

INTER-CENTER COOPERATIVE RESEARCH PROGRAMME

# POPULATION AND ENVIRONMENT



*Meeting organized by CICRED, the IUSSP Committee on Population and Environment, and the "Département des sciences de la population et du développement" of the Catholic University of Louvain-la-Neuve, at Louvain-la-Neuve, Belgium on 7-9 November, 1991*

*CICRED - PARIS*

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## FOREWORD

by Mr Léon Tabah, Chairman of CICRED

Readers will find in this modest brochure some materials collected on the occasion of a workshop organized jointly by CICRED, the IUSSP *Committee on Population and Environment*, and the *Département des sciences de la population et du développement* of the *Université catholique de Louvain*, at Louvain-la-Neuve (Belgium), on the 7-8-9 November 1991.

The workshop was an initiating meeting on the interrelationships between population and environment in the context of development, a relatively new subject at the level of national demographic research centers. The general theme was the impact of population growth and distribution on the physical environment in particular areas, and vice versa, the effects of environmental changes on population trends and distribution in these particular areas. To put it in a simplistic way, a too high, or on the contrary a too low, population growth might affect the environment, while a change in the environment, such as desertification or deforestation, might lead to emigration, resource depletion, health hazards, and so on. For example, the recent demographic literature contains an increasing number of articles dealing with "environmental migrations".

Even if we have to recognize that the subject of environmental deterioration is an agonizing and pressing concern at global level, therefore affecting everyone, we must also acknowledge that, on the one hand, many global environmental problems find their sources at local and national levels and, on the other hand, that the people of specific areas are in various ways affected by environmental changes and respond or adapt differently to these changes. There is an urgent need to manage local environments in an ecologically responsible manner for the wellbeing of the residents of the affected areas, and much beyond the immediate vicinity, for avoiding secondary effects on surrounding populations. It is well known that many global issues have started at micro-level but later have multiplied to the meso-level, and ultimately to the macro-level.

I am a strong believer in the beneficial effects of the action taken at the personal and community levels, or to put it in a language of full imagery, "within earshot", that is to say by people who communicate at short distance, pertain to the same milieu, and used to acting together for their own and immediate good. Pro-active and innovative strategies should be adapted to the natural, cultural and socio-political conditions of the local contexts as each area is generally affected by its own crisis problems. There is an ineluctable need for action at areal and people levels. These actions will have more extensive and long-lasting consequences than actions decided in high places, because they are perceived and treated by the actors themselves.

All aspects of the complex issues of population-environment have been dealt with at the Louvain-la-Neuve workshop : what the IUSSP *Committee on Population and Environment* called the "hot issues", or problems to be tackled immediately, such as deforestation, desertification, air pollution, soil pollution, soil erosion, water pollution, and especially sensitivity of the communities to primary environmental care; and in addition what was termed by the Committee as "warm issues", calling for long lasting and persistent actions in many ways exceeding the possibilities of local communities, such as eradication of poverty and impoverishment, greater social equity, containment of the urban explosion by redesigning and implementing new urban settlements, slowing down the flows of migrants from the countryside, redressing the imbalanced population distribution, especially the excessive development of coastal areas, and so on.

Without a shadow of doubt, local communities have to share responsibilities for the solutions of "hot issues", while "warm issues" are more appropriately the responsibilities of national institutions and call for action at political level.

Quite obviously one could not think of environment without thinking of resources and development. The four factors population-resources-environment-development are

closely linked within a web of interactive feedback processes. Populations – or people – constitute the main resource, and attempts should be made to know to what extent they are a passive or an active agent of the environment at the local or national sphere.

Due to its complexity the subject is typically one that should be treated more appropriately at center level rather than at individual level. It is in the mandate of CICRED to promote interchange of knowledge and experience of such complex issues as the interfaces of population and environment through a series of workshops assuring guidance and follow-up of the investigations.

We hope that the Louvain-la-Neuve workshop was just a launching meeting that will be followed by one or two others until the full achievement of the research.

I want to express my deep thanks to Professor Hubert Gérard, Chairman of the *Département des sciences de la population et du développement* of the *Université catholique de Louvain* for generously hosting the workshop. My gratitude also goes to Professor John Clarke, Chairman of the *IUSSP Committee on Population and Environment* who have accepted to draft the background paper which guided the discussion and will serve as a framework for the implementation of the project. Professor Clarke also has drafted the report of the meeting and has edited the present brochure.

Finally I cannot thank enough UNFPA without whom this undertaking could not be realized.

Léon TABAH  
Chairman of CICRED

Meeting on *Population and Environment* organised by CICRED, the IUSSP Committee on Population and Environment, and the "Département des sciences de la population et du développement" of the Catholic University of Louvain-le-Neuve at Louvain-la-Neuve, Belgium on 7–9 November, 1991

## POPULATION AND ENVIRONMENT : AN INTRODUCTORY NOTE

by

Prof. John I. Clarke (Durham, U.K.)

### World population growth and environmental degradation

Population growth and environmental degradation are two of the great concerns of our age, as both are seen to be problems of local and global importance. The links between them are generally not clearly understood, though population growth is usually regarded as an underlying factor of environmental change, associated with the huge scientific and technological advances which have transformed societies, economies and politics over the last two centuries. A number of major processes have greatly altered the relationships between population and environment :

- the multiplication of the world population about 5½ times since 1800, and the diversity of demographic transition so that the dynamics of populations have never been so varied;
- the large-scale migrations of peoples mainly of European origin into formerly less peopled continents and regions – into the Americas, Africa, Australasia and Inner Asia – altering substantially the patterns of human occupation of the earth's surface;
- the huge expansion of the industrial and service sectors of human activity, provoking marked concentration of population in economic core areas;
- massive urbanization, initially in developed countries but subsequently in the developing world, with particular concentration of population in mega-cities;
- the intensification of modern agriculture the decline of more extensive forms of traditional agriculture and the relative depopulation of environmentally 'negative areas' (e.g. deserts, tundra, mountains) and 'marginal areas' (e.g. moorlands, sahel, semi-deserts);
- the growing economic differentiation of populations, over-simplistically dichotomised into developed and developing countries, but involving a very wide range of economic progress and environmental impacts;
- the growing social differentiation of populations, increasing existing cultural contrasts through diverse levels of education, housing and social/health provision as well as the roles and status of women; and
- the growing political fragmentation of the world, increasing the number of independent states, which has the effect of nationalizing populations, thus influencing their distributions and dynamics as well as their impacts upon environments.

### **Diversification of population environment (P-E) relationships**

These various processes are sometimes systemic but operating locally, as for example population growth and political fragmentation; but others may be regarded as more cumulative representing the global accumulation of local changes, such as the expansion of the industrial sector and the changing roles of women. Whatever the case, these processes have combined to diversify greatly the world patterns of population and of population-environment (P-E) relationships. Population densities range from largely uninhabited wildernesses like Antarctica to more than a quarter of a million persons per square mile in a city like Hong Kong. Polarization of population continues, with 48 per cent of the world's population now living in cities while a similar percentage of the earth's surface is barely occupied. By the end of this century, it is estimated that nearly half of the world's urban population will live in cities with one million inhabitants or more, and more than two-thirds of the world's total population will live within 60 km of the coast, often in regions extremely vulnerable to rising sea levels caused by global climatic change.

Although the proportion of people living directly from the land is declining, their numbers are growing. Generally, those who are land-bounded use much less resources than those who aren't. Indeed, it has been estimated that the average person in the developed world uses at least 30 times as many resources as the average person in the less developed world, a contrast which would be greatly enlarged if one compared the populations of the most and least developed countries, say Japan and Sierra Leone. Moreover, the city-dwellers of the more developed countries use so many resources that their cities become unsustainable, while cities in the developing countries cannot meet their basic needs of food, fuel, clean water and clean air. In addition, the poorer countries are greatly affected by the material demands of the rich countries. World-wide use of resources by wealthier populations in contrast to their more localized use by poorer populations impedes realistic universal indices of carrying capacity, which have been usually based merely upon population-resource ratios of specific areas and have also failed to incorporate the concept of sustainable development. Environments have not been regarded qualitatively and holistically enough, but only for their available resources for development at a given moment; this has been reflected in the demographic literature from Malthus onwards - environmental quality has often been omitted from considerations of population, resources and development.

P-E interrelationships are never simple and are always changing. Human perceptions and utilizations of environments have varied greatly with time, place and population, responding to changes in culture, population growth, methods of production, energy use, government policies, international debt, trade and aid, as well as many other factors. Similarly, environments have variously influenced populations, formerly far more deterministically than to-day, and more deterministically in least developed than most developed countries.

### **International Concern**

The inexorable growth of world population and the use of resources accompanied by environmental degradation and global environmental change have imposed a need for governments and the international community to take a variety of measures and to exert a variety of pressures in order to reduce the rate of degradation. Short-term measures are necessary to restrain and control those activities and technologies which are the ultimate causes of environmental degradation, but equally important are longer term pressures to tackle the underlying or proximate factors such as population dynamics, the nature of the world economy, and the poverty of the many which contrasts with the wealth of the few.

Fortunately, numerous international organizations have taken up these issues, from the UN Conference on the Human Environment in Stockholm in 1972, through the Club of Rome, UNEP, UNESCO's Man and Biosphere, the Brandt Commission, the Brundtland Commission, UNFPA, FAO, ILO, WHO, UNICEF, IUCN, UNDP and UNCED, which is the current focus, meeting in Brazil in 1992. Recent stress and urgency have been on global environmental change, in which population growth has been seen largely in global terms. Hence there is a great need for social scientists and demographers in particular to disaggregate the

generalizations about population growth and to look at its components : fertility, mortality and migration. The ISSC in its Human Dimensions of Global Environmental Change programme is giving a lead to social scientists, and national research councils are also greatly involved. It is in this context that the joint meeting in Louvain-la-Neuve can play a part.

### Macro and micro-approaches

Scale is a very important factor. The complex web of P-E interrelationships may be examined at many spatial scales from the global to the local; from, for example, the demographic effects of global warming to the local causes and consequences of polluting technologies. The spatial scale is inevitably influenced by the nature of environmental phenomena under consideration; hence land use and urban pollution necessitate a finer grain of analysis than climate. P-E interrelationships may also be studied at different time-scales from the long-term impact of rising sea-levels upon human population distribution and of population growth upon marine pollution to the sudden impact of disasters, natural or human-induced : earthquakes, typhoons, tidal waves, nuclear explosions, wars...

The matter of scale of analysis is further complicated by the problem of linking explanations of demographic or environmental phenomena at different levels of scale – the influence of climate upon patterns of population distribution globally is maximal, but locally it is usually minimal; similarly, while the local demographic impact of an earthquake may be devastating, generally earthquakes have negligible effects upon world population growth. On the other hand, some localized environmental phenomena have global effects (e.g. Krakatoa, Gulf War), while others are much more restricted. So we have the problem of linking uniqueness and generalization, of relating behavioural analyses of local phenomena with aggregate explanations of the global scene. The problem is also exacerbated by the increasing speed of change, accompanied by a growing number of disasters, catastrophes, shifts and discontinuities, all with low predictability and posing great problems to scientists who find it easier to deal with constants, cycles and trends. Despite these problems, there is work being done and to be done at many different scales.

### Research questions

What are the research questions facing the demographer in the analysis of P-E interrelationships ? They are so numerous and varied that they are not easily classified, but the following headings may be helpful.

#### **1. Population data issues**

At the macro level there is a need for linking population data with environmental data. Unfortunately, the availability of population data is for irregular political/administrative units which often do not match the realities of population distribution, whereas in recent years remote sensing imagery has provided sometimes more detailed and up-to-date environmental data for more uniform areal grids. Matching these contrasting data sets is a difficult task. Standardized georeferenced demographic data are desirable for better analyses of P-E relationships, and not enough are available. In addition, work should be done on estimating population numbers from remote sensing imagery.

#### **2. Population concentration**

There is insufficient published data, internationally or nationally, about the rapid process of population concentration, too often identified only with urbanization, and of the depopulation of negative/marginal areas. Quantitative analyses are necessary, and also in relating population data with environmental phenomena such as attitude, climate, vegetation, distance from sea and geographical regions, both internationally and nationally.

### **3. Identification and analysis of P-E crisis areas**

Current P-E crisis areas must be identified and analysed. They vary greatly in size and population density from areas of desertification, water shortage, deforestation, and mountain erosion to heavily populated deltas, estuaries and islands. Particular focus should be given to ecologically fragile areas or "unsustainable enclaves", where poor populations are often in excess of critical carrying capacities and who may be practising methods of farming and forestry which are particularly deleterious to environments. In addition, research should be directed to two types of area of major potential P-E crisis, because of the huge populations involved : (a) coastal zones vulnerable to inundation and (b) megalopolitan areas with acute problems of pollution. In view of the growing concern about mega-cities in the developing world, comparative research on the impact of population pressure upon their environmental degradation is vital.

### **4. P-E relationships in settlement systems**

Settlements vary greatly in size, site, function, population composition and rate of growth, and thus in their environmental impact. Population size is not the only causal factor; rate of growth may be more significant especially when large cities have difficulties in absorbing numerous rural-urban migrants. Thus it would be valuable to look at P-E relationships in whole settlement systems. In particular, it is important to examine how the consumption demands of cities for fuel, food and water affect rural environments.

### **5. Migration in P-E relationships**

Migration has various direct and indirect effects, as well as positive and negative effects upon P-E relationships at both source and destination. Similarly, it has multiple causes and motivations, many of which are non-environmental. Migration is not always a relief to environmental degradation in rural areas or the prime cause of it in urban areas. In view of the uncertainties about the benefits and disbenefits of rural-urban migration to the balance of environmental degradation, detailed investigations should be undertaken of the environmental causes and effects of differing migration streams. Moreover, this should also be done for international migration streams, which are generally from lesser to more developed countries where economic opportunities are greater, but the growing number of refugee movements has complicated the patterns. For such movements environmental factors are often difficult to dissociate from the web of political and economic factors, but research is necessary.

### **6. Health and environmental degradation**

Inadequate environmental management in both developed and developing countries poses health problems, especially in the latter countries where environmental diseases like malaria, river blindness and sleeping sickness still exert a terrible toll. Intensive agricultural development, moreover, has not always been beneficial, sometimes polluting water supplies; and rapid industrialization has frequently led to major pollution problems, not only in China and India but also in eastern Europe. Research opportunities are manifold, as well as in the potential health problems associated with the greenhouse effect, notably the increase in carbon dioxide, and with the effects of global warming upon disease vectors, heat stress and food production.

### **7. Fertility and the environment**

A field which has attracted only sporadic and sometimes controversial attention is the relationship between fertility and fecundity on the one hand and environmental characteristics and crises on the other. Certainly, there should be more work on the effects of specific environmental factors like altitude, and also of environmental crises such as droughts and floods, for which the fertility responses are varied.

## **8. Women and children in the environment**

There can be little doubt that the varying roles of women in populations around the world have led to considerable contrasts in their use and control of resources and in their contribution to environmental management. Despite their greater vulnerability to pollutants of air, food and water, especially in child-bearing and child-rearing, they have often been ignored in development and environment policies. Furthermore, despite their numerous agricultural activities, they have little access to land ownership, credit facilities and modern technologies. Obviously, women should be involved in decision-making about environmental issues, and research should be directed to showing how women's roles can be ameliorated with environmental benefits, instead of them working harder in response to environmental degradation. Just as women are vital in primary health care (PHC), so are they in primary environmental care (PEC). Indeed, PHC and PEC are linked, particularly through child health and the need for greater education of women, which has such important effects upon both fertility and child mortality. Educated families and households are more likely to improve P-E relationships – or are they more likely to migrate out of difficult rural areas ?

The above list is by no means a taxonomy of work to be done in the P-E field. It is a list of headings as a framework for discussion, which may be modified by those attending the meeting at Louvain-la-Neuve. It is deliberately broad and general in order to incorporate a wide range of demographic research. Participants may find the headings useful as pegs on which to hang their work; alternatively, they may find that the pegs are too few and too flimsy. Whatever the case, we look forward to meeting you in Louvain-la-Neuve.

17 September, 1991

## REPORT OF THE MEETING

by

Prof. John I. Clarke (Durham, UK)

### 1. Participants

The joint meeting on 'Population and Environment', organized by CICRED, the IUSSP Committee on Population and Environment and the Institut de Demographie of the Université Catholique de Louvain-la-Neuve was held at Louvain-la-Neuve, Belgium during Thursday-Saturday 7-9 November 1991. It was attended by 27 participants from 5 continents and 16 different countries : Austria, Belgium (4), Brazil (2), Canada, France (3), India, Indonesia (2), Mali, Mexico, Netherlands, Nigeria, Pakistan, Philippines, Poland, Thailand, United Kingdom (3) and USA (2). Apart from the Belgian participants, all participants represented different population centres, some of the 335 belonging to CICRED.

Seventeen of the participants were invited by CICRED (van Arsdol, Djuhari, Gonzalez, Gould, van Imhoff, Jillani, Legrand, Limanonda, Lutz, Martine, Ouaidou, Picouet, Raymundo, Serageldin, Soengeng, Tabah and Zaba); seven were members of the IUSSP Committee on Population and Environment (Ajaegbu, Clarke, Hogan, Nangia, Noin, Poulain and Potrykowska) and three were there as members of the Institut de Démographie of the Université de Louvain-la-Neuve (Gérard, Periquet and Tabutin).

### 2. Organisation

Léon Tabah, Director of CICRED, chaired the 2½ days of detailed discussions; John Clarke, Chairman of the IUSSP Committee on Population and Environment, acted as Co-ordinator of the meeting; and Hubert Gérard assisted by Michel Poulain of the Institut de Demographie were the admirable local hosts and organizers, contributing greatly to the success of the meeting.

### 3. Objectives of CICRED

The main objective of the meeting was to design a work programme in the field of population-environment (P-E) relationships, in particular a series of topics from which the various population centres around the world would select for analysis and implementation. No population centre need feel committed to all or any part of the programme, but it is hoped that a common approach would evolve and that many centres would be attracted to this important and relevant theme. The key word is flexibility. All population centres belonging to CICRED will be asked if they wish to take part, and those who do will submit a brief report of their activities at the end of 1992. It is then hoped to hold another meeting on this theme sometime in 1993 and a final meeting in 1995.

### 4. Co-ordinator's Introduction

Prior to the meeting, John Clarke as Co-ordinator had written a short paper entitled "*Population and Environment : an Introductory Note*" (see pages 3-7), which had been circulated to all intending participants. At the beginning of the meeting he presented this paper, speaking around it on a number of general issues :

- Concerns about world population growth and global environmental change (GEC)/environmental degradation;
- Changing interrelationships between population and environment;
- Over-simplistic correlations between population growth and environmental change and the important roles of intervening/direct/ultimate factors;

- World population growth and GEC as aggregate phenomena, each comprising greater diversity than ever previously known;
- The wide variety of spatial and time scales at which P-E interrelationships may be examined, and the problem of scale-linkage;
- The association of long-term population growth with massive population redistribution at the continental scale, as well as marked demographic, economic and social differentiation and political fragmentation, leading to a changing balance of world population distribution;
- The abandonment of more difficult environments and concentration of population in economic core regions and urban centres, notably mega-cities with special P-E problems particularly for the urban poor;
- Growth of rural populations in developing countries, leading to growing population pressures with varying responses, and the need for a balance between environmental conservation and the alleviation of poverty in sustainable development;
- The varied roles of women and children around the world, and their potential contribution to primary environmental care;
- The environmental benefits and disbenefits of migration, internal and international, which are rarely calculated;
- Local and global problems of environmental health and morbidity/mortality;
- The more limited relationship between environment and fecundity/fertility;
- Varying perceptions of P-E relationships across countries cultures, age groups and classes of society; and
- The growing interest in studies of P-E relationships by UN organizations, World Bank, international unions in social sciences, government research councils, academic institutes and foundations.

Then the Co-ordinator looked at the roles that IUSSP and CICRED might play, the former incorporating individuals working in demography and population studies, and the latter grouping population centres. He proposed the following broad research fields (specified more in his *Introductory Note*) :

- (i) Population data issues
- (ii) Population concentration
- (iii) Identification and analysis of population crisis areas
- (iv) P-E relationships in settlement systems
- (v) Migration in P-E relationships
- (vi) Health and environmental degradation
- (vii) Fertility and the environment
- (viii) Women and children in the environment

##### 5. Centre Presentations

At this stage participants made individual presentations of the work of their centres and organisations, which included the following themes :

- (a) Bhassorn Limanonda (Institute of Population Studies, Chulalongkorn University, Thailand) .

- Rural-urban migration, and problems of the urban poor

- Effect of rapid economic development on environmental degradation
  - Resettlement of population affected by natural disasters
  - Effect of rural-rural migration on deforestation.
- (b) Soegeng Waloejo (Center for National Family Planning Studies, Jakarta, Indonesia)
- Role of women and children in the environment
- (c) Corazon Raymundo (Population Institute, University of the Philippines, Diliman Quezon City)
- Census of upland populations and projections
  - Migration to uplands
  - Studies of urban slums
  - Poverty areas in Manila
  - Women and children and landless peasants
- (d) George Martine (SPN Institute, Brasilia, Brazil)
- Population growth and environment
  - Amazonian deforestation
  - Increased market economies leading to growing population concentration
- (e) Nassour Ouaidou (CERPOD, Bamako, Mali)
- Modelling system of population, agriculture and environment in the Sahel
  - Problems of self-sufficiency
  - Population, drought and desertification
- (f) Ligia Gonzalez (Consejo Nacional de Poblacion, Mexico)
- Population distribution policies for regions
  - Identification of 305 micro-regions based on population, settlements and natural resources
- (g) Sudesh Nangia (Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi, India)
- Population and environment scenarios in mountain areas, metropolitan regions, rural areas under different environmental settings, transitional zones
  - Population in slums and squatter settlements
  - The urban poor and their access to basic services
  - Impact of sea-level rise along coasts of India
- (h) Daniel Noin (Universite de Paris I, France, and Chairman IGU Commission on Population Geography)
- Global approach to population : detailed maps of population growth, concentration, international migration flows
  - Aridity and desertification
  - Natural and man-made disasters
- (i) Hyacinth Ajaegbu (Department of Geography and Planning, University of Jos, Nigeria)
- Environmental management

- Impact of environmental degradation on population in derelict mining areas
  - Rehabilitation of population and settlement affected by environmental degradation
  - Environmental and population education
  - Organization of local communities to manage their environments
  - Mapping of population and environment data in Africa (the Nigerian case)
- (j) Dominique Tabutin, Institut de Démographie, Université Catholique de Louvain-la-Neuve, Belgium)
- Political demography in developed countries
  - Theoretical framework to interrelate demography and environment
  - Women and environment in Africa
- (k) Alina Potrykowska (Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warsaw, Poland)
- Methodological and statistical base to link population and environmental data
  - Population concentration and its relationship with environmental pollution
  - Problems of depopulation in rural areas
  - P-E relationships in settlement systems
  - Identification of 27 ecological crisis areas
  - Relationship between migration and environment
  - Health and environmental degradation
  - Environmental protection and regional development policies in crisis areas
- (l) Evert van Imhoff (Netherlands Interdisciplinary Demographic Institute, The Hague, Netherlands)
- Policy research aimed to prevent environmental problems
  - Mathematical model of theoretical framework of P-E relationships
  - Development issues related to population and environment— case study of Eastern Zaire
- (m) Djuhari Wirakartakusumah (Demographic Institute, University of Indonesia, Jakarta, Indonesia)
- Problem of transmigration, forest fires and environmental degradation
  - Urbanization, industrialization and environmental health
  - Socio-economic characteristics of poor families
- (n) Michel Picouet (Laboratoire Population-Environnement, Université de Provence – ORSTOM, Fuveau, France)
- Interdisciplinary research on P-E issues : migration; farming systems; population pressure; environmental degradation
  - Interrelationship between physical and social aspects of population in a region (Tunisia)
  - Developing a questionnaire related to P-E issues
- (o) Wolfgang Lutz (IIASA, Laxenburg, Austria)
- Model building to identify the relationships between population, economy and environment : DODO model for Mauritius

- (p) Daniel Hogan (Nucleo de Estudos de Populacao, Universidade Estadual de Campinas, Brazil)
- Migration dynamics and their impact on environment in Sao Paulo
  - Environmental policy in Sao Paulo
  - Deforestation in the Amazon region and Atlantic rainforests
  - Study of a river basin in the interior of Sao Paulo : water quantity and quality; environment and society; population carrying capacity; eco-tourism; environmental quality and quality of life
- (q) Bill Gould (Department of Geography, University of Liverpool, UK)
- P-E in historical population studies especially in UK
  - P-E in Third World population studies : population impact analysis; health impact analysis; rural population pressures in Western Kenya, Northern Pakistan and Jamaica
  - The range of migration responses to environmental pressure
  - Fertility/migration relationships and local population pressure
- (r) Basia Zaba (Centre for Population Studies, London School of Hygiene and Tropical Medicine)
- Directory of P-E research
  - Demography of nomadic pastoral groups and their impact on environment
  - Fertility behaviour and agricultural societies in Africa, especially the effect of land inheritance
  - Migration and fertility in Bangladesh
  - Interaction between population growth, land tenure and land management problems
- (s) Ismail Serageldin (Hopkins Population Center, The Johns Hopkins University, Baltimore, USA)
- Ecology and fertility/fecundity
  - Toxic waste disposal
  - Conceptual framework integrating biosphere, technosphere and social sphere
  - Need for regional foci
- (t) Maurice van Arsdol (Population Research Laboratory, University of Southern California, Los Angeles, USA)
- Rising sea-level and coastal carrying capacity of population in California
  - Population response to pollution and urban crisis areas
  - Perceptions and attitudes to P-E relationships
- (u) Thomas Legrand (Departement de Demographie, Université de Montréal, Canada)
- Effects of move from subsistent to commercial agriculture in West Africa
  - Migration to Bamako and Dakar and the urban environment
  - Effects of irrigation on soil salination and health in Mexico
  - Pollution in Quebec
- (v) M.S.Jillani (National Institute of Population Studies, Islamabad, Pakistan)
- National conservation strategy

- Macro-spatial distribution models
- Inter-linkages between population, environment and development in a village of Punjab
- Population distribution, migration, urbanization and squatter settlement programme
- Carrying capacities of agro-ecological zones of Pakistan
- Coastal areas.

Leon Tabah summarized the presentations by noting (a) the complexity of the interrelationships, (b) the fact that among these population centres the effects of population growth upon environment appeared to be analyzed more than those of environment upon population, and (c) the comparative dearth of policy and global studies.

John Clarke noted that most of the proposed research themes in his introduction were being tackled by this small sample of population centres affiliated to CICRED, with the possible exception of the P-E relationships in settlement systems, and the addition of a number of conceptual, theoretical and cultural studies as well as modelling, an approach deliberately excluded from the programme of the IUSSP Committee on Population and Environment.

## **6. Discussion of Research Themes**

There followed a consideration of research themes, in particular ones which were additional to those proposed by John Clarke. Initially, however, there was a lengthy and rather inconclusive discussion on whether stress should be laid upon the effects of population on environment or vice-versa. Views varied from those who emphasised the environmental influence upon population, to those who stressed that CICRED represented demographic research centres and that we should use our demographic expertise and focus upon population characteristics rather than environmental characteristics. Others saw the need for integrated approaches and interrelationships. It was pointed out that many demographic studies have been inadequate when they have ignored the environments in which people live, and the positive and negative effects of both populations and environments upon each other. Certainly the field of P-E relationships was regarded as complex and difficult, but in these times of ecological crises, such as loss of biodiversity, global warming and rising sea-levels, growth of mega-cities, mountain deforestation, and over-concentration of population in Asian deltas, it is a vital interdisciplinary research field in which demographers have an important role to play. Too often the field had been over-simplified as one in which there was only one solution : population control. But populations cannot be easily controlled from a demographic viewpoint.

In the light of this general discussion, participants went on to identify a number of research fields supplementary and complementary to those previously proposed by John Clarke, listed earlier :

- (i) P-E modelling
- (ii) P-E policies
- (iii) P-E education
- (iv) Environmental quality and quality of life
- (v) Perception of P-E relationships
- (vi) P-E relationships in historical perspective
- (vii) Impact assessment of positive and negative, planned and unplanned effects of P-E relationships
- (viii) Analysis of energy/water consumption in P-E relationships
- (ix) P-E projections
- (x) P-E sanitation and community health
- (xi) P-E relationships under different occupational and family systems
- (xii) Field analyses of the Malthusian and Boserupian hypotheses

## **7. Selection of Three Broad Research Themes**

The second day's discussion was initiated with another presentation by the Co-ordinator, who commented upon the fact that the list of possible P-E research themes might be almost unending and that there was a need for CICRED to focus. The IUSSP Committee on Population and Environment had already decided to focus upon the relationships between population and (a) deforestation, (b) desertification and (c) heavily industrialized areas, as well as (d) gender-environment issues. At the same time, the ISSC Working Group on Population Data in the Human Dimensions of Global Environmental Change Programme were confined to looking at the problems of linking population and environmental data. He felt that the research themes might be divided into (a) hot (crisis) issues, such as deforestation, desertification, coastal concentrations, mega-cities and disasters, and (b) cold (later referred to as long-term or warm) issues, such as perceptions/ attitudes of communities to primary environmental care, migration as a response to environmental change, and the influence of environmental variables upon the cost of child-rearing.

Broadly, this approach gained favour with the participants, although notable qualifications and amplifications were made :

- that public issues should be taken into account;
- that the time dimension is important;
- that crisis issues are region and country-specific;
- that CICRED centres should find their own agenda;
- that hot and warm issues should be examined under the three key demographic variables : fertility, mortality, migration;
- that there was a need to define demo-ecological indicators;
- that different regional strategies should be in the context of global strategies;
- that researchers should be aware of population planning strategies and environmental planning strategies, so that they could be matched;
- that interdisciplinary co-ordination of research poses problems;
- that CICRED should participate in the current debate at the global level, as well as at other levels;
- that resources cannot be distinguished from environment, and that population is a resource;
- that the concept of sustainable development, though not easily defined, is very important in the context of using resources for the benefit of mankind in perpetuity;
- that comparative P-E studies should be undertaken in developed and developing countries (though this view was contentious);
- that large-scale modelling had not been very useful;
- that emphasis should be given to micro-studies of P-E relationships within communities, as well as the effects of exogenous forces and the effects transmitted to other areas;

- that a proper methodology was required with both quantitative and qualitative approaches, a theoretical framework, and a clarification of how to use existing data and what kinds of new data are necessary; and
- that a literature review was desirable.

At this stage, it was decided that for purposes of simplification it was appropriate to give consideration to three broad research themes :

- theoretical framework and methodology
- crisis issues
- long-term issues

Accordingly, the meeting divided into three working groups to consider further these themes.

### **8. Theoretical Framework and Methodology**

The working group (Chairman Serageldin) tackling this topic produced at least three descriptive, analytical models to provide a framework for further consideration:

- (a) The first relates P-E to development (Figure 1). The physical environment consists of natural resources, embedded in and subject to the laws of the ecosystem. To a certain extent, the ecosystem possesses regenerative capacity : this determines to what extent natural resources are renewable. Once environmental use exceeds a critical threshold level, environmental degradation sets in, eventually leading to environmental exhaustion.

Together with other factors of production, natural resources enter the production process. In general, the final output may be allocated to three final uses:

- consumption, determining the standard of living;
- investment in capital, technology and education, increasing the capacity to produce in the longer run; and
- environmental protection, increasing the natural resource base, especially relevant when environmental stress exceeds the critical threshold level of regenerative capacity.

Population affects directly :

- consumption = demand for output
- labour = factor of production.

One important example of an indirect effect of population is that the population growth rate determines the fraction of output which has to be reserved to maintain the current level of development. The higher the growth rate the more difficult it becomes to invest (= develop) or to protect the environment (= achieve sustainability).

- (b) The second model (Figure 2) identifies the relationships between population dynamics and the environment. When studying P-E interactions, a first step is to distinguish between the effects of E on P and P on E, because they have different mechanisms. It is also important to distinguish between the factors that influence the population of a given territory (i.e. fertility, mortality and migration) and the population characteristics (size, distribution, structure) that

Figure 1.

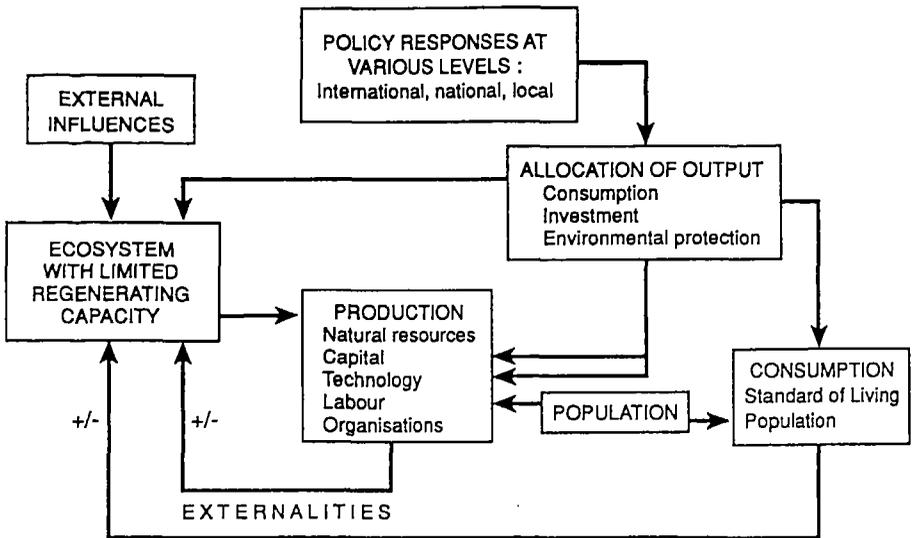
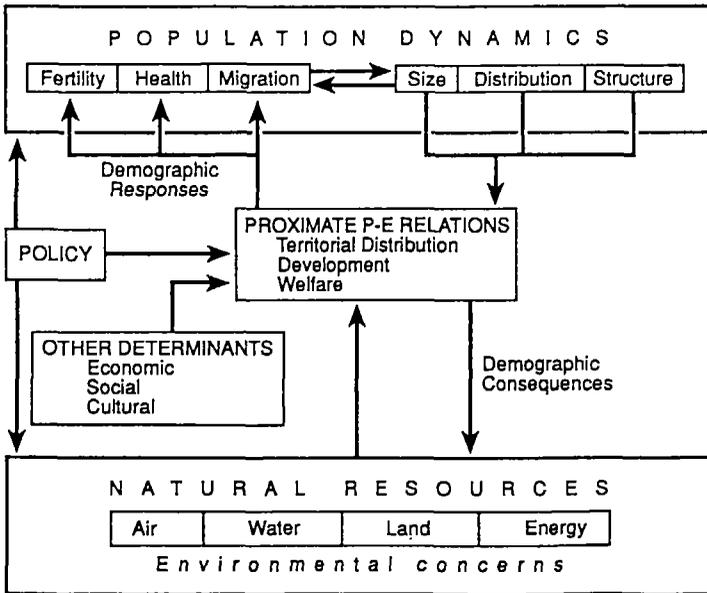


Figure 2



influence the physical environment either directly but mostly indirectly through a complex system of intermediate variables and mechanisms.

As for the environment, it is useful to distinguish four aspects identified by the four basic elements described by the pre-Socratic ancient Greek philosophers : air, water, land and fire (= energy). In question is the sustainable management of these basic resources to support human life on earth.

- (c) Thirdly, in view of the diversity of P-E relationships, it was proposed that the following three groups of research issues should be distinguished :
- (i) Population, territorial distribution and environment : concentration, settlement systems, in-migration and out-migration, coastal areas, communities etc.
  - (ii) Population, development and environment : the impact of work processes and technologies in the primary, secondary and tertiary sectors.
  - (iii) Population, welfare and environment : education, communication, health, nutrition.

Within each of these three groups crisis issues and long-term issues may be identified, at different scales and over different time periods.

The participants in this working group were conscious that they had not produced predictive models for policy use, but hoped that the mechanisms might be more clearly understood.

## 9. Crisis Issues

The working group (Chairmen : Ajaegbu/Ouaidou) looking at hot/crisis issues distinguished three levels :

- (a) Macro : Global warming  
Ozone depletion  
Loss of biodiversity and species extinction
- (b) Meso : Acid rain  
Mego-cities  
Deforestation  
Desertification  
Pollutions
- (c) Micro : Deforestation  
Desertification  
Drought  
Volcanic eruptions  
Flash floods  
Earthquakes  
Landslides, soil erosion  
Forest fires  
Wastes and pollutions  
Industrial disasters  
Noise  
Poverty

Some of the crisis issues may start at the micro-level, but later multiply to the meso-level or even to the macro-level. Demographers are required to analyze the population dimensions of these issues : how population contributes to these processes, how they affect

the population, how many are affected, how people respond and adapt. Hitherto, many of the statements regarding the population dimension have been very simplistic, stressing mainly the effects of population especially growth rates, migrations and concentration/urbanization, but neglecting or minimizing the effects of environment on population. Demographers should analyze all aspects : impact of populations, consequences on populations and responses/adaptations by populations.

The working group also suggested that the crisis issues might be further grouped according to their relatedness in the following way :

(a) Mega-cities and conurbations

Industrial concentrations and pollutions  
Wastes – household, etc.  
Water resources  
Floods  
Urban slums and poverty  
Noise  
Acid rain  
Ocean pollutions etc.

(b) Natural disasters

Earthquakes  
Landslides  
Floods  
Forest fires etc.

(c) Drought and desertification

Bushfires  
Overgrazing  
Overcultivation, etc.

(d) Deforestation

Settlement effects  
Loss of biodiversity, etc.

(e) Agriculturally caused disasters

Pollution of soil  
Soil erosion and gullyng, etc.

(f) Global issues

Warming  
Ozone depletion  
Sea-level rises etc.

These issues should be studied with a view to determining:

- how populations contribute to the processes involved in the issues (e.g. through population size, growth, concentration, etc);
- how populations are affected by the catastrophes (e.g. survival, security, health, quality of life, quality of environment, development); and
- how populations respond and adapt to disasters, including the strategies and survival/adaptation options open to them.

The linkages and interrelationships should be examined on the basis of loops between population and environment variables. Feedback loops should be part of the modelling of the specific research topics.

Finally, after some discussion, especially concerning the significance of policy matters and unacceptable differentials in consumption patterns, it was decided that the key crisis issues for proposed research by CICRED centres were the P-E relationships, including policy implications, in the five following :

- (i) growth of mega-cities and large conurbations
- (ii) the process of deforestation
- (iii) the process of desertification
- (iv) the occurrence of disasters/catastrophes
- (v) the growth of contrasting consumption patterns.

### 10. Long-Term Issues

The working group (Chairman : Raymundo) concerned with long-term issues gave initial consideration to the directional effects of population on environment (e.g. loss of biodiversity, clustering, urbanization) and of environment on population (e.g. environmental refugees, cost of children). They found the Malthusian and Boserupian positions central to the long-term research issues. The impact on the environment was seen as Population (P) x Affluence (A) x Technology (T)

$$\text{where Affluence} = \frac{\text{Consumption}}{\text{Population}}$$

$$\text{and Technology} = \frac{\text{Impact}}{\text{Consumption}}$$

<u>According to Malthus</u> : either	P is constant	
	or	P + A-
	and	A- P-
<u>According to Boserup</u> :	P+ T-	
		T- A+
<u>According to Optimists</u> :	A+ P-	

However, some regarded the Malthusian/Boserupian dichotomy as contentious and too polarized.

The group then went on to specify seven long-term research issues in P-E relationships :

- (i) the effects of rising population on land management and agricultural productivity
- (ii) the effects of rising population on water management and availability
- (iii) the effects of climatic changes on long-term population distribution
- (iv) the effects of migration and urbanization on the environment
- (v) the effects of environmental change on migration
- (vi) the effects of pollution and environmental degradation on maternal and child morbidity and mortality

- (vii) the effects of population growth on local biodiversity through increasing crop specialization and/or loss of wildlife habitats.

## **11. Conclusion**

After identifying and accepting the key crisis and long-term issues for P-E research by CICRED population centres, the meeting concluded with the Chairman's reiteration of the policy of CICRED to recommend these topics to affiliated centres on the understanding that they are not mandatory. Inevitably, centres have their own research agendas, but it is hoped that the identification of key issues will encourage and stimulate common approaches and international collaboration. In this vein, the Co-ordinator on behalf of the IUSSP Committee on Population and Environment looked forward to further collaboration with CICRED in this research agenda.

30 November, 1991

## POPULATION PROSPECTS WITH SPECIAL REFERENCE TO ENVIRONMENT

by

Léon TABAH

During the next 35 years the world will be the object of an unprecedented demographic evolution with considerable economic and social consequences, as well as impacts on the environmental resource base upon which sustainable development ultimately depends.

According to the United Nations (1) and to the World Bank (2) demographic projections, we have started to witness a genuine change in the world with the beginning of what is called the demographic transition of the Third World countries, that is their progression into a phase of declining fertility accompanying the declining mortality.

The generations born since the early '60s will experience during their young and adult life an upheaval in the world demographic map owing to the inevitable staggering of entry into the phase of transition which, obviously, will not happen at the same time and at the same pace in all countries. Some countries, notably those in Africa south of the Sahara, have scarcely begun the process, and it would indeed be superficial to view this as merely "historical backwardness", while almost all other countries are rushing ahead so fast that they will reach the end of the process two or three times quicker than many developed countries in the nineteenth and up to the beginning of the twentieth century.

The passage through the demographic transition signifies that the quantitative changes of the population would occur with qualitative transformations that would entail necessarily extensive repercussions on the world economy and on the environment. One wonders whether for the first time population growth would be intimately associated in the Third World with more "affluence", and whether the theory of transition – a major theory of demographers – should not be entirely revisited.

Or, to phrase this basic question in another way : to what extent will the demographic transition of the Third World bring about subsequent increased demand for energy, food, water, and will be linked with more stratospheric ozone depletion, greenhouse effects, and global spread of air pollution?

One argument which arouses scepticism about the application of the theory of demographic transition in the Third World is that for the industrialized countries the process was a "silent revolution", extremely slow, induced by the progress of education and general well-being, while in many Third World countries the process is deploying very fast, impelled by policies at governmental level with considerable exhortation from mass media and without significant advance in consumption. To take the example of China – one quarter of the entire Third World population – the abrupt decline of fertility has been accomplished essentially thanks to governmental measures and surveillance at individual level. In all Asian countries, as well as in many Latin American countries, strong incentives towards family planning are playing a decisive role on the fertility decline.

If this reasoning is correct, the merit of population policies and of family planning programmes should be recognized as an action permitting not only the acceleration of the demographic transition and therefore, as obtaining faster, lower volumes of population when

the transition is complete, but also to accomplish this result with less industrialization, and generally less detrimental effects on the environment, in contrast with the industrialized countries whose lifestyles are the sources of the primary risks to our common future. These have been the main beneficiaries of the wealth accumulated through the processes of economic growth that have produced environmental degradation and resources depletion.

It is not necessary to justify this assertion to consider that population growth is the only, or even the main, factor of the deterioration of the environment. Other factors are also at play, especially the technologies utilized since the last world war, and unequitable development which have seen the economic and social situation of the South worsening, particularly since the 1970s.

Let us consider this aspect. In the second part of this article we will discuss the demographic outlook and its environmental consequences.

## I. THE EFFECTS OF THE POPULATION ON THE ENVIRONMENT

The question of knowing to what extent population growth and distribution create a distinctive impact on the quality of the environment has become extremely controversial.

Surprisingly enough, the subject has not greatly attracted the scientific community of demographers. At the 1989 International Population Conference in New Delhi, there was no mention at all of the subject among the 89 papers presented and discussed. Only recently has a committee of the International Union for the Scientific Study of Population been set up under the chairmanship of Professor J.I. Clarke. This deficiency in the demographic community is all the more regrettable as the global risks for the environment have their roots at the local level which should normally fall under the competence of local or national institutions. It is well known that the problems of managing local common property resources are closely linked with the problem of protecting the global commons, such as the atmosphere and the ocean. The Survey made by the Preparatory Committee for the United Nations Conference on Environment and Development has shown that 70 per cent of the countries have identified environment and development problems associated with their population dynamics (3). Almost all countries today have ministries or agencies for environmental policy design and implementation backed by appropriate legislation (4).

More and more economists consider that environmental consequences are not adequately recognized in economic accounts and they are interested in the environment factor as they start envisaging environmental resources as economic goods. The evaluation of net national product should include environmental resource use as other goods and services. Environmental resources are more and more part of a standard economic thinking in a broad ecological system whose carrying capacity is far from being infinite. See for example Partha Dasgupta and Karl-Goran Maler (5), N. Keyfitz (6).

It has been hitherto difficult to assess the scope and scale of the linkages at work between population and the environment, and how they operate. One reason is that the necessary environmental data are generally absent, especially for developing countries. We have not reached the situation in which we are actually able to trace the causalities between population, environment, resources and development. Therefore, it is not surprising that extreme views are rife on the subject.

Some authors have concluded that population growth is an essential, and even dominant, factor of the environmental deterioration : P.R. Ehrlich and A.H. Ehrlich, 1991 (7),

National Academy of Sciences, 1991 (8), N. Myers, 1991 (9), R.E. Bilborrow, 1992 (10), and others.

According to these authors, population pressures constitute a determining factor among many others. The three factors population, consumption and technology interact in a multiplicative fashion on the environment with other factors such as socio-economic inequities, cultural constraints, government policies and the international political order. Each of the three factors reinforces the others' impacts, but the role of the population is bound to be significant, even when population growth is relatively restricted.

N. Myers gave some illustrative examples in support of his assertion. During the 1970s and the 1980s, the amount of per capita arable land declined by 1.9 per cent a year, due to population growth surpassing the expansion of arable land, and led necessarily to the application of fertilizers and pesticides to cope with the growing needs of a growing population, consequently deteriorating the resources base.

Myers estimated that grain gained from the effects of the Green Revolution – irrigation, fertilizers and other inputs – were worth 29 million tonnes a year, equivalent to the world needs to feed the population increase (28 million tonnes at current nutritional levels), while the total loss from all forms of environmental degradation adds up to 14 million tonnes of grain output a year.

The emission of carbon dioxide is estimated at 2.4 billion tonnes in 1950, and at least 6.8 billion tonnes in 1985, with an average increase of 3.1 per cent a year. As the rate of population growth was 1.9 per cent annually, Myers drew from these figures the conclusion that population was responsible for two-thirds of the increase in carbon dioxide emissions, while the "affluence" and the technology factors were jointly responsible for only 1.2 per cent a year.

According to a recent study by OECD (11), for the time being, a proportion of 30 per cent of emissions of carbon dioxide are produced by developing countries and 70 per cent by industrialized countries. These proportions would likely be reversed by the end of the first quarter of the next century, according to the US Office of Technology Assessment (12), with the population growth of the Third World on the one side and with measures of environmental conservation taken by the industrialized countries on the other side. If this comes true, it signifies that the environmental problems, mostly from today's industrialized countries will turn to be essentially caused by today's Third World.

As concerns the emissions of methane, which cannot be as readily reduced as emissions of carbon dioxide, its production is bound to increase with population growth since it comes from rice paddies, ruminant livestock, biomass burning, natural gas, which are all expected to expand with the increased food needs of the growing population and dietary upgrading. To cater for the increased food needs, land productivity should increase by 50 per cent in developing countries by 2025 according to L.A. Paulino (13) cited by Myers. Yet, in many parts of developing countries, especially Africa as a whole, food productivity has been contracting because of land degradation and poor agricultural planning.

The Third World currently produces 17 per cent of global chlorofluorocarbons (CFCs), one of the main ozone-depleting chemicals, but with the growing demand on refrigerators, one of the major producers of CFCs, the Third World would expand CFC production tenfold under the joint effect of population growth and amelioration of well-being. Nonetheless, we might anticipate that the expected increase of refrigerators in the Third World will be due more to reducing the backwardness of the consumption rather than to population growth.

We have to acknowledge that the population factor is playing an important role in deforestation with the need for cheap energy and the practice of slash-and-burn by landless farmers. According to J.C. Allen and D.F. Barnes (14), an increase of 1 per cent in population is associated with an increase of 0.5 per cent of deforestation in the Third World. If their

econometric analysis is correct, it means that in all developing countries the deforestation rate is about 1 per cent a year, which is extremely high. As a matter of fact this is only an average and in Africa the rates are much higher in countries such as Nigeria (14 %) or Ivory Coast (15 %). The two main proximate causes of deforestation in the Third World are new agricultural settlements on to increasingly marginal lands and the high cost of energy leading to the use of fuelwood (R. Bilsborrow, 1992 (10)), while the ultimate causes are population growth and poverty. A study by FAO (15), based on a statistical analysis for 60 developing countries concluded that population growth is significantly associated with deforestation. And the future is not promising : according to the UN demographic projections almost 80 per cent of the population of 2025, some 6 billion inhabitants, is expected to be living in tropical areas of the world, putting pressure on the remaining forests.

The impact of population growth and redistribution, especially the absolute increase in human numbers each year and migration to cities are also playing a direct substantial part in water shortage. It is already estimated that as many as 2 billion people live in areas with chronic shortages, with the water often contaminated by pollutants and pathogenic agents. Human consumption of water has doubled this century and it will at least double again with the population growth during the next three decades (16).

If the analysis of the authors convinced of the responsibility of the population factor in the deterioration of the environment were confirmed, the resolution of environmental degradation should rest, at least partly, in the control of population growth, therefore essentially in the Third World.

Barry Commoner (17), also in search of the respective influence on environmental quality of the three factors, population, consumption and technology, made the opposite conclusion. Discussing through decomposition analysis the number of automobiles as an indicator of the pollutants emitted in 65 developing countries over the period 1970–1980, he came to the result that, in the annual rates of change of the environment, the population was responsible for 2.5 per cent, affluence for 0.2 per cent and technology for 5.4 per cent. In sharp contrast to the previous authors, Commoner concluded that the influence of technology on environmental impact is more than twice as high as the influence of the population factor. He arrived at similar conclusions concerning the production of electricity (effect of population : 2.7 per cent, average annual change in GDP per capita : 0.7 per cent, average annual change in electricity with respect to GDP : 8.1 per cent), and concerning the impact of nitrogen fertilizer (population : 2.5 per cent, agriculture production per capita : -0.6 per cent, nitrogen use per unit of agricultural production : 6.6 per cent). In all these calculations, the effect of population seems in harmony with the rate of population growth, while the effects of the two other factors – consumption and technology – are essentially dependent on the nature of the technology used. What is surprising in this analysis is the very low, or even negative, impact of the consumption factor. We will see later that it might be very different in the future with the deployment of the population transition.

Whatever the quantitative impact of the population on the environment may be two conclusions emerge from the literature. First, population growth is not the sole force that undermines the environmental resource base, but one among others, and especially the technology used. What is variance are the respective shares of responsibilities and we should recognize that the statistical tools to deal with this basic question are extremely rudimentary. Secondly, the three factors, population, consumption and technology, interact in a multiplicative fashion, and it is these interactions that will matter in the future as the two last factors will have increased influence. Environmental economics and population growth and distribution will be tied to each other in an intricate web.

Let us turn now to the time horizon as we can assume that the next four decades will definitely witness a different demographic path from the past. As the populations of most of the Third World, except sub-Saharan, are entering into lower fertility rates with growth rates nonetheless extremely high by historic standard, the interactions of population and the two other factors will exercise their full strength, unless two conditions are met, jointly or independently.

These two conditions are :

- 1.-- The development of the Third World will be achieved in a different way than for the industrialized countries, with alternative options made with "clean technologies".
- 2.-- The decline of fertility will not be accompanied by much affluence, contrary to the theory of demographic transition, as was experienced in the past by the industrialized countries when the concerns of the environment were almost absent.

Concerning the first condition, we should recognize that some growth in the use of energy by developing countries is inevitable and for the present time, development scenarios for these countries follow the same material-intensive patterns as the industrialized countries. As a matter of fact, the economies of the Third World countries that are experiencing strong economic growth are all adopting an energy-intensive heavy industrialization phase. This is the case of Korea, Taiwan, the countries that belong to the Association of Southeast Asian Nations (ASEAN), and more recently Turkey, Mexico, Brazil. In 1950, there were 6,000 factories in Taiwan; the number is now around 100,000. Last summer the standard index of pollution in the industrial center of Hsinchu reached twice as much as during the worst days in Los Angeles.

Bangkok, Peking and Manila rival Taipei as concern pollution. Throughout all Asia measures of safeguarding the environment are absent or ignored. The decision-makers consider that the costs of environmental protection are too high and are having constraining effects on their development strategies. In all developing countries, the development concerns surpass environmental ones, at least for the time being. Preventing soil degradation at the village level has less priority than the increase of food production to feed a growing population.

Besides, the poor do not in general have the means of undertaking soil conservation measures that would preserve their resources. Their first task is to meet immediate basic human needs. To do so, they are often compelled to overexploit the natural resources on which their long term development depends.

Preventing carbon dioxide emissions by restricting automobile transport in cities like Mexico, Cairo, Bangkok, Rio de Janeiro, or Sao Paulo, is attempting the impossible. Exerting pressure on developing countries to shift to environmentally-sound technologies is putting a burden on the economies of these countries. At the present time, the technologies of industry, agriculture, transportation are basically the same in developing countries as they are in the rich countries, without the resources for the adoption of measures to protect the environment. It is very unrealistic to request the developing countries to take preventive measures of environmental pollution by abandoning the production technologies that generate it. As the Brundtland Commission stated in 1987: "The industries most heavily reliant on environmental resources and most heavily polluting are growing most rapidly in the developing world where there is more urgency for growth and less capacity to minimize damaging side effects". It is therefore irresponsible to call for "environmental protection" without assessing what effects such protection will have on the economic activities of the Third World.

Besides, the industrialized countries themselves have not been able to shift the technologies adopted since the 1950s : use of inorganic nitrogen fertilizers, synthetic pesticides, synthetic petro-chemical products, truck freight, etc. They are not ready to return to earlier less productive technologies until new safe technologies are devised. It is generally recognized that nuclear energy is creating problems, as a matter of fact not unexpected, and that the present nuclear plants are badly ageing, requiring additional cost for their maintenance. There is growing concern for the costs of disposal, without a real solution for the present. It is estimated that 800,000 children have been affected by the Chernobyl catastrophe. More than 600,000 hectares of land and forest are unexploitable for a very long period in the region. The demographic consequences of the Chernobyl events in the areas of the catastrophe have been recently and openly discussed by L. Rybakovsky (18): decline of fertility, concerns about a likely increase of morbidity and mortality, desertification in large areas. It was a national disaster and any repetition could have an international dimension.

If it is true that industrialized countries contribute more to environmental damage than the developing countries the latter also suffer more than the former. The Bhopal catastrophe is a case in point which, unfortunately, is bound to be repeated in developing countries if industrialization occurs without the necessary financial needs. The Brundtland Commission stated that the common need for global environmental security requires a substantial and sustained increase in the flow of financial resources to support the broad development needs of developing countries.

The main question is : is the date of reaching the end of the population transition too close for permitting most current technological constraints to be overcome? At this stage, is it likely that the expansion of agricultural production will be feasible on a world scale without dire environmental effects if the present technologies, such as those of the "green revolution", are modified? We should remember that, in Asia, the increase in agricultural production is possible only through increased productivity rather than through an increase of arable areas. Is it likely that the industrialization of the world will be accomplished with proper energy before long?

## II. THE DEMOGRAPHIC OUTLOOK AND ITS ENVIRONMENTAL IMPLICATIONS. An open-ended demographic future

The world's future in demographic terms would seem to be very open-ended, judging by the United Nations' projections, since the high and the low variants put the population in 2025 at 9.42 and 7.59 billion respectively, i.e. a difference of 1.83 billion. The truth probably lies somewhere between the two. But it is obviously not a matter of indifference whether the actual figure will be closer to one or the other as far as resources and the environment are concerned, even if 91 per cent of this 1.83 billion difference were accounted for by today's developing countries and only 9 per cent by today's developed countries, which consume more raw material and cause more environmental pollution. It is true, on the other hand, that a good number of developing countries are also responsible for damage to the environment as a result of the poverty and many of them will progressively experience a form of development, as we will comment now.

### The growing diversification of the Third World

Many of today's developing countries are and will be moving into the category of industrialized countries. We are witnessing a demographic diversification in the Third World. The simple two-speed pattern of population growth of twenty years ago has been superseded by one that is increasingly varied. All the signs are pointing to a world where demographic change is taking place at several speeds and giving rise to a vastly different geographic distribution of its population. The idea of a North-South demographic divide is no longer valid, as can be seen from both the United Nations and World Bank projections. It is equally obvious that, at the same time, we are beginning to see the end of a pattern of economic development at two or three speeds. The world scene is becoming even more varied and one where today's developing countries will move in different directions, with some rapid catching up on the industrialized countries from both the demographic and the social and economic standpoints. The "old Third World" is split into diverse degrees of successful developers and the rest. And, looking at this more closely, it is obvious that those countries which are quickest in accomplishing the demographic transition are the ones best placed in terms of international competition. Take the example of the "four dragons" so often referred to : they are now well into the post demographic transition phase and there is little or no difference between them and the countries of Western Europe in terms of both fertility and mortality. In the radical changes that are beginning to occur within the hierarchy of world powers it is clear that countries that were for a long time considered as underdeveloped will soon be up among the leaders.

It is equally clear that, while accomplishing the demographic transition will not in itself ensure development, without this demographic transition development in the Third World is inconceivable. Even in a soft form as we will discuss later on.

### A persisting poverty

Though the idea of an "ever-widening divide", so widely accepted during the 1950s and 1960s, is by no means a thing of the past, the divide is no longer simply between the whole of the North and the whole of the South, but between the North plus a substantial part of the South, on the one side, leaving on the other side large black spots that are likely to persist for a good many years to come. These areas include almost all of sub-Saharan Africa, where under-exploitation of natural resources, compounded by totally unrestrained population growth, political unrest and environmental damage is isolating this sub-continent from the world economy.

In Asia, which comprises the most heterogeneous collection of countries from both the economic and demographic standpoints, the future of many populations looks scarcely more hopeful. Alongside the dramatic success stories there are, according to the World Bank, 600 million people living in "absolute poverty". This means not only low income and malnutrition but also lack of access to education, health care, housing, drinking water and main drainage. This poverty is rife not only in Bangladesh, Myanmar, Pakistan, Afghanistan and Cambodia, but also in countries where the overall situation is beginning to improve, as in the Philippines (where it is estimated that 35 per cent of the total population live in poverty) and Sri Lanka. In India it is reckoned that 40 per cent of the population, and more particularly the inhabitants of the North-Eastern states, are below the poverty line. In China 130 million people, mainly in rural areas, are known to be living in penury.

In short, it can be said that a substantial proportion of the Third World's inhabitants, an estimated 1 billion at least, are untouched by the process of development and, since this vast population has not yet gone through a process of genuine demographic transition, it is likely to double by the year 2025. In 1985 it accounted for 40 per cent of the lowest income group (below \$ 480 per head according to the World Bank) totalling an estimated 2.4 billion people. It is to be hoped, of course, that a proportion of this population will move out of "absolute poverty" before it doubles. The way the world demography evolves will, to a large extent, depend on what the future holds in store for this vast section of the world population, since it is destined to have the most prolonged and highest growth rate. Its magnitude, constantly renewed, has been singularly resistant to reduction in all parts of the world and its persistence is beyond our comprehension.

Demographers as well as environmentalists are keeping a constant eye on the poorest of the poor. Demographers for the reasons we just mentioned, and environmentalists are also maintaining a strong interest in this fraction of the population because they consider that poverty and environmental degradation are closely linked, as are opulence of the industrialized countries with the environment, with the difference that the poor bear the brunt of the environmental damages while the rich have the resources to try counteracting them. The poor living in absolute poverty are dependent for their survival upon the environmental resources of soil, water, forests, fisheries and biotics that make up their main stocks of economic capital, they have no alternative than to exploit their environmental reserve base at an unsustainable rate, causing irreversible injury, deforestation, desertification and soil erosion on a wide scale. It is well recognized that poor people are forced into ways of living which induce further destruction because of the complex cycles of poverty, inappropriate development and environmental deterioration. In many countries most domestic energy comes directly from biomass resources. In some sub-Saharan countries, such as Burkina-Faso, Chad, Ethiopia, Malawi, Mali, Niger, Senegal and Tanzania, wood accounts for 90 per cent of national energy consumption, even in rich oil-producing countries such as Nigeria (Eckholm and al (19)). Urbanization is not mitigating the problem as urban consumption of wood is to be blamed as well as rural consumption. Some studies describe the surroundings of sub-Saharan cities as deforested "rings of desolation". According to G. Barnard and L. Kristofersen (20), as the energy crisis is worsening, a considerable amount of the world population will be forced, in a near future, to consume wood faster than it is being grown unless new sources of energy are made available to poor people.

And it is the women who endure the most the consequences of environmental deterioration. There is a growing literature on the subject, well summarized by I. Dankelman

and J. Davidson (21). Once again, we have to recognize that women are playing a central role in both population and environment.

### **The build-up of a momentum which will weigh heavy on the future**

During the forty-five postwar years, the world has built up a substantial growth momentum within its demographic structures as the result of high birth rate during this period, as evidenced by the fact that, despite the slower growth rate, the absolute figure of world population will continue to increase for several decades. From 2.5 billion in 1950 the world population had doubled by 1987, will exceed 8.5 billion in 2025 and, according to the World Bank, is likely to be over 11 billion by the end of the next century. According to the United Nations medium variant, the annual increase, 47.2 million in 1950-1955, rose to 80.7 million in 1980-1985 and will continue to rise to a peak of 95.5 million. It will not be until 2020-2025 that the annual increase will drop back to its 1980-1985 level. According to the high variant, the annual increase is likely to climb to a figure of 126.3 million by 2020-2025 before it begins to drop back.

In terms of individual countries a good example of this growth momentum is Kenya, which has one of the world's highest population growth rates (4.04 per cent between 1985 and 1990 according to the United Nations figures). Half of this growth can be calculated as being due to current reproductive behavior and the other half to past reproductive behavior.

As was said earlier, the UN projections are based on the assumption that each country in turn will reach a situation of zero growth. The World Bank has worked out the figures for these stationary populations which in many cases are substantial multiples of the 1985 figures. Take the case of Algeria : the 1985 population was estimated at 21.9 million. The fertility rate is expected to fall from 5.9 for 1985-1990 to 2.1 for 2025-2030, with a population at that date of 57.8 million but which would continue to increase up until 2100, by which time it would have reached the stage of a stationary population of 80.4 million.

It is interesting to compare the projections for Algeria and Tunisia. Algeria, which until 1985 had not managed to formulate a family planning program that had any real impact on fertility, is destined to see an almost fourfold increase in its population, whereas Tunisia, which as early as the mid-1960s adopted a policy that encouraged family planning, can expect its population to increase "only" about two and a half times before reaching the stage of zero growth, which it will do over a shorter space of time (7.1 million in 1985 to 17.3 million in 2075). And this is despite the fact that these two countries around the year 1960 had fairly similar birth rates. Algeria has recently decided to adopt a policy of "maîtrise de la croissance démographique". But a delay in adopting a population policy is always very difficult to retrieve and it can cause insoluble problems, especially with a fragile environment characterized by insufficient water resources.

### **A relatively new phenomenon : migration due to environmental degradation**

There is likely to be a far higher level of migration from regions in the world with high population growth and low development into regions with the opposite characteristics, i.e. with a depressed demographic pattern but with very healthy economic development, particularly since, as recent years have shown, the former are in many cases politically unstable, thus prompting flows of workers and their families. The developed world will find itself with diminishing and ageing labor force and faced with a young and abundant labor supply in the Third World prepared to cross the ocean in search of work. Migration, in fact, is coming from further and further afield, facilitated in increasingly less expensive means of transport. This is particularly true as regards Europe and the Southern and Eastern Mediterranean, where for the moment no real center of development is emerging as is happening in Asia and to a certain extent in Latin America.

With the intensification of migration, internal or international, the human environment of most inhabitants will change drastically. And with the combination of differential fertility and international migration it will also change the ethnicity distribution of the population.

In certain years flows of migrants are also affecting regions of the Third World depressed by environmental degradation towards other parts of the Third World, or of the industrialized countries. More and more migration flows tend to ignore borders of Third World or industrialized countries. Let us take one example, even if it might be considered as an extreme case : the Sahel region in Africa. In Mali a demographic survey conducted in 1985 provided information on the causes of migration (B. Thiam, 1992 (22)) : causes relating to drought accounted for 51.5 per cent as compared with 45.7 per cent related to work or study and 28 per cent for family or other reasons. There are good reasons to believe that the Mali case is only one among many others, especially Brazil, and that with continuous environment deterioration in the Third World the exodus could grow considerably. S. Ricca (23) estimated that around 1983, 35 million Africans live outside their countries of origin, i.e. 8 per cent of the sub-Saharan African population, one of the highest as compared with other large regions of the world. There are mass migrations into tropical countries due in part to both population growth and deforestation. N. Myers cited the cases of Colombia, Ecuador, Peru, Bolivia, Ivory Coast, Nigeria, India, Thailand, Vietnam, Indonesia and the Philippines.

It is true that international migration, or migration among African countries, has been part of the African way of life for generations, pastoral nomadism being a distinguishing cultural feature of African population but more and more environmental reasons are gaining significance. One of the most extreme and striking cases is the migration caused in the areas of the Chernobyl catastrophe. R. Rybakovsky (18) indicated that in the Kiev province where the population got the information sooner than others the positive balance of migration of 93,000 people in 1985 was replaced by a negative one of 49,000 in 1986. And many more inhabitants want to leave the areas, especially in Gomel area of Byelorussia. The economic factor is no longer the main cause of migration flows and the environmental one could take sizeable dimension in the future.

The geographical distributions of the populations within the countries are far from optimal according to the resources and to the environment. Sixty per cent of the world population already live in coastal areas and sixty five per cent of cities with populations above 2.5 million inhabitants are located along the coasts. This growth of coastal populations is exerting strong pressures on the marine environment and its resources, and they become increasing sources of pollution as sewage discharge effluent goes directly into near-coastal waters. As more than half of the humanity lives in coastal areas the potential changes in sea level as a result of global warming should draw considerable attention before these changes occur.

Also, with global warming intra-regional shifts in agricultural productivity, and consequently in geographical distribution of population, will possibly take place which is beyond any forecasts at this time. Some adaptation of the population will necessarily have to take place.

Ecological risks due to a combination of climatic changes, rapid urbanization and high density of population – and we will see that some densities in the Third World could reach high levels in the some densities in the Third World could reach high levels in the future because of population growth – could jeopardize the life in many parts of developing countries should natural catastrophes occur.

### The prospect of demographic transition in the Third World

What are the prospects of the world demography during the next decades according to the United Nations and the World Bank projections ? And when will the demographic transition be completed in these projections ?

It can be reasonably assumed that the demographic transition will be completed, or approaching completion, when the total fertility rate (TFR) is 2.1 since this generally goes with a life expectancy permitting population replacement. This does not, however, imply zero growth, because of the time lag in the adjustment of the structure to fertility and mortality effects. For the world as a whole, the medium-variant projection of the United Nations extrapolated to the year 2030 gives an aggregate TFR of 2.1, a growth rate of 1 per cent, a 70-

year life expectancy at birth (for both sexes), and a 70 per cent rate of urbanization. This process of demographic transition would be almost completed in the Third World as a whole, the world containing 7.1 billion inhabitants in the countries of today's Third World and 1.4 billion in the today's industrialized countries.

As an indicator that a country is well on the way to completing its demographic transition, we selected a TFR of 2.5 rather than 2.1, because experience has shown that at that stage, although it has not fully completed its transition it is not far off, and that it is well down the path to economic, industrial and social development.

Table 1 indicates when the different countries are expected to attain a total fertility rate below 2.5. Table 2 provides aggregate populations for the major world regions at various dates, divided into two groups of countries, depending on whether their TFRs will at that time be above or below 2.5. Both sets of calculations are based on the United Nations medium-variant projections.

All the columns in Table 2 concern today's developing countries, except for the two right-hand ones, which show aggregates for today's industrialized countries and for the whole world respectively. The regions are those used in the United Nations projections.

At the beginning of the projection period, in 1985, few Third World countries other than China had a TFR below 2.5. They were mostly countries with relatively small populations, below 5 million : Mauritius, Hong Kong, Barbados, Cuba, Martinique, Puerto Rico. Between 1985 and 1990, the four countries which enter this group (apart from South Korea : 44 million inhabitants in 1990), are once again of limited population size, and the same can be said of those added between 1990 and 1985 : Sri Lanka, Guyana, Jamaica and Thailand. It is towards the end of the century that countries with large populations – mostly in Asia – begin to appear in the low-fertility group : Turkey in 1995–2000, Tunisia, Indonesia, Fiji, Malaysia, Vietnam, Argentina, Chile, Colombia, Costa Rica, Mexico, Panama in 2000–2010. Then, between 2010 and 2020, many countries make their entry : from North Africa (Algeria, Egypt, Morocco), Latin America (Brazil, Dominican Republic, Ecuador, Peru) or Asia (Bahrain, East Timor, India, Kuwait, Philippines, Myanmar). At the end of the projection period (2020–2025), we find three African countries (Cape Verde, Ghana, South Africa), some from the Near East (Iran, Jordan, United Arab Emirates), and above all, Bangladesh, Pakistan and Cambodia.

Nonetheless by the year 2025, a long list of developing countries will still be a long way off completing their demographic transition : 40 out of the African countries, 8 Latin American countries and 8 Asian ones (5 of them in the Near East).

At the turn of the century, almost all Asian countries and much of Latin America should consequently be well on the way to completing their demographic transition, while sub-Saharan Africa and part of the Near East will still be a long way off. According to the World Bank estimates, we cannot expect TFRs of around 2.5 for a large part of sub-Saharan Africa until the year 2050. Moreover, this is only an average, and a considerable number of African countries would still have TFRs exceeding 3 : Niger, Malawi, Rwanda, Mali, Mauritania, Gambia, Sierra Leone.

What is striking is that, between now and the year 2025 – a mere 35 years – the population of the countries which will have completed, or almost completed, their demographic transition will amount to almost 6.8 billion, or five times that of today's industrialized countries (Table 2). Thirty-five years is an excessively short period for a transformation of such amplitude, given that the countries concerned will also by then somewhat industrialized and highly urbanized. A much longer time was necessary for today's industrialized countries to come to the end of the demographic transition process, and become both industrialized and urbanized. It seems an impossible challenge for the Third World, and the world as a whole, if the international community does not fundamentally change its ways of reacting and thinking, in particular from the environmental standpoint. Production, whether industrial or agricultural, should be conducted so as not to weaken or diminish our planet's capacity to sustain life, and so as to protect our environment in both the present and the future.

TABLE 1 : Period when a total fertility rate (TFR) level below 2.5 will be reached

1980-1985	1985-1990	1990-1995	1995-2000	2000-2010	2010-2020	2020-2025	Beyond 2025	Beyond 2025
Mauritius China Hong Kong Barbados Cuba Martinique Puerto Rico	Reunion Korea Guadeloupe Uruguay	Sri Lanka Thailand Guyana Jamaica	Israel Surinam Trinidad Turkey	Tunisia Indonesia Fidji Malaysia Viet Nam Argentina Chile Colombia Costa Rica Mexico Panama	Algeria Egypt Morocco Bahrain East Timor India Kuwait Myanmar Philippines Brazil Dominican Ecuador Peru	Cape Verde Ghana South Africa Cambodia Bangladesh Jordan Iran Laos Nepal Pakistan UAE	Angola Botswana Benin Burkina Faso Burundi Cameroon Chad Congo Comoros Djibouti Eq. Guinea Ethiopia Gambia Guinea Guinea Bi Ivory Coast Kenya Lesotho Liberia Libya Madagascar Malawi Mali Mauritania Mozambique Namibia Niger Nigeria	Rwanda Senegal Sierra Leone Somalia Sudan Tanzania Togo Uganda Zimbabwe Zaire Afghanist Bhutan Mongolia Oman Qatar Saudi Arabia Yemen Bolivia El Salvador Guatemala Haiti Honduras Nicaragua Paraguay Venezuela

Source : United Nations. *World Population Prospects 1990*.

United Nations, New York, 1991. Medium variant.

TABLE 2 : Population projections (in millions)

	North Africa		South Sahara	Latin America	Caribbean	Central America	Temperate America	Tropical America	Asia
	Africa	Africa							
<b>1985</b>	TFR > 2.5	553	123	430	390	17	105	223	1649
	TFR < 2.5	2	0	2	14	14	0	0	1065
<b>1990</b>	Total	555	123	432	404	31	105	223	2714
	TFR > 2.5	640	141	499	430	19	118	247	1780
<b>1995</b>	TFR < 2.5	2	0	2	18	15	0	3	1209
	Total	642	141	501	448	34	118	247	2989
<b>2000</b>	TFR > 2.5	745	159	586	471	18	131	274	1911
	TFR < 2.5	2	0	2	22	18	0	3	1376
<b>2010</b>	Total	747	159	588	493	36	131	274	3287
	TFR > 2.5	865	179	686	407	18	38	299	1810
<b>2020</b>	TFR < 2.5	2	0	2	131	21	107	3	1774
	Total	867	179	688	538	39	145	55	3584
<b>2030</b>	TFR > 2.5	1135	209	926	366	21	40	0	764
	TFR < 2.5	13	11	2	262	22	133	61	3344
<b>2040</b>	Total	1148	220	928	628	43	173	61	4108
	TFR > 2.5	1260	66	1194	158	25	49	0	848
<b>2050</b>	TFR < 2.5	192	190	2	559	23	151	66	3723
	Total	1452	257	1196	717	48	200	66	4571
<b>2055</b>	TFR > 2.5	1291	73	1218	184	26	54	0	228
	TFR < 2.5	306	201	105	573	24	159	70	4556
<b>Total</b>	1597	274	1323	757	50	213	70	424	4784

Source : United Nations. *World Population Prospects 1990*.

United Nations, New York, 1991. Medium variant.

### Doubts about the demographic outlook

Should the United Nations and the World Bank projections be realized, there will be many more areas of development and environmental crises in the future. The crises could be such that they cast doubts about the materialization of the projections. Some distortions would necessarily occur such as different trends in fertility, less improvements in health and mortality and intensification of migration.

First, these projections are presented as if they were vectors unaffected by any external factors, proceeding in a vacuum without any hindrance. They are not endogenized. It is this that makes them scarcely credible as soon as they go beyond one or two decades. One of the first certainties is that each of the following factors – population, environment, food and energy – has assumed global significance and interacts closely with the others.

The second reason for doubt is that it is not conceivable that some form of demographic equality will gradually emerge at the end of the demographic transition given that this situation will apply not only to the world population as a whole but also to that of each individual country. It is difficult to accept this idea since it would imply either that people will become equal in terms of economic and social conditions, or that differences in economic, social and even cultural conditions will no longer have any effect on either fertility or mortality.

So far, however, no hypothesis of any other kind has been put forward and perhaps therefore, for want of anything better, we can accept the idea, provided the calculations are not extended too far into the future, following the example set by the United Nations.

A third serious doubt as regards these projections is the seeming implausibility of many of the results. For example is it conceivable that Africa with its many ecological and economic problems, where school enrolment rates and the number of doctors are the lowest in the world, where industry is limited and where there is a growing division between vast urban conglomerations and immense tracts of derelict land, is likely to see its population increase sevenfold between 1950 and 2025, and thirteenfold between 1950 and the end of the next century? The population of Africa, which represented less than 10 per cent of the world population in 1950 would see its share rise to over 25 per cent – unless, of course, it is assumed that there could be massive emigration, a hypothesis which demographers working in international organisations have not dared to put forward; or that mortality rates could cease to decline and would even rise as a result of the worsening of nutritional and economic conditions, the emergence of new diseases as AIDS or the resurgence of illnesses such as malaria, or cholera ; or that there could be a combination of all these adverse circumstances – something that cannot be ruled out, at least in certain regions.

Is it likely that the Sahel countries (Burkina Faso, Chad, Gambia, Mali, Mauritania, Niger and Senegal) will see their populations increase fourfold on average between 1985 and 2025, and by almost as much again between 2025 and the end of the next century ? The population of Ethiopia, which has been going through one famine after another over the last twenty years, is forecast to increase threefold between 1985 and 2025, and by as much again by the end of the century. Rwanda's population density is expected to rise from 232 per km<sup>2</sup> in 1985 to 841 per km<sup>2</sup> in 2025 and to double by the end of the century. In Nigeria, where according to the FAO the carrying capacity of the land is already very limited, population density is forecast to triple between 1985 and 2025 when the population would be 300 million, that is to say virtually the same as the present population of western, southern and northern Europe combined. In Bangladesh, the population density already exceeds 800 per km<sup>2</sup> but the figure is expected to reach 1,600 by 2025 and close on 3,000 during the course of the next century. The population of Algeria, where there is concern about the available water resources and reserves, is forecast to double between now and the year 2025 and rise by at least a further 40 per cent during the next century. There are many other examples which could be quoted that cast doubt on the projections, particularly when they are taken too far, but which nonetheless are valuable in demonstrating that deviations in trajectories are bound to occur and that an attempt should be made to envisage these.

The paradox with these projections is that the populations forecast to expand the most rapidly in the future are precisely those that are being subjected to the strongest demographic pressures, and which for a number of decades have been confronting problems that they are unable to solve and that are getting worse.

Admittedly, it has been true that, until now, the poorer a population was, the faster its growth. But tomorrow's world is unlikely to be a repetition of yesterday's and it is very probable that populations facing difficulties, because of the deterioration of their environment for example, will try to move into less hostile surroundings : in fact, we are already beginning to see migratory movements in Africa and Brazil caused by deterioration of the environment as we said earlier.

A fourth source of doubt is just how quickly birth control will become widely practised in the poorest part of the Third World, especially sub-Saharan countries, and it is this which leads us to believe that, for these countries, the high rather than the low variant of the United Nations projections is likely to be closer to the truth.

These medium-variant projections forecast that the fertility in Africa between 1990–1995 and 2020–2025 will drop from 6.00 to 3.05 – in other words a far sharper fall than occurred in India, despite persistent unsuccessful governmental dissemination of contraceptive methods over the last few decades.

It seems likely that the more plausible hypothesis for Africa will be the high-variant projection for a drop in the fertility rate from 6.32 in 1985–1990 to 3.96 in 2020–2025, rather than the medium-variant figure of 3.05. The low-variant projection of a drop in the fertility rate to 2.45 (the rate of the industrialized countries twenty years ago) would seem to be quite unrealistic. Unfortunately for mortality, the assumptions for Africa as a whole should also be on the high levels. We will come to this point later.

The United Nations and World Bank projections for a relatively steep decline in sub-Saharan Africa and the poorest regions of the Third World are only likely to be proved correct if recourse to contraception were to change. So far, the use of contraceptive methods has been conditional on acceptance of them, determined to a great extent by the improvement in women's status and level of education, and the more general improvement in living conditions. It is not inconceivable that we may see the development of what might be termed the "contraception for the poor people". It is not inconceivable that a fertility transition take place in response to economic hardship, as was suggested for sub-Saharan Africa by E. Boserup (24), helped by large-scale campaigns to promote birth control using ever more powerful and wide-reaching mass media. It is virtually certain that the future will see the introduction of cheap modern methods of contraception within the reach of even the poorest members of society, and that the current inhibitions about their use will gradually disappear. Such publicity campaigns are already being waged vigorously in Asia, Latin America and even in Africa north of the Sahara; by contrast, south of the Sahara, they are still timorous or even non-existent. It should also be mentioned that governments have never been so convinced as now of the need to contain population growth when this is unduly high. In this respect, considerable progress has been made since the first major policy conference on the subject, held in Bucharest in 1974 and even the one held in Mexico in 1984.

### Concern about health and mortality, especially sub-Saharan Africa

A fifth reason of doubt and concern about the projections of the UN and the World Bank concerns the mortality trends, about which 5 points may be made :

- 1.-- It is suspected that there has been an increase in mortality rates in tropical countries. It is virtually certain that malaria is staging a strong comeback and there is a clear and steady rise in the incidence of this disease. The World Health Organization reckons that there are no less than 1.7 billion inhabitants of tropical regions facing the threat of malaria because the situation there is unstable and getting worse. The latest estimates put the current number of cases of malaria per year throughout the world at 100 million and the number of carriers of the parasite at 264 million, mostly

on the African continent and in Central and South America, particularly Amazonia. In some countries where the disease is rife, such as Nigeria, Kenya and Gambia, between 20 and 30 per cent of the deaths of unweaned infants are due to malarial infection. The WHO also reports a recrudescence of venereal disease as a result of population movements or lack of health care facilities.

- 2.-- The extraordinary and dramatic appearance of AIDS on the world health scene is another growth source of concern. It is more of a pandemic than an epidemic disease and one which is liable to become a significant demographic factor. In J. Caldwell, P. Caldwell and P. Quiggin's (25) views the sociological and family structures of Africa are likely to make the population of this continent particularly vulnerable to this pandemic. Unofficial figures for some sub-Saharan Africa countries put the number of infected adults as high as 20 per cent and even more in urban areas in West and Central Africa. According to the last report of WHO, 10 to 12 million people have been already infected and for the year 2000 the figure could reach 30 to 40 million. Heterosexuality is responsible for 90 per cent of the infected people and 10 per cent concern children infected by their mother. It is estimated that 8 to 10 million children will be infected by the year 2000, most of them in sub-Saharan Africa. In fact the virulence of the pandemic is related to a number of behavior patterns, and which are not easily modified since they are rooted in the social fabric. It is in this context that J. Caldwell places the sexual and conjugal behavior of African populations. In regions with the highest incidence the death rate could double, which means that one out of two deaths would be attributable to AIDS. According to G. Heilig (26) the progression to AIDS seems to be only a matter of time in industrialized countries, and will have a significant effect on life expectancy, unless a cure and a vaccine could slow down the pandemic. The same could be said for developing countries.
- 3.-- The third cloud on the horizon in the Third World as far as health is concerned stems from these countries' economic difficulties. These are causing cutbacks in expenditure on health care, which already represent a far from adequate proportion of their total budget—rarely more than 5 per cent.
- 4.-- Fourthly, environmental damage may make health progress an illusion, or partly cancel out its effects. The extension of deserts diminishes food supplies. Pollution and lack of water encourage the spread of diseases transmitted by this medium. Water also represents a danger in those regions of the Third World which are subject to flooding, particularly in tropical America and Asia (eg. Bangladesh). Traditional barriers to infection often give way with migration to overpopulated and insalubrious cities, where health care facilities cannot keep up with population growth, all the more so given the economic restrictions.
- 5.-- In the fifth place, many Third World countries which are well down the path to development are rapidly joining the levels of health and mortality of the industrialized countries, so that what can be said now is that there is a widening gap in terms of health and mortality between, on the one hand, the industrialized countries and those countries of the Third World which are making economic progress and, on the other hand, those Third World countries that are not managing to move into the stage of demographic transition and of development. This brings us to the idea that the differences between countries in terms of health and life expectancy are not tending to disappear.

#### Uncertainties about the rich countries

There are finally as many question marks about the demographic future of the industrialized countries as about that of the Third World. The industrialized countries have entered into what is termed the "post-transition phase" for which there has been no precedent. Neither governments nor experts have any direct experience of this phenomenon whose causes are rooted in society itself and could be eliminated only as the result of radical change.

As far as the demographic future of the developed countries is concerned, we are in the dark, as is evidenced by the vagueness of the term "post-transition phase". All of the alternatives outside the well-trodden paths are open. The industrialized countries no longer have the certainty of the transition theory that has been guiding them until now. The only certainty is that of an inevitable ageing of the population and of having become magnets for the poor and jobless of the South. The projections concerning these countries are more a matter of judgement than genuine science.

### Overview and conclusions

The environmental concern, and the costs of dealing with it, is another factor widening the gap between industrialized countries and the Third World as there is no doubt that population growth and its increasingly unbalanced distribution within the countries are playing a definitive role on the deterioration of the environment. Admittedly, the true quantification of the relationship is subject to heated controversy and many intervening factors are operating with the population in a complex web, such as poverty, modern technologies aimed at increasing the production to keep up with the population growth and the need to catch up on living conditions with the industrialized countries, uneven income distribution, and so on. It might even be that these factors are more responsible for the environmental degradation than population.

It is likely that for the present time the Third World is more responsible for factors affecting the environment linked with population – deforestation and water shortage – whereas industrialized countries are more responsible for factors linked with the industrialization. The relative impact could be around 1 to 3. Nonetheless, with the process of population transition of the Third World, and some forms of "affluence" associated necessarily with it, the relation could change drastically, and even reverse in a not too distant future.

We have commented that many of today's developing countries are or will be moving into the category of industrialized countries and that there is a causal chain : demographic transition–development–industrialization–environmental problems. Never have we had so much evidence as we have today of the effect of demographic factors on development. If we take a close look at this, we see that it is those countries which are quickest in reaching the stage of demographic transition which are best placed on the international economic scene, and further ample evidence of this can be found in the contrary examples of sub-Saharan Africa and some Asian countries such as Pakistan, Bangladesh, Cambodia. It can also be said that it is those countries which are in the midst of this period of demographic transition that have the advantage as regards the development of their economy, benefiting as they do from a steady inflow of plentiful and cheap labor. The newly industrializing economies of Asia possess the three prerequisites for success, i.e. the emphasis placed on agriculture, a process of industrialization focussed from the outset on exports and a demographic policy designed to curb population growth.

A major issue is whether the countries which have completed their transition, or are getting closer to that stage, will have the technological and financial resources to remedy environmental damage. An estimate based on the United Nations medium variant indicates that, by about the year 2025, the population that will have completed the phase of demographic transition, and thus have achieved some form of industrialization, will be 6.8 billion, of which 1.4 billion in today's industrialized countries and 5.4 billion in today's developing countries. We can imagine what this means in terms of consumption of natural resources and efforts to prevent deterioration of the environment. What will the air we breathe and the water we drink be like if this population of about 6.8 billion human beings, which will have completed the phase by the year 2025, also manages to industrialize as it hopes to do as the 1.2 billion inhabitants of today's "rich" countries are doing? Going from 1.2 billion to almost 6.8 billion "post-transition" inhabitants in the space of only 35 years will create enormous problems of adjustment. And the source of these problems will not be the size of this population, but its propensity to damage or, on the contrary, to preserve the environment.

Is the theory of demographic transition to be revised, since fertility may turn down sharply without real development, and therefore without strong industrialization? This is what the case of China might suggest. But this country is an exception, and its rapid fertility decline was the result of a vigorous unprecedented policy. Further, China can be expected to reach by the year 2025, or shortly after, an advanced stage of development and industrialization. The country will be in a good position to recover during the next century the dominant position it occupied during the first millenium, thanks to its massive population.

One of the basic questions is whether those countries which will be going through the phase of demographic transition will have the ability to develop in a manner different from that of today's industrialized countries, that is to say with less energy than is required for development by today's industrialized countries. The question is well discussed by N. Keyfitz (27); "If a tight relation exists between energy use and income, and for unalterable physical reasons the correlation is as high as it is in the world today, then there is no way that the LDCs can attain the incomes of the developed countries...". In this connection, the rich countries' pleas for good behaviour are likely to fall on deaf ears so long as they themselves are not setting the example of "clean industrialization" or transmitting their "environment-cleaning" technologies and, most important, the resources needed to apply them in the developing countries.

There are indications that the United Nations high-variant projections are more plausible than the medium-variant projections for the poorer countries of the Third World, at least as regards fertility. For sub-Saharan African or other very poor countries, the assumptions of both fertility and mortality decline on which the projections are based seem highly unrealistic. The health problems encountered by the poorer countries, with the AIDS pandemic and the resurgence of malaria and more recently cholera, translate the catastrophic health conditions prevailing in many of these countries, which could put a brake on population growth as commented by J. Caldwell (28). Under the most pessimistic scenario, both fertility and mortality decline would slow down, delaying the end of the demographic transition. The medium-variant projection would only be accurate because of errors in both variables which would cancel one another out in the final rate of growth.

Whatever the case, these calculations show that there is something contradictory about a Third World policy which consists in accelerating the demographic transition by encouraging family planning, while taking no, or very few, steps to preserve the environment. The nearer a country draws to the end of the demographic transition, the more urgent it needs action to protect its environment. The two policies, family planning and environmental protection, should be closely associated if the balance of the ecosystem is not to be severely disrupted, and the association must be a very long-term one. We may say that, to support family planning in the Third World without providing the means necessary to protect the environment, is to be guilty of disrupting this balance. In population and environmental policy alike, the rich countries are responsible to the developing ones, as they are to themselves, for transmitting the necessary technologies and resources for implementing them.

Clearly, it is first and foremost to the one billion inhabitants lagging behind as regards demographic transition and development that the information and education campaigns on contraception should be directed in order to slow population growth over the long term. During the second half of the next century, the growth in world population is likely to come almost entirely from sub-Saharan Africa.

Finally, the hypothesis of a move towards a certain degree of demographic homogeneity, with the scenario of stationary populations in almost every case by about the end of the next century, as forecast by the projections is unconvincing. As Paul Demeny (29) writes, "the idea of a trend towards a stationary population may be justifiable from a normative standpoint, but it lacks support from the theoretical, empirical and historical standpoints". There is no objective necessity for a stationary population and there is no historical basis for it. Future demographic trends are not programmed, and a stationary population is not their automatic outcome. And, in fact, differences in fertility and mortality have never been as marked as they are today : the ratio of the fertility rate of Germany or Italy and that of many sub-Saharan countries is 1 to 5. These differences have grown over time,

instead of diminishing. Differential demography will continue affecting all sorts of relationships among countries.

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The International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria :  
Wolfgang Lutz

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To understand and analyze the complex linkages within economies, societies and the environment requires an inter-disciplinary, systems approach. IIASA scientists are currently undertaking studies designed specifically to explore and illuminate the many complex links.

IIASA was asked by the World Federation of United Nations Associations to provide scientific support to the Secretariat of the UN World Conference on Environment and Development (UNCED) held in Brazil in June 1992, by examining some of the underlying social, economic and institutional causes of unsustainable development; by building conceptual models expressing the most important linkages; by examining some policy directions for sustainable development and the challenges that systems analysis faces in formulating and implementing these policies; and through a number of case studies, illustrating the usefulness of systems analysis in meeting these projects. A draft report was sent to UNCED by December 1991 and a final book will be published in 1992. The studies make use of contributions from IIASA's work on energy use and global change, climate change strategies, biosphere dynamics, forestry, water resources and population, and that of the Netherlands Institute for Public Health and Environmental Protection (RIVM).

The linkages among energy use, patterns of emissions and depositions of oxides of sulphur and nitrogen oxides, and risk of forest damage will be examined in case studies. Research also includes case studies of the linkages among industrial activities, patterns of emissions and depositions of heavy metals and environmental toxification.

Another important case study is examining the linkages among population change, development and environment in a small relatively closed system – the island of Mauritius – with a view to evaluating alternative development paths. IIASA is working with the University of Mauritius.

Work will also continue on a study of the linkages among population, agricultural development and the environment, with special reference to Africa and Asia, especially in those countries that will heavily influence future trends of global change. It will also provide an interactive simulation model to study the consequences of population growth on rising food demand, agricultural intensification and expansion, soil availability, climate change and environmental degradation.

A further activity, in collaboration with the Department of Geography, University of Uppsala, Sweden, will involve mapping in a GIS the degree and extent of environmental change that could occur in relation to the spatial distribution of population, and ecosystems vulnerable to such changes.

Future work will depend to a certain extent upon the outcome of UNCED.

Centre International de Formation et de recherche en Population et Développement (CIDEF),  
Université Catholique de Louvain, Louvain-la-Neuve, Belgium

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CIDEF is the result of collaboration of two institutes created by the University in the 1960s - L'Institut d'études du développement and L'institut de démographie - supported by UNFPA and the Belgian government, and it will be transferred to Africa from 1995. The two institutes have their own well established teaching and research programmes, and L'Institut d'études du développement includes several regional research visits for the contemporary Arab world (CERMAC), Latin America (CRLA), Africa (CRA) and Euro-Asia (EACDE), while L'Institut de démographie organises the celebrated annual colloquium, La Chaire Quetelet.

CIDEF runs a third cycle course for professionals on population and development, which is linked with its Global Programme of Training in Population and Development, which is part of the comprehensive effort of UNFPA to assist developing countries in the integration of population into development strategies, policies and programmes. It is being undertaken in conjunction with host country governments and participating institutions: the Centre of Development Studies (CDS) at Trivandrum, Kerala State, India; the Institute of Social Studies (ISS) in cooperation with the Netherlands Interdisciplinary Demographic Institute (NIDI) at The Hague, Netherlands; and the Latin American Demographic Centre (CELADÉ) at Santiago, Chile in cooperation with ECLAC.

The Global Programme gives special attention to the interrelations between macro-economic policies, social development and population dynamics. It addresses itself to staff members of macro-economic policy and planning units, ministries of education, health, social development, agricultural planning and industrial development, to population programmes officers and to individuals having operational responsibilities at field level. In line with UNFPA policy, the programme also gives special attention to issues concerning women and to increasing women's opportunities to participate in development as decision-makers, programme planners and community workers.

Since February 1991, CIDEF and the two institutes have come under the Département des sciences de la population et du développement of the Université Catholique de Louvain, which has created a study group on 'Population, environment and development', which is increasing inter-disciplinarity.

ORSTOM et le Laboratoire Population-Environnement  
de Marseille (LPE), Université de Provence, Marseille, France : Michel R. Picouet

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ORSTOM, LPE and several Tunisian organizations - L'Institut Sylvo-Pastoral de Tabarka (ISPT), L'Institut des Régions Arides de Medenine (IRA) and the Commissariat Régional de Développement Agricole de Siliiana (CRDA) - have created an inter-disciplinary research group, comprising social and natural scientists, which has launched an experimental study of the interrelationships between the evolution of natural environments and population dynamics in three rural regions of Tunisia.

The experiment is based on the following stages:

- to describe the state of degradation of the natural environment and to identify the immediate causes; and in parallel, to analyse the demographic and social dynamics in function of land ownership and use, with the objective of proposals for regional development;
- to study the processes of adaptation of populations to their environments, especially the impact of movements of population, and to appreciate the influence of historical evolutions on agro-pastoral systems of production;
- to put forward medium-term proposals for new P-E balances through reconstruction of degraded environments.

Prospective analyses come after the initial studies which will be undertaken simultaneously and will involve (1) the synchronic approach looking at the problems of population growth and pressure on ecological elements in relation to social and economic aspects; and (2) the diachronic approach looking at evolutionary and historical aspects, the effects of thresholds, potentials for regulation and problems of ecological reversibility. They will open up a wide variety of fields of study, which will pose problems for reconciliation.

The bio-climatic gradient is steep in Tunisia, and consequently three contrasting regions have been chosen, all particularly affected by degradation of soils and vegetation:

- 1 The North-West region, mainly comprising the mountains of the Kroumirie and the Mogods, largely covered by cork oak forest, with abundant rainfall, vegetation intimately linked with human activity, high population density and recent out-migration.
- 2 The region of Siliiana in central Tunisia, with steppe covered spurs affected by erosion, traditional cultivation and transhumance, rising population pressure and pastoral activities, constant planning interventions and recent out-migration.
- 3 The region of the shotts and oases in the south, with low and irregular rainfall, rare and degraded vegetation affected by oasis extension, relatively dense and rapidly growing nomadic and sedentary populations affected by out- and in-migration.

The main aim of the research is to establish the precise relationship between natural environments and population by identifying and using demo-ecological indicators, a very difficult task, but which will throw light on the human and environmental implications of development.

Netherlands Inter-Disciplinary Demographic Institute (NIDI), The Hague, Netherlands :  
Evert van Imhoff

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This program, which is still in its preliminary phase, studies the interrelationship between demographic development, social and economic development, and the environment. One of the main goals of the present activities is to formulate research projects that are capable of bringing in structural financial support for environmental studies.

NIDI has undertaken a case study on "environmental management and population pressure" in the Virunga National Park, North Kivu, Eastern Zaire. This two-wave survey studies the local population's attitudes with respect to the environmental significance of the National Park, against the background of severe population pressure in the area leading to a quick expansion of settlements and agricultural land towards and across the borders of the Park. Deforestation outside the Park is almost complete and the Park itself suffers from illegal tree cutting, as well as poaching.

Recently, an analysis was completed on the way in which global demographic concerns have been incorporated in the report "The first global revolution", published under the auspices of the Club of Rome. In this analysis, the world population problem was subdivided into four distinct sources of concern:

- 1 Overpopulation is a problem in itself: congestion, mega-cities
- 2 Population as a scaling factor in the aggregate impact on natural resources:  $I = PAT$
- 3 Population growth inhibits economic development: growth continues poverty. Apart from poverty as a problem of its own, this mechanism also supplements the impact of population on the environment: poverty leads to marginal agriculture, resulting in deforestation, erosion and desertification. Therefore, the relationship between population and environment cannot be studied without taking into account the much wider issue of economic development and the distribution of welfare.
- 4 Unequal distribution of population growth, in combination with unequal distribution of economic resources, may lead to international conflicts and mass migration.

A final conclusion was that, irrespective of whether or not population is an independent source of problems, population control may be an effective and essential component of policy measures required to fight problems of environmental degradation and economic underdevelopment.

Institute of Geography and Spatial Organization, Polish Academy of Sciences, Warsaw,  
Poland : Alina Potrykowska

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The main areas of research activity in the field of population–environment studies may be summarised as follows:

- 1 Research methodology: survey research
- 2 Population data issues: population census data; population research from the register data; bank of population and natural environment data
- 3 Population studies: population change and migration; fertility and mortality; multiregional population projections; internal and international migration
- 4 Population concentration and deconcentration: project on depopulation of rural areas in Poland – expert report
- 5 Identification and analysis of P–E crisis areas: the analysis and the synthesized map of natural environment of Poland, and the environmental pollution; the identification of 27 hazardous regions in Poland; the Atlas of Natural Environment in Poland
- 6 P–E relationships in settlement systems: impact of the environmental degradation and the changes in the local rural settlement system; migration change – environment and the settlement system in Poland; the urban settlement system; the population in heavily industrialized regions; social structure and housing conditions in large cities
- 7 Migration in P–E relationships: the elderly migration and the natural environment in Poland; the environmental causes of migration
- 8 Health and environmental degradation: housing and living conditions and environmental pollution in urban agglomerations; hazardous regions in Poland (mortality and environmental factors)
- 9 Strategies and regional policy; regional policy in crisis areas: field research and strategies of P–E development in frontier regions; international comparative studies of Eastern and Western frontier regions in Poland.

Department of Geography, University of Liverpool, UK :  
Bill Gould

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The Department has long had research interests in population geography, in which a concern for population and environment (in a broad sense) has been central. Researchers in the Department with interests in population studies have collaborated in P-E studies with Departmental colleagues in physical geography with a major concern for long-term and medium-term environmental change, and also with colleagues in Economic History and Public Health, and with the Centre for African Studies, Institute of Latin American Studies and the School of Tropical Medicine. The two major areas of P-E concern are in historical population studies and in Third World population studies.

The main thrust of P-E research in historical population studies is in urban mortality studies in the UK, and it is likely that this work will be extended to North America in the near future. It has involved studies of infant mortality and occupational mortality, and is set against a context of concern for the urban environment and public health measures. Closely related are the broader issues concerning the politics of the various public health strategies in relation to changing epidemiological regimes. From these studies, and from collaborative work in Sweden, an overview is emerging of the impact of the environmental improvements on urban population change in early industrial cities.

Research interests in P-E in the Third World are, by contrast, concerned much more with migration and, to a lesser extent, with fertility than with mortality. Current work is in Africa, Asia and Latin America and the Caribbean, in critical areas where there is either a high rate of population change or significant environmental pressure or both. Inevitably, population analysis is a central issue in the environmental debate, both in GEC and the implications for long-term population redistribution away from vulnerable areas of drought and flood.

Recent and projected research activities in migration in the Third World have tended to focus on areas of considerable population pressure on the rural resource base:

- 1 Western Kenya: Research on colonial and contemporary patterns of movement from this densely peopled former labour reserve have emphasized the critical importance of circular migration as the prime means of alleviating local population pressures on land.
- 2 Northern Pakistan: Research has focused on the migration response of young people to new economic and educational opportunities in an area of immense environmental fragility in the Karakoram mountains.
- 3 Jamaica: Studies of migration and return examine the economic and social effects on rural and urban areas.
- 4 Brazil: Migration and malaria.

Two main themes arise from this Third World work: the range of migration responses to environmental pressure; and the fertility /migration relationships as responses to rising population pressure.

Centre d'Etudes et de Recherche sur la Population pour le Développement (CERPOD) de  
l'Institut du Sahel, Bamako, Mali : Nassour G. Ouaidou

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One of the essential missions of CERPOD is to help the Sahelian states to integrate the population variable into their planning and development, and therefore in the implementation of population policies and programmes. There is no doubt that rapid population growth is not the only obstacle to lasting development of Sahelian economies and to the resolution of their socio-economic problems, others being the limited health facilities, education, labour market and nutrition along with deforestation and deterioration in the urban environment. However, the simultaneous implementation of agricultural, environmental and population programmes would contribute to the solution of these problems and to the search for ways of lasting development.

The PAGE system has been elaborated by CERPOD and RTI in the framework of phases III and IV of the RAPID (Ressources pour L'Analyse de l'Impact de la Population sur le Développement) project financed by USAID, in order to examine the interrelationships of population, agriculture and environment in the context of the Sahel countries and to propose policies and programmes capable of solving identified problems.

The PAGE system is composed of three models: a population projection model, an agriculture model, and an environment model. PAGE is a population-driven model designed to initiate policy dialogue and to be used as a training tool to demonstrate the impact of population growth on the agricultural and environment sectors. The consumption of agricultural products and energy by urban and rural populations are simulated with this model. The initial version is a national level model with urban and rural "sub-regions"; but with slight modifications and sufficient data the model could be adapted for up to ten regions with urban and rural sub-regions.

Mali constituted the first application of PAGE in 1991, another country being added later in the year. The exercise is in close collaboration with ministerial departments, and in particular those of planning, agriculture and environment, where services in charge of policies, programmes and research are the preferred partners in the project.

Demographic Institute, Faculty of Economics, University  
of Indonesia, Jakarta, Indonesia : M. Djuhari Wirakartakusumah

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The Demographic Institute is conducting a series of studies on population and environment, reflecting the diverse P-E problems in Indonesia, arising especially from rapid population growth, rapid urbanization, big city growth, industrialization and population redistribution. The following researches have been undertaken:

- 1 Evaluation of the Transmigration Program: studies on the quality of life enjoyed by the transmigrants in four different provinces: former tidal lands which developed rapidly (eg. Siak in Riau), former tidal lands which developed slowly (eg. Rasau Jaya in West Kalimantan), dry lands which developed rapidly (eg. Pasir Pengairan in Riau), and a transmigration site which adopted the People's Core Program (eg. Alue le Merah in Aceh).
- 2 Urbanization in Indonesia: studies of residential areas expanding at the expense of relatively fertile farmlands, resulting in air, water and noise pollution.
- 3 Identification of poverty in Jakarta: to coincide with the implementation of government programs designed to improve the welfare of the poor. They include social, economic, cultural, health and demographic characteristics, the definition of poverty and indicators of levels of poverty.
- 4 The effects of industrialization and urbanization on environmental health: health characteristics of migrants in Jakarta to be compared with those of non-migrants in source areas of migrants.
- 5 Housing for low-income families in urban areas: to prevent forcible land acquisition, expansion of environmentally unhealthy neighbourhoods and increased slum areas, housing for low-income urban dwellers must be planned.

Indonesia's development is orientated to the eastern regions of the country. In this context, a study on how transmigration affects the environment will be enlightening. There will be rapid population mobility in the years to come. Consequently, inter-regional demographic schemes will be very important in anticipating how population mobility affects the environment. Experiences gained in resettling people to the western regions will be different from those to be encountered in the eastern regions.

National Institute of Population Studies (NIPS), Islamabad, Pakistan : M.S. Jillani

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The work of NIPS is in the context that Pakistan, from the global perspective, is not a major polluter or a major consumer of natural resources. It is faced, however, by rapid population and urban growth, low aggregate income, poverty, insufficient and degraded quality of basic human needs like potable water, sewerage, housing, health facilities and education, as well as environmental degradation resulting from the convergence of a limited natural resource base, an accelerating rate of economic and demographic change and inadequate institutions for resource management. NIPS encourages P-E studies and has future plans to examine all important aspects of the problem.

NIPS collaborated with the International Union for the Conservation of Nature and Natural Resources (IUCN) in undertaking a major policy review exercise in 1988. As a consequence, the government set up a National Conservation Strategy (NCS) to which NIPS provided an environment-demographer and facilities. The NCS has worked on various macro-spatial distribution models, allocating population growth across tehsils and agro-ecological zones.

NIPS is regularly making use of RAPID and STORY BOARD programmes, and presentations are made before national and regional leaders, drawing their attention to the effect of population growth on the social sectors, including quality of services, standard of living, and future requirements in different sectors with special reference to environmental conditions. It has also undertaken a case study on inter-linkages between population, environment and development in a village of Punjab, showing how although the village is not densely populated the degraded land and soil, brackish water for irrigation, and a lack of knowledge regarding natural resource management have led people to the conditions of poverty.

Another study examines the implications of rapid population growth on spatial distribution, squatter settlements and slums in big cities, and the resultant environmental hazards and deterioration in public services.

NIPS has also an undertaking with the NCS Secretariat to incorporate the P-E component into its on-going and future research. One proposal focuses on the carrying capacities and P-E linkages in the agro-ecological zones of Pakistan, specified in the NCS document. The main objective is to examine the spatial distribution, density, change and growth of population, which depend on the economic conditions and availability of food, and to find out the maximum sustainable size of resident population in a given ecosystem.

Population Institute, University of the Philippines (UPPI), Diliman Quezon City, Philippines :  
Corazon M. Raymundo

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Key P-E concerns in the Philippines are (1) continued rapid population growth which contributes to a decline in the quality of life for the majority of Filipinos; (2) encroachment of population into marginal ecosystems; and (3) continued influx of rural migrants into densely-populated urban areas. At national level, correlation between growth of population and trends in forest cover, land productivity, metropolitanization and changes in land use pattern have served as important inputs for adopting general thrusts in environment and development. But resource allocation and local-level planning and implementation need better data at specific geographic levels.

UPPI serves as an official backstopping research agency for the Philippine Population Program, and P-E is one of its recent areas of research interest; as such, there has been no systematic cumulative effort. Inasmuch as the population and environment linkage has been identified at the public policy level, the expertise of UPPI has been called upon in articulating, operationalizing and projecting the interrelationship for planning and program purposes. In response to this, the researches are reactive to some immediate need for information. Others are either indirectly addressed to environment factors or are conducted in areas which are environment-relevant. The following research topics have been undertaken either as the main implementing or a supporting agency:

- 1 Census of upland population (with Dept. of Environment and Natural Resources and National Statistical Office)
- 2 Projection of upland population (with University of the Philippines in Los Banos)
- 3 Population, resources, environment and sustainable development: University of Philippines Assessment Project
- 4 Urban slums and the fertility/health conditions of women and children (with Dept. of Health)
- 5 Agricultural development, status of women and fertility
- 6 Food, nutrition and population in urban areas (with University of the Philippines in Los Banos, and Food and Nutrition Research Institute)
- 7 Rural resettlement and development
- 8 Rural to urban migration and development
- 9 Rapid assessment of poverty areas in Metro Manila (De La Salle University)
- 10 Migration to the uplands
- 11 Continuing efforts in establishing levels and trends in fertility, migration and mortality in subnational areas

These topics cover most of the critical P-E problems, but the Philippines also unfortunately experiences a disproportionate share of natural disasters (earthquakes, volcanoes, typhoons) which have profound demographic, environmental, social and economic effects, arguing for a systematic and comprehensive inquiry.

Institute of Population Studies, Chulalongkorn University, Bangkok, Thailand :  
Bhassorn Limanonda

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Established in 1966, the Institute's MA teaching program in Demography includes a few courses related to population and environment: human ecology, migration and population redistribution, urban sociology, problems of urbanization and industrialization.

Most of the research projects carried out have concentrated on population studies, leading to nearly 200 publications over 25 years, but a few concern the interrelationship between population and environment, especially in the field of migration and population redistribution. The projects have investigated the impact of different patterns of population movement and mobility on socio-economic changes and environmental changes at both places of origin and destination, with significant implications for policy planning in Thailand. It is also hoped to expand research on the status of women and on women in development in order to incorporate environmental issues.

Some of the Institute's staff have joined with the University's Institute of Environmental Studies and other governmental organizations in carrying out research studies on environmental problems, many of which are associated with the rapid economic growth in Thailand during the last decade. Consequently, in recent years the Institute of Population Studies has put more effort into expanding its research interest in environment related issues. Like many other research institutes, it has also had the opportunity to join the University's program dealing with the impact of disasters upon human life. Two particular projects that it is investigating are the impact of (i) typhoons in the southern region of Thailand, and (ii) flooding caused by dam damage in the North eastern province upon population relocation, human settlement and social adjustment. The findings will be used to propose recommendations to the various governmental agencies for policy formation in dealing with environmental issues.

Population Research Laboratory and Department of Geography, University of Southern  
California, Los Angeles, USA :  
Maurice D. Van Arsdol, Jr. and Douglas Sherman

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The State of California contributes to and reflects global processes which are altering relations between population and environment. It experiences rapid population growth, large-scale migration from developing nations, reindustrialization, service sector development, rapid urbanization, factory agriculture, growing social, economic and ethnic differentiation and redistribution of population towards the interior. Major environmental problems include water supply, air quality, waste disposal, lack of infrastructure and climate change. There is a need to interrelate population and environment data, analyze California as a series of ecological systems, and specify the determinants and consequences of different population, development and environmental policies.

Past and recent research has addressed the following topics:

- 1 Energy and water resources: determine relations between efficiency of use of energy/water and output; projection of future energy/water use for subareas.
- 2 Pollution: perceptions of pollutions; pollution control and demographic behaviour with respect to pollution sources.
  - a) Air pollution – relations between population, air pollution per capita and total air pollution loads for pollution points, urban ecosystems and eventually for larger area; effects on population stocks and flows.
  - b) Waste disposal – paucity of sites for solid waste disposal.
  - c) Ocean pollution – effects of ocean mining, dumping and transport.
- 3 Organization of urban ecosystems: problems posed by future urbanization including size, densities and patterns of cities, physical features of cityscape, environmental modifications etc.
- 4 Loss of biodiversity in forest, desert and mountain areas.
- 5 Population redistribution and potential environmental refugee problems associated with underlying resident population pressures on land, forest and water resources, especially effects of toxic chemicals upon urban air basins, ground water supplies, watersheds and urban residents, and effects of global warming on coastal areas.
- 6 Climate modification, global warming and rising sea level: ascertain effects of rising sea levels and wave surges on low-lying agricultural, urban and metropolitan areas, especially crop land displacement, crop loss and population displacement from the densely populated coastal areas of California. Particular objectives are to predict and map the extent of the enhanced-risk zone for coastal hazards; develop appropriate population projections for coastal counties; and communicate results to "stakeholders" likely to affect the population and land use future of California.

Institute for the Study of Society, Population and Nature (ISPN), Brasilia, Brazil :  
George Martine

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ISPN is an independent, non-governmental, non-profit organization. It works under contract with federal, state and local governments, as well as with international agencies. ISPN collaborates with universities and research centers in the Amazon and Center-West regions, the rest of Brazil and abroad. ISPN receives donations from foundations and non-governmental organizations which share its concerns. Financial support from the John D. and Catherine T. MacArthur Foundation was instrumental in setting up the Institute, which maintains a permanent multidisciplinary staff, complemented by a wide variety of consultants for specific project. In specific cases, ISPN provides support to post-graduate students or post-doctoral fellows. Researchers at ISPN have a long tradition of research on the Amazon and the Center-West, covering a span of twenty years. They also have considerable experience providing advisory services to the public sector and to international agencies.

Projects and activities are currently being negotiated, executed or concluded with the Brazilian National Research Council (CNPq), Secretariat of Environment (SEMAM), National Program for the Environment (PNMA), Brazilian Association for Population Studies (ABEP), Vale do Rio Doce Company (CVRD), International Center for Tropical Agriculture (CIAT), State University of New York (SUNY), United Nations Population Fund (UNFPA), United Nations Children's Fund (UNICEF), United Nations Women's Development Fund (UNIFEM), the World Bank, the Embassy of France, the Rainforest Alliance and the Ford Foundation. In addition, technical consultancies are being carried out in various countries in Latin America, Africa Asia.

ISPN's main areas of activity are:

- 1 Population: migration, fertility, mortality, population and development, population and environment.
- 2 Regional development: urbanization, industrial development, frontier expansion, mining, spatial concentration and deconcentration.
- 3 Social development: poverty, women, children, minorities, social policy.
- 4 Rural development: agricultural modernization, rural employment, colonization, agrarian reform.
- 5 Health: tropical diseases (particularly malaria in the Amazon), social and economic aspects of health.
- 6 Evaluation: monitoring and evaluation of the impact of public health policies.
- 7 Research methodology: survey research, field research in frontier regions, use of census data.

Centre for Population Studies (CPS), London School of Hygiene and Tropical Medicine,  
London, UK : Basia Zaba

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As a population centre, CPS has undertaken a wide range of demographic research but has only recently interested itself in P- E research, conceptually and practically. A number of projects have concerned researchers over the last few years, especially in Africa (Sahel, Kenya) and Kazakhstan.

The latter country has experienced a major transformation through huge irrigation projects which have led to unparalleled ecological disasters in an area of very rapidly growing population - drought, stagnant swamps, salination, wind blown salt, etc. Further agricultural pollution has been caused by the excessive quantities of insecticides and artificial fertilisers which have contaminated the soil and drinking water. In addition, industrial air pollution in the cities, particularly from the petro-chemical complexes, and radiation from atomic testing sites in the north of the Republic are causing concern because of their possible health effects.

The research programme proposed is to evaluate the components of demographic change in Kazakhstan, and study their relationship to indicators of environmental degradation on a district basis. The implications of future growth, combined with industrial and agricultural activity in the region, will be assessed in terms of both local and global environmental effects. Survey methodology will be developed to integrate demographic and environmental information at the household level, which would be of particular relevance to the needs of rapidly industrialising developing countries. The research programme will not only involve nutritionists and demographers of the London School of Hygiene and Tropical Medicine, but also the Central Asian Forum of the School of Oriental and African Studies, and the Institute of Geography of the Kazakh Academy of Sciences. The latter Academy are compiling a GIS to monitor environmental and socio-economic changes, which should provide a rich source for these studies.

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In the area of Population-Environment, the IGU Commission on Population Geography has had only limited activities during its latest 4-year session, 1988-92. Meetings held at Kiel, Lille, Peking and Warsaw have all considered other themes, as will the meeting to be held in Los Angeles in the summer of 1992. Only the Lille symposium in 1990, which was concerned with spatial inequalities in mortality, approached the question, several papers dealing with it. The most interesting (and the most discussed) have sought to observe the role of environmental degradation on high mortality in old industrial regions (Silesia, northern Bohemia). The question has not been decided; other complementary analyses are necessary to confirm the influence.

As far as publications are concerned, apart from the publications of the various symposia held since 1988, a number of volumes arising from past activities of the IGU Commission deal specifically with P-E issues :

- Geography and a Crowding World, ed. by W. Zelinsky, L.A. Kosinski and R.M. Prothero, OUP, 1970
- Population Redistribution and Development in South Asia, ed. by L.A. Kosinski and K.M. Elahi, Reidel, Holland, 1985
- Redistribution of Population in Africa, ed. by J.I. Clarke and L.A. Kosinski, Heinemann, 1982
- Population and Development Projects in Africa, ed. by J.I. Clarke, M.M. Khogali and L.A. Kosinski, CUP, 1985
- Population and Disasters, ed. by J.I. Clarke, P. Curson, S.L. Kayastha and P. Nag, Blackwell, 1989
- Mountain Population Pressure ed. by A. Ahmad, J.I. Clarke, C.B. Shrestha and A. Trilsbach, Vikas, 1990.

The IGU Commission is planning to collaborate with the IUSSP Committee on Population and Environment and UNESCO in a symposium on 'Population and Environment in Arid Regions' to be held in Amman, Jordan in 1994. The Royal Geographical Society (RGS) of the United Kingdom and the Higher Council of Science and Technology (HCST) of Jordan, who have a joint research and development programme in the Jordanian Badia, will also be involved.

International Union for the Scientific Study of Population (IUSSP) Committee on Population and Environment : John Clarke

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Established in 1990 for a four year period until 1994, the IUSSP Committee on Population and Environment is one of nine scientific committees of the IUSSP. It has eight members – John Clarke (UK – Chairman), Hyacinth Ajaegbu (Nigeria), Richard Bilsborrow (USA), Daniel Hogan (Brazil), Sudesh Nangia (India), Daniel Noin (France), Alina Potrykowska (Poland) and Michel Poulain (Belgium) – and two consultants, Nathan Keyfitz (USA) and Basia Zaba (UK). Marc Lebrun, Deputy Executive Secretary of IUSSP acts as secretary to the Committee.

The Committee's main objective is to examine the interrelationships between population and environment, in particular between population growth and its component elements (fertility, morbidity, mortality and migration/mobility) on the one hand and environmental degradation/deterioration on the other. The interrelationships will be studied at a variety of scales from the immediate locality to the global scale. The Committee also wishes to stimulate and coordinate the work of demographers in this field, and special attention will be given to the following themes: desertification, deforestation, pollution, mega-cities, communities and methodology.

The first main activity undertaken was a joint symposium with the British Society for Population Studies (BSPS) on Population and Environment held on Thursday 19 January 1991 in the Centre for Population Studies in the London School of Hygiene and Tropical Medicine. During the symposium eight papers were presented by Paul Harrison, Nathan Keyfitz, Richard Bilsborrow, Pauline Airey, Daniel Noin, Alina Potrykowska, Ken Wilson and Matthew Lockwood, and another was submitted by Daniel Hogan. The symposium was attended by 62 persons, and some of the papers are to be published in a number of the European Journal of Population Studies. The Committee held a workshop meeting on the following day, 11 January 1991.

The IUSSP Committee has collaborated with the ISSC Working Group on Demographic Data in the Human Dimensions of Global Environmental Change programme, of which John Clarke is also chairman and Hyacinth Ajaegbu a member. Following a meeting in Washington in January 1991, John Clarke and David Rhind with the help of research assistants, sponsored by CIESIN (the Consortium for International Earth Science Network, based in Michigan, USA), produced a 147 page report Population Data and Global Environmental Change published by ISSC/UNESCO in 1992.

The IUSSP Committee also collaborated with CICRED and the University of Louvain-la-Neuve over the meeting on 'Population and Environment' held in Louvain-la-Neuve, Belgium during 7-9 November 1991, which is the subject of this monograph. The Committee took the opportunity to hold a business meeting at Gembloux, Belgium on Wednesday 6 November 1991.

John Clarke, as Chairman of the Committee, was invited by the Pontifical Academy of Sciences to present a paper on 'The impact of population change on the environment' at its meeting on 'Resources and Population' held in the Vatican during 17-20 November 1991. The paper will be published as part of a special number of the Population and Development Review.

Two conferences are planned for the latter half of 1992. The first is another joint meeting with BSPS, this time a three-day meeting to be held during 9-11 September 1992 at Exeter College, Oxford in the UK, which will involve about 30 papers on the theme of 'Population and Environment'. Apart from one open session, there will be five sessions on:

- population movement and land use change: shifting environmental burdens;
- prospects and progress in synthesizing environmental and demographic data;

- rural household economics – equilibrium mechanisms or runaway engines?
- climate change and ecological limits – demographic change and consequences; and
- influencing development policy through population environment research.

It is expected that a volume will ensue, to be published by OUP. The conference coincides with the annual conference of BSPS, and is organized by Basia Zaba.

The second conference in 1992 will be held in the University of Campinas, Brazil during Monday 30 November – Thursday 3 December and will be concerned with 'Population and Deforestation'. There will be 15 invited papers and at least five contributed papers, with five sessions :

- population carrying capacity of forest regions;
- human settlements and transformation of frontier forest regions;
- health consequences of ecological disturbance in humid tropical forests;
- fertility and the family in the forest frontiers;
- ecosystems, socio-economic systems and population dynamics.

Co-sponsor for the conference will be the Brazilian Association for Population Studies (ABEP), and it is organised by Daniel Hogan.

The Committee is also collaborating with the IUSSP Committee on Gender and Population in its conference on 'Women and Demographic Change in Sub-Saharan Africa' to be held in Dakar, Senegal during 3–6 March 1993, by assisting in the organisation of a session on the environment.

The IUSSP General Conference at Montreal, Canada in September 1993 will be the occasion of another meeting organised by the Committee. Michel Poulain is the organiser of Session 39 on 'Population pressures and the environment'. The session will focus on the demographer's contribution in studying the relationships between demographic factors on the one hand and resources of food, water and energy, waste disposal, pollution or utilization of space on the other.

Other meetings at an earlier stage of organisation are to take place in

- (a) Warsaw and Cracow, Poland in June 1994 on 'Population and pollution in industrialized countries', which will mainly focus on population and pollution but also deal with social and economic aspects of the phenomenon. Collaboration will be with the Committee on Spatial Planning of the Polish Academy of Sciences and the State Committee for Research. Alina Potrykowska will be the local organiser.
- (b) Amman, Jordan in 1994 on 'Population and environment in arid regions' in collaboration with the IGU Commission on Population Geography, and UNESCO, as well as the Jordanian Higher Council for Science and Technology and the Royal Geographical Society of the UK which have a joint Jordan Badia Research and Development Programme. Fouzi Sahawneh (University of Jordan) will be the local organiser.

Committee members have also acted as advisers to the preparation of the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in June 1992, and to the proposed meeting of the United Nations Development Programme (UNDP) in 1994.

Finally, the IUSSP Committee has a proposed African programme which it is hoped to fund in the near future. Organised by Hyacinth Ajaegbu it has a number of different strands:

- compilation and publication of an annotated bibliography of existing published works on population and environment in Africa, and relevant documents, statistics and reports;
- a regional conference on population and environment;
- a volume on the interrelationships between population and environment in Africa;
- a mapping project, mapping areas and intensity of environmental problems over space and time, and relating them to population;
- an environmental information (education) project, producing and disseminating some population and environment awareness information; and
- a pilot community/neighbourhood environment management project, to design and carry out specific environment management activities, as well as determine population actions that may enhance the success of their environment management activities.

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