Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin

Environmental degradation in the Aral Sea basin has been a touchstone for increasing public awareness of environmental issues. The Aral crisis has been touted as a 'quiet Chernobyl' and as one of the worst human-made environmental catastrophes of the twentieth century. Just a few decades ago, it was the fourth-largest inland body of water in the world. Today, it has fallen to sixth place . . . and it continues to shrink.

This multidisciplinary book is the first to comprehensively describe the slow onset of low grade but incremental changes (i.e., creeping environmental change) which affected the region. Over a dozen researchers explore every facet of this environmental disaster: changes in landscape, water level and salinity, river flow changes, fish population dynamics, desertification, public health, and political decision-making. The demise of the sea cannot be blamed on natural factors. Its sorry state is clearly the result of decisions made to irrigate the fertile but dry sands of Central Asian deserts for the sake of cotton production. This involved a hidden cost to the inhabitants of the region which far outweighed the benefits derived. In addition to the sharp reduction in the size of the sea and in the quality of its water, environmental degradation has had a drastic negative effect on human health in the region. The book is an attempt to 'set the record straight' on how decision-makers allowed small incremental changes to grow into an environmental and societal nightmare.

This book presents a set of case studies on a region of worldwide environmental interest, and outlines many lessons to be learned for other areas undergoing detrimental creeping environmental change. It therefore provides an important multidisciplinary example of how to approach such environmental disasters for students and researchers of environmental studies, global change, political science and history.

MICHAEL H. GLANTZ is a Senior Scientist in the Environmental and Societal Impacts Group, a program at the US National Center for Atmospheric Research (NCAR). He is interested in how climate affects society and how society affects climate, especially how the interaction between climate anomalies and human activities affect quality of life issues. He is a member of numerous national and international committees and advisory bodies related to environmental issues. In 1987 his *Scientific American* article on drought in Africa was given an award by World Hunger Year. In March 1990 he received the prestigious 'Global 500' award from the United Nations Environment Programme. He has written and edited several books and is the author of numerous articles on issues related to climate, environment, and policy. His most recent books are: *Scientific, Environmental, and Political Issues in the Circum-Caspian Region* (Kluwer Academic Publishers, 1997), *Currents of Change: El Niño's Impact on Climate and Society* (Cambridge University Press, 1996), *Drought Follows the Plow: Cultivating Marginal Areas* (Cambridge University Press, 1994), *Climate Variability, Climate Change and Fisheries* (Cambridge University Press, 1992), *Teleconnections Linking Worldwide Climate Anomalies: Scientific Basis and Societal Impact* (Cambridge University Press, 1991), *Societal Responses to Regional Climate Change: Forecasting by Analogy* (Westview Press, 1988), and *Drought and Hunger in Africa* (Cambridge University Press, 1987 and 1988).

one of the worst human-made environmental catastrophes of the twentieth century

Creeping Environmental Problems and Sustainable Development in the Aral Sea Basin

Edited by
MICHAEL H. GLANTZ

CAMBRIDGE
UNIVERSITY PRESS

Produced with technical and financial support from the United Nations Environment Programme

PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE
The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS
The Edinburgh Building, Cambridge CB2 2RU, UK http://www.cup.cam.ac.uk
40 West 20th Street, New York, NY 10011–4211, USA http://www.cup.org
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

First published 1999

Printed in Great Britain at the University Press, Cambridge

Typeface Lexicon 9.75/13pt (*from The Enschedé Font Foundry*)
and Monotype Gill Sans *System* QuarkXPress ™ [SE]

A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication data

Glantz, Michael H.
Creeping environmental problems and sustainable development in the
Aral Sea basin / edited by Michael Glantz.
p. cm.
Includes index.
ISBN 0 521 62086 4 (hb)
1. Environmental degradation – Aral Sea Watershed (Uzbekistan and Kazakhstan)
2. Sustainable development – Aral Sea Watershed (Uzbekistan and Kazakhstan)
I. Title.
GE160.U6G55 1999
363.7′009587 – dc21 98-24788 CIP

ISBN 0 521 62086 4 hardback

CONTENTS

NIKOLAI V. ALADIN, Zoological Institute, Russian Academy of Sciences, 1, University quay, St. Petersburg 199034, Russia

VITALYI N. BORTNIK, State Oceanograpic Institute, Federal Service of Hydrometeorology and Nature Protection, Kropotkinskyi per 6, Moscow 119838, Russia

LEONID I. ELPINER, Water Problems Institute, Russian Academy of Sciences, 3, Gubkina Str., Moscow 117971, Russia

MICHAEL H. GLANTZ, National Center for Atmospheric Research, PO Box 3000, Boulder, Colorado, USA 80307

ANATOLY N. KRUTOV, The World Bank, Resident Mission in Uzbekistan, 43 Academician Suleimanova Str., 700017 Tashkent, Uzbekistan

NINA M. NOVIKOVA, Water Problems Institute, Russian Academy of Sciences, 3, Gubkina Str., Moscow 117971, Russia

NIKOLAI S. ORLOVSKY, Ben-Gurion University, Desert Institute, Sde Boker, Israel

ASOMITDIN A. RAFIKOV, Geography Department, Presidium of the Academy of Sciences, Republic of Uzbekistan, Gogol St. 70, Tashkent, Uzbekistan

V.V. SUMAROKOVA, State Hydrological Institute, 2nd Line of Vasiljevskyi Ostrov 23, St. Petersburg 119053, Russia

K.V. TSYTSENKO, State Hydrological Institute, 2nd Line of Vasiljevskyi Ostrov 23, St. Petersburg 119053, Russia

ELIZABETH A. VOSTOKOVA, Institute of Ecology and Evolution, Russian Academy of Sciences, Leninsky Prospect 33, Moscow 117071, Russia

ILIYA ZHOLDASOVA, Institute of Ecology and Biology, Karakalpak Department, Uzbek Academy of Sciences, Berdach St. 41, Nukus 742000, Karakalpakstan, Uzbekistan

ALEXANDER N. ZOLOTOKRYLIN, Institute of Geography, Russian Academy of Sciences, Staromonetny 29, Moscow 109107, Russia

IGOR S. ZONN, Russian National Committee for UNEP, Baumanskaya St. 43/1, Moscow 107005, Russia

INTRODUCTION

This book has proven to be a labor of love. It began in 1994 with support from the United Nations Environment Programme (UNEP) Water Unit's director, Walter Rast. The idea was to document the incremental changes that have taken place in the Aral Sea basin in the past several decades. As is now well known, the Aral Sea has dropped in level about 17 meters in the short time span of three-and-a-half decades, and has dropped in volume by two-thirds. The Aral Sea's commercial fishing industry has collapsed. And as a result of chemical fertilizers and pesticides in the runoff from the fields to the rivers and the sea, human health in the region surrounding the Aral coastline (called the Priaralye) has been greatly affected.

The approach taken was to identify researchers who have spent years, if not decades, monitoring some aspects of environmental change in the Aral Sea basin. It therefore involved researchers from a variety of disciplines and countries who dedicated, and continue to dedicate, their professional lives to improving our understanding of environmental changes at the regional level. The environmental aspects presented include the following: landscape changes, changes in sea water quality and quantity, desertification processes, regional climate change, changes in the deltas, human health, political ideological changes related to the environment, streamflow variations, fisheries, and environmental impacts of the Karakum Canal.

The framework suggested as a guideline to these researchers in the preparation of their assessments was to enable them to view the changes that they were to write about as creeping environmental problems (or CEP). CEP are long-term, low-grade, incremental but cumulative environmental problems. Each researcher was asked to try to identify with hindsight predetermined thresholds of change. The thresholds included the following: awareness of a change in the environment (not necessarily seen as a problem but only as a change); awareness that the change had become an environmental problem; awareness that the problem had become a crisis; awareness of the need to act to address the CEP; and actions actually taken to address the crisis. Each author recorded the progression of change through the thresholds in his/her own way, as no rigid outline was imposed. The idea was to get the researcher's perceptions of change in the particular location in the Aral basin and with the particular environmental factor on which he or she had focused. Several authors put their findings with regard to thresholds in the form of charts. Others chose to discuss these threshold changes in their text.

ELISABETH VOSTOKOVA discussed Aral basin landscape changes that she

had witnessed over a period of more than thirty years. Landscape refers to large areas containing different types of ecosystems and vegetation (plant) communities. At first, her observations were on the ground and, later as satellite imagery became available, she continued her monitoring of changes from space imagery as well.

VITALYI BORTNIK is an authority on the status of the Aral Sea's water quantity and quality. His work has been instrumental in monitoring the changes in the Aral Sea level, surface area, water volume, and salinity levels of the sea. His assessment suggests that as obvious as the human impacts of water diversions from the region's two major rivers may be, there is also an impact of the natural variability of the regional climate on Aral Sea level.

Arid lands are known to be quite fragile and therefore vulnerable to the activities of human settlements. The Aral Sea is sandwiched between two major deserts, the Karakum and the Kyzylkum. As the sea dries up, the newly exposed seabed becomes vulnerable to wind erosion. Plants will not grow on this salt-laden soil. As there is nothing to stop the soils from blowing away, the region becomes a source of salt and dust storms. The water that is diverted from the rivers, the Amudarya and the Syrdarya, is used for irrigation of desert sands, primarily for the production of cotton and, to a lesser extent, rice. As the water runs off from the fields, carrying with it chemical fertilizers and pesticides, it is later reapplied to fields further downstream. The soils become increasingly saline and eventually crop yields and total production drop, and the land has to be abandoned. These are some of the desertification problems discussed by ASOMITDIN RAFIKOV in his chapter.

ALEXANDER ZOLOTOKRYLIN presents data in support of the view that the climate in the region of the Aral Sea basins has changed over the past several decades. While some of those changes are natural in origin (e.g., climate varies on a variety of time scales from months to millennia), other climate changes may have been induced by the shrinkage of the sea. It is generally suggested that the winters have become colder and the summers hotter in the past few decades. In other words, the regional climate has become more continental.

NINA NOVIKOVA has spent much of her professional life working in the delta of the Amudarya. She provides the reader with detailed description of vegetative changes over time in the deltaic area. She discusses the impact of reduced river flow into the delta and the loss of lakes and a degradation in the types of vegetation in the area as a result of increasing desiccation in the delta and its surrounding area.

One of the major concerns of groups around the world is the poor health status of much of the population of the Priaralye. LEONID ELPINER notes that the degradation of health in the region had been registered for some decades, but it was not officially permitted to be discussed or presented to the public. Only with *glasnost* and *perestroika* in the USSR in the mid-1980s were such data allowed to see the light of day, so to speak. Elpiner shows through statistics the poor state of health of inhabitants closest to the sea, compared

with those in Uzbekistan or in the former Soviet Union as a whole. He lists numerous diseases and other health problems plaguing people in the Dashowuz part of Turkmenistan, the Kyzyl-Orda region in Kazakstan and in Karakalpakstan, an autonomous political unit in Uzbekistan.

IGOR ZONN traces the political context in which creeping environmental changes in Central Asian states have taken place. He begins with Lenin's plans to transform nature in Central Asia and follow up with Stalin's grandiose schemes to make Central Asia the source of 'white gold' – cotton – for the textile factories and military activities in Russia and for export to foreign markets. This chapter answers some of the questions people often raise when learning of the demise of the Aral Sea: how could such an environmental catastrophe occur in such a short period of time?

K.V. TSYTSENKO and V.V. SUMAROKOVA focused their research on the two major rivers feeding the Aral Sea, the Amudarya and the Syrdarya. They discuss interannual variability in river flow, as well as interdecadal changes and what those variations have meant for the condition of the sea. They discussed changes in the quantity and quality of river water, as these rivers were recipients of return flow and contaminated water runoff from the fields. The rivers are the lifeline of the sea, and they are the lifeline of the irrigated activities along their courses.

One of the first and most visible physical and socioeconomic impacts of the contamination of sea water was on the sea's fish population and its commercial fishery. ILIYA ZHOLDASOVA has studied fish populations in the Aral Sea and its deltas for several decades. She has observed considerable change in both fish spawning habitats and in the fish populations themselves. She provides fairly detailed accounts of the fate of Aral fish populations that were endemic to the sea, as well as those that have been introduced. Most popular articles on the Aral region note that the fishery had failed by the late 1970s, and that fish had to be imported from the Pacific Ocean and the Baltic Sea for processing in Muynak (Karakalpakstan) factories in order to provide employment to a large part of the local population (on the order of tens of thousands of fish industry workers).

NIKOLAI ORLOVSKY, former Deputy Director of the Institute of Deserts of the Turkmen Academy of Sciences, reports on the environmental impacts of the Karakum Canal. This constructed canal is the longest in the world, registering a length of about 1400 km. It draws a considerable portion of water from the Amudarya. The canal passes by several oases in Turkmenistan (around which major population centers have developed). Aside from the adverse environmental impacts associated with this unlined canal cut out of barren desert sands, the Karakum Canal is an apparent irritant to other Central Asian Republics, as it deprives the Aral Sea of about 15 km^3 each year; it deprives the Uzbek Republic from using that volume of water further downstream for watering its own fertile but dry desert sands; and it takes the water out of the Aral basin and puts it into the Caspian basin.

ANATOLY KRUTOV supplies an overview to the environmental problems in one of the key Central Asia Republics implicated in the Aral crisis: Uzbekistan. He discusses the plethora of environmental problems, as well as the numerous legislative attempts to address those problems, mostly failed attempts. He notes that the recent increase in flow in the rivers and into the sea may be only a temporary respite from the environmental catastrophe that awaits the sea, in the absence of effective governmental responses to the identified creeping environmental problems.

The final chapter was prepared by NIKOLAI ALADIN. Aladin is well known in the former Soviet Union for his repeated field trips to the shores of the Small Aral Sea. He studied changes in fish populations, among other aquatic organisms in the Aral Sea and in the Small Aral for almost two decades. His studies have been labor-intensive and represent a considerable monitoring effort. He notes that the sea's characteristics have varied throughout time, with evidence that the sea level had been much lower and the sea had even disappeared, only to return. He suggests that the sea has in fact been influenced by human activities for a few thousand years, that the recent level of human impacts is much greater and, therefore, much more damaging to aquatic ecosystems.

This set of studies is intended to provide a baseline assessment of some of the creeping environmental problems in the Aral Sea basin. When first proposed to some potential funding sources, the editor was advised that there was little interest in how the Aral Sea environmental crisis had developed and that the current interest was in preparing the Central Asian Republics for the future and in 'saving the sea'. But UNEP supported the view that it was important to attempt to reconstruct the history of how the Aral crisis developed over time, in the hope that lessons could be learned on how to proceed into the future.

Environmental groups around the world have developed a strong interest in the Aral Sea, following the exposure to the world of the state of the sea's degradation in the mid-1980s. A considerable amount of lip service had been paid to 'saving the sea' in the early 1990s. UNEP produced a diagnostic study of the problems of the Aral Sea, which served to spark renewed interest in the region. The World Bank then reluctantly got involved in the Aral region, drawing up numerous plans for multilateral cooperation to save the sea and to develop the economies of the Central Asian Republics.

As noted in some of the chapters in this volume, there have been some positive changes in the region, in terms of agricultural activities and water use. More water has been getting to the sea (a series of wet years in the early 1990s), and there was a reduced use of chemicals on the land because of the high cost of these agricultural inputs. However, there is some evidence that 'saving the sea' *per se* has been given a much lower priority than was the case in the early 1990s. While governments talk about it, it appears that little can or will be done about it by policy-makers in the region. However, one must wonder if the interest of the global community in the plight of Central Asian Republics

would remain high if the sea were allowed to disappear. The sea may be more important as a symbol of human misuse of the environment and as a symbol of how much damage humans can do in a short period of time in the absence of concern for the state of the environment. Saving the sea would not be just a symbolic act, however, but it may prove to be an action that serves to sustain interest in and support for the economic development fate of the Central Asian Republics.

Note on Russian names

It is important to note that an attempt was made to achieve consistency in the transliteration of Russian terms and location names. However, this proved to be an almost impossible task. Compounding the problem of transliteration is the fact that the spelling of locations in Central Asia has changed since the breakup of the Soviet Union in December 1991, as each of the newly independent republics sought to nationalize their country's names. It is also important to alert the reader to the differences among references at the end of each chapter. They are not necessarily filled with the same level of completeness of reference information. This is partly the result of different styles of reference between the United States, the Soviet Union and the republics of the former Soviet Union. Nevertheless, the information provided in the references will enable the reader to locate the source of that information. I hope that this does not detract from the importance of the information provided by the contributors in their chapters.

Acknowledgments

This book has involved the dedicated work of several people whom I would like to acknowledge with my sincere appreciation. First and foremost, I must thank D. JAN STEWART for her tireless effort in producing numerous drafts of this manuscript. Sincere thanks also go to JAN HOPPER, who worked diligently in making the first effort to input the entire manuscript into the computer. JUSTIN KITSUTAKA provided excellent graphic support for most of the figures in the book.

Scientific coordination and support was supplied by IGOR ZONN. It goes without saying that the manuscript and the logistics of organizing the contributors and the translation of their papers, as well as the endless queries to the authors in the former Soviet Union could not have been done without the friendship and dedication to this project of IGOR ZONN. NINA NOVIKOVA was instrumental in identifying and seeking answers to problems generated by translation from Russian to English. We met on several occasions in Moscow (trips of opportunity) to iron out technical problems, including those introduced through translation and differences in the way scientific concepts are defined in different cultures.

I would also like to thank the contributors for their continued interest in this project and in their desire to assist in identifying thresholds of change for their specific creeping environmental change and problem. They have been and continue to be dedicated researchers and dedicated practitioners who hold onto the possibility that a concerned effort could 'save the Aral Sea' and the ecosystems and populations dependent upon it. They have more than a century of combined experience in the Aral region. This book provides them with a chance yet again to share their knowledge and expertise with the broad community of people interested in the future of the Aral Sea and its inhabitants.

Finally, not the least important is the support (moral and financial) that the Water Unit of the United Nations Environment Programme (Nairobi, Kenya) provided for the initiation of this project. Their moral support was a crucial factor in seeing this manuscript through to completion. GERHART SCHNEIDER, TAKAHIRO NAKAMURA, and WALTER RAST of the Water Unit provided a useful critique of a draft of the manuscript.

MICHAEL H. GLANTZ
Boulder, Colorado
Summer 1998

1 *Sustainable development and creeping environmental problems in the Aral Sea region*

MICHAEL H. GLANTZ

The Aral Sea region (Figure 1.1) has been characterized in the popular press and in the scientific literature as a region deep in crisis: an environmental crisis, a health crisis, a development crisis, and most of all a water crisis. Clearly, the rapid shrinking of the Aral Sea in Central Asia has captured the attention, and to some extent the interest, of governments, environment and development organizations, the public, and the media around the globe. Once considered a quiet catastrophe, one that has evolved slowly, almost imperceptibly, over the past few decades, the demise of the Aral Sea is now acknowledged as one of the major human-induced environmental disasters of the twentieth century. In the late 1980s, the Soviet Union issued a set of disaster stamps, one of which related to the demise of the Aral Sea (Figure 1.2).

The blame for this situation has been put on such factors as the domination of the region by Soviet authorities who ruled from Moscow, over-dependence on the cultivation of cotton, the rapid expansion of irrigated agriculture, totalitarian regimes, a controlled news media, inappropriate use of cost-benefit analyses, and the Cold War.

Figure 1.1 The Aral Sea region.

Figure 1.2 Russian postage stamp depicting the Aral Sea. Note ship trapped by receding sea level.

Those harmed by the crisis include, but are not limited to, the following: human populations (especially women and children) in the regions adjacent to the sea and in the lower reaches of the Aral basin's two major rivers (the Amudarya and the Syrdarya), regional vegetation and animals, fish and other living organisms in the aquatic environment, soil quality, air quality, ground and surface water quality, environmental sustainability and societal resilience, and some Central Asian administrative districts.

We now know about most of the environment-related problems in the Aral Sea region and we are now learning through anecdotes that various people in the former Soviet Union (and likely in other countries as well) have known about them for a very long time, almost from their inception (e.g., Goldman, 1972). In fact, signs of change were appearing everywhere throughout the first twenty years of the Aral Sea problem (1960–80): wind erosion, salt-laden dust storms, destruction of vital fish spawning grounds and the subsequent collapse of fisheries, increased salinity of sea water, waterlogging and secondary salinization of soils, disruption of navigation, the division of the sea into separate parts as a result of sea level decline, the need for extra-basin water resources to stabilize the sea level, the loss of wildlife in the littoral areas, the large reduction of streamflow from the region's two major rivers, a dramatic change in regional climate, the disappearance of pasturelands, and so forth. In fact, there were several scientists in the Soviet Union and outside of it who made projections about the fate of the sea and the territory surrounding it. For example, Davis (1956) noted:

> Some of the inland seas and lakes have recently been the scene of extensive human activity which has had notable effects upon coastlines . . . Among these are the changes in the offshore areas and coasts of the Caspian and Aral seas owing to large-scale development of dams for power and irrigation on the rivers supplying water to these seas. [An] extensive lowering of water level is beginning in the Aral Sea basin with the development of irrigation projects on the Amu Darya and Syr Darya, which supply most of the water to this sea. It is the aim of these projects eventually to divert for irrigation most or all of the waters of the rivers from entering the sea. It has been calculated that within twenty-five years the water area of this sea will shrink to half the size that it was in 1940, when the irrigation projects began. This would bring about an increase of nearly 13 000 square miles of land area. (DAVIS, 1956, p. 517)

Clearly, a considerable amount of information already exists in disparate sources about the Aral basin and the various physical processes of environmental change and environmental degradation.

But political leaders, among others with decision-making power, have not acted on many of these changes in the past. Why? Is it that there have been no financial resources available to do so? Is it that there has been no desire on the part of national, regional, or local leaders to do so? Has it been because there is no *perceived* reason among policy-makers at any level to take immediate action (e.g., did they happen to believe that the sea was not worth saving because its waters could be used more cost effectively elsewhere? Were they led to believe that water would likely be diverted from Siberian rivers to the arid lands of Central Asia)? In fact, at least as early as 1927, Soviet scientists exposed the ultimate fate of the Aral Sea if water diversions from the Amudarya and Syrdarya were not limited in the future. Tsinzerling (1927) constructed scenarios of impacts based on increased amounts of water diversions from these rivers. His scenarios were mimicked in the region by the decades of events that followed.

I would argue that a major part of the environmental and health problem in the Aral Sea basin relates to the nature of these adverse environmental changes and to the nature of human society, especially in the way people look at slow-onset, low-grade, long-term and cumulative environmental changes (e.g., creeping environmental problems or CEPs).

> **creeping** \krē-piŋ\ *adj* : developing or advancing by slow imperceptible degrees < a period of ~ inflation> –
>
> from Webster's Ninth New Collegiate Dictionary, 1991.

A major feature shared by various CEPs is that a change in this type of environmental problem is not much worse today than it was yesterday; nor is the rate or degree of change tomorrow likely to be much different than it is today.

So, for the most part, societies (individuals as well as government bureaucrats) frequently do not recognize changes that would prompt them to treat their environments any differently than they had on previous days. Yet, incremental changes in environmental conditions often accumulate over time with the eventual result that, after some perceived threshold of change has been crossed, those previously imperceptible increments of change 'suddenly' appear as serious crises. If no action is taken, as is often the case, those incremental changes will likely continue to build until they emerge as full-blown disaster(s). In the Aral Sea region, the traditional indicators of these crises relate primarily to the declining levels of the sea; they include changes in water quantity and quality, water diversions, water use, and water-related diseases.

It is important to recognize many of the environmental changes in the Aral Sea region as CEPs with likely adverse consequences at some time 'down the road'. It is also important to realize that, although technologies might exist somewhere in the world 'to save us' from the worst consequences of local or regional environmental changes, governments affected by the CEPs might not be able to afford them. Therefore, ways must be devised to deal more effectively with CEPs than we apparently do at present. We must learn to deal better either with their underlying causes, their consequences, or their characteristics (such as rates of change).

Introduction to the notion of creeping environmental problems

Just about anywhere one lives, people are constantly bombarded with bad news about the environment. Some of that news is about environmental problems of a global nature (e.g., global warming, ozone depletion) and some of it is about problems at the local level. Some of these problems have long lead times before their adverse consequences become apparent, while for others adverse consequences can develop over relatively shorter time frames (e.g., tropical deforestation). The list of environment-related problems around the globe is quite long and, unfortunately, is still growing: air pollution, acid rain, global warming, ozone depletion, deforestation, desertification, droughts, famines, water quality, and the accumulation of nuclear, toxic, and solid waste. Each is the result of long-term, low-grade, and slow-onset cumulative processes. Each is a creeping environmental problem.[1]

1. In a letter critical of the US National Research Council report *Confronting Natural Disasters* (NRC, 1987), the writer (Smith, 1988) noted that the report chose to focus solely on a particular set of 'natural hazards' that happen to be initiated by events that are 'sudden and of short duration'. To do so excludes other hazards that cause orders of magnitude more human damage. The report identifies one class of these other hazards: long-term problems such as desertification, deforestation, and drought. It goes on, however, to reject them because 'mitigating these hazards requires a greater ecological or social emphasis, and civil engineering approaches are less critical.'

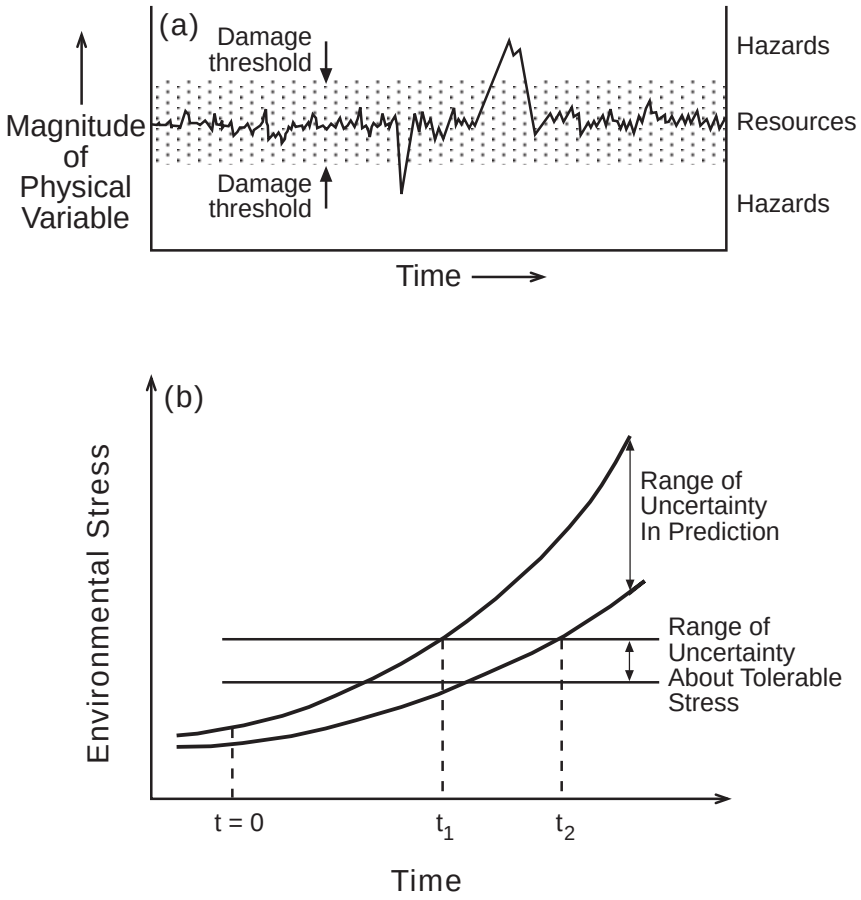


Figure 1.3 (a) Schematic of a rapid-onset natural hazard (Burton and Hewett, 1974). (b) Schematic of slow-onset (creeping) environmental problems (Döös, 1994).

Decision-makers worldwide have had considerable difficulty in addressing ways to slow down, arrest, or reverse these gradually occurring adverse changes. While societies respond relatively quickly to step-like adverse changes in the environment or to problems perceived by experts or the public as crises – for instance 'rapid-onset hazards', such as earthquakes and flash floods (Palm, 1990) – they have much more difficulty in developing an awareness of the risks associated with slow-onset, long-term, low-grade, cumulative change (Figure 1.3).

Thresholds

For each of the creeping environmental changes there may be identifiable thresholds beyond which continued degradation of the environment will increase the likelihood of major, even irreversible, changes in the environment. While our concern should be focused on *thresholds* of

environmental change, thresholds are usually easier to talk about than to detect.

For CEPs such as desertification and water quality degradation, at first changes may be noted by individuals at the local level, but may not be considered an immediate or even a potential threat. Such changes in their earliest stages will likely go unreported to local or regional authorities or to national researchers.

Once a creeping environmental change is perceived to have intensified in time, space, or impact, it may be brought to the attention of authorities by local inhabitants, officials, or by environmental researchers who happen to be working in that particular locale. A further deepening or broadening of the adverse consequences associated with environmental change could generate concern at the national policy-making level. At this point the international media can also get involved, generating international awareness of the local or regional problem. Who it is that might be the first to generate awareness of a creeping environmental change and of subsequent thresholds of awareness can vary from one region to the next and from one type of creeping environmental problem to another: it could be a farmer, an hydrologist, a scientist, a policy-maker, or a news reporter.

Because these full-blown problems derive from slow-onset, low-grade, long-term and cumulative environmental changes, it is not easy to identify universally accepted, objective, quantitative indicators for thresholds. Nevertheless, several generic thresholds could be subjectively identified for the evolution of CEPs: a first threshold relates to awareness of a change in the environment that has not yet been perceived as a problem; a second threshold could relate to the awareness that a previously undetected environmental change has become a problem; a third threshold relates to the realization that the problem has reached a crisis stage; a fourth threshold relates to the realization that there is a need to take action to cope with the problem; a fifth threshold is one beyond which direct and specific actions (not just the convening of conferences or workshops) are taken to resolve the CEP.

Why do CEPs continue?

Creeping environmental problems change the environment in a negative, cumulative and, at least for some period of time, an invisible way. As a result of these minor insults to the environment over time, during which no obvious step-like changes occur, both governments and individuals tend to assume 'business as usual' attitudes. People fear change (e.g., Hoffer, 1952) and, unless a crisis situation is perceived, they are not likely to change their behavior in the absence of any incentive to do so.

Most environmental changes are surrounded by scientific uncertainties. For example, are they primarily natural or human-induced changes? Lack of scientific certainty is often cited as another reason for political inaction on

CEPs. Yet, policy-makers are constantly forced to make policy decisions in the midst of uncertainty. For most CEPs, there is often a minority voice, often quite loud, which insists on highlighting the scientific uncertainties, as opposed to emphasizing what is known. Such conflicting interpretations of the science among factions within the scientific community tend to weaken the resolve of those who are expected to act (the public, policy-makers, the media). Thus, the selective use of information on creeping environmental issues drawn from the scientific literature allows policy-makers to pursue any decisions they wish, regardless of the true validity of the scientific information used. Whenever scientific uncertainty is perceived to have been used as an excuse for avoiding political risks associated with decision-making, it should be explicitly challenged as simply an excuse (a tactical measure) to delay meaningful action. Scientific uncertainties will always surround CEPs, and decision-makers must learn to cope with them.

Another reason why CEPs continue is that many changes to the environment are not considered detrimental in their early stages. Such changes would likely be viewed as environmental transformation, not degradation. For example, the cutting down of a small part of a mangrove forest to create a shrimp pond would not necessarily signal a stage in the destruction of a mangrove forest ecosystem (transformation). If, however, numerous ponds were to be constructed in the same location, then the mangrove forest ecosystem and its interactions with other ecosystems would eventually cease.

The willingness of some people to take slightly higher risks also explains inaction on CEPs. Considerable discussion exists in the scientific literature and the popular media about people who are risk-takers and about those who are risk-averse. The former are gamblers, while the latter tend to be more conservative in their approaches (and responses) to environmental change. Yet another risk-related category is that of the risk-maker.

Risk-makers are those decision-makers whose decisions make risks for others, but not necessarily for themselves. For example, reluctance to take action either to slow down or stop desertification processes threatening a village situated far from the capital city where the politicians live will likely have little, if any, direct or immediate adverse political fallout on decision-makers at the national level. Their inaction generates increased risks for the inhabitants of the threatened village, but not necessarily for themselves. With regard to the declining level of the Aral Sea, in reality there were no direct adverse impacts on those policy-makers in the Kremlin, or even in Tashkent, who made decisions about agricultural development in Central Asia, decisions that ultimately led to the degradation of the Aral Sea environment. This can be viewed as a variation of the NIMBY syndrome related to environmental pollution (i.e., 'you can pollute anywhere you want, but not in my back yard'; hence, Not In My Back Yard). Often, environmental change is of little concern unless it directly affects someone's home or workplace.

Yet another constraint on timely action to address a CEP involves the fact

that what appears to be an environmental crisis to one person may be considered an opportunity by someone else. While some people may be concerned about environmental degradation, others might believe such degradation is a necessary – and acceptable – tradeoff for improving regional economic development prospects.

Creeping environmental problems in the Aral Sea basin

In the late 1950s, the Aral Sea was the fourth largest inland body of water on the planet, with a surface area of 66 000 km^2. In 1960 the mean level of the Aral Sea was measured at 53.4 m, and it contained about 1090 km^3 of water.

The perennial flows of the basin's two major river systems, the Amudarya and Syrdarya, had until recently sustained a stable Aral Sea level. Over the centuries, about half of the flow of the two rivers reached the Aral. A flourishing fishing industry existed, based on the exploitation of around 20 commercially valuable species. The forests and wetlands surrounding the sea, especially in the Syrdarya and Amudarya deltas, were biologically productive, containing unique species of flora and fauna that had adapted to the natural saline characteristics of the sea. Historically, the levels of the Aral Sea were rather stable, fluctuating less than a meter in the first half of the twentieth century, and by no more than four meters during the preceding 200-year period.

In the span of just four decades, the Aral Sea basin was transformed into a major world-class ecological and socio-economic disaster (Micklin and Williams, 1996). Since the beginning of the 1960s, when the leaders of the Soviet Union embarked on a program to increase river diversions in order to expand irrigated cotton production in this arid region, the Aral Sea level dropped continually and dramatically. In fact, the annual average rates of sea level decline had actually accelerated: from 0.21 meters/year in the 1960s, to 0.6 m/yr in the 1970s, and reaching 0.8 m/yr in the early 1980s (1981–86) (Mnatsakanian, 1992). In all, the sea's level has declined by about 17 meters, and its surface area has been reduced by half. Today it has fallen to sixth place, with respect to its size, as an inland body of water. The initial and primary focus of attention has been on the declining level of the sea, in part because that change has been highly visible (especially from space). However, it is but one of several creeping changes in the Aral basin to have occurred during the past half-century.

Other creeping environmental problems in the basin include reduced inflow to the sea from the Amudarya and Syrdarya, monocropping of cotton and of rice, declining water quality, salt and dust storms, salinization of water and soils, vegetation changes, and escalating health effects. Because of the low-grade nature of these and other problems, high-level policy-makers, as well as decision-makers at other levels, have apparently had difficulties in

identifying them as problems and then, once identified as such, in coping with them. As with CEPs elsewhere, it has been difficult to identify in advance thresholds of environmental change in the Aral basin that could serve to catalyze action to arrest environmental degradation. The following list of examples of CEPs in the Aral basin is meant to be suggestive and not exhaustive.

EXPANSION OF COTTON ACREAGE

The desire of Soviet leaders to expand cotton production onto desert lands increased the dependence of Central Asian Republics on irrigation and monocropping. Monocropping has adverse impacts on soil conditions, which prompts increasing dependence on mechanization, pesticides, herbicides, and fertilizers. Socio-economically, these policies are also risky in the sense that a regional economy based on production of a single agricultural crop is highly vulnerable to the variability of climate from year to year and from decade to decade, as well as to the 'whims' of demands, and therefore price, of the marketplace. The chart in Figure 1.4 depicts agricultural water use in the Amudarya and Syrdarya basins as of the late 1980s.

A sizeable portion of Central Asia's agricultural production is dependent on irrigation. Irrigated agriculture in the region predates by millennia the era of Tsarist conquests in the eighteenth and nineteenth centuries. What is 'new' about irrigation, however, is the huge amount of water diverted from the region's two major rivers, the Amudarya and the Syrdarya. Table 1.1 shows the expansion of cotton acreage in Central Asia between 1940 and 1986. The demands of cotton production for irrigation water are high (Table 1.2). Each year increasing amounts of water had been required to irrigate new fields and

Figure 1.4 Agricultural water use in the Amudarya and Syrdarya basins (Tsutsui, 1991).

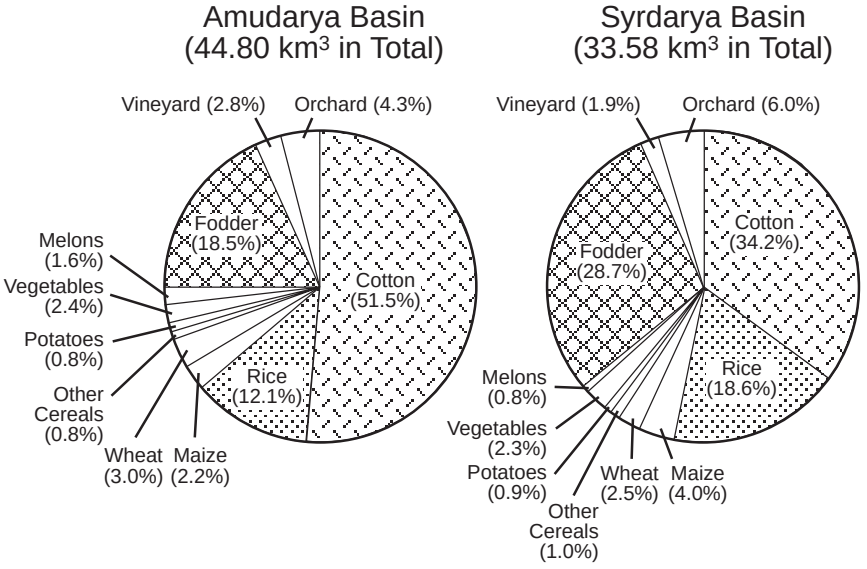


Table 1.1 **Cotton sowings (× million hectares)**

Unit	*1940*	*1971–75*[a]	*1976–80*[a]	*1981–85*[a]	*1985*	*1986*	*Increase 1940–86 (%)*
Uzbekistan	0.924	1.718	1.823	1.932	1.993	2.053	122
Tajikistan	0.106	0.264	0.295	0.308	0.312	0.314	196
Turkmenistan	0.151	0.438	0.504	0.534	0.560	0.650	330

Note: [a]Average per year for this period.

Source: Critchlow (1991).

Table 1.2 **Land under irrigation (× 1000 hectares)**

Country	*1950*	*1960*	*1965*	*1970*	*1975*	*1980*	*1985*	*1986*
Uzbekistan	2276	2570	2639	2750	2995	3527	3908	4171
Tajikistan	361	427	442	524	566	627	660	703
Turkmenistan	454	496	509	670	855	960	1160	1350

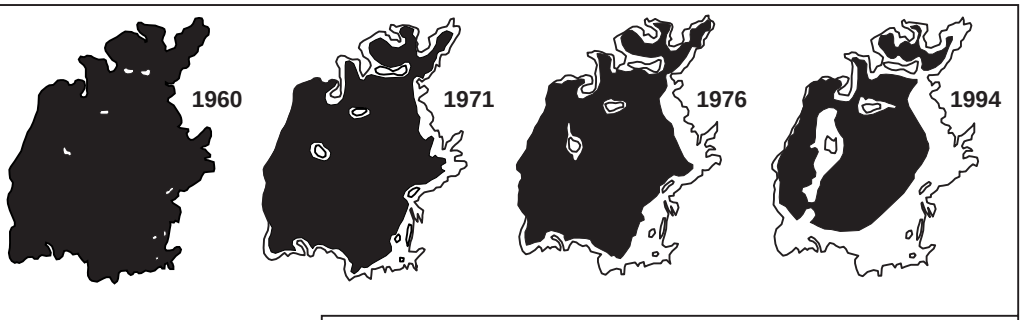
Source: Zonn (this volume).

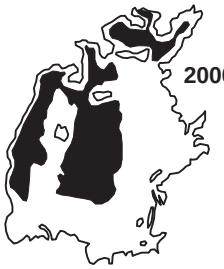
for the flushing of salts from the old ones. In addition, starting in 1954 with the construction of the Karakum Canal in Turkmenistan, relatively large amounts of water had been diverted each year from the Amudarya to irrigate lands in that republic. The current withdrawals for the Karakum Canal are estimated to be about 15–20 km³ per year (or 23–30% of the Amudarya's total annual flow).

SEA LEVEL DECLINE

The decline in the level of the Aral Sea has received considerable political attention, both domestically and internationally. It became a highly visible problem in the mid-1980s. Increasing water diversions from the two main regional rivers robbed the sea and deltas of their annual fresh-water replenishment. The rate of decline of the sea can be seen in Figure 1.5. Note also that declining levels were accompanied by an even more rapid reduction in the volume of the sea and by an increase in sea-water salinity.

Another problem related to sea level decline and reduced sea surface area has been the increase in the number, frequency, and impacts of dust storms. In the mid-1970s, dust storms captured the attention of Soviet policy-makers when cosmonauts, during one of their space missions, identified major dust storms raging over the exposed seabed in the receding southeastern part of the Aral Sea. The exposed seabed enabled winds to pick up dust laden with a variety of chemicals and carry it hundreds of kilometers from the original site. Farms downwind of the storms were covered with these dry depositions,





Year	Average Level (meters)	Average Area (sq.-km)	Average Volume (cu.-km)	Average Salinity (grams/liter)
1960	53.4	66,900	1090	10
1971	51.1	60,200	925	11
1976	48.3	55,700	763	14
1994		31,938	298	
Large Sea	36.8	28,856	273	>35
Small Sea	40.8	3,082	25	~25
2000		25,217	212	
Large Sea	33.4	21,776	186	>60
Small Sea	41.6	3,441	26	~20

Philip Micklin: 1995

Figure 1.5 Levels of the Aral Sea (Micklin and Williams, 1996).

prompting farmers to claim that the productivity of their land, as well as their health, were being adversely affected. Since then, the number and intensity of these dust storms along the exposed seabed had increased. The appearance of these storms exposed Soviet leaders, and belatedly the rest of the world, to yet another consequence of diverting water from Central Asia's two main rivers.

DECREASING FLOWS OF THE AMUDARYA AND SYRDARYA INTO THE SEA

Historically, the Amudarya had supplied about 70% of the water to the Aral Sea, more than twice the flow of the second major regional river, the Syrdarya. From the early 1960s, the decline in Syrdarya flow was noticed and, by the late 1970s, no water from this river reached the sea. As for the Amudarya, a sizeable amount of its water has been diverted into the Karakum Canal. In the mid-1990s, the last extension of the Karakum Canal into south-western Turkmenistan was completed, an event that will likely translate into additional diversions of water from the overdrawn Amudarya. There were a few years in the late 1980s when virtually no water from the Amudarya reached the sea. In the early 1990s, however, after several years of favorable snowpack in the Pamirs, water reached the sea and its deltas once again.

DECLINING WATER QUALITY IN THE RIVERS AND IN THE SEA

As fields in Central Asia were continually irrigated on a large scale, soil fertility declined rapidly. This prompted farmers to use increasing amounts

of fertilizers, herbicides, and pesticides in order to maintain, and even expand, cotton production. Many of these chemicals found their way, through return flow, to the rivers, as well as into the region's groundwater. In order to avoid, or rather delay, the continuing salinization of soils, increasing amounts of water had to be used to flush the land in an attempt to make it free of salts and other compounds. Much of this drainage water ended up in the region's rivers and, eventually, the sea itself. Drainage canals were constructed to divert some of the contaminated water away from the sea, and much of it ended up in a regional desert depression, known as Lake Sarakamysh.

DEGRADATION OF DELTA ECOSYSTEMS

Another example of the ecological consequences of reduced streamflow into the sea has been the degradation of the highly productive Amudarya and Syrdarya deltas, a problem which has become increasingly pronounced during the past thirty years (Novikova, this volume; Smith, 1994). One of the consequences of the desiccation of the deltas has been a pronounced reduction in vegetative cover, a loss that destroyed habitats for wildlife and migratory birds. Wildlife had, to a large extent, disappeared from the delta regions. Worse yet, forest ecosystems, such as the unique tugai forest, have been devastated as the soils dried out or became salinized or waterlogged, depending on local soil conditions. Frederick (1991) highlighted the economic importance of the deltas in the recent past, noting that they provided a 'feeding base for livestock, a source of reeds for industry, spawning grounds for fish, and sites of commercial hunting and trapping.' Each of these delta-related ecological and societal processes has either been sharply curtailed or terminated altogether.

Today, Uzbek and Kazak leaders, supported by recent recommendations from World Bank consultants and staff, propose to rejuvenate deltaic ecosystems, apparently abandoning some of the more ambitious schemes designed to save the entire Aral Sea.

DECLINE OF FISH POPULATIONS IN THE ARAL SEA

Along with a decline in the quality of river water came a decline in the quality of Aral Sea water. At a 1977 Soviet conference on the environmental impact of a drop in the level of the Aral Sea, a paper prepared by two Uzbek scientists reported that there had been a sharp reduction in fish landings (Gorodetskaya and Kes, 1978). As a result of the desiccation of the sea's fish spawning grounds, they suggested that the demise of the region's commercial fisheries was imminent. Borovsky (1980) also suggested that the demise of the Aral Sea's fisheries would be one of the first consequences of declining sea levels. Reteyum (1991) wrote that 'in 1965, the Council of Ministers of the USSR passed a special resolution, On Measures to Preserve the Fishery Importance of the Aral Sea'. He cited this as one of the examples in support of

Table 1.3 **Decline in fish catches over time**

Year	*Metric tons of fish*
1960	43 430
1965	31 040
1970	17 460
1975	2940
1980	0
1985	0
1990	0

Source: From Létolle and Mainguet (1993), p. 182.

his belief that signs of deterioration in the Aral Basin were seen as early as the mid-1960s.

Table 1.3 shows the sharp decline over time in fish catches. This decline provided a visible threshold for decision-makers to see that their inaction with regard to declining sea level and water quality had adverse biological consequences. By the late 1970s, it was quite clear that the Aral Sea's fisheries were in irreversible decline. A once-thriving fishing industry was being slowly destroyed by increasing amounts of pollutants entering the sea from its two feeder rivers. In addition, the salinity of Aral Sea water increased to such an extent that several areas had salinity levels equivalent to that of the open ocean.

References to Aral Sea fishery problems were registered by Goldman (1972) in his book on environmental pollution in the Soviet Union.

> Although the quality of the fish native to the Aral Sea was not as high as it was in the Caspian, the impact of polluting and shrinking the Aral has been even greater. From a typical haul of 40 000 metric tons in 1962, the catch dropped to 20 000 metric tons in 1967 (*Soviet Geography*, 1969). Apparently by 1970 it had fallen to 16 000–18 000 metric tons (*Sotsialisticheskaia industriia*, 1970). And as the salt content of the sea rises, the expectation is that the remaining fish in the Aral will rapidly be annihilated. (*Kazakhstanskaia pravda*, 1969)

Today, no fish are caught commercially in the sea; the former sea ports of Muynak (to the south) and Aralsk (to the north) are now stranded several tens of kilometers from the receding shoreline. Up to the early 1990s, fish had been shipped in from distant locations (the Arctic, the Baltic, the Pacific) for processing in Muynak's fish cannery. But this expensive option came to an abrupt halt in 1994. The loss of the Aral Sea's fisheries sparked the collapse of the entire industry, causing unemployment and the decline of the economies of former coastal towns such as Muynak and Aralsk.

INCREASES IN HUMAN DISEASES

The dependence of several Central Asia Republics on cotton production has not only adversely affected the physical environment, by upsetting

fragile ecological balances in many parts of the Aral Basin, but it has also had a major impact on human health (see Elpiner, this volume). Documented widespread regional health effects have only recently been reported to the public: high infant and maternal mortality and morbidity rates, a sharp increase in esophageal cancers directly attributable to 'poisoned' water resources, gastrointestinal problems, typhoid, high rates of congenital deformities, outbreaks of viral hepatitis, the contamination of mothers' milk, and life expectancies in some areas about 20 years less than for the Commonwealth of Independent States (CIS) in general. Groundwater supplies, too, have been contaminated as a result of the widespread and wanton use of chemicals on irrigated cotton fields. By all statistical measures, the region's human health profile fares poorly in comparison to the rest of the CIS (Feshbach and Friendly, 1992; Ellis, 1990). Adverse impacts of all-out cotton production on health have been compounded by the relative paucity of medical and health facilities in the Aral Basin. In addition, water treatment facilities in the region are wholly inadequate (and in many areas nonexistent), necessitating the use of untreated surface waters from rivers, irrigation canals, and drainage ditches for municipal purposes.

Systematic research on public health conditions in the Aral Sea basin began in the mid-1970s. From that time, the negative dynamics of deteriorating public health conditions in the region were observed. Had such research been undertaken and its results exposed earlier, adverse public health conditions would have been identified by the end of the 1960s, and would probably have been linked to the presence of pesticides (Elpiner, 1990). In addition, Kuznetsov (1992) noted that 'unfortunately, secrecy over an entire series of research results in the 1970s, especially medical-epidemiological data, precluded their publication at that time and the predictions associated with them did not become available to the public in time.'

One situation deserves special mention, namely, the deteriorating health conditions of the Turkic-speaking people living in the semi-autonomous republic of Karakalpakstan, situated in northwest Uzbekistan, along the southern shore of the Aral Sea. More than one million people have been affected:

> There is a shortage of clean water, and there is not enough even for drinking. In several parts of the region the consumption of water per person per day is about 5 liters, compared to an average of 200 to 300 liters. The mineralization (salt content) of this water stands at 2 to 4 grams per liter, and the bacteria content exceeds the maximum permissible concentration by 5 to 10 times. Through the dispensary system the Ministry of Health discovered a truly tragic picture: 60 percent of those examined – children and adults – have serious health problems; 80 percent of pregnant women suffer from anemia; intestinal infections are widespread; the infant mortality rate is much higher than national average figures and in several regions reaches 82 deaths for every 1000 live births. Diseases never before seen here are appearing, for example gallstones and kidney stones. (Rudenko, 1989, p. 44)

Another human health tragedy that deserves mention is in Dashowuz (or Dashkhovuz) in Turkmenistan. A report on *The Health of Mothers and Children in the Aral Sea Region of Turkmenistan* (Radzinsky, 1994) noted the impact on health of the contamination of the Dashkhovuz water supply, attributing much of the problem to the agricultural sector. The report stated that:

> The middle and lower reaches of the Amu Darya run through Turkmenistan . . . the quality of the Amu Darya water is a cause for concern, because its mineralization and chemical pollution are increasing uncontrollably . . . The increasing deterioration of drinking water quality and its contamination with toxic chemicals and pathogenic microorganisms are closely linked to the extensive use of large quantities of mineral fertilizers, pesticides, and defoliants in the cotton-growing regions of Turkmenistan, especially in the fields of the Dashowuz Oasis, which is the largest cotton-growing region in the country . . . The application of such large amounts of mineral fertilizers, pesticides, and defoliants for so many years could not help but affect the environment of the Aral region and has naturally had a detrimental impact on the health of the local population. (Radzinsky, 1994, pp. 5–6)

In the absence of any major improvement in regional health care or in detoxifying water and land resources in the Aral basin, the only way out for regional inhabitants, other than perpetuating the status quo, has been emigration. However, despite Soviet plans to encourage those most directly affected (e.g., the people of Karakalpakstan) to migrate to areas outside Central Asia, few have opted to leave their homelands. Thus, with few meaningful actions to improve the health of the people or the environment in the Aral basin, the total sum of misery can only increase, particularly since the region boasts an extremely high population growth rate, ranging from 2.6% to 3.2% per annum. If current growth rates continue, the population of the five Central Asian Republics could double to 60 million by the early decades of the twenty-first century.

A most recent attempt to address the health problems in the Aral Sea basin's disaster zone was an assessment of the well-known nongovernmental organization, *Medicins Sans Frontières* (MSF, Doctors Without Borders). In mid-1997, it sent an exploratory team to Karakalpakstan (in Uzbekistan) and Dashkhovuz (northern Turkmenistan) to assess the severity of the needs of the local inhabitants for the purpose of developing possible MSF programs in the region. This is not a typical activity of the MSF, as it usually responds to conflict and refugee situations in which there has been a breakdown in health services. Its recent assessment of the needs of Mother and Child Health underscores the entire situation in the region, and it will decide how it can best address it, given that it would be such a unique situation for MSF. MSF is no stranger to dealing, under very difficult conditions, with high rates of infant mortality, diarrhea, acute respiratory infections, and the spread of infectious diseases.

CRISIS AWARENESS

Exactly when the adverse environmental changes in the Aral Sea basin were awarded crisis status has been a source of controversy. All observers seem to agree that 1960 marked an important turning point for regional environmental quality. Whatever environmental conditions existed before 1960 were considered to have been more sustainable than those which followed that watershed year. The year 1986 can also be viewed as important, as Gorbachev's policy of *glasnost* (openness) began to take hold and discussions of the degradation within the Aral Sea basin became both public and vociferous. The year 1991, too, has been cited as an important marker for the Central Asian Republics; they began to view themselves as republics independent from the former Soviet Union.

One could also consider 1992 to have been an important year with regard to the recognition of a crisis in the Aral Sea region. Late that year the United Nations Environment Programme (UNEP) completed what some might call a pioneering effort to produce a 'Diagnostic Study of the Aral Sea' crisis. The study (UNEP, 1992) highlighted several problems facing leaders of the newly independent Central Asian Republics. As a result of this particular UNEP activity, the interest in and concern about the fate of the region was given higher visibility around the globe. This prompted other international organizations, especially nongovernmental organizations (NGOs), to deal with requests from Central Asian leaders to help resolve their environmental crises. 'Save the Aral Sea' then became the rallying cry of governmental and nongovernmental organizations alike.

'Saving the Sea,' however, is easier said than done. Any actions implemented to save the Sea carry with them major disruptions in the way things are usually done. As a result, support for 'business as usual' seems to be the order of the day. As noted earlier, a reliance on 'business as usual' can be blamed on the way that people and, therefore, societies tend to look at CEPs. They see little urgency associated with a particular creeping environmental change, so they tend to postpone dealing with it until it is almost too late.

Today, several of the incremental changes in the Aral basin are viewed as having developed to such an extent that they have turned into full-blown crises. Such belated responses by society to CEPs are not unusual; they occur in rich and poor countries, in capitalist and socialist countries, and in democratic and authoritarian regimes. They occur in response to local CEPs as well as to regional, international and the truly global ones. It appears to be a problem not of social organization but one of human nature. If Central Asian Republics in the Aral Sea basin, along with the international donor community, can be convinced to address cooperatively and in a timely way creeping environmental problems and the human activities that caused them, their adverse consequences could be mitigated and, perhaps, even arrested and reversed.

CEPs and sustainable development

Ever since the notion of 'sustainable development' was first raised in 1980 in an IUCN World Conservation Strategy document and, later, highlighted in the Brundtland Commission report in 1987 (WCED, 1987) and, again, in Agenda 21 (Sitarz, 1993) at the 1992 Earth Summit in Rio de Janeiro (Brazil), its usage has spawned what could be called a growth industry in academic research and economic development circles. Scores of definitions now exist, as do position statements on the notion and critical reviews of it. It seems that there are so many meanings associated with sustainable development, that policy-makers can find one in the scientific or economic literature to support any particular policy they wish to pursue in relation to development and the use of natural resources.

Discussions of sustainable development usually focus on one, or a combination of, the following processes: ecological, economic or social sustainability (e.g., Redclift, 1987). Saving ecosystems has been increasingly downplayed by those who favor economic growth and development over the prevention of environmental degradation. Natural resources are to be used, they might argue, and have little intrinsic value in themselves. The economic sustainability of a political system may overlook the need of people in general ('need' is subjectively defined and has many meanings); for example, one might argue that 'the poor will always be with us; let us try to keep their numbers relatively small.' Environment-oriented decision-makers favor the need to sustain ecosystems. Social sustainability suggests that governments have a responsibility to sustain a culture or way of life, which harks back to protecting the environmental setting on which it depends.

With regard to coping with environmental changes in the Aral Sea basin, going back to basics, perhaps, might not be a bad idea. These basics, according to my preferences, have been succinctly stated by Lélé (1994): (a) What is to be sustained? A particular resource or ecosystem in a particular form? The income it generates? Or the lifestyle it supports? (b) For how long? A few generations? Or forever? (c) How? That is, through what social process? Involving what tradeoffs against other social goals?

With regard to the Aral Sea region, more than a few questions need to be answered. For example, what is it that governments are seeking to sustain? Soil fertility? Human health? Fish populations? The economy? A ways of life? The deltas? The well-being of the region's leaders? How long do we wish to sustain it? The Aral Sea, as we know it, has been around for tens of thousands of years. Is that long enough? Can we now alter it in pursuit of human goals? Will the activities pursued in order to achieve sustainable development goals by, say, the year 2003 enable them to achieve the same goals by the year 2023? In other words, are short-term attempts at sustainability compatible with achieving sustainability in the long run?

Discussions of sustainable development generally raise questions concerning the relationship between present and future generations, often referred to as intergenerational equity issues (Partridge, 1981). Some people jokingly say that the future has done nothing for us, so we have little responsibility to future generations. Others contend that we have a moral responsibility to take into consideration the impacts of today's decisions on future generations – children, grandchildren and great-grandchildren. Still others argue that we do not know what future generations will either want or need, so there is little we can do for them from the vantage point of the present.

We frequently forget that there are five generations alive at any given time. Generational representatives can be brought together for intergenerational discussions about sustainable use of the environment. Great-grandchildren can ask of their great-grandparents why they let the environment deteriorate to the extent that it has. Great-grandparents, for their part, can ask their great-grandchildren what 'things' they are willing to give up so that environmental conditions can be improved. These generations can communicate with one another and can determine to some extent what future generations might want.

We are already aware of existing environmental sensitivities in the region. However, it would be useful to jump ahead a few decades into the future, in an attempt to identify new societal sensitivities. We need to 'leap-frog' well into the future in order to create a vision of sustainable economic development. For example, where do the Central Asian Republics want to be in 2003? And in 2023? What will it cost them to reach their goals? Assume that, as of today, there are few problems that have reached crisis stages, such as those related to water quantity, water quality, human health, ecological health, and population. Can we identify 'new sensitivities' that national and regional policy makers might have to face in the future if they were to pursue a 'business as usual' strategy?

The Aral Sea is not the only inland drainage basin that is facing severe pressures related to the issue of sustainable development, or of ecological or social sustainability. One might also look at other similar regions dependent on finite water resources to see how well (or poorly) they might have dealt with their situation. How did they approach sustainable development? What sensitivities have they come up against, with regard to population- environment-development interactions?

For example, in a recent book on the Great Lakes of North America, called *The Late, Great Lakes: An Environmental History*, Ashworth (1987) drew attention to the ever-present conflict between the *in situ* use of existing natural resources – in this case, seemingly abundant water supplies – and the need for that water in other distant locations to sustain economic growth and development.

The Great Lakes have several environmental problems: the lake beds and waters are suffering from varying degrees of pollution, several species of fish are no longer suitable for human consumption, lake flora and fauna have been adversely affected by more than a century of chemical and other toxic

effluents. In addition, if global warming of the atmosphere were to occur, as suggested by various atmospheric scientists, computer models postulate that the water level in the Great Lakes would decline. A decline in water level would expose toxic lake-bed sediment to wind action and, therefore, its distribution throughout the basin and beyond.

In addition to all of these problems plaguing the Great Lakes sandwiched between two of the richest, most technologically advanced countries in the world, there is a growing demand on the basin States and Provinces to 'share' their lakes' waters with other nonriparian states. The following lengthy quote from Ashworth captures this dilemma for Great Lakes policy-makers.

> All of these problems, however, are pallid beside the threat looming on the western [US] horizon, where mining and agricultural interests are readying large-scale plans to lay pipelines to the Great Lakes, supplying by pump and pipe the water God doesn't supply by rain to the arid [parts of the west].
>
> The concept is simple. The need is *here*; the water is *there*; and the shortest distance between two points is a straight line, preferably a round, hollow one, made of concrete and filled with water . . . The plans to pump water west amount to nothing short of a plan to drain the Great Lakes. Drain the Great Lakes? It sounds preposterous, and it is, but not because it cannot be done. It can. The technology exists; the need exists . . . It comes from the assumption, basic to the idea of diversion, that the water can somehow be put to better use on the Plains than it can be in the Lakes. (Ashworth, 1987, p. 9)

Inland drainage basins such as these, and many of the rivers and streams that feed them, have become the repository for various kinds of waste. This is a problem faced by both industrialized and agricultural countries. There is no easy way to reverse the adverse impacts on the environment of such accumulated chemical and toxic waste. But there are ways, at least in theory, to prevent long-term, low-grade environmental changes from becoming major cumulative environmental disasters.

On the one hand we talk easily of sustainable development goals, while on the other hand we cannot deal effectively and in a timely way with creeping environmental problems. CEPs challenge our ability to achieve sustainable development because they are often not readily apparent. CEPs have plagued societies throughout history, right up to the present; and there appears to be little hope that this will change. Only by encouraging leaders from all levels to respond decisively and effectively to CEPs can one hope to improve the way in which societies interact with their physical and biological environments. Improved societal responses to CEPs can enable countries to achieve whatever 'sustainable development' goals they have set for themselves.

Timely responses to CEPs: What can be done?

US political scientist Anthony Downs, in his article called 'Up and down with ecology: the "issue-attention cycle" ', identified five stages in the

dynamics of the issue-attention cycle. These stages are, by analogy, similar to the way society, over time, tends to deal with creeping environmental problems: (1) the pre-problem stage, (2) the alarmed-discovery-and-euphoric-enthusiasm stage, (3) realizing-the-cost-of-significant-progress stage, (4) the gradual-decline-of-intense-public-interest stage, (5) and the post-problem stage (Downs, 1972).

With regard to the interest in environmental changes in the Aral Sea region, the pre-problem stage began in the mid-1960s and perhaps earlier, when the first signs of unusual environmental changes began to appear. In this period, some Soviet scientists did draw attention to potential severe and sometimes irreversible environmental changes in the sea and its deltas. They did so at risks to their careers.

Stage two was delayed until the mid-1980s because of the nature of the political system, the nature of the problem (i.e., a CEP), and because of the proposed technological fixes (e.g., the diversion of Siberian river water to Central Asia). Once the fate of the Aral region and its inhabitants became officially exposed to the public within and outside the Soviet Union, the international community, as well as national groups, began mobilizing to help national and regional authorities to address the Aral 'problem'.

Stage three began with the identification of the magnitude of the environmental problem faced by the region's authorities and inhabitants. However, once the high costs associated with correcting those problems were identified, enthusiasm about resolving the problems, at least in the short term, tended to wane. Another factor blunting enthusiasm was the realization that unlimited funding from international organizations such as the World Bank would not be available. Republics in the region quickly came to realize that the funding that would be made available would come with 'strings' attached.

This realization has been followed by stage four, a decline in interest in resolving the difficult environmental problems of the region, and a search for one grandiose costly plan to make all of the region's environmental ills go away. In this phase, realistic 'can-do' proposals can emerge, along with an improved appreciation of the problems faced and the limited funds available to address them. Environmental problems are then prioritized.

The fifth stage of the cycle (the post-problem stage) has not yet been realized in the Aral region. In this phase one can assume that 'environmental awareness' intensified and that the problems generated by human involvement in creeping environmental change had begun to be addressed. Capacity building and institutional development receive greater attention, given the demonstrated linkages between environmental quality and sustainable development, however one chooses to define it. Improved management of resources and improved interactions between human activities and the natural resource base are often generated by a political, as well as an economic, development goal.

Most creeping environmental problems confronting societies involve human activities. Delayed responses to such changes, until a crisis situation emerges, are costly to both society and the environment. Thus, it is necessary to improve societal understanding of the dynamics, as well as the implications, of CEPs in order to prompt more appropriate, effective, and timely responses to them by policy-makers.

Rich countries, despite their present-day claims to be so poor, may be able to get away with responding to their full-blown environmental crises by 'throwing large sums of money at them.' However, in countries with limited, scarce or dwindling resources, 'muddling through' is likely to lead to an environmental crisis or, even worse, the realization of a dreaded, irreversible situation for which they have few, if any, resources with which to respond.

Regional organizations in Central Asia: five heads are better than one

It is often difficult to bring together, into an effective regional organization, states that have been independent for a long time. It is even more difficult to do so with newly independent states, as each state seeks to develop its own national identity and policies.

States in the Aral Sea region have an opportunity to address a common set of problems; problems that stem from a key shared regional resource: water. Each state has a water-related 'bargaining chip', so to speak, with regard to other states in the region. The leaders of the five Central Asian Republics still have a unique opportunity to develop a truly effective (cooperative as opposed to competitive) regional organization centered on the management and use of regional water supplies. Given inherent limitations on the availability of national and international financial resources to resolve all present-day environmental problems in the Aral basin, an effective Central Asian regional organization in which no single country dominates could go a long way towards arresting regional CEPs and in achieving a regionally defined form of sustainable development. Such an organization could help the republics cope with new environmental sensitivities that will likely emerge in the next few decades.

How important is the Aral Sea anyway?

The Aral Sea may be more important to the region than many observers realize, especially if states in the region hope to achieve any degree of sustainability. In fact, one could argue that the sea itself is a key to the region's future well-being, both symbolically as well as realistically. Symbolically, it is much more than a useless body of water in a sandy desert depression. It has intrinsic value as a body of water sandwiched between two deserts. The relatively rapid demise of the sea has captured the attention of the international community. Realistically, it affects regional inhabitants. It affects regional

climatic conditions. Its declining sea level has generated various proposals to institute heroic, high-tech schemes to preserve it (melt glaciers, pump Caspian water uphill, etc.). Its decline has also generated ill-will among people within and between the region's republics.

'I HAVE MET THE ENEMY AND HE IS US!'

Clearly, it is much easier to identify problems than it is to resolve them. Yet, societies everywhere have poor records in dealing with CEPs, let alone resolving them. We should correct this mismatch between the rates of environmental change and the rates at which decisions are taken to address them. Methods need to be devised to slow down, arrest, and wherever possible, reverse the CEPs which plague the environment and inhabitants in the Aral basin.

Human behavior issues must be addressed. To avoid dealing with behavioral factors that impinge on regional environmental quality would likely mean that similar behavioral processes will occur in those regions where governments and scientists hope to make gains (e.g., the deltas). The underlying causes of environmental degradation in the Aral Sea basin must be confronted.

A major goal must be to 'Save the Sea' in some form. This does not necessarily mean that it must be restored to its pre-1960 level; nor does it mean that the sea should be abandoned altogether, focusing instead on protecting only the deltas. Central Asian leaders must look to the future with a vision. They must identify where they want to be in the year 2003 and then again twenty years later, so that we can identify critical human, as well as other, resources that will be required to get us there. In other words, identify the level of environmental health leaders want to bring to the region by a designated point in time by which goals are to be met, and then try to work toward achieving it.

Conclusion: Steps decision-makers can take now to encourage sustainable resource management in the Aral Sea basin

Whatever the notion of sustainable development means, it does not mean that a nation or a region must live off its own resources. Autarchy clearly does not work well, especially in today's interconnected world. Nations have resources that they can either exploit or trade for other resources that they need. What sustainable development does mean, among other things, is that a nation must not overexploit its natural and human resources. The following discussion suggests some steps that can be taken immediately by political leaders of the Aral Sea basin states.

1. It is very important to improve awareness of the interdependence between the officially designated disaster zone around the Sea and upstream regions. Their fates are geographically entwined. That awareness should serve to reinforce the value of a regional political organization of equals; a regional organ-

ization, unlike most others around the globe where one or two countries tend to dominate the process.

2. It is also important to improve the awareness of the tradeoffs between environment and development. Today there are numerous examples of successes and failures in national and regional attempts at sustainable economic development. Examples relevant to the region should be collected and 'mined' for insights into what might or might not work in the Central Asian political, environmental and social context. For example, methods could be devised to enable upper basin states to share in the downstream profits derived from water used for economic development. This would provide an incentive to upper basin states to protect the water quantity and water quality that they pass on to lower basin states.
3. It is imperative that societies improve their awareness of the nature of creeping environmental problems and the ways in which societies have dealt with them. Most environment-related problems are partly or wholly human-induced. Early intervention in these creeping processes of change can improve the chances for sustainable development in the long term.
4. Numerous reports on development planning, in both industrialized and in developing countries around the world, have criticized the lack of involvement of local people in national planning efforts. This shortcoming, in fact, has been blamed for the failure of many development projects to live up to their stated goals. Capacity building within countries includes the involvement of the public in decision-making processes. There is a fallacy that must be dealt with here: namely that 'experts' are only those who come from another country. There is considerable expertise, actual and potential, within the Aral Sea basin countries. This reservoir of knowledge must be nurtured and brought into the development process. It is particularly vital that local people, who are directly affected by a given environmental problem, have a stake in the success of development planning activities.
5. There are no readily apparent quick-fixes – technological or otherwise – to resolve the environmental and, therefore, the sustainable development crises afflicting the Aral Sea basin. Problems in the region have been accumulating throughout the past century (not just since 1960). They may require 'creeping solutions' – incremental steps that can be taken to improve the health of the people, the economy and the environment. In this way, solutions will also work to achieve the region's vision and goals for sustainable development (see Agarwal, 1996). By addressing creeping environmental problems through planned, incremental steps, the nations of the region may improve their efforts at sustainable resource management.

As a final comment, the international community and the Central Asian Republics have defined a disaster zone that encompasses the southern region of the Aral Sea. It includes the Karakalpak Republic and the Khorezm Region of Uzbekistan, the Kyzyl-Orda Region of Kazakstan, and the Dashkovuz Region of Turkmenistan. This is unfortunate, because the river systems of the Amudarya and the Syrdarya, in fact, define the disaster zone. There will be no way to resolve the crises in the Aral region without recognizing explicitly the

interconnectedness of the administrative units that share the resources provided by these river basins.

In ecology there is a saying: 'you can't do just one thing.' In other words, you cannot change one element of an ecosystem without inadvertently having an effect on other elements of that ecosystem. Similarly, anything that affects the flow of waters along their natural course has an impact elsewhere. It is important that the Aral Sea basin be viewed holistically as a 'meta-ecosystem': a system that cannot be separated into its many linked parts. Collective problems must be met with collective solutions.

References

Agarwal, A., 1996: *The Curse of the White Gold: The Aral Sea Crisis*. New Delhi, India: Centre for Science and Environment. March, 49-51.

Ashworth, W., 1987: *The Late, Great Lakes: An Environmental History*. Detroit, Michigan: Wayne State University Press.

Borovsky, V. M., 1980: The drying out of the Aral Sea and its consequences, Scripta Publishing Co. (from *Izvestiya Akademii Nauk SSSR, seriya geograficheskaya*), **5**.

Burton, I. and K. Hewett, 1974: Ecological dimensions of environmental hazards. In: F. Sargent (ed.), *Human Ecology*, 253–83. Amsterdam: North-Holland.

Critchlow, J., 1991: *Nationalism in Uzbekistan: A Soviet Republic's Road to Sovereignty* Boulder, Colorado: Westview Press.

Davis, J. H., 1956: Influence of man upon coast lines. In: W. L. Thomas Jr. (ed.), *Man's Role in Changing the Face of the Earth*. Chicago, IL: University of Chicago Press.

Döös, B. R., 1994: Why is environmental protection so slow? *Global Environmental Change*, **4**, No. 3, 179–84.

Downs, A., 1972: Up and down with ecology – the 'issue-attention cycle', *The Public Interest*, **28**, 38–50.

Ellis, W. S., 1990: The Aral: a Soviet sea lies dying, *National Geographic* (February), p. 83.

Elpiner, L. I., 1990: Medical-ecological problems in the eastern Aral region. Paper presented at University of Indiana conference on 'The Aral Sea Crisis: Environmental Issues in Central Asia' Bloomington, Indiana: mimeo.

Feshbach, M. and A. Friendly Jr., 1992: *Ecocide in the USSR: Health and Nature under Siege.* New York: Basic Books.

Frederick, K. D., 1991: The disappearing Aral Sea, *Resources* (Winter issue). Washington, DC: Resources for the Future, 11–14.

Goldman, M. I., 1972: *Environmental Pollution in the Soviet Union: The Spoils of Progress*. Cambridge, Massachusetts: The MIT Press, 234–5.

Gorodetskaya, M. Ye. and A. S. Kes, 1978: Alma-Ata conference on the environmental impact of a drop in the level of the Aral Sea, *Soviet Geography*, **19** (10), 728–36.

Hoffer, E., 1952: *The Ordeal of Change*. New York: Harper and Row.

Kazakhstanskaia pravda, 1969: Kazakhstan periodical, February 6, 1969, p. 2.

Kuznetsov, N. T., 1992: Geographical and ecological aspects of Aral Sea hydrological functions. *Post-Soviet Geography*, **33**(5), 324–31

Lélé, S., 1994: Sustainability, environmentalism, and science. *Pacific Institute Report*, Spring, p. 5.

Létolle, R. and M. Mainguet, 1993: *Aral*. Paris: Springer-Verlag.

Micklin, P. and W. D. Williams (eds.), 1996: *The Aral Sea Basin*. NATO ASI Series, The Environment, Vol. 12. Berlin: Springer-Verlag.
Mnatsakanian, R. A., 1992: *Environmental Legacy of the Former Soviet Republics*. Edinburgh, Scotland: Center for Human Ecology, University of Edinburgh, p. viii.
NRC (National Research Council), 1987: *Confronting Natural Disasters: An International Decade for Natural Hazard Reduction*. Washington, DC: National Academy Press.
Palm, R. I., 1990: Chapter One: Introduction to the study of natural hazards. In: R. I. Palm, *Natural Hazards*, 1–17. Baltimore, Maryland: Johns Hopkins University Press.
Partridge, E. (ed.), 1981: *Responsibilities to Future Generations: Environmental Ethics*. Buffalo, NY: Prometheus Books.
Radzinsky, V. Ye. (ed.), 1994: *The Health of Mothers and Children in the Aral Region of Turkmenistan*. Kiev: Zdorovya Publishing House.
Redclift, M. R., 1987: *Sustainable Development: Exploring the Contradictions*. New York: Methuen Press.
Reteyum, A. U., 1991: Letter in Overview Section, *Environment*, **33**(1), p. 3.
Rudenko, B., 1989: 'Solenye Peski Aralkum' (The salty sands of the Aral), *Nauka i zhizn*, **10** (October), p. 44.
Sitarz, D., 1993 (ed.): *Agenda 21: The Earth Summit Strategy to Save Our Planet*. Boulder, CO: Earth Press.
Sotsialisticheskaia industriia, 1970: Russian periodical, August 15, 1970, p. 2.
Soviet Geography: Review and Translation, 1969: Russian periodical, No. 3, p. 146.
Smith, D., 1994: Change and variability in climate and ecosystem decline in Aral Sea Basin deltas, *Post-Soviet Geography*, **35**(3), pp. 142–65.
Smith, K. R., 1988: Overview: Natural hazard reduction. *Environment*, **30**(6), 2–4.
Tsinzerling, V. V., 1927: *Irrigation in the Amudarya Basin*. Moscow: Izd. Upravleniya vodnogokhozyaistva Srednei Azii (Publishing House of the Water Management Board of Central Asia).
Tsutsui, H., 1991: *Some Remarks on the Aral Sea Basin Irrigation Management*. Nara, Japan: mimeo.
UNEP (United Nations Environment Programme), 1992: *Diagnostic Study for the Development of an Action Plan for the Aral Sea.* Nairobi, Kenya: UNEP.
WCED (World Commission on Environment and Development), 1987: *Our Common Future*. New York: Oxford University Press.