coastal region. A prerequisite to rational land development planning in this region is an inventory of natural resources and an evaluation of land potentiality for a variety of uses. Remote sensing has been used to study the areal extent of land use change and has proven particularly effective in this context in terms of the level and uniformity of detail which has been achieved. On the basis of remote sensing it was found that in one research locality the area of dunes and exposed rock increased between 1987 and 1992 by about 12 hectares per year due to land degradation processes. Agricultural zones declined in the same period by about 205 hectares per year due to the extension of urban centres. The changes discovered pose serious issues which planners must urgently address.

Although technological advances such as remote sensing have improved detection of some aspects of land use changes, many difficulties remain in monitoring population-environment interactions in arid environments in arid areas. There remains a paucity of robust demographic data for the populations of arid environments. This problem arises for several reasons. The most basic of these is that mobility is an essential strategy which has emerged in human populations as an ecological response to aridity. This is especially true amongst pastoral societies dependent on the mobility of their animals to access scarce grazing resources. In many ways human mobility can be seen to be a sound ecological response to aridity.

Case Example from Nigeria

Over the course of the last century circulatory movements, mainly of men, have taken place from the northern parts of Sokoto in Nigeria. The movements have been largely but not solely seasonal in timing. Extreme seasonal aridity for six to seven months of the year constrains agricultural production but at the same time provides an opportunity for absence. For the people of Sokoto, drought has brought an extension and exacerbation of problems with which they have to contend at the best of times. They respond by extending and modifying patterns of mobility. The majority continue to circulate temporarily.

For the most part circulatory movements by pastoralists take place for positive reasons and allow those who move a very considerable measure of flexibility and freedom.

This response to arid environments is however a standard reason given for the **poor quality of demographic data available in arid regions**, since both national census-takers as well as academic researchers are poorly equipped to register population characteristics amongst highly mobile populations. As a result many births and deaths amongst nomadic pastoralists go unrecorded, making estimates of fertility and mortality unreliable.

Aggravating the lack of adequate systems for monitoring demographic change in highly mobile populations are a range of other adaptive strategies which make the demographic regimes of the populations of arid areas very different from those of other peoples and which may well not be recorded by standard strategies for data collection (see Box 3).

Box 3: Demographic Responses to Arid Environments

- **Short-term adaptations to drought**
Extension of seasonal responses
Circulatory movement
Flexibility of production
- **Long-term adaptations to drought**
Biological
Demographic
Economic
Migration

Such adaptations include biological responses to drought which may produce strong seasonal concentrations of births and deaths, as well as economic responses including out-migration movements related to periods of drought which can reduce the size of populations in an arid region at the time of a snapshot demographic survey or census. In addition, political factors may influence how demographic data are recorded or presented. Since in many states central governments are unhappy about the potential threats to their power which might come from the populations of peripheral arid regions, misrepresentation or under-recording of the data about these populations is not uncommon. At the same time some populations in arid regions resent or fear central government control and consequently avoid registration of vital demographic events in order to pursue their own economic and political agendas.

The third and final cause of uncertainty facing decision makers concerned to developing appropriate demographic and environmental policies for arid regions is the absence of any agreed theoretical framework for handling population-environment interactions. As a result, discussions about population in relation to development strategies for arid regions often occur in the absence of any consideration of environmental issues, with debate being constrained to socio-economic and political dimensions. The question 'Is environmental degradation a demographic issue?' is often ignored. This and the equally pressing matter of to whom and for whom environmental and demographic policies should be directed is a matter to which we shall return later.

Box 4: What Causes Environmental Degradation?

Aggregate analyses of population and physical resource information are valuable to the extent that they show trends and alert us to problems, but they are insufficient as guides to action and policy making. The conclusion that population increase causes environmental degradation through intensifying resource use should not be reached from aggregate data analysis, in the absence of critical evaluation of the physical and human processes involved in demographic and ecological change. No universal relationship has been proven between population increase and environmental degradation and although rapid population growth often occurs in tandem with the emergence of acute environmental problems, some researchers have provided evidence of instances of rapid population growth having no deleterious effects on the environment. Each situation of degradation is caused by a number of interacting factors and the significance of any one factor such as population increase will vary from place to place depending on local specificities.

If uncertainty is a major obstacle to effective policy making, as has been claimed above, then the solutions must surely include

- (a) the reconciliation of disagreements over matters of definitions,
- (b) the extension of research on populations in arid environments with a recognition of the need to adopt strategies for data collection which are not based on models derived in temperate lands, but which are more sensitive to the time and space characteristics of populations in arid regions and
- (c) the funding of research which devotes much greater attention than in the past to the detailed processes linking population trends and environmental change.

3. Policy makers need to recognize more fully the complexity of meaningful evaluations of population-environment interactions. Aggregate macro-scale analysis can result in what is termed the ecological fallacy. In-depth process-based research is required to establish meaningful understanding of the relationships which interconnect demographic and environmental regimes.

There is little doubt that the rapid demographic growth which arid lands have experienced in recent years has had major environmental implications.

Case Example from Spain

The desertification of territory in the Ebro basin of Spain took place by means of a dual process. Firstly the increase of the population - 150 per cent in fifty years - called for the extension of the cultivated area. Until the twentieth century lands were cultivated only once in seven years and in some places as seldom as once in thirteen years. Secondly little by little the fallow period was reduced until land was cultivated once in two or three years. Grazing for sheep decreased and spaces in which the ecological balance was less stable had to be used.

The farmers of the mid-Ebro basin came to see irrigation as the solution to the aridity of their land. Faced with rising population numbers and increased demand for food, farmers tried to alter the local ecosystem through irrigation rather than by adopting different crops.

Although modern trading systems permit population growth to take place without an immediate local increase in food production, it remains the case that the greatest demands on the environment are usually local as populations seek, through increased cultivation of nearby land, to achieve their basic food needs: that is, a minimum required per capita intake of 1700 calories per day.

Many researchers have noted that population increase also raises the probability of pollution and environmental degradation in fragile environments, as common or shared property resources such as water and air become too heavily exploited. This occurs because users have inadequate incentives to maintain the quality of these key resources and because policy makers have failed to see the need for intervention in the allocation of resources, access to which has historically been governed only by received social norms. In some circumstances resource pressures such as these have led to innovative and more productive agricultural practices, but in arid environments the scope for adaptation has been less than elsewhere and environmental degradation has been the more usual outcome.

Case Example from Tunisia

While population growth undeniably has a direct environmental impact, most researchers would stress that population-environment interactions are two-way and involve many complex and indirect linkages. This is well illustrated by research on population-environment relationships in the High Tell of Tunisia. There are three main types of physical environment in this semi-arid region: mountain terrain covered by forests and maquis, alluvial plains used for cereal culture and valley sides constituting a transitional zone between the mountain and the plain and used for polyculture. Over the last sixty years a three-fold population increase occurred in the High Tell. This resulted in a highly uneven impact on the environment and on rural society. Not all places or social groups proved equally vulnerable to the pressures associated with population growth. For example, the reduction in forest and the increase in maquis vegetation was shown to be associated amongst other features with the crisis of the peasantry, due on the one hand to the increased surface area controlled by large-scale agricultural producers and on the other to rapid population increase amongst the poorest groups. Inevitably it was not only land-use types that changed over time, but also the size of population gaining a livelihood from different niches within the system. The most important message emerging from this research is that as the population of any given area grows, it evolves a diverse range of survival and livelihood strategies in relation to the use of land.

Within a region many different demographic regimes may operate in parallel with one another and consequently a region will often be typified not by a single population crisis but by many different types of population - environment problems.

There is a need for policy makers to recognize the complexity of meaningful evaluations of population-environment interactions and to appreciate that population growth is not just an environmental concern about an increase in demand for food, but also increased population needs for fuel, clothing, shelter and wider livelihood requirements, all of which have environmental implications. Furthermore, understanding population-environment relationships requires the researcher to focus at an appropriate scale of analysis to ensure that relevant types of explanation are being invoked.

4. Environmental and demographic systems are dynamic and constantly changing. Traditional responses to drought have become more difficult both in the current context of economic and societal change and in relation to the rigidities associated with the political organisation of territory by states.

Demographic systems and production systems are constantly changing, responding to new pressures both from the societies of which they are part and from the wider economic systems with which they must interact.

Case Example from Syria

The pastoral populations of Syria have shown dynamism in their sheep production systems in the steppe. They have adapted in a variety of ways to external influences on their livelihood such as the effects of political decisions, technical advances and population growth, as well as the problem of environmental degradation. Their adapted livelihood systems have, however, caused further degradation through barley cultivation and the pressure on grazing resources caused by larger numbers of animals. They have been forced by wider economic and societal pressures into becoming more nomadic and their livelihood systems now rely heavily on purchased feed and rented grazing, as well as on subsidised fuel. Off-farm income is also being increasingly used to make up the shortfalls in the family income.

Changes in pastoral activity brings new forms of interaction with other economic systems

Case Example from Jordan

A major research project is currently being conducted in the Badia (desert) region of Jordan. It aims to investigate the relationships between population and the environment. More significant than the numbers of agro-pastoralists in the Jordan Badia is the change in environment-pastoralist linkages which has taken place over recent decades as a result of the possibility of importing feedstuffs and of transporting water within the region to support the animals being grazed there. This development has broken the effective linkage of grazing resources and numbers of animals being grazed and has removed the imperative for moving animals from one area to another to find grazing. At a local scale therefore, the traditional pattern of dependence on the physical environment of the ever shrinking proportion of the population who look to pastoralism as their chief source of livelihood has disappeared. This is not to say that serious overgrazing is no longer a threat nor that population-environment linkages are no longer of importance. On the contrary, the increased scale of twentieth-century living simply means that population-environment links are also manifested at a different scale, as is amply illustrated by the remarkable fact that water from the Badia catchments is transferred to supply urban demands in the west of Jordan.

Demographic trends also underline the significance of linkages between the Badia and the rest of Jordan. An increased interdependence has been observed between the Badia population and the wider Jordanian economy and society.

There is a need not only to build dynamic models, but also to seek to establish schema which link variations in the ecological realm with agro-economic systems and demographic regimes. These linkages show the importance of other needs such as firewood and alternative sources of livelihood.

Box 5: A Household-Environment Typology

The interface between household and the environment is critical in the stability of population-environment relationships.

From a range of variables (land use, carrying capacity, firewood supply, size of unit, land rotation, crops, frequency of cultivation) it has been found that it is possible to distinguish between the variables which are currently changing and those which remain static. For example pastoralists are increasingly buying in, rather than producing, fodder for their animals. This can be used to prevent overcropping of fragile areas. Equally gas and electricity are becoming more widely available. This reduces deforestation for firewood and could permit planting of firewood species. By contrast shortage of water continues to restrict carrying capacities. Equally the threat of drought remains. Such typologies and linkage studies permit identification of appropriate entry points for policy makers.

Case Example from Southern Tunisia

In the region of Nefzaoua, Southern Tunisia, nomadic populations were encouraged by the Tunisian government to settle. Environmentally the area is arid with only the occasional heavy rainstorm. It is prone to extreme cold and fierce winds. Natural water sources in the oases of Nefzaoua, have permitted dates to be grown. Considerable differences in economic activity and demographic behaviour have been observed between traditional settled oasis dwellers and the more recently settled nomads. One result has been that the former balance between oasis dweller and his/her environment has been disturbed. Each group has different traditions and attitudes to use of the land and to the environment yet they now share the same space. Some deforestation for fuel has occurred and natural water sources are becoming salinated.

Failure to understand the linkages between demographic and environmental attitudes and practice can result in policy formulation which further marginalises an arid zone population and disadvantages other groups living in arid areas.

Migration is a clear example of one mechanism by which the populations of arid areas have and continue to adapt to changing local and regional economic and environmental circumstances. However, the societal context in which migration is taking place is constantly changing. The potentials for circulatory migration and for temporary migration in periods of crisis have changed.

It is not just demographic and livelihood systems which are always changing, but also environmental systems. Oscillations in environmental conditions are an inherent characteristic of arid regions. Policy makers need to recognize that cycles of increased aridity followed by spells of reduced aridity have been the norm and they need to consider why current trends towards increased aridity seem to be the cause of particular hardship to the populations of arid lands. It has been suggested that cycles in aridity have been matched over time by the ebb and flow of populations, with periods of increased mobility interspersed with phases of sedentarization. Current political and socio-economic systems have reduced the opportunities for flexible responses by human populations to changing environmental circumstances. International frontiers have restricted mobility across regions, while more significantly lines drawn in society by state governments have increasingly operated to marginalize the position of nomadic and semi-nomadic peoples. There is a danger that current strategies in response to drought may produce a more permanent switch to other livelihood forms rather than, as in the past, operating as a temporary deviation from pastoral nomadism.

If policy makers are to be sensitive to the nature of the problems facing the populations of arid regions, they need to recognize more fully the temporal nature of the cycles of aridity. Policies for crisis situations are an essential feature of any arid zone policy. Attempts must be made to provide new ways for populations to respond in a flexible fashion to periods of drought before returning to their former lifestyle, rather than forcing them to flee drought in such a fashion as to result in a permanent transfer of human and physical resources away from the arid zone.

5. Policy makers need to be especially aware that vulnerability in times of crisis is unevenly distributed amongst the populations of arid areas. Vulnerability is associated time and again with those who are economically marginal to the national economy, those who are politically least able to represent their own interests and those such as women, children and ethnic minority groups who find themselves too weakly located relative to the dominant power relationships of society.

A comprehensive survey of management policies invoked in arid lands to reduce the pressures associated with situations involving rapidly changing population-environment relationships is not possible here. Simplistic interventions have often been attempted based on an inadequate evaluation of the complex causal relationships involved. Those perceiving rising population numbers to be an indirect but significant cause of increased grazing and hence the cause of increased risk of land degradation and desertification, have advocated a range of policies designed to 'protect' the environment (such as fencing off areas of arid land to protect wild life or botanic species within special reserves). In contrast, those that see the ultimate source of difficulty to be one stemming from changing social and economic systems resulting in the emergence of inappropriate forms of rural production have sometimes called for a return to former patterns of land use in arid regions. They fail to recognize, however, the demographic reality of increased population numbers seeking to earn a livelihood from increasingly scarce resources as well as the changed aspirations and perceived needs of the peoples of these regions.

A Further Case Example from Syria

The case of Syria is of particular interest concerning the rehabilitation of traditional management systems. The country was the first in the region to initiate a large sheep and range management programme based on the ancient Arab pastoral management system known as 'Hema'. Advocates of the system argued that it would result in a return to harmonious land/person relationships destroyed by state land reform. The project, although it attracted wide support from herders, failed to revert degradation. In fact it resulted in an increase in numbers of sheep and increased pressure on the rangelands. Several factors led to this failure. The project was based on an idealised view of the evolution of social organisation of tribes that relied on the traditional system of range management. Supporters of the project argue that tribal land alienation through land reform was the main factor leading to the disappearance of the 'Hema' system. Such an analysis legitimates the restoration of tribal rights. Tribal solidarity, however, had been severely altered before land reform due to the penetration of agrarian capitalism. In the implementation of the project there was apparent consensus between experts, authorities and agro-pastoralists, but this proved more apparent than real. Each group had different objectives. Politically it was seen as a way to establish Arab socialism in the steppe areas. Agro-pastoralists were attracted by the subsidised feed supplies.

Box 6: Management Policies: With or Despite Pastoralists?

Recurrent failures in dryland development policies have led to a growing recognition that profound changes are urgently needed in development strategies. Technicist biases associated with a general lack of understanding of the social and cultural basis of life in arid areas are considered a major cause of the unsatisfactory results of past programmes. Sedentarisation programmes for nomadic populations, land alienation and land use regulations imposed on agro-pastoralists have often been justified by articulation of the view that societies in arid areas make an inefficient and destructive use of the environment. The normalisation of this view and the neutralisation of alternative understandings has served well the political agenda of those in power. Negative images of arid lands societies have enabled the justification of state interventions primarily aimed at strengthening government control over populations generally perceived as politically unstable.

In the case of the Middle East there is a clear deficit in social and technical research focused on populations of arid areas and their production systems. Bridging the gap will require a substantial research effort. Pastoral communities are often more a social and cultural construction than a reality. They are imagined communities either idealised or despised, depending on what is politically convenient.

Clearly there is a case for both of the management strategies referred to above as long as they are not seen as global solutions either to the difficulties faced by the populations of arid regions or to the desires of environmentalists to preserve certain types of habitat. Small areas fenced off as wildlife or botanic reserves may serve many useful purposes, but large areas cannot be set aside in this way since such land management clearly impinges negatively on agro-pastoralist needs. In the absence of alternative strategies for such groups this only increases pressure on remaining land with the possible risk of increased rates of land degradation. Equally there is clearly a place for policies which recognize the great value of local knowledge systems arising from the peoples of arid regions concerning their traditional management of fragile environments. Such knowledge, however, in itself does not solve the developmental problems facing planners concerned about how to foster sustainable agro-pastoral systems in the context either of the political economy of the modern state or the socio-cultural dynamics determining lifestyle expectations.

Analysis of policy interventions in the population-environment field in arid lands shows very clearly the risk of causing more damage than good, but this is not and should not be used as a basis for either apathy or inaction in the policy realm. In particular, research reported in this volume clearly shows that not all members of the populations of arid regions are equally vulnerable to the pressures which change has brought to this environment.

Case Example from Mali

Studies undertaken in Mali have assessed the degree to which population movements following the Sahelian drought were a temporary response to a crisis situation and resulted in permanent population displacement.

In the Malian Gourma the 1984-5 crisis resulted in massive population movements to urban centres. By 1987 a substantial number of these migrants were still congregated around the towns and the majority were still there in 1991. Traditional survival strategies had failed to enable these people to reintegrate into their traditional economies.

A study of drought in Douentza examined short and long term responses to drought. The study found that in times of drought it was not just pastoralists who moved. Drought was sufficiently severe to result in permanent displacement particularly of women and children.

Drought has created a peri-urban, extremely poor population, which retains contacts with their previous lifestyle through the occupations practised and dependence on natural resources.

Given the nature of current power relationships in most societies, the most vulnerable groups in a crisis situation are those who are economically marginal relative to the national economy and who are spatially peripheral to the centrally biased interests of the state. For example, women and children are the most likely members of the household to suffer from times of environmental crisis. Since policies should be focused on empowering these groups through considering ways to improve their entitlement to key resources and thus reduce their vulnerability, there is no need for policy makers to await the advent of environmental crisis, such as the next major drought, prior to taking action. Studies of causal relationships in famine situations have shown that famine and mass starvation are not an inevitable consequence amongst the most vulnerable groups.

Equally there is no reason why population growth should necessarily be the cause of environmental degradation if policy makers strive to improve the resource entitlements of the most vulnerable elements of both rural and urban populations of arid lands. By implementing policies focusing on the specific mechanisms which make groups differentially vulnerable in terms of their economic position, ethnicity, location or gender, decision makers have the potential to have a real impact in reducing overall vulnerability. This in turn will reduce the likelihood of such groups adopting survival strategies which are environmentally damaging.

Policy Conclusions

To conclude, the contributions of participants at the IUSSP conference held in Amman, Jordan, have gone far beyond presenting a purely academic assessment of the problems associated with population-environment inter-relationships in arid lands. They identified policies which need to be addressed and proposed more sensitive management strategies to deal with the crises facing the peoples of these regions. In particular it has been recognised that :

1. **Further research on populations in arid regions is urgently required** in order to reduce the considerable uncertainty which currently surrounds much of the policy making on the topic due to a paucity of good demographic and environmental indicators and to an ambiguity over the definition of many of the key terms.
2. **Population growth presents particular geographical challenges to arid environments**, with demographic pressures leading to demands not only for enhanced food production systems, but also for increased fuel resources and alternative sources of livelihood.
3. **Population-environment interactions have always been changing over time**. Cycles of drought have always been followed by periods of reduced aridity and then a return to drought. This pattern should be accepted as the norm rather than the exception in policy making for the peoples of arid lands. The socio-economic and political circumstances of the late twentieth century have made it more difficult for the populations of these lands to respond to drought because of the emergence of new spatial barriers to movement and the reduction in the flexibility of traditional human response systems. All policies for arid areas should differentiate between crisis management and long term management strategies but given the nature of arid areas all should incorporate, as an integral part of their policies, strategies for crisis management.
4. **Strategies to conserve arid environments for future generations, such as the establishment of parks and areas where grazing of livestock is prohibited, while not totally inappropriate, may have very adverse effects for current pastoralist populations by denying them access to traditional grazing rights.**
5. **While local knowledge of environmental resources may in many ways be superior to those of so-called external experts, attempts to return to former population-environment systems may be ineffective where the strategy ignores the objectives and aspirations of the present population.** There is a need in policy design to move from a rhetoric which recognises the need for local population involvement to the reality of local population participation in planning procedures. This requires that planners do not simply observe the practices of local peoples, but that policies are informed as much by the objectives of the populations of arid regions as they are by the external views of ecologists and economists.
6. **Tremendous inequality in power relations exists amongst the peoples of arid regions and between them and the governments of the countries in which they reside.** In particular, there is a need in policy formulation to be sensitive to the most vulnerable population groups (politically and spatially marginal minorities, economically marginal producers and the domestically vulnerable members of the household notably women and children) who will be the first to suffer from ill-conceived interventions in fragile arid environments.

Conference on Population and Environment in Arid Regions

List of the papers presented at the conference on 'Population and Environment in Arid Regions' organised by the IUSSP Scientific Committee on Population and Environment, The International Geographical Union Committee on Population Geography and UNESCO, held at the University of Jordan, Amman, from 24th-27th October 1994.

Session 1: Opening Ceremonies and Overviews on the Theme

- 'Introductory Address' by John I. Clarke
- 'Population et environnement dans les régions arides du monde' by Daniel Noin

Session 2: Human Causes of desertification

- 'Population, Biomass and the Environment in Central Sudan' by Hassan Musa Yousif
- 'Monitoring of Human Impact on Land Cover by Remote Sensing: Case Study of the Mediterranean Desert of Egypt' by Boshra B. Salem and Mohammed A. Ayyad
- 'La désertification et l'homme en Algérie' by Djilali Sari
- 'Les causes humaines de la désertification. L'expérience du Burkina Faso' by Nayire Evariste Poda
- 'Le rôle de l'homme dans la dégradation de la végétation au Nord-Cameroun' by Jean-Louis Dongmo
- 'Human Cause of Desertification in Peninsular India' by A. R. Subramaniam

Session 3: Environmental Problems of Living in Arid Regions

- 'La relation population - environnement dans le Haut Tell tunisien' by Laurent Auclair, Lamia Laajilli Ghezal and Roger Pontanier
- 'The Consequences of Drought for Populations in the Malian Gourma' by Sara Randall
- 'Problems of Land Use in Kenya's Arid and Semi-arid Lands (ASAL)' by M. B. K. Darkoh
- 'The Impacts of Labour Migration on the Sustainability of Agricultural Development in Arid Regions' by B. Knerr
- 'The Present Situation in Spain regarding the Transformation of Arid Land into Irrigated Land' by Antonio Higuera-Arnal
- 'The Process of Depopulation-Repopulation in Arid Regions of the Ebro Valley' by Maria Carmen Faus-Pujol

Session 4: Population Dynamics in Arid Regions

- 'Mobility: An Essential Strategy in the West African Dry Zone' by R. Mansell Prothero
- 'Population and Environment in the Jordanian Badia' by Musa Samha
- 'The Dynamics of the Agro-pastoral Population in the North Syrian Steppe' by Marina Leybourne
- 'Dynamique de population et aridité: une expérience dans les régions arides de Tunisie' by Michel R. Picouet and Mongi Sghaier
- 'Population Dynamics of an Arid Zone in India' by M. S. R. Murthy

Session 5: Population-Environment Management Policies for Arid Regions

- 'Policy Implications of Fertility Trends in the Badia of Jordan: An Evaluation of the Relationship between Reproduction and Production in an Arid Environment' by Allan M. Findlay and Mohammed Maani
- 'The Reintroduction of Traditional Dryland Resource Management Systems: A Critical Analysis of the 'Hema' Project in Syria' by Ronald Jaubert and Riccardo Bocco
- 'Désertification, interaction (population et environnement) et patrimoine en Afrique du Nord' by Noredine Chalbi
- 'Population et désertification en Mauritanie' by M. Fahem Abdel Kader
- 'Population Dynamics and Environment Interactions: The Value of Integrating Household Analysis. Relating Theory to the Policy Needs of Arid and Semi-arid Regions' by Behrooz Morvaridi

The International Union for the Scientific Study of Population (IUSSP) is the foremost international professional association dedicated to the scientific study of population. Its four basic objectives are:

1. encouragement of research into demographic issues and problems world-wide;
2. stimulation of interest in population questions among governments, international and national organizations, the scientific community and the general public;
3. promotion of exchange between population specialists and those in related disciplines;
4. wide dissemination of scientific knowledge on population.

The Scientific Committees and Working Groups of IUSSP are the principal means of implementation of the scientific programme of the IUSSP. Generally they have a life of about four years. Scientific Committees are active in well-defined fields of research whereas the Working Groups are often established in newer areas in which the Council of IUSSP thinks further development and definition of scientific issues is required.

Additional information on the IUSSP and its scientific activities and publications are available on the website: www.iussp.org