

**AAAS Atlas of
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International Directorate
1200 New York Avenue, NW
Washington DC, 20005, USA
Telephone: 202-326-6650
Fax: 202-289-4958
Internet: [http://www.aaas.org/
international/](http://www.aaas.org/international/)

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AAAS Atlas of population & environment

Paul Harrison
Fred Pearce

FOREWORD BY Peter H. Raven

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AAAS Atlas of population & environment

Executive editor

Victoria Dompka Markham
Director, Center for Environment
and Population (CEP)

Senior AAAS advisor

Richard W. Getzinger, PhD
Director, AAAS International
Programs Directorate

Principal contributors

Paul Harrison
Fred Pearce

Principal researcher

Lars Bromley

Other contributors

Philip Lightowlers
Maggie Thurgood

Project editor

Helen de Mattos

Research editors

Jane Lyons
Christine Hawkins

Research assistants

Carrie Miller
Liz Dew

Reviewers

Gayl D. Ness, Professor Emeritus of
Sociology, University of Michigan
(UM), and Director, UM Population
Environment Dynamics Project
Geoffrey Lean, international
environmental writer and journalist

Case studies

L.J. Gorenflo, The Nature
Conservancy
Holly Strand, World Wildlife Fund

Cartography and diagrams

Lars Bromley
David Burles
Simon Blyth

Design

Price Watkins

Consultants

Uwe Deichmann
Prashant Hedao

Color separations

Swaingrove

Software donation

Environmental Systems Research
Institute, Inc. (ESRI)

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Asia Pacific

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Banson





3 Turville Street
London E2 7HX, UK
banson@ourplanet.com

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advance science education, and
shape policy issues grounded in
science and technology.

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Introduction

Population and environmental issues are, in and of themselves, extremely complex; linked, they create a whole new set of dynamics which add to that complexity. In conceiving this *AAAS Atlas of Population and Environment*, the AAAS International Programs Directorate wanted to bring together population-environment linkages in ways that make them easily accessible to policy and decision makers, students and the general public. Our hope is that in presenting the issues clearly, the debate surrounding population-environment dynamics and our understanding of the issues will broaden in the coming years.

In origin, atlases contained both maps and expository text. It is on this tradition that we have tried to build, providing maps and graphics that quantify and illustrate many of the issues, and text that lays out the broader links between population dynamics and the environment and places them within their historical perspective. This is followed by a series of analyses of individual topics – both ecosystems and human activities such as migration or trade – that bring together what is known about the ways in which people impact the Earth's environment. Lastly the atlas contains six case studies that look at population-environment relationships in selected areas.

None of this could have been done without the help and support of a large number of institutions and individuals. We are grateful to the Summit Foundation, the Turner Foundation and the Hewlett Foundation for their generous support, without which this project would not have been possible. We would also like to thank the World Wildlife Fund (WWF-US) and The Nature Conservancy (TNC) for their contribution of the case studies. Thanks are also due to the many individuals in those organizations listed at the end of the book, whose skills, willingness to share data, advice, encouragement, and above all unflinching good humor, made this publication possible.

Covering all aspects of the population-environment relationship is nearly impossible in any circumstances, let alone in a single introductory volume. However, by drawing on very current research and data as well as the most up-to-date mapping techniques, we have attempted to provide a cogent entry-way to some of the most important concepts and questions facing us at the beginning of the 21st century. In producing the *AAAS Atlas of Population and Environment* we have tried to make that critical link between the scientific data, research and analysis of issues, and policies and public understanding. We hope you will find it useful.

Richard W. Getzinger, PhD
Director, AAAS International Programs Directorate

Victoria Dompka Markham
Director, Center for Environment and Population (CEP)

Foreword

O PINIONS vary widely on the numbers of people that individual areas, or the world as a whole, can support, and objective analyses of the relationships that exist between population and the environment are few and far between. In view of this lack of readily available, clearly presented information, this volume fills an important void. Its graphics, analyses and discussions of individual ecosystems provide the kind of basis that any educated person would like to have in approaching this subject or in acting intelligently in many areas of modern life. It is thus a most welcome contribution to the growing body of literature about the environment, focusing exclusively on what is clearly the key area of concern.

As our numbers continue to grow, with increasing pressure on the environment everywhere, it becomes more and more important to understand in as much depth as possible the many and diverse aspects of this set of relationships. In this volume, you will find them laid out in a way that is graphically appealing, clear, consistent with contemporary thought on the issues and readily accessible to the intelligent lay person. In doing so, the book makes a contribution that is exceedingly timely, one that will lead to further analyses and reflection on the part of individuals, governments and corporations, as the authors have clearly intended.

Although it has long seemed obvious that there is an important linkage between such factors as human population density, rate of growth, consumption and the choice of particular technologies on the one hand, and the state of the environment on the other, the quantitative analysis of such relationships has by no means been adequately pursued, and they are often poorly understood and represented. For these reasons, it is of great importance to make what we do know accessible to both specialist and broader audiences, as a basis for developing theory further and for making the best decisions we can now. Although it is difficult to view the pertinent facts clearly and without bias, it is evident that no relationships are more important for us to understand as we strive to create a sustainable world for the 21st century and beyond. General statements, speculation and intuitive deductions about the impacts of various aspects of human population on the environment are no longer sufficient as a basis for effective action, and additional empirical evidence and analyses are badly needed. This book does not attempt such analyses, but rather endeavors to establish a common base of understanding about what is known in this area. In doing so, it makes an important contribution.

In its opening chapters, this book illustrates the various ways in which population factors, such as rates of growth, absolute growth, consumption, migration and the application of various technologies, affect both in the short term and more enduringly the health of the world's ecosystems. Here, Paul Harrison presents an overview of exceptional clarity concerning the relationship between population dynamics and the environment. This treatment does not represent original research, but rather is a presentation of contemporary thinking and data. The extensive use of graphics makes every page a rich source of easily understood facts and figures about the central relationships that this book explores.

The balance of the book presents an extensive series of analyses of individual habitats throughout the world, considering in depth what is known about the ways in which they are impacted by

pressures associated with population. This is a feature that will provide useful insights in many areas and for many different people.

One of the most difficult aspects of providing sound analyses of these relationships in the past has been the difficulty of linking the social and natural sciences. Here, however, we find the issues presented in a multidimensional fashion, demonstrating the cross connections between human and natural environmental factors in determining a particular outcome. In such an area, the AAAS, which brings together the wide array of all the sciences, has a comparative advantage, and is particularly suited to undertake interdisciplinary studies.

Where do we stand in our efforts to achieve a sustainable world? Clearly, the past half century has been a traumatic one, as the collective impact of human numbers, affluence (consumption per individual) and our choices of technology continue to exploit rapidly an increasing proportion of the world's resources at an unsustainable rate. Ehrlich and Holdren's IPAT relationship, discussed in the second chapter of this book, lies at the heart of understanding the population-environment relationship and needs to be understood both in terms of the amount of resources necessary to produce each unit of consumption, and also the amount of waste or pollution generated in the process. At any event, during a remarkably short period of time, we have lost a quarter of the world's topsoil and a fifth of its agricultural land, altered the composition of the atmosphere profoundly, and destroyed a major proportion of our forests and other natural habitats without replacing them. Worst of all, we have driven the rate of biological extinction, the permanent loss of species, up several hundred times beyond its historical levels, and are threatened with the loss of a majority of all species by the end of the 21st century.

As George Schaller, the noted conservationist, has put it, "We cannot afford another century like this one" (i.e., the 20th century). As the new millennium begins, human beings are estimated to be consuming directly, wasting or diverting more than 40 percent of the total net terrestrial photosynthetic productivity, and to be using about 55 percent of the world's renewable supplies of freshwater. Median World Bank estimates, however, have the human population increasing by another 50 percent over the next half century, before leveling off at perhaps 10 billion people by the year 2100. Trends over the past decades, which indicate a slowing in overall population growth, support these projections, but it is clear that our population will not, in fact, reach stability unless we find effective ways to continue to address growth and to achieve goals that we have selected.

At the same time, levels of consumption are rising throughout the world, even though it has been estimated that if everyone in the world were to live in the way we do in the United States, it would require three more planets comparable to Earth to support them. The notion that development will eventually lead all of the world's people to achieve standards of consumption comparable to those enjoyed in our country, using the technologies we have available now, is clearly inaccurate; and yet it implicitly underlies many of our actions, thoughts and aspirations. We live in a world in which the World Health Organization considers that half of us are malnourished at some level, taking into account vitamins, minerals and calories, and one in which one in four people survives on less than a dollar per day. It is not a world in which conditions will be improved by wishful thinking, but only by concrete action, based on the kind of understanding that this book will help to make possible.

The realization that the peoples of the world, rich and poor, are interdependent, and that the rich have a responsibility to help the poor and that they will need to do so in order to be able to achieve overall stability, is a relatively recent one, coming into focus with the formation of the United Nations following the Second World War, and especially with the 1972 Stockholm conference on the global environment. Much has been written about these matters over the past few decades, and when the nations of the world came together at the Earth Summit in Rio de Janeiro in 1992, it was hoped that effective action could be taken to address the complex needs involved in building a sustainable world, and particularly the ways in which social justice was necessary both morally and as a condition of forming such a world. Day by day, this is becoming more important as more and more people make larger and larger demands on relatively static types and amounts of resources.

In view of the complex relationships presented in the pages of this book, it evidently is not feasible to estimate the Earth's carrying capacity for people as an absolute. Rather, it is the complex relationship between population density, consumption and choice of technology, together with the choices that we make about the quality of life, that will determine the number of people that an individual area, or the Earth as a whole, can support sustainably. The diversity of our planet is decreasing rapidly, and has done so dramatically for the past 400 generations, since crop agriculture and the domestication of animals provided the means for building villages, towns and cities, and gave rise to the complex human societies in which the manifold activities that we call civilization take place. The question that the relationships presented in this book bring into focus is one of choice: what kind of world do we wish to have and to leave for our children and grandchildren, all those who come after us. Human populations will attain sustainability, but will it be sustainability marked by dull, monotonous, unhealthy landscapes, or one in which the biological and cultural riches that we enjoy in the early years of the 21st century will be maintained and enhanced, sources of material and spiritual enrichment for everyone?

In making the many choices involved in constructing the world of the future, we must go far beyond the mechanical calculations of an Adam Smith to the vision of a Gandhi, who said, "The world contains enough to satisfy every man's need, but never enough for our greed". It is absolutely necessary to adopt a spiritual approach if we want the world of the future to be a nurturing one, filled with variety of all kinds; but it is not sufficient to have such an attitude to understand what we must do to achieve this goal. In order to do so, we must understand the relationships that are so well presented in the present volume in a way that will inform the debate for years to come.

One puts down this book feeling a debt of gratitude to the authors, editors and those who prepared the illustrations for the enlightenment and feeling of rational hope that they have conveyed by laying out the realities of the all-important population-environment relationship so clearly, comprehensively and well. In order to build a better, more prosperous and healthier life for our children and all those who will come after us, we all badly need the kind of clarity of understanding that this very welcome book represents. Given that understanding and our commitment to deal effectively and well with our own future, we shall certainly be able to succeed beyond our most optimistic assumptions.

Peter H. Raven
Director, Missouri Botanical Garden

