biological wealth & other essays

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Foreword by M.S. Swaminathan

World Scientific

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World Scientific
New Jersey • London • Singapore • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 912805

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

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

BIOLOGICAL WEALTH AND OTHER ESSAYS

Printed in Singapore by World Scientific Printers (S) Pte Ltd

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Dedication

I am pleased to dedicate this book of essays to Jim Watson, who has contributed profoundly to revolutionizing biology. Not since Darwin have we witnessed such a fundamental transformation of biological sciences. DNA is a household word today. However, as Jim wrote, "Unfortunately, lots of well-intentioned outsiders today see recombinant DNA as a test case for the scientist's responsibility to society" (from *A Passion for DNA*: *Genes, Genomes and Society*, p. 57).

These essays reflect a similar concern about a much misunderstood opposition to DNA research, on the one hand, and, paradoxically, its commercialization on the other.

Foreword

This book on biological wealth by Prof. Krishna R. Dronamraju is a timely publication. Research on genetic modification with particular reference to crop plants is now at a crossroad. On the one hand, recombinant DNA technology has opened up uncommon opportunities for developing novel genetic combinations. Some of them can be of immense value in the battle against biotic and abiotic stresses. Others may be of help in bringing about a nutrition revolution. On the other hand, there is serious apprehension in the public mind about the food and environmental safety aspects of genetically modified crops. Ethical considerations are also becoming important not only in technology choice but also in the equitable sharing of benefits.

Biodiversity is the feed stock of the biotechnology industry. Unfortunately, the primary conservers of economically valuable biodiversity and the holders of traditional knowledge tend to remain poor, in contrast to the prosperity of those using their knowledge and material. This is why the legally binding Convention on Biodiversity places great stress on the ethical and equity aspects of benefit sharing. The Cartegena Protocol on Biosafety provides an international framework for dealing with the biosafety aspects of transgenic plants and animals.

Prof. Dronamraju has dealt with all these issues in a lucid and authoritative manner. This book shows the way of ensuring that the benefits of the gene revolution triggered by recombinant DNA technology reach the unreached. It also emphasizes the need for a strong ethical push

to match the technological pull represented by genomics, proteomics, the internet and genetic engineering. Hence, this book should be widely read by all concerned with the use of genetic modification technologies for fostering sustainable food and health security.

M. S. Swaminathan

Introduction

Several of these essays were written for a semi-popular audience in three countries: the United States, India and Great Britain during the years 1997–2001. They cover a number of topics which have arisen since the successful application of DNA technology. They include various issues and controversies that are certainly topical today, such as biodiversity, genetic engineering, genetically modified organisms, the genome project, intellectual property rights, cloning, stem cell research, GATT, WTO, CBD, and so on. Biological research, in particular the applied aspect of biology that we call biotechnology, has changed radically over the last twenty years. Much of it is driven by commercial and market forces, which are bent on exploiting every new discovery and observation for financial gain.

These developments have led to some interesting consequences of global importance. Initially, the great discovery of the molecular structure of DNA by James Watson and Francis Crick in 1953 ushered in the DNA revolution, which is clearly the most important event in biology since the Darwinian revolution of the nineteenth century. Biology used to be regarded as a rather unglamorous subject, whereas the physical sciences, especially nuclear physics (and later particle physics), occupied a much loftier place in universities as well as in the public mind. The development of nuclear weapons for security purposes was partly responsible for that state of affairs. However, the tide turned rapidly in favor of biology with the discovery of recombinant DNA in 1973 by Herbert Boyer and Stanley Cohen. It was already clear by then

that the new technology had the potential to revolutionize both agriculture and medicine in a profound way. Indeed, the prospect of recombinant DNA contaminating everything in the world was considered so dangerous that a conference of distinguished molecular biologists was convened shortly afterwards at Asilomar in California to assess the potential risks of any future experiments involving recombinant DNA. Almost thirty years later, many of those concerns, fortunately, remain groundless. For instance, in reviewing a large number of protocols for somatic cell gene therapy in humans, we found the experiments to be no more dangerous than many others in biology and perhaps less so than some. I was a member of the Recombinant DNA Advisory Committee (RAC) of the U.S. National Institutes of Health from 1992–1996. The unfortunate death of one patient undergoing gene therapy in Philadelphia was due to the sloppy work of the investigators.

Biological wealth

The DNA revolution in recent decades has focused attention on the biological wealth of our planet that is exemplified in the biodiversity that is around us. As the economic and scientific implications of the biological wealth of our planet have become more obvious in recent years, commercial and business interests have taken a keen interest in exploiting these new opportunities. Commercial exploitation, in turn, has led to a vast number of intellectual property claims to biological materials that were unheard of twenty years ago. The first patent issued for a "man-made" living organism was in relation to the bacterium, *Pseudomonas aeruginosa*, in 1981, in the celebrated case of Diamond versus Chakrabarty. These developments have greatly blurred the boundaries between biological research and commercial or industrial application.

The commercial success of biotechnology has led to an explosive growth of small private companies, attempting to develop various products of importance to agriculture and medicine. These, in turn, led to an extensive intellectual property rights (IPR) system which was primarily developed by the United States and western Europe. It is now

widely recognized all over the world that a sound IPR is a prerequisite for global trade and especially the transfer or sharing of technology. However, this problem opened a "Pandora's Box," leading to claims and counterclaims and even abuse or misuse of the system in several countries. False claims and non-recognition of indigenous contributions abound. Industrialized countries have had a clear advantage at the outset. Many people in developing countries have come to believe that the IPR system is a new variant of economic imperialism where the developed countries dictate the "rules" of the "game." In the meantime, the economic programs of agencies such as the GATT, the WTO, the IMF and the World Bank have tended to promote the world order that was established after the second world war where developing countries contribute to the economies of developed countries by providing cheap labor and natural resources including biodiversity in perpetuity.

It is ironic that the perpetuation of the new world order is administered and promoted by the educational elite of the developing countries who are largely educated in western Europe and the United States and are imbued with a sense of responsibility to carry on that mission. They have come to play a key role in perpetuating an international economic order in which rich countries continue to become richer and poor nations have clearly become poorer. This situation is not unlike the indentured labor that existed during colonial times when a few small European countries were able to enslave entire sections of Asia, Africa, Central and South America; the only difference being that now it is the developing countries that are indentured in a system that is clearly exploitative. There are powerful forces which are employed for the sole purpose of maintaining the *status quo*. Even in peace time, huge armies, expensive weapons and intelligence networks are maintained at great cost by developed countries. The slightest deviation by a developing country from the established economic order can be met not only with economic and political retaliation, but the threat of armed invasion as well.

Such international agencies as the World Trade Organization (WTO), the World Bank and the International Monetary Fund (IMF) are dominated by the large multinationals from the United States and Europe whose economic interests they serve. These rich and powerful

businesses and industries of the private sector exercise their influence outside the democratic framework of the family of nations. No country or community elected the officials of these companies through a democratic process, yet their decisions and policies shape the destinies of billions of people on a global scale.

These facts are relevant to the future of our biological wealth or biodiversity because much of world's biodiversity is located in the poorest countries. Economic policies, industrialization and exploitation of biodiversity adversely impact on the biosphere in several ways. It is easy to see the consequences that have resulted from the post-second world war economic order. Seventy percent of the world's CO_2 emissions and the highest proportion of CFCs are emitted by the industrialized nations which contain only about twenty-three percent of the world's human population. On the other hand, developing countries with seventy-seven percent of world's population account for only thirty percent of the world's emissions. In *per capita* terms, the emission of carbon is ten times higher in industrial countries than in developing countries. The United States emits about twenty-five percent of all carbon emissions while consuming about twenty-five percent of all petroleum produced, even though its population is only about five percent of the world's population.

Extensive and repeated expeditions for rare medicinal plant species by those engaged in pharmaceutical development, both in the private sector as well as in the public sector (e.g. The U.S. National Cancer Institute), are resulting in the extinction of valuable plant species. Environmental pollution, human population growth and commercial exploitation have reduced the numbers of plant and animal species drastically.

According to the 2000 Red List published by the International Union for the Conservation of Nature (IUCN), a total of 11,046 species of plants and animals are threatened, facing a high risk of extinction in the near future. This includes twenty-four percent of mammal species and twelve percent of bird species. Most threatened mammals and birds are found in Indonesia, India, Brazil and China, whereas plant species are declining rapidly in South and Central America, Central and West Africa, and Southeast Asia. In the last 500 years, human activity has forced 816 species to extinction, but the rate of extinction in recent

years has increased very greatly. Many species are lost even before they are discovered.

Approximately, twenty-five percent of reptiles, twenty percent of amphibians and thirty percent of fish are listed as threatened by the IUCN. A total of 5611 threatened plant species were listed by the IUCN in 2000, but as only four percent of the world's total plant species have been evaluated, the true percentage of threatened plant species could be much higher.

Economic inequality

According to a report issued by the United Nations Development Programme (UNDP), over one billion people lack even the most basic consumption requirements although the total global consumption of goods and services exceeds US$25 trillion per year. Of the 4.4 billion people who live in developing countries, almost three-fifths lack basic sanitation, one-third safe drinking water, one-quarter adequate housing, and one-fifth access to a modern health service or primary education.

The following statistics are of interest:

Category	**Wealthiest countries**	**Poorest countries**
Meat and fish	45% of global supply	less than 5%
Protein intake (average/day)	115 grammes	32 grammes
Energy consumption	58% of global output	4%
Telephone lines	74%	1.5%
Paper consumption	84%	1.1%
Vehicles	87%	less than 1%

Source: United Nations Development Programme (UNDP), Annual Report 1999.

Intellectual property rights and biodiversity are playing an increasingly important role in the world economy. As mentioned earlier, much of the global biodiversity resides in the developing countries. Yet, these countries lack sufficient resources and trained personnel to enjoy the full economic benefits of their own biodiversity. On the other

hand, the developed countries have been able to reap the full benefits of the biodiversity that is owned by the developing countries. Indigenous communities, who have traditionally conserved and maintained biodiversity in their areas, rarely receive a share of these profits.

To understand the economic disparity between the rich and poor countries, consider the following facts: (a) Half the world — nearly three billion people — live on less than two U.S. dollars a day, (b) The GDP (Gross Domestic Product) of the world's poorest 48 nations (i.e. a quarter of the world's countries) is less than the wealth of the world's three richest people combined, (c) nearly a billion people entered the twenty-first century unable to read or write, and (d) less than one percent of what the world spends every year on weapons would be needed to put every child into school (Source: Global Economic Prospects, World Bank Report 2001).

Most of the increase in debt owed by the poor, developing countries during the 1990s was to pay interest on existing loans. During the years 1990–1997, developing countries paid more to service existing debts than they received in new loans, a total transfer of US$77 billion from the poor countries to the rich. In other words, this is the equivalent of a "global ghetto," a poverty cycle from which the developing countries could never hope to get out in the foreseeable future.

The World Bank's 2001 analysis of long-term economic trends shows how the economic disparity between the richest and the poorest countries has widened (Source: Globalization, Growth and Poverty, World Bank Report 2001):

3 to 1 in 1820
11 to 1 in 1913
35 to 1 in 1950
44 to 1 in 1973
72 to 1 in 1992

Those who are opposed to the WTO, the IMF and the World Bank argue that these organizations are designed to perpetuate and widen the economic gap between the rich and poor nations.

"Globalization" itself has become the latest "dirty" word, a symbol of economic oppression and a tool that aids the rich nations in oppressing the poor. Multinational corporations are said to be the chief beneficiaries of "globalization."

Social and international issues

The topics discussed in this book should interest all educated readers, although I do not expect them to agree with all my views. They should also interest students of sociology and international relations dealing with issues in technology transfer or sharing. These essays reflect the complex issues that are generated by various individual, institutional, national and global issues involving intellectual property rights and biodiversity.

There are several international issues regarding the ownership of plant and animal species. These are reflected in the statements issued by the Convention on Biological Diversity (CBD), the World Trade Organization (WTO) and other U.N.-associated organizations. National sovereignty is often transgressed by claims of international patents, such as those filed for *basmati* rice and the medicinal derivatives of the *neem* tree, both of which have been used by the people of India for thousands of years.

These and other related issues bearing on the economic benefits of biodiversity, the growing gap in biotechnology between the rich and poor nations as well as other aspects of science in developing countries are discussed in these essays.

Acknowledgements

In developing these ideas and concepts over the last several years, I have derived much intellectual stimulation from contacts with many colleagues and friends, especially Prof. M. S. Swaminathan, Prof. Joshua Lederberg, Sir Arthur C. Clarke, and, above all, my mentor J. B. S. Haldane.

I am much indebted to the massive compendium, *Cultural and Spiritual Values of Biodiversity*, which was edited by Darrel Addison Posey of Brazil, the Oxford Centre for the Environment, Ethics and Society in the United Kingdom, and several co-editors, and published by Intermediate Technology Publications, London (U.K.), under the auspices of the United Nations Environment Programme (UNEP) in 1999. In particular, I have benefitted greatly by reading the chapter on "*Ethnoscience, TEK and its application to conservation*" by L. Jan Slikkerver, the chapter entitled "*Forests, culture and conservation*" by

Sarah A. Laird, and another on "*Ethical, moral and religious concerns*" by Jeff Golliher. Furthermore, other writings of M. S. Swaminathan, Klaus Topfer, Vernon Heywood and Madhav Gadgil have been most helpful. I would like to thank Michele Wambaugh for assistance in preparing the manuscript for publication.

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