

A 2020 Vision for Food, Agriculture, and the Environment

Speeches Made at an International Conference



June 13-15, 1995

*Jointly Hosted by the
International Food Policy
Research Institute and the
National Geographic Society
Washington, D.C.*

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CONTENTS

FOREWORD

<i>Per Pinstrup-Andersen</i>	vi
--	----

INTRODUCTION

<i>David Nygaard</i>	1
--------------------------------	---

WELCOME

<i>Gilbert M. Grosvenor</i>	3
<i>David E. Bell</i>	4
<i>H.E. Speciosa Wandira Kazibwe</i>	5

2020 HINDSIGHT, CHALLENGES, AND VISION

2020 HINDSIGHT: SUCCESSES, FAILURES, AND LESSONS LEARNED IN FEEDING THE WORLD, AN AUDIOVISUAL PRESENTATION Text by <i>Kellie Gutman, Rajul Pandya-Lorch, and Barbara Alison Rose</i>	7
--	---

THE CHALLENGE FOR A 2020 VISION: EXTENT OF TODAY'S HUMAN SUFFERING AND A VIEW TOWARD 2020 <i>Per Pinstrup-Andersen</i>	9
--	---

KEYNOTE ADDRESS

<i>J. Brian Atwood</i>	15
----------------------------------	----

KEYNOTE ADDRESS

<i>H.E. Speciosa Wandira Kazibwe</i>	20
--	----

TO THE YEAR 2020: THE IMPACT ON PEOPLE

WHO WILL GO HUNGRY? SCENARIOS FOR FUTURE GLOBAL AND REGIONAL FOOD SUPPLY <i>Mark Rosegrant</i>	29
--	----

THE COEXISTENCE OF GLOBAL FOOD SURPLUSES AND FAMINE: POVERTY'S ROLE IN THE FOOD EQUATION <i>Nancy Birdsall</i>	38
--	----

THE DEPLETION OF NATURAL RESOURCES: THE IMPACT OF FOOD <i>Gordon Conway</i>	45
--	----

INTERNATIONAL PERSPECTIVES ON HUNGER AND THE ENVIRONMENT	49
<i>Klaus Jürgen Hedrich</i>	49
<i>Bal Ram Jakhar</i>	52
<i>Donald Brown</i>	52
THE WORLD'S POPULATION IN FLUX: ISSUES AND PRESCRIPTIONS	
TO 2020	59
<i>Margaret Catley-Carlson</i>	59
<i>Sudhin K. Mukhopadhyay</i>	66
IMPROVING NATURAL RESOURCES TO FEED THE WORLD:	
PREREQUISITES FOR SUSTAINABLE AGRICULTURE	69
<i>Sara Scherr</i>	69
<i>Reuben J. Olembo</i>	72
<i>Lester Brown</i>	75
TECHNOLOGY'S CONTRIBUTION TO FEEDING THE WORLD IN 2020	80
<i>Peter Hazell</i>	80
<i>Hubert Zandstra</i>	82
<i>Gordon Sithole</i>	85
INTEGRATED PEST MANAGEMENT IN THE ANDES	
<i>César Cardona</i>	87
USING GENETIC MAPS AND MARKERS TO INCREASE RICE YIELDS	
<i>Susan McCouch</i>	89
THE MARCH OF MALNUTRITION TO 2020: WHERE ARE THE SOLUTIONS?	93
<i>Lawrence Haddad</i>	93
<i>Kalanidhi Subbarao</i>	96
<i>Julia Tagwireyi</i>	100
TOWARD A CONSENSUS FOR ACTION	
<i>Per Pinstrup-Andersen</i>	104
REGIONAL VISIONS AND REQUIRED ACTION	
SUB-SAHARAN AFRICA	
<i>Baba Dioum</i>	109
ASIA	
<i>Sartaj Aziz</i>	111
LATIN AMERICA	
<i>Eduardo J. Trigo</i>	117
WEST ASIA AND NORTH AFRICA	
<i>Adel El-Beltagy</i>	120

A GLOBAL VISION AND REQUIRED ACTION	125
<i>Anders Wijkman</i>	125
<i>Ismail Serageldin</i>	129
CLOSING REMARKS: A SUMMING UP	
<i>Keith Bezanson</i>	134
APPENDIX: Agenda	143

FOREWORD

During the past few years, the International Food Policy Research Institute has become increasingly concerned at the apparent complacency in the international community about the future of the world's food situation. As a result, in late 1993 IFPRI began an initiative to look toward the year 2020 to identify the critical issues that must be confronted if the world's growing population is to be fed and the livelihoods of today's poor and hungry are to be improved. This initiative, "A 2020 Vision for Food, Agriculture, and the Environment," has as its goals to seek consensus about the problems of ensuring adequate future food supplies while protecting the world's natural resources for future generations, to create a vision of what the future should look like, and to recommend steps that must be taken immediately to make that vision come true.

With enthusiastic interest and backing from the international development community, IFPRI began research in early 1994 on topics related to the future world food situation. It organized a series of seminars and workshops on specific topics and geographic regions of the developing world. In addition, it initiated a number of publication series that aim to bring attention to and encourage debate on these critical issues.

The response by the development community to these 2020 Vision activities was impressive. To increase the circle of participants, IFPRI organized an international conference to bring together representatives from nongovernmental organizations, government, and aid agencies as well as researchers and other interested parties from around the world to discuss 2020 research findings and begin to identify solutions to the urgent problems of hunger, poverty, and environmental degradation. The conference was held in Washington, D.C., June 13 to 15, 1995, and was co-hosted by the National Geographic Society.

More than 500 people from 50 countries participated in the conference. Some 30 speakers summarized state-of-the-art know-

ledge and thinking on particular issues; identified priorities for regions, countries, or donor agencies; and made recommendations for future policies and programs in the food and agricultural sectors. Throughout the conference, question-and-answer sessions provided members of the audience with the opportunity to raise and discuss issues. In addition, the conference included an innovative role-playing session in which the panel members addressed realistic issues of food security in a hypothetical country.

This document contains the speeches as they were presented at the conference (it does not include the discussion or role-playing sessions). A unique collection of information and informed opinions on the pressing problems facing the world during the next 25 years, this compilation shows, I believe, broad agreement among the participants that the world cannot afford to be complacent and that immediate action must be taken if the unfortunate scenarios that some predict are to be avoided.

At IFPRI, work on the 2020 Vision agenda continues. A 2020 Vision document, "A 2020 Vision for Food, Agriculture, and the Environment: The Vision, Challenge, and Recommended Action," which was distributed and discussed at the conference, is being revised and will be published in the coming months. Research findings will continue to be published in a series of 2020 Vision discussion papers, 2020 Vision briefs, and the 2020 Vision newsletter *News & Views*. During the next 12 months, 2020 Vision research findings will be discussed in seminars held in a number of countries throughout the world. It is our hope that countries will take on the challenge of developing a 2020 Vision for their own countries and international institutions, and that they will be supported by the international community.

Per Pinstrup-Andersen
Director General

INTRODUCTION

David Nygaard
Conference Moderator

The conference "A 2020 Vision for Food, Agriculture, and the Environment" was a forum for presenting the results of 2020 research, workshops, and seminars to help solve the urgent problems of hunger, poverty, and environmental degradation. At the conference, a distinguished group of researchers, policymakers, donors, and development practitioners from around the world gave their views on the complex issues that will determine world food security in the next 25 years. Conference sessions explored the relationships between the environment and agriculture, agriculture and economic development, economic development and poverty, and poverty and hunger.

The conference opened with welcoming remarks from Gilbert M. Grosvenor, David E. Bell, and H.E. Speciosa Wandira Kazibwe and an audiovisual presentation reviewing the world's food and environmental record of the past 25 years. Per Pinstrup-Andersen then examined the current food and hunger situation and the challenges to achieving a 2020 Vision. Two keynote addresses, by J. Brian Atwood and H.E. Speciosa Wandira Kazibwe, provided alternative perspectives on these global issues.

The next session focused on people, looking at how food production and consumption during the next 25 years will affect the poor. Mark Rosegrant presented projections of future food supply, and Nancy Birdsall addressed the role of poverty in food security. Gordon Conway's speech considered the relationship between food production and threats to the world's natural

resources. Then three participants, Klaus Jorgen Hedrich, Bal Ram Jakhar, and Donald Brown, each gave international perspectives on hunger and the environment.

Changes in population will clearly play a large role in determining whether the 2020 Vision can be achieved. Margaret Catley-Carlson and Sadhin K. Mukhopadhyay highlighted expected trends and developments in population growth, urbanization, migration, and health, as they relate to food and natural resource management.

The theme of the next session was the need to improve natural resources in order to feed the world sustainably. Focusing on the status of water, land, and forests, Sara Scherr, Reuben J. Olemba, and Lester Brown, described how mismanaging these resources may limit agricultural growth in the future.

Then followed an examination of technology's contribution to feeding the world in 2020. Peter Hazell, Hubert Zandstra, and Gordon Sithole examined the determinants of growth in agricultural production, including the future role of research and new agricultural technologies, such as biotechnology, and their impact on the environment. César Cardona and Susan McCouch described two technological innovations that promise to raise agricultural productivity.

Next Lawrence Haddad, Kalanidhi Subbarao, and Julia Tagwireyi looked at malnutrition to the year 2020 and examined issues linked to food production, food access, and food use. They also considered malnutrition as it relates to poverty, health, urbanization, and dietary transition.

The final morning of the conference was devoted to clarifying the 2020 Vision and required actions. Per Pinstrup-Andersen presented a broad consensus for actions needed to achieve the Vision. He was followed by several speakers who gave regional perspectives. Baba Dioum offered a regional vision and actions required to achieve it for Sub-Saharan Africa; Sartaj

Aziz, for Asia; Eduard J. Trigo, for Latin America; and Adel El-Baltagy, for West Asia and North Africa. Anders Wijkman and Ismail Serageldin, representing international multilateral organizations, each discussed the global vision and strategies. In a final session, Keith Bezanson summarized the outcome of the meeting.

WELCOME

GILBERT M. GROSVENOR

President

The National Geographic Society

Welcome, and good morning. I am Gil Grosvenor, president of the National Geographic Society. It is my very great privilege to be co-hosting this important conference.

It is a pleasure to have representatives from over 50 countries here this morning. This is not new for us. Our writers and photographers are working as we speak in anywhere from 25, 35, maybe more countries, so we are used to working internationally. And, of course, we have many visitors from around the world at any one time. But it is rare for us to have such a large, varied international representation as we have here today, and that is very exciting for us.

Geography is our mission. And I think our second president, almost 100 years ago, said it all in a few words. Alexander Graham Bell broadly defined geography as "the world and all that is in it." And, you know, that is pretty much the way we do it today. We do not feel you can separate out components. And the issues that you will be dealing with today, tomorrow, and Thursday, are to us, pure geography. They are as far-ranging as the world and all that is in it. Any geography that you want to talk about is part of the problems that you are going to be dealing with. And conversely, every part of the problem you are dealing with makes three days of geography.

Geography goes to the very heart of the quality of life on Planet Earth. Will there be enough food and resources to support an exploding population? And, if not, what to do? Fairly basic, fairly basic geography.

So the issues you will be discussing here are critical, complex, more often than not intertwined: food, agricultural practices, water, population, competition for the land use, and pollution. I mean, that is geography. And we must all realize that these issues, which seem light years from the comfort of this auditorium, impact each one of us daily.

I am sure you have all had your coffee and your juice and a hearty breakfast this morning, and yet we all know there are more than 1 billion people on Planet Earth today, about 20 percent of our population, who either have nothing to eat or are on the brink of hunger, and that of course could frequently lead, and I am sure will, to famine, wars, and massive migrations.

The National Geographic's role is to educate people about life on Planet Earth so that we humans understand each other better, so that we better understand the cycle of life, and so that we do a better job of conserving our natural resources. We believe that in today's world, National Geographic's role is more critical than ever, i.e., the role to interpret and to publish what you will be deliberating on for the next three days.

As the world becomes more industrialized and more convenient—CNN, drive-through McDonald's, microwave ovens, fax machines—we seem to detach ourselves further and further from the earth, much more so than our forebears did, and they more so than the Native Americans before them. And the further we do withdraw from the earth, the less we see the need to conserve resources. Our forebears treated the land as sacred because their livelihoods depended on taking care of it, the health of their families depended upon it.

Consider this: In just 100 years in this country, we have gone from an agrarian society, where the vast majority of people had a personal stake in caring for the land and the water, to one in which only 3 percent of Americans make their living as farmers today. More Americans work in the Department of Agriculture today than work on the land. It is sad, but it is also true.

Most Americans think water comes magically from the faucet. They have little understanding where it really comes from, where it goes once it swirls down their drain, or the reality that water is a finite resource. And that is but one critical resource about which they know very little.

We must not take important resources for granted. We must conserve and preserve all of our precious natural resources.

At National Geographic, we believe that educating the public to understand the critical natural resource issues is the key to the survival of the quality of life that we enjoy today in this country.

I recently saw some statistics on the pressures upon Earth's resources that astounded me. They are statistics that I suspect are on the tongues of everybody in this room, but when I came to grips with it, it was frightening.

In 1970 the human population was 3.6 billion. Today, in 1995, it is 5.6 billion. And it will be 8 billion within 25 years. How will we support 8 billion people with the same amount of water, for example, that we had in Biblical times. I am not sure anybody in this room knows how we are going to do that.

From 1970 to 1990, the number of automobiles more than doubled, from 250 million to 560 million, producing all kinds of opportunities and also all kinds of problems.

Oil consumption, obviously tied to the automobile, increased from 17 million barrels to 24 million barrels a day, even though the price went up, even though there was an international move to conserve fossil

fuels. We still could not control the consumption.

Soft drink consumption per year more than doubled, from 150 million barrels to 364 million barrels. And, of course, predictably, the amount of aluminum used for beer and soft drink cans increased by more than 1,700 percent, from 72,000 tons to 125 million tons of aluminum per year.

And these statistics go on and on. You probably know them better than I do. And yet the great wide public has virtually no understanding and therefore no sensitivity to this issue. And I am not blaming them; rather I am blaming us. We have not been very good about articulating the critical consumption of natural resources.

We either need to figure out how to make our resources stretch further or how to reduce consumption of those resources at a time when the population will surely continue to grow exponentially. Either way, it will take the best of minds, including many in this room, to sort through our options. Then we will need a major commitment to educate an international audience about our choices for the future, if we hope to maintain any kind of quality of life on the planet.

I just wish you good luck. I hope you have a productive conference, and I pledge to you that the National Geographic Society will continue to raise the consciousness of tens of millions of potential allies in our fight, your fight to help conserve Planet Earth's resources.

I thank you very much. Have a great three days, and I trust you will enjoy yourselves at our Society headquarters.

DAVID E. BELL

Board Chair

International Food Policy Research Institute

May I, on behalf of the International Food Policy Research Institute, add my welcome to that of President Grosvenor? And may I thank him and the National Geographic

Society for co-hosting this conference and for making their excellent facilities available.

Just a couple of sentences about the International Food Policy Research Institute (IFPRI). The Institute was founded in 1975 and is one of the 16 centers in the Consultative Group on International Agricultural Research (CGIAR) system—the only center focused wholly on policy. IFPRI's headquarters are here in Washington—diagonally across the street from where we are now—but its researchers work all over the world, typically in collaborative research with scientists in developing countries.

Now a word on the concept of this conference. The original idea came from Per Pinstrup-Andersen, director general of IFPRI. As the concept was worked out, it expresses the concerns of Per and the IFPRI staff and board about a number of trends regarding food, agriculture, and the environment; about the challenges facing us over the next 25 years; and about the apparent widespread and worrisome complacency about the world's food situation. Therefore, IFPRI organized an initiative around these issues, comprising:

First, the research by IFPRI staff, working with research scientists in many parts of the world. The scope and range of this research are suggested by the lists of discussion papers and briefs included in your conference folders.

Second, a number of small meetings and workshops to discuss particular issues. A list of these is also in your conference folder. They involved experts from national agricultural research systems, the Food and Agriculture Organization of the United Nations (FAO), the World Bank, and other sources of expertise. The list shows that there were three regional workshops in Africa, Latin America, and South Asia, plus a number of subject matter meetings. The most recent meeting was held in Italy three weeks ago: a workshop on fertilizer and plant nutrients co-sponsored by FAO and

IFPRI. There have also been meetings of an international advisory committee, a technical review committee, and an outreach committee.

Third, the research and meetings have led to a series of publications: a bimonthly newsletter, briefs, discussion papers, and others, all listed in your folder.

Fourth, this conference.

And finally, after the conference, there will be follow-up symposia around the world.

All this work has been funded by some 20 donors.

We have been pleasantly surprised by the enthusiastic response to the 2020 initiative, including the response to the invitations to this conference.

We welcome all participants, many of whom have traveled long distances to be here.

We look forward to a stimulating and productive meeting.

H.E. SPECIOSA WANDIRA KAZIBWE
Vice President of Uganda

On behalf of my President, who is the chair of the International Advisory Committee of this wonderful initiative, I want to welcome you all to this meeting.

I want to thank Mr. Grosvenor and his team for having accepted this burden of sharing with us what must be done to make sure that everybody has something in their stomachs and that we conserve the environment.

I want to also thank the chairman of the IFPRI Board and his team, and Per, with his very hard-working experts who traveled all over the world and have since come up with the background for us to be able to know where we are going.

For us in the developing world, initiatives of this kind give us hope, even though the climate (political, geographical, social, and cultural) has not changed. Why do we think

it has not changed? It is like we are still living in the jungle where survival of the fittest is the order of the day. And we, especially those of us in the developing world, hope that through joint efforts of this kind we can forge a better future for the world. We believe that if we work together, we can indeed be partners and not recipients in the development process.

We have a saying in my country that if you have a scar, during the healing process even your neighbor who sees you scratch it, does not know how itchy it is. In Africa, in particular, the place I know best, and in other countries that belong to the developing world, the reasons why we are not solving our problems is not because we do not know how the scar is itching. It is just that we are caught up in the hard wind of a very fast moving world.

We want to be players in this initiative,

not spectators. That is why when you invited my President—when he became chairman of the advisory committee on this initiative—we felt not only privileged but challenged, and we can assure you that through this kind of partnership we are ready to move our world from a world of superstition to a world of science, with efforts that will erase the feelings that turn our people to believe in fate, with the feeling that we must indeed act now if we are to solve the problems that we have.

I want to once again welcome you and to assure you that this initiative, with all of us here, will move us ahead. This initiative and the vision we have for the year 2020 will become a reality if each and every one of us plays our relevant roles to the maximum.

I thank you very much.

2020 HINDSIGHT: SUCCESSES, FAILURES, AND LESSONS LEARNED IN FEEDING THE WORLD, AN AUDIOVISUAL PRESENTATION

Text by Kellie Gutman, Rajul Pandya-Lorch, and Barbara Alison Rose

The late 1960s and early 1970s were dominated by concerns about feeding the world, especially what was then called the Third World. Global population had reached 3.7 billion, double the level of a half-century before. Seventy million new mouths were being added every year, 90 percent of them in developing countries. More than 900 million people were food insecure—they did not get enough to eat to lead productive lives—and many more were living in poverty. About 12 million hectares of land, the equivalent of another Bangladesh, were being brought into agricultural use each year to feed the burgeoning population. The combination of rapid population growth, widespread hunger, and rampant poverty seemed a prescription for disaster. Add to this a series of natural disasters, such as the great Sahel famine, cyclones in India and Bangladesh, and drought in the Soviet Union, and it is not surprising that concerns about a world food crisis began to gather momentum. In 1973, oil price hikes and the Soviet Union's surprise purchase of most of the world's wheat surplus fueled fears of a continued crisis.

Asia was the biggest concern. Experts were predicting imminent famines and starvation. In 1968, Nobel Laureate Gunnar Myrdal warned that India would have difficulty feeding more than 500 million people. Others were declaring that the limits to growth on the planet would soon be reached.

These prophecies did not unfold. The Green Revolution, in the form of high-yielding crop varieties—especially rice and wheat—increased irrigation, and expanded use of chemical fertilizers and pesticides, together with better agricultural policies, largely prevented the predicted famines and

widespread starvation.

During the 1970s, Asian cereal production rose by a third, mainly driven by a large jump in cereal yields. Wheat production alone grew by 70 percent. Modern rice varieties covered 33 percent of land under rice cultivation. This remarkable advance in Asia's food production came about through the hard work and commitment of scientists and farmers, supported by enlightened national policymakers and international donors. By 1980, the number of people who were hungry in East and South Asia had declined by more than 100 million to about 650 million.

The impact of the Green Revolution extended far beyond the farmers' fields. Agriculture was the engine of economic growth for much of Asia, particularly Southeast and East Asia. In countries like Thailand and Malaysia, agricultural growth rates rose to around 5 percent a year. As their incomes rose, rural people demanded more consumer and other goods, generating growth in other sectors of the economy. In Indonesia, Korea, Thailand, and Malaysia gross domestic product grew by 7 percent or more a year during this decade.

Not all developing countries benefited from the Green Revolution. Because the agricultural technologies of the Green Revolution emphasized rice and wheat and were heavily dependent on the combined use of fertilizers, pesticides, and irrigation, much of Africa and Latin America were left out. But there were exceptions. Kenyan farmers quadrupled maize yields in the first half of the 1970s. In Colombia, rice production more than doubled by 1975 thanks to adoption of new varieties.

By 1980, there was a sense that the world food crisis had passed. Global food

supplies were up by 25 percent from 1970; cereal reserves were abundant. There was a general feeling that the Green Revolution was solving the problem, and that it was just a matter of time before Africa and Latin America followed in Asia's footsteps.

But throughout the 1980s, Africa reeled from a series of droughts. Ethiopia and Sudan suffered severe famine. In Latin America, tropical forests were burning at a rate of 8 million hectares a year. In Asia, groundwater supplies were being depleted or contaminated, salinization and waterlogging of productive soils were occurring at an alarming rate, and flora and fauna were disappearing as farmers pushed into new lands. Farmers and agricultural laborers were noticing the consequences of overexposure to agricultural chemicals. And throughout most developing countries, particularly those in Africa, population continued to grow unchecked.

While the Green Revolution averted the predicted crises, it was not enough to banish hunger completely. Storage facilities often did not exist to handle the bounty; farmers often did not have timely access to markets; pests and post-harvest losses often destroyed some of the increased food production. And even as food supplies rose, food did not reach everyone in need. Those who could not afford to buy food or the inputs necessary to grow it went hungry. While the Green Revolution provided farming and nonfarming jobs, these were not enough to keep pace with population growth. And many of the technological fixes were running their course. Poverty remained pervasive.

At this time, a few voices were raising concerns about the environmental consequences of misuse or overuse of Green Revolution technologies, the bypassing of women and their views in the development and use of new technologies, and the improbability that the Green Revolution could be extended to Africa. People had new concerns centered on the financial crises in

Latin America and the need for realigning many developing country economies.

The Green Revolution lost steam. Many developed and developing countries turned away from agriculture. Bilateral and multilateral assistance to agriculture began to decline. Many developing country governments cut their spending on agriculture and reduced their previously strong support for agricultural research. Despite dwindling financial resources, environmental, gender, and regional concerns gained some attention. Grass-roots efforts within the nongovernmental community raised awareness of these issues and sought local solutions. National and international agricultural research efforts began reexamining research priorities.

Despite the slowdown, by 1990 there were 150 million fewer hungry people than two decades earlier and 1.5 billion more people were being fed. There was economic progress in Southeast and East Asia and pockets of Latin America and Africa. We were moving toward sustainable agriculture and protection of the natural resource base. We recognized that hunger is more than a matter of producing enough food to eat.

The Green Revolution taught us some valuable lessons: famines are not the results of natural disasters but poor policies; people must have the resources to grow the food they need or the income to buy it; agriculture must be the basis for economic development in most low-income countries; agricultural technologies must be developed to produce more food on existing agricultural land to protect the natural resource base; and agricultural technology must go hand in hand with enlightened economic policy.

The Green Revolution bought us time. With research and technological investments and better policies, it gave us tools to prevent world food crises. It showed us that agriculture is essential to feed people, alleviate poverty, and embark upon broad-based economic growth.

THE CHALLENGE FOR A 2020 VISION: EXTENT OF TODAY'S HUMAN SUFFERING AND A VIEW TOWARD 2020

PER PINSTRUP-ANDERSEN

Director General

International Food Policy Research Institute

Excellencies, ladies and gentlemen, colleagues, and friends.

As we have just heard, global food production increased faster than population growth during the past 25 years. We do not have a global food shortage today, largely because people with foresight made the right decisions in the past. One of the questions we must address during the next two-and-a-half days is whether such foresight is still with us, and, if not, how we bring it back.

The world has won important battles in the area of food security, but the war has not been won. Failure to take appropriate action now may result in a loss of future battles. And many more battles must be fought.

Success in food production is one of the reasons international food prices have continued to decline since the world food crisis of 20 years ago. But another reason is that more than a billion people earn less than a dollar a day. These people are unable to buy the food they need and thus create the demand that drives the market. The result is lower prices and continued hunger.

Eight hundred million people—that is one out of every six persons in developing countries—do not have access to the food they need for healthy and productive lives. They are what we call food insecure. They are hungry and they do not have the means to fill that hunger. They are not just statistics. They are real people like you and me. The difference is that we can afford to go to lunch at 12:30 p.m.—they cannot.

One-third of all preschool children in

developing countries—200 million children—are malnourished. That is almost the size of the population of the United States. They are underweight for their age. They do not grow to their full capacity, and they are frequently sick. Many of them die before they reach school age, and those who survive perform poorly in school. Many of those who survive grow up to be adults with low labor productivity. The world may have won some food security battles, but 200 million children did not. The 40,000 who died yesterday will not get a second chance.

This does not have to continue. IFPRI's 2020 Vision is a world where every person has economic and physical access to sufficient food to sustain a healthy and productive life; where malnutrition is absent; and where food originates from efficient, effective, and low-cost agricultural systems that are compatible with sustainable use and management of natural resources. I hope all of you will make it your Vision.

This Vision is based on the principle affirmed by the United Nations and its members that freedom from hunger is a human right. This right implies that national governments, assisted by the international community, have a responsibility to create an economic and social environment in which every person is capable of meeting his or her food needs in a sustainable manner.

Whether the Vision is fully achieved by year 2020 depends on appropriate action taken by civil society and national governments in both developing and indus-

trialized nations.

That commitment to the 2020 Vision and associated action will not only eliminate hunger, malnutrition, and poverty, it will set the world on the road to sustainable broad-based economic development. However, a lack of commitment will lead to deeper human misery, further degradation of natural resources, and lost opportunities for improving the well-being of people in both developing and developed countries. We must act now. For each day we wait, many thousands of children will die and many millions of people will be hungry, poor, and desperate. Lack of action today could lead to social and political instability throughout many regions of the world, as well as a global refugee crisis. There has been a ten-fold increase in refugees since the mid-1970s to 50 million displaced persons today. As poverty and hunger become more entrenched, this number will only grow.

Do not believe for a minute that you will not be affected. A world of extreme poverty on the part of many, and overt material excesses on the part of some, is an unstable world. A continuation of the dramatic deterioration of the relative income distribution experienced during the last 30 years will lead to more social and political upheaval, misuse of available resources, and falling living standards for all.

Lost opportunities for exports, increasing pressures on the borders from refugees and displaced persons, environmental problems of global significance, and increasing international instability are some of the ways in which the industrialized world will be affected.

So how do we proceed to achieve the 2020 Vision? This morning, I will discuss the major challenges and opportunities, leaving a presentation of recommended action until Thursday. More details are available in the document you received when you registered.

This morning I would like to make seven points.

First, it will be a tremendous challenge to achieve the 2020 Vision. Between now and 2020, world population will increase by about 40 percent, to a total of 8 billion people. This amounts to a population increase of more than 90 million people a year, the largest in human history. About 94 percent of this increase will occur in developing countries. Sub-Saharan Africa's population will more than double, and Asia's population will increase by some 1.5 billion people. Diets will change toward more livestock products, which will place further pressures on future food supplies. Add to this, the efforts needed to eradicate already existing food insecurity and malnutrition and you have a major challenge.

If national governments and international institutions continue on the course they have followed in the late 1980s and early 1990s, the 2020 Vision will not be achieved. Food insecurity, hunger, and malnutrition will not be eliminated and more natural resources will be degraded. Although food insecurity and malnutrition will fall in East and Southeast Asia, they will increase dramatically in Sub-Saharan Africa. However, there are opportunities for changing these projections. Mark Rosegrant will give more details on this in the afternoon, and we will discuss a specific strategy for Sub-Saharan Africa on Thursday.

My second point is that the world's natural resources can support the 2020 Vision. At this time, achieving the Vision depends not on resource constraints but on action taken or not taken. Continuation of current practices that lead to degradation of our natural resources will impose serious environmental constraints on the earth's ability to feed future generations.

Although the data are somewhat uncertain, 2020 Vision research and consultations show that between one-quarter and one-fifth of the world's agricultural land, permanent pastures, and forest and woodlands have been degraded over the last half-century. Overgrazing, deforestation, and

inappropriate agricultural practices account for most of the damage. To a large extent, these practices result from poverty, population pressures, lack of access to credit, insecure property rights, and inappropriate technology. If degradation continues at current rates, the consequence will be severe for future agricultural productivity and the food security of the rural poor.

Fortunately, a large share of current land degradation is reversible. Much of the degraded land can be restored to its original productivity, but doing so is usually extremely expensive. Low and rapidly declining soil fertility is a major concern in a number of developing countries, including many of those in Sub-Saharan Africa, where failure to replenish nutrients over a long period of time is leading to nutrient mining of the soil. One reason is the very low use of both organic and inorganic fertilizers, and the projected increase in fertilizer use to 2020 is grossly insufficient to restore soil fertility in those areas.

Water is another critical issue. Waterlogging and salinization resulting from poor water management in developing-country regions threaten current and future agricultural productivity. Inappropriate management and allocation of water are resulting in inefficient use of water, widespread waste, and increasing water scarcity. National and international conflicts are already brewing over rights to scarce water and will certainly worsen if we do not begin to use water more efficiently.

Because agriculture uses a large share of all water used, improved efficiency in that sector is important for all water users. In contrast, agriculture uses only a small share of total energy. Therefore, although energy use in agriculture is increasing rapidly, efforts to save energy may be better focused on other sectors.

While pesticide use in agriculture has increased dramatically, losses to pests are still high. People in both developed and developing countries are coming to realize

that pesticides compromise human health, contaminate soils and water, damage ecosystems, exterminate species, and lead to pesticide resistance. According to 2020 Vision consultations, it is clear that past practices of pesticide use cannot be sustained and that environmentally sound alternatives are required. The challenge is to combine current methods of controlling pests with new methods in a way that controls pests but has few or no negative environmental effects or health risks.

Marine fisheries are an important source of food. Widespread overexploitation is causing collapse in some areas, and international disputes over fish stocks are increasing. Our estimates are that fish catches will not increase between now and 2020. The challenge is to maintain the present levels of harvest from natural fisheries while increasing sustainable aquaculture production.

My third point is that although food production will need to rise a great deal to meet food demands by 2020, IFPRI's projections indicate that these demands can be met at the global level without price increases. In fact, we project a decline in real food prices in the international market. However, having enough food to meet global market demand at lower real prices does not imply food security for all. As I mentioned, more than a billion people cannot afford to meet their food needs. Therefore, falling food prices and increasing food insecurity can coexist. Current complacency about the world food situation results from a mistaken view that sufficient food in the international market means that people have access to the food they need to be healthy. Regional food shortages will occur in both Asia and Africa and may be especially severe in Sub-Saharan Africa. That region's need for food imports is projected to triple by 2020, and it is unlikely that African countries will have the foreign exchange to pay for it.

This brings me to my fourth point,

which is that the world has missed opportunities for alleviating poverty and food insecurity through agricultural growth during the last 10 to 15 years. Governments of many low-income developing countries have failed to provide the required support to agriculture, and international assistance to agricultural development has fallen markedly during the last 10 years.

Other goals including efforts to alleviate poverty and protect the environment have taken on increasing prominence. We must recognize, however, that more intensive farming, on a sustainable basis, is a precondition for alleviating poverty and environmental degradation in low-income developing countries. This is because most poor people live in rural areas and depend directly or indirectly for their livelihoods on agriculture and because farmers are the stewards of the natural resources.

The role of agriculture in generating broad-based economic growth is well documented. Research in a number of developing countries, including low-income countries in Africa and Asia, has shown that growth in agriculture generates considerable additional growth in other sectors. The experiences of several fast-growing economies, such as China, Indonesia, and Korea, confirm these findings. In low-income developing countries, including most of Sub-Saharan Africa, agriculture provides a large share of national income and employs much of the national labor force. In those countries, the agricultural system is frequently the only sector that can lead the way to broad-based economic development. A stagnant agriculture usually results in a stagnant economy, rapidly increasing poverty, and food insecurity. On the other hand, a vibrant agriculture leads to a vibrant economy, decreased poverty, and improved food security. Developing countries' desire to industrialize is not in dispute. The question is whether it is done at the expense of agriculture or on the basis of agriculture. The former has failed, the latter succeeded.

Faster agricultural growth, based on sustainable intensive farming and reduced unit costs of production, will be an important step toward achieving the 2020 Vision.

As we heard earlier this morning, the research that led to the Green Revolution helped to accelerate intensive farming, increase production, and lower costs per unit of food produced. In fact, the unit costs of producing wheat and rice dropped by around 30 percent. The impact of reduced unit costs on the food security of poor consumers can be enormous because the poor spend a large share of their incomes on food.

The 2020 Vision is most likely to be achieved if accelerated food production can be brought about at falling unit costs. Developing countries must pursue low-cost rather than high-cost agriculture. They cannot do so, however, without more investment in agricultural research.

Low-income developing countries are grossly underinvesting in agricultural research compared with industrialized countries, even though agriculture accounts for a much larger share of their employment and incomes. Their public spending on agricultural research is typically less than a half of a percent of agricultural gross domestic product, compared with about one percent in higher-income developing countries, and 2 to 5 percent in industrialized countries. Developing countries have far too few agricultural researchers given the number of people engaged in agriculture and the amount of land farmed. Growth in public spending on agricultural research in developing countries has slowed from 7 percent a year in the 1960s to 2.7 percent in the past decade. Many developing countries are even reducing their support for agricultural research. This downward trend has been underway for quite some time in parts of Africa and has recently been present in Latin America.

Existing technology and knowledge will not permit production of all the food needed for 2020. Continued support for agricultural

research at present levels will result in virtually no improvement in reducing malnutrition in children and moderate reduction in world food prices. Further cuts in public investment in agricultural research will have severe consequences for global food production by reducing yield growth. Instead of declining, world food prices will rise, and the number of malnourished children will increase.

Tremendous opportunities for reducing unit costs exist not only in food production but also in food marketing and distribution. The marketing costs for agricultural inputs and outputs are very high in many developing countries, particularly in low-income, food-deficit countries. More efficient and competitive marketing could greatly reduce these costs for the benefit of consumers and producers. Improving the efficiency and effectiveness of food marketing is also critical for feeding the urban population of developing countries, which is expected to more than double over the next 25 years. Last, but not least, international trade liberalization and the rapid changes in diet expected in developing countries during the next 25 years provide opportunities for competitive agricultural systems in developing countries to expand employment in agricultural processing, packaging, and other similar activities. As international trade liberalization proceeds, agricultural systems that are not competitive will lose out in both domestic and international markets, with severe negative effects on food security and poverty.

My fifth point is that broad-based economic growth and reduced food prices will not dramatically reduce the number of malnourished children unless accompanied by access to primary health care, clean water, and good sanitation along with education, empowerment of women, and good child care. While considerable progress has been made on providing these services, we must do much more if we are to achieve the 2020 Vision.

My sixth point is that low-income developing countries need to increase their rate of investment to achieve the 2020 Vision. Higher-income developing countries, such as Indonesia, Malaysia, and Thailand, now invest more than 35 percent of their incomes while investments in Sub-Saharan Africa are around 15 percent and falling. Foreign financial assistance may be of some help in increasing investments in low-income developing countries, but domestic savings rates must be increased as well. Moreover, international capital is less likely to be available for low-income, food-deficit countries than it is for higher-income, rapidly growing developing countries. Reallocation of international assistance and domestic government funds will be necessary to achieve the 2020 Vision.

My final point is that foreign assistance to help developing countries achieve the 2020 Vision may be good business for donor countries. A 2020 Vision study just completed shows that for each dollar invested in agricultural research for developing countries, their imports increase by more than four dollars, of which about one dollar refers to agricultural imports. Developing countries with healthy populations and growing economies make good markets for industrialized countries.

In conclusion, let me briefly reiterate three main points:

1. Although the global food situation looks good, as we move towards 2020, tremendous human suffering due to food insecurity, hunger, and malnutrition occurs in large parts of the world; and natural resource degradation is rampant.
2. The world's natural resources are sufficient to remove this suffering by 2020. The most important question today is not whether we can feed the world. Rather, it is whether civil society and governments in both developing and developed countries have the political will to feed the world and to commit to taking the

actions that are needed today. Failure to take action will affect us all.

3. The agricultural sector played an essential role in leading broad-based economic growth and industrialization in higher-income developing countries of Asia. Many low-income developing

countries are failing to take advantage of that lesson.

I have tried to highlight some of the challenges facing us as we move to achieve the 2020 Vision. On Thursday, we will present to you our recommended global and regional action.

KEYNOTE ADDRESS

J. BRIAN ATWOOD

Administrator

United States Agency for International Development

I want to congratulate IFPRI and the National Geographic Society for convening this conference and for focusing our attention on the future. As the Administrator of a government agency struggling to survive the present, I find looking forward particularly stimulating.

The columnist Walter Lippmann once observed that politicians should not be "right too soon." What he did not say was that they cannot be successful if they are right too late. Perhaps that is why this city tends to neglect the future. I suspect the same is true of every capital city. It is so difficult to gain the attention of today's voters even when discussing threats that hold dire consequences for successor generations.

Yet we know we must address critical long-term issues. None are more important than food security. So I congratulate IFPRI and the National Geographic Society for forcing us to relate the policies and budgets of today to the challenges of tomorrow.

You ask us to look at the year 2020. That is in itself provocative. But I want to provoke even more by asking you to consider two very different visions.

The first 2020 is, quite frankly, a terrible place, the consequence of today's proclivity to focus on ledgers that neglect investments in the future.

In this vision of the year 2020, world population exceeds 8 billion—a 50 percent increase.

More than a billion and a half people live on the edge of starvation—twice the number of today.

Twenty-five million children die annual-

ly from malnutrition and the diseases that accompany it—again twice as many as today.

Food production has increased, but too slowly; untouched tracts of land are a thing of the past, as more and more marginal lands are put under the plow.

Nations that once were food secure, either by production or income, have become food insecure again. Spreading social conflicts and the competition over resources impede the use of proven methods to grow food, store it, and ship it.

The loss of biodiversity has by now claimed so many specifics that opportunities to discover new food groups and medicines are reduced to nil.

Food prices soar, making the steady decline in world food prices experienced from 1950 to 1992 a distant memory. Nations find themselves spending an increasing proportion of their incomes to maintain their diets and, in so doing, undercut their own potential for economic growth.

In the traditional food-exporting nations of North America and Europe, new parasites and diseases, many liberated by reckless development in remote areas, periodically wipe out grain crops and animal herds.

Unfortunately, one does not require much of an imagination to picture this version of the year 2020. Some of the manifestations are already with us. One does not need to extrapolate much from the scenes of today—the 40 million refugees and displaced persons, the structural food deficits, the failed states—to imagine the

world of tomorrow.

But there is another vision of the year 2020, one that assumes a more enlightened approach to international cooperation. One that can be produced with leadership and ingenuity.

In this 2020, the gains of the Green Revolution have been protected, not lost to new diseases and environmental damage.

Marginal lands are mostly intact because improved agricultural technologies have made existing fields far more productive.

Grain stocks are tight, but integrated pest management and effective storage techniques free up millions of bushels that once were lost.

Advance planning, prepositioning, and regional cooperation cannot avert drought but minimize the consequence—famine.

Development assistance supports broad-based economic growth and builds political institutions, defusing conflicts before they ignite.

Demands on humanitarian assistance continue, but not to the point where they exhaust available resources, or constantly command the center stage of international diplomacy.

We all know which 2020 we would choose. But can we make our political systems respond. Perhaps. The corollary to Lippmann's admonition that politicians should not be right too soon is that leadership must be right on time. And it is already late!

We will determine which future comes to pass. Not merely "we," meaning the people of 1995. But "we," the development experts, the researchers, the farmers, the citizens, and, yes, even the politicians—we will determine the future if we succeed in communicating to our publics what is at stake.

The issue is more than research, more than agriculture, more than grain and meat and food itself. The issue is food security. And the hardest challenge of all is to look beyond the end of the furrow, beyond the

narrow development program, beyond the specific research proposal, and to focus on what really is at issue.

I say to the traditional national security thinkers that food security is a fundamental issue of foreign policy. It is, in fact, a condition whose absence is a major contributor to international instability. Food insecurity motivates people to migrate, engage in civil conflict, and otherwise disrupt economic growth and peaceful coexistence.

We are uncertain about how the world will look 25 years hence, but one thing is certain that, in 2020, people will know that the years that immediately followed the Cold War demonstrated how events might transpire—for the better with the global embrace of democracy and the free market, or for the worse with the spread of civil wars that sowed chaos, drove refugees from their homes, and left failed states and ruined lands in their wake. Twenty-five years from now people will certainly understand that, all too often, food was the linchpin of events, especially in the developing world.

Twenty-five years from now, people will be less forgiving of those who wanted to use foreign aid only to facilitate transitions or to substitute for military involvement.

People will ask us why we did not counter the real threats to our people's security. People will ask why the Cold Warriors, long after their victory, continued to fight a war that was over. People will ask why American leadership, so significant in the Cold War, was so absent in the new world of so much disorder. Or will they?

Then, there is the world of opportunity. Food insecurity is also an economic growth issue as IFPRI and this conference have well recognized. Many developing nations are primarily agrarian, and broad-based growth simply cannot take place if rural populations have no means of improving their incomes or their nutrition.

Food insecurity is an environmental issue. Subsistence agriculture drives the

exploitation of marginal lands, misuse of water supplies, exhaustion of soils, deforestation, release of greenhouse gases, and the loss of genetic diversity.

Food insecurity is a population, health, and nutrition issue. Food insecurity is intimately connected with poor maternal health, high rates of infant mortality, and the disempowerment and illiteracy of women—key factors that drive higher birth rates and degrade health standards—further exacerbating the hunger problem.

And food insecurity is a democracy issue. Where democracy exists, starvation from famine has been rare, as Amartya Sen has shown us.

This problem is not going to go away. If current trends continue, food problems in Africa could grow exponentially. In Asia, where population grows, the eventual emergence of a gigantic middle class intent upon a richer diet, and the failure to preserve the gains of the Green Revolution could again create a dependency on imported food, even as overall wealth increases.

World food production in general and developing-country food production in particular may become more variable due to global warming. In nations already on the margin and lacking in resilience, these changes can have a disastrous effect. And the natural resource base, including the biodiversity that could yield potential food sources, many of which have hardly been identified, much less developed, is likely to continue to deteriorate.

How do we deal with the challenge of creating a food-secure world? How do we persuade our publics that food insecurity affects them and that they must be involved in finding solutions? And what policies should we pursue, especially when development funding of all kinds is diminishing?

First, we need to point out how our own self-interest is affected. Food insecurity is not someone else's problem. Someone else's hunger threatens us. And conversely, someone else's progress benefits us, and de-

velopment assistance is critical to that progress.

Much of the dwarf wheat and rice grown in the United States now incorporate genes first identified in Asia. Resistance to pests, to drought, to bacterial and viral diseases—qualities on which American farmers rely to turn out crops for our own consumption and for export—derive in large measure from genetic material and germplasm identified abroad. The same is true of new growing methods, and these things were not just identified by accident, but as part of development programs designed to do just that. Every case just mentioned are programs supported by the United States Agency for International Development (USAID).

If we are talking about self-interest, we need to point out that increased food security abroad means jobs here at home. One-third of U.S. farm acreage currently grows crops for export, providing the country with a \$22 billion trade surplus and more than 750,000 jobs. But hungry people make poor customers. IFPRI's own excellent study, released at this conference, shows that agricultural aid pays back \$4 for every dollar invested in expanded grain exports and in growing trade in a variety of food-stuffs. And rising agricultural productivity ultimately leads to expanding sales of non-food goods and services that better-fed, emerging middle classes invariably need and want to buy.

Self-interest also extends to crisis prevention and its savings—in illegal migration that does not flood across borders, in food aid and humanitarian assistance that are not required, and in funding for peace-keeping and national reconstruction that does not have to be found. Indeed, self-interest is inseparable from prevention and prevention, is the least expensive—yet most effective way—to address significant problems while advancing our own interests.

In Africa, for instance, we cannot address growing food problems simply with

relief. Since last year, the United States has spent more than a half billion dollars in Rwanda and Burundi, mostly for relief. Yet we know that the same amount of money invested in development assistance could save much larger amounts in future relief. We must reverse the trend in which relief competes with development funding. We must make relief operate as part of a continuum that includes recovery, long-term development, and then trade and investment.

The Greater Horn of Africa Initiative is an example of this approach. It is founded on the assumption that, while drought may be inevitable, famine is not. Ten governments, in partnership with development agencies and affecting some 22,000,000 at-risk people, are working to establish early warning systems to quickly identify food crisis areas; preposition food stocks to minimize the social disruptions of famine, especially refugee movements; and support regional approaches to planning and crisis management.

The Initiative for the Greater Horn really has two objectives:

First, to prevent natural events from becoming regional disasters, demanding endless humanitarian relief and threatening stability; and second, to lay the groundwork for regional cooperation and institutional growth that will make it possible to address the structural food deficits that are still emerging. By helping to prevent famine, we help societies to meet a challenge and cohere; by helping societies to cohere, we increase the chance that they will find the resources, the skills, and the will to address other issues that impede their growth.

The President's Greater Horn Initiative, now embraced by the countries of the region, underlines a critical part of the way we make our case to our publics. We cannot separate food issues from the larger issue of development. We need to find new ways to do our business. Part of this is practical. In a time when most industrial states are devoting fewer resources to devel-

opment assistance, we cannot expect that aid for any particular concern, even one as demonstrably valuable as agricultural research, will be immune to funding cuts. This means that we must do more with less.

Another part of the answer lies in the integrated approaches that we have been pursuing. The issue of food is bound up in other issues, and lasting progress will be achieved only if progress is achieved in those areas as well.

Thus, for us, food security involves laboratory research, policy, and how it affects what is planted and sold, and by whom.

- Food security involves economic growth, especially access to resources and who can accumulate resources sufficient to ensure proper nutrition.
- Food security touches on education, especially the education of women who represent the majority of farmers in places like Sub-Saharan Africa.
- Food security involves population programs, for improved nutrition means lowered birthrates and increased child survival, two demographic factors that strongly affect who goes hungry and who is fed.
- Food security involves the natural environment. Today in India, 100 million acres of forest are still standing precisely because improved methods of rice and wheat production have reduced the pressures to cut them and put them into agricultural production.
- Food security is an issue of democracy. Participation and accountability are the natural antidotes to starvation and maldistribution of food.

The third and final way to make our case and enlist the support of our publics is to remind them what we have achieved and the challenges that lie ahead. There is a connection: we have learned so much in the last 25 years. The experience and the scientific tools available to us now were

undreamed of in 1970. Not only in genetics, but in the social tools that can encourage people to adopt improved methods and the economic tools of the free market. The only way to deal with the next quarter century is to understand what worked during the last quarter century. In that regard, we need to do much more than refute the silly charge that foreign aid has not worked. We need to build on our success and plan for the future.

One of first tasks is protecting the achievements of the last 25 years, the gains of the first Green Revolution. Not only do those gains mean that hundreds of millions of people have food to eat, the declining real food prices that have accompanied productivity gains have benefited everyone, but most especially the poor and the vulnerable. Continued and increasing productivity of the breadbaskets and rice bowls of the developing world must not be taken for granted.

We talk a lot about sustainable development. Well, the Green Revolution created development, and it falls to us to sustain it. In doing so, we also need to remember that advances in areas where the first Green Revolution took hold underpin food security in all regions, by helping to make food more available and affordable. If anything, such interdependence will become more pronounced in the future.

At the same time, we need to find ways to bring a second revolution to bear on the special problems of areas with problem soils and areas subject to climatic vagaries, especially drought. Some of the answers will come from research on how natural resources are managed and how land, water, fertilizers, and other inputs can be made

more sustainable and more productive. Other pieces of the puzzle will come from continued advances in developing new crop varieties with tolerance to both physical and biological stresses. The combination of research tools and integrated approaches make the task more doable than ever before.

Those of you who specialize in agricultural development will not succeed in making the public your partners if you do not create a partnership with your colleagues in other development fields. Now is the wrong time for parochialism. We must reach out to NGOs and PVOs, to environmentalists; to population experts; to health, education, and democracy experts; to old and new academic partners; to private industry; and to communities here and abroad. We have to share responsibilities and avoid duplication, use resources to their maximum, and train and enlist anyone who can make a measurable contribution to improved food security.

We know that our legislatures and our citizens care about the hungry. That they understand, increasingly, how aid creates jobs and trade. Their search for measurable results plays to our strength, for the pursuit of food security has produced tangible improvements at home and throughout the world.

Now is the time to build on that legacy. Like all visionary years, the year 2020 will arrive. And as the visionary becomes real, we will know all too well if the salient reality is hunger, pain, and conflict; or hope, health, and prosperity. So, to those politicians who do not wish to be right too soon, I say "Wake up, it's getting late."

KEYNOTE ADDRESS

H.E. SPECIOSA WANDIRA KAZIBWE

Vice President of Uganda

I believe many of you will agree with me that it is very difficult for a woman to fit in a man's shoes. But, in Uganda, we say that nothing is impossible because everybody came from a woman, men and women alike. So, I bring greetings from my President Yoweri Museveni and the people of Uganda.

Ugandans are indeed honored for the challenge given to participate in this important crusade for a better-fed humanity and the protection of the environment. At home, we always say, "East, West, home is best." Think globally, but act locally. So, my address will focus on Uganda. I believe that through the examples I am going to give on what we are doing in Uganda, the doubting Thomases will believe too that the 2020 Vision is feasible and is achievable. I also know that the vision for a Uganda without hunger in the next 25 years is relevant to Sub-Saharan Africa in particular, but also the whole of the developing world in general.

Uganda is found in the heart of Africa, and it sits astride the Equator. It is between longitude 30 and 35 degrees east. It is a high plateau with an altitude of between 3,000 and 6,000 feet above sea level. Its highest peak, called the Margherita, is 16,700 feet high and has snow the year-round. It is part of the range of mountains called the Mountains of the Moon. The country has a dense network of rivers, lakes, and swamps, all of which occupy over 20 percent of the total land mass. These physical features indeed give Uganda a mild and pleasant climate, with a mean temperature of 26 degrees. In fact, the mini-

mum temperatures, the annual ones, range between 8 and 23 degrees Centigrade.

I believe many of you are wondering how a country on the Equator can have this kind of climate and snow. Sometimes we say that as part of the diversification and improving on the employment of our people, we should start skiing so that many of you can come and ski there during the summer—of course, it is summer all the year there. The annual rainfall ranges between 500 and 2,500 millimeters. The relative humidity ranges between 70 and 100 percent.

The above facts show that Uganda is endowed with a climate, altitude, and soils that favor the growing of a wide variety of tropical, subtropical, and temperate crops. Indeed, while I was watching the film, I could see that Uganda was part of the Green Revolution of the Far East because we grow rice, both upland and swamp rice. We are growing apples in the western part of the country. We grow millet, which researchers do not talk much about and which we know is part of our cereals and is very nutritious. And, for us women, after a hard day's work, it is the simplest food to prepare for our husbands and children; it takes a very short time. We also grow tropical crops like sugarcane.

The bimodal rainfall patterns permit two crops' harvest every year in most parts of the countries. In fact, in my part of the country where I was born, we sometimes harvest four crops of maize. We have plenty of good arable land, but only 8 percent of this arable land is under food crops. But this is enough for our 19 million people and we now have a surplus for export.

Uganda is, therefore, too ready to become the food basket of Africa. However, what kind of farmers are going to be our partners in the realization of our vision in the year 2020? Most of our farms are no more than five acres per family. Virtually all of our agriculture is rainfed. The agricultural tools are the hoe, the machete, and the ax. The main source of energy is the human muscle. Indeed, this is a place in Africa, and possibly in most of Sub-Saharan African, where this muscle is a woman's muscle. This is the farmer about whom was asked, "What are you going to do for this farmer and her husband?"

The system of production that promotes smallholder farmers, in our experience, however primitive it may look, is very resilient. It ensures a degree of food security at the household level. Despite all of the problems that Uganda has had, we have not lacked food for the people inside the country. I am sure you all heard about Idi Amin. Everything was destroyed during his rule—the infrastructure, educational institutions. If you go to the countryside, the people there have more experience in research and they may be able to tell you how to achieve the 2020 Vision with no infrastructure on the ground. Our big constraint has been marketing and distribution, coupled with the low purchasing power of the peasants in the villages.

The resilience of our smallholder farmers is exemplified by the coffee sector. It survived all of the difficult times and, indeed now, Uganda is the world's fifth largest producer of coffee. At the other end of the tunnel, we have our brothers from Angola whose coffee sector virtually collapsed because it is based on the theory of large-scale production. With the war, I doubt whether they have any coffee to talk about.

Our advice, therefore, is that when we look at the farmer on the ground, the track record, the experience, and given the uncertainty and the political field we are talking about in Sub-Saharan Africa in the short and

medium term, before the politics in the region is resolved, more research must be done on how best to improve the productivity of the smallholder farmer. With improved productivity will come enough to feed the family, to feed the country, and surplus for sale, as we have demonstrated in Uganda.

We need simple technologies to alleviate the problem of pseudo-drought. I know many times we hear in the country there is a drought in the eastern part of the country, but with a rainfall of between 500 and 2,500 millimeters of rain, how can we talk about droughts? We are a people who believe when the rains do not come that there is a witch in the village. We play the drums and chase the witch away. Maybe because of the vibrations and the dancing we raise plenty of dust and we get precipitation and it rains. Yet we know that the simple technology of having micro-dams in the villages to trap this rain water and the harnessing of wind power to pump water into the fields would be a welcome security in case of delay in the coming of the rains.

In the medium term, our goal is to provide extension services to our farmers in the whole agri-business chain. We have started educating them on the availability of agricultural inputs within their localities that can boost the productivity of their land. Vocational education is increasingly being promoted to the community so that when opportunities present themselves they can move from the land to the factories. While promoting the small-scale farmer, we are not forgetting the large-scale farming.

Our long-term goal is the modernization of the whole of the agricultural sector. More people will inevitably have to move from the land into the factories. So, currently, we are promoting investment into agro-based industries, and we believe that this is inevitable.

My President, as a good number of you know, has been all over the globe, looking for investors in the industrial sector. And I

want to tell you, in line with what Brian Atwood said earlier, the early bird catches the worm. If you want to reap, you have to invest. We are looking for partners. If anybody wants to reap from any agribusiness in Africa, they must be prepared to invest as much as they invested in the Far East for them to be able to realize the Green Revolution that we have been talking about.

In Uganda, we know that the policy that has helped us to achieve the little that we have is that government has gotten out of doing business. We have sold the public enterprises that were very much involved in the marketing of produce. How have we done this? We have said, "compete with the private sector." And it has paid dividends.

But, we know that the trade in the world, which we are being told to liberalize, is done on paper but not in practice, especially in the agricultural and food sectors. How can we, the children of the world who are malnourished with kwashiorkor, be told to start running at the same time as children who never suffered malnutrition even when they were in the womb. That is what you are asking the children of Africa and the developing world to do.

You liberalize the markets while you keep subsidizing yours. We do not have the muscle in the developing country to tell you that if you do not stop subsidizing, we shall stop giving you development aid. Where is the equity in this issue of global liberalization?

Due to marketing bottlenecks, our farmers do not have access to markets that would, in turn, stimulate them to produce more. For instance, in the United Kingdom, one kilogram of steak costs \$30. In Japan, they play music to their cows and they dance with them and a kilogram of steak costs \$200. In Uganda, where our cows feed on what mother nature has given us, a kilogram of first-class steak costs only \$2.50.

With the removal of these bottlenecks and steady markets, our farmers can and indeed are capable of producing more. When we

promoted our farmers, we just got up as politicians and said, "double production." The muscle power of a woman was liberated on maize because it was not a cash crop. Husbands concentrate on crops like coffee and cotton. But the food crops have always been the domain of the woman and she would get some money from increased production of maize. Kenya, our neighbor, was ready to buy the maize. But what happened? Tons and tons of yellow maize, very cheap, were dumped into Kenya by the United States.

So, we would like to really tell you that in Uganda we believe, even with minimum input now, we can actually move forward on the road to the realization of the 2020 Vision. Due to the enabling policies of government and provision of basic infrastructure like roads, the importation of cereals dropped from 36,000 metric tons in 1974 to only 7,000 in 1990. And, as I talk now, the World Food Programme does not buy food from anywhere else. They buy from our farmers, which means we have started exporting.

The agricultural sector has attained a growth rate of 4.4 percent per annum, and this is on rainfed agriculture with hardly any fertilizers being used by the farmers, with little technical assistance. With the right policies in the right direction and with the continuation of peace, we know that we shall be able to continue this growth.

At this juncture I wish to assure you that we shall not allow the 2020 Vision to mature at the cost of degrading the environment. We shall not, if that happens, be able to sustain our vision. Forests and grasslands are crucial for the maintenance and productivity of the soil, especially in our humid tropical soils of Uganda, which are very prone to leaching.

After wide consultation with the people all over the country, we, as Ugandans, have agreed that we must have a common code of conduct in the form of a law that we shall use to manage our environment for the good

of our grandchildren. So, we have submitted a bill in parliament, and we are going to have an environmental monitor for the whole country. Through our program of decentralizing and empowering people to take charge of their affairs, they will also make by-laws within their communities and localities to enforce environmental protection for future generations.

We are replanting forests and planting trees where there were none before. Indeed, through our youth and women's programs, we have started reclaiming the bald mountains. These are mountains in the western part of the country which are bald, and we would like to plant them with trees.

But the long-term solution in protecting our trees is the use of alternative sources of energy. Ninety-five percent of fuel used in the home, both for cooking and lighting, is fuelwood. We have a program to expand the production of hydroelectric power generation and transmission through the building of big and small dams throughout the country.

It is imperative, therefore, that agriculture and natural resource programs address issues that affect the players. When we talk about the players, and consider all of the aid programs, which mainly target agriculture, money comes in and is spent on something like a new four-wheel drive truck, used around Kampala. They put on demonstration projects near Kampala, and the real farmer, this woman we have been talking about, ends up hearing about the workshops and seminars and sees the four-wheel drive vehicles taking the dead AIDS victims to the village. At the end of the day, the real farmer does not end up benefiting from the program.

I would like to say that not all of these projects are like that, but given the fact that when we borrow money from the World Bank for an agricultural program, we must repay it. It is not a donation. And, when we talk about donor funds, it creates a feeling among the people in the developing

countries that this is a gift. At donor's conferences people say, "Oh, the World Bank has given us money." And, you know, if you have not worked for what you have got and if you believe you are not going to pay, you are not going to internalize that program to make it your own. We must address these issues of financing, issues of our relationships with the agencies that loan us money, to be sure they go to the right programs.

Somebody was asking, "Why is it that the developing countries are not putting more in agriculture?" You borrow for agriculture, and it is a long-term loan. Then you have your neighbors around threatening to invade you. That means insecurity. Then you find AIDS is killing your people. This is the dilemma of a politician, a policymaker who has so many priorities. Each problem is a priority at any time in the life of a leader in a developing country like Uganda.

We know that the people who are very interested in making sure that the world does not go hungry are women. It is the woman who will care whether her child is hungry. It is this woman who, if she is educated, will insist on having vegetables in her backyard so that her child does not have to suffer from blindness due to a very simple nutrient that comes in carrots. But this woman may not know. She will think someone has bewitched this bright child of hers.

In Uganda, women, who are crucial players in any development effort, are being empowered. You can see that as I am a living example of that. It is not mere tokenism. In our country, women are moving to the commanding heights of politics, administration, the professions, commerce, and industry because we sustained our country when our husbands went away. We pulled on the trousers that they left behind, and we are saying that because our area is still insecure, we must know and learn how to manage society.

This trend has not only stopped at the top. It is creeping in right from the villages.

The engines of change in the developing world in Africa are going to be the women. They have experienced hunger. They have experienced conflict. They are only too ready to move ahead, to make sure that this man is fed.

The point I wish to make with regard to food, agriculture, and the environment is that at the moment in my country women produce 80 percent of the food. They are responsible for 60 percent of the planting of all crops, food and nonfood, 70 percent of weeding without the hoe, which you saw on the screen slideshow earlier, 60 percent of the harvesting, and 90 percent of food processing and preparation. They are factories, human factories. They should, therefore, play their proper role in the determination of food and agricultural policies. They must participate actively in the implementation of those policies and be able to earn the fruits of their labor, which is not the case in our rural communities at the moment.

Household food security in Africa is still the domain of women. It is remarkable that they feed Africa without access to inputs such as credit. They even have limited access to agricultural land. In my country, a woman plants food on her father's land, her brother's land, her husband's land. But if her brother, her father, and her husband know that she is going to sell that food, she will be taxed, not by the revenue authority but by her husband, by her father, by her brother. And these, the taxation levels, are not inconsistent with the norms of taxation. These women are not educated and their daughters have a slim chance of being educated and, most importantly, a slim chance of participating in decisionmaking.

The women of Uganda and Africa (I may be speaking on behalf of the women of Africa because we have held many conferences on this topic) recommend that in order to realize the objectives we have set ourselves in the next 25 years, women must be facilitated to own land. They have the labor, the muscle, tilling the land is theirs,

but the crucial resource of land is not in their hands, so we cannot expect them to improve its productivity.

Women must gain access to credit. In this regard, lending policies should be reconsidered since they are largely based on one's ability to provide collateral for the loans. Let me take an example of a successful credit scheme in Uganda where, I must say, the people of the United States of America helped us. In this scheme, money was loaned to farmers, both women and men. But, being a Minister of Gender, both men and women, I know that the men, instead of taking money to the land, married a second wife. I want to assure you that having more than one wife is more of a liability than an asset because the more women you have, the more children you have, and now the government is sending every child to school. So you end with 3 people in the home producing food for about 50 people, with a hoe, a machete, and an ax. A women's group of some 30 persons, on the other hand, borrowed about \$280 to grow soya beans. Within six months, those women had paid back that loan and they were able to plant more soya beans from the profits and they even built a small store.

When it came to the payment rate, without collateral, over 88 percent of women repaid their loans. The men never achieved 40 percent repayment rates. The point I want to emphasize is that we can use these cases that have been tested for future credit programs. Currently, we are pushing—we the women leaders of Africa—for a banking facility for women, which will take us from smaller scale to become medium-scale producers. We also want to be big scale.

Unfortunately, women's issues normally come on the second to last page of any agenda, and people say, "Oh, but there are so many banking programs in Africa, the women should benefit from those." So Mr. Brian Atwood, recruit me to work for USAID.

The workload for women must be reduced through the provision of relevant technology. This woman is the machine. She is supposed to be the faucet. Americans do not know where water comes from. My God, let them come to Africa. The women there know where the water comes from and they know which water may be good for drinking, just by looking at it, which water may give diarrhea to the children, and this water is being shared by the whole ecosystem, including the insects, the lizards, the frogs, and the snakes. Let us release this woman of Africa from the unnecessary trekking to collect water, trekking to collect firewood, so that we give her the minimum training to enable her to participate and benefit from the programs and the wonderful research by IFPRI to realize the 2020 Vision. Women should make decisions on what to grow, how to grow it, and most importantly they must be involved in the marketing of what they produce and in the disbursement of the returns from their sweat.

There is a program that is supported by Action Aid, and it is taking place in Bangladesh, El Salvador, and one district in the Ugandan mountains. I would like to quote from a short-term evaluation of what they have been doing. We have found that after an average of about 100 contact hours, participants learned to read and write, some to an extent that they were writing fluent oral histories and letters. Compared to the World Bank's stated average of 25 percent, 70 percent of those who initially enrolled in this program, passed the standard literacy test. I quote, "A breakdown of the results showed that men and women performed equally in writing. Men performed better on reading, but women performed better in numeracy."

"The program has also led to many community actions which have succeeded in making the links between literacy and wider development. In conducting a household by household survey of their village and

examining changes in the local population over recent years, women were moved to discuss family spacing." Women organized community meetings to address this topic.

They invited trainers from the Ministry of Health, but these trainers came on the women's own terms. If you come, you are going to eat millet with us. You are not going to sleep in the hotel because, if you talk about my spacing in my family, you must live in a place that I live in so that you can help me to judge my income and advise me on how many children you think I should have. They insisted that their husbands attended these meetings—a feat that is almost impossible to achieve in Sub-Saharan Africa. To get a man to talk about the number of children he has, you are testing the will of God.

Similarly, a map of natural resources today, compared to resources 20 years ago, promoted discussion of deforestation, and the women were mobilized to organize their own tree nurseries. After 100 hours of learning how to read and write, these women were empowered to discuss the 2020 Vision. If someone had lectured them about family planning or deforestation, they would probably not have listened. But because these women came to their awareness through their own analysis of the issues, they now have a real sense of ownership of the issues and strong conviction to them.

The results of this program included terracing, the introduction of new crops, using new planting techniques, protecting water sources, building piped water systems. The women are using their muscle to lay pipes so that they can tap this water that comes from the snow in the mountains. Dysentery, a problem two years ago, is no longer heard of in this particular area. Women are establishing their own grain stores after discussing the type of technology they think is relevant to them. And, they are also constructing basic latrines. It used to be taboo for a woman to dig a latrine, but now the women are digging the latrines

because the men sometimes are so drunk, if they go down there, they may not come out.

These 100 hours of training have done wonders and, indeed, this is really what I wanted to talk to you about most. There is also widespread reporting of changed attitudes and behavior. Men are consulting women for the first time on certain types of household decisions, such as the building of kitchens, latrines, and paying school fees. Women, for the first time, were gaining access to male compounds where decisions are traditionally made. There are even cases where men are now helping women to carry water. It is taboo in the mountains for a man to carry water; your manhood would be threatened. But, after this functional literacy program there is the sharing of the household chores so that women have time to discuss other issues that affect the environment and food security.

Another notable impact has been increased school enrollment. In one parish, school enrollment tripled and all the new children are reported to be sons and daughters of parents who have been attending this functional literacy program. Equally important is the fact that girls are now reported to be going to school, more or less, in equal numbers as the boys.

I would like to challenge you to really concentrate on targeting this woman.

Incidentally, when you read many documents on the literacy rate of women in Africa, they will tell you, "Oh, in Uganda, 55 percent of women are literate." But what does this mean? In my own assessment, less than 70 percent of women have ever seen a blackboard. Twenty percent are the likes of me, but the 70 percent in the villages, what they mean by "I know how to read and write," is "I will be able to read that this bus goes to Kampala, Kam-pa-la." That is all. This issue must be addressed.

If we are to address issues of population growth, and in Sub-Saharan Africa the population growth rate is over 4 or 5 percent in some countries, it is the women who will

make the decisions. The experts also tell us that world agricultural production has been falling during the last three decades, from 3 percent in the 1960s to 2 percent in the 1990s, and this will decline further to 1.8 percent by the year 2010. Who is going to be the engine for us to be able to reverse or to forestall this decline, and to make sure we move in the right direction?

Given its size and natural resources, Africa at a population of about 702 million is currently underpopulated. Africa is the second largest continent in the world. It is much bigger than the China you are worried about. Why is everybody worried about lack of food for Africa? The answer is poverty. It is very difficult—this is my own experience and do not let many developing country leaders lie to you that it is very easy—to tell people, "space your children, reduce the number." In the project I referred to the functional literacy program was coupled with income-generating programs for the people, and there is better health. But when you find a woman who first got pregnant at the age of 15 and then lost each and every child she had for five years, how do you get to that family and start talking about population issues because the child is the source of labor. The child is the social security in time of old age. We must concentrate on the reduction of poverty, and we need the assistance of the developed countries because poverty is bad for everyone.

Today, the developed world uses 80 percent of the world's resources. I think because the developed world is the one that talks about human rights a lot, let us see them demonstrate this by transferring this 80 percent to be shared by the greater population so that we have an equitable flow of food around the world. Putting in place infrastructure will help assure that the developing world is indeed in a position to fight its own poverty, to ensure its own survival.

Poverty is a major cause of environ-

mental degradation. Unfortunately, it is increasing. The gap between the rich and poor is increasing everyday. Poverty undermines the cohesion of states, destroys the basis of human rights and is a source of instability in the world and destroys the environment. Take the example of the Clinton initiative Brian Atwood was talking about. Uganda is one of the countries that is to participate in this initiative. It is the case of chicken and egg. When we say, "allow us to make decisions that affect us," we are told, "No, no, no. Do it this way." People can get angry. They can get very angry because the feeling is that when you have problems, nobody cares, and when you have peace, people do not want you to be empowered to make decisions that will help you realize the 2020 Vision that Per Pinstrup-Andersen has been dreaming about.

Food, agriculture, and the environment are going to be the engines of development for the Third World. These initiatives should help us to look at this whole problem in its true global dimensions, in its true totality so that from peace we continue on the road to prosperity.

To an environmentally sensitive world, the eradication of poverty must be on top of the agenda. It is within the means of the developed countries of the world to assist in its eradication. Our 2020 movement must work to convince the developed countries to liberalize trade and to grant the developing countries access to their markets. I do not know how a Japanese policymaker explains to a Japanese taxpayer that, instead of buying a kilo of steak at \$2.50, you should buy it at \$200. How do you explain that when you are saying that the market is liberalized? In fact, when we hear what is happening between the United States of America and Japan on trade, you know the saying, "When two elephants fight, it is the grass that suffers."

Most developing countries are indebted to the extent that virtually all of their export earnings are spent on debt-servicing. The

debt burden has become crippling and intolerable. We are not saying that we should blame anybody for it, but I think both the developed and developing world have been responsible for this crippling debt. We are all to blame, so together we must join hands to see how we can alleviate this problem of poverty.

When I was in Dakar in April, I told the Americans who were there, "You see, when people talk about debt and structural adjustment, it is not vice presidents like me who suffer. No, it is that poor woman in the village."

The outflows from the developing to the developed countries are increasing and not decreasing. The poor are becoming poorer and will continue to clear the forests, to use marginal land, to overgraze, and to create deserts and wastelands in order to service the debt and, hopefully, survive. The low input, low output agriculture will continue to create hunger, because like Per Pinstrup-Andersen said, "We are milking the cow. This is the land and we are not feeding it." So it will eventually starve with the resultant land degradation.

In Uganda, our call is to design a new approach to managing. Let us call on governments to be transparent. Let us call on experts to come and look at the way we are managing this poor taxpayer's money. Because even when we borrow it, this taxpayer will pay. Through this approach, we shall come up with examples of accountability and transparency that will be able to help us stabilize our economies. And, indeed, the examples of this nature will help people who are doubting Thomases to believe that indeed even if Jesus died many years ago, and Mohammed, we all live in the image of God and we can still have saviors in our midst.

If the economic conditions of the developing countries were to improve, most of us would get off the land in order to conserve and protect the environment. And, if this were to happen, then the much vaunted population bomb would not likely explode,

especially in Uganda and the generally underpopulated Africa. So, the issue of population must be related to potential development rather than the presence of poverty in African countries.

I do not want to end my address without addressing a trend that is beginning to disturb us in Africa and that is related to the protection of the environment and whether we shall be in a position to achieve this 2020 Vision. There have been several incidents of attempted dumping of hazardous toxic and radioactive wastes on our continent. In fact, recently one of our ministers disclosed to parliament that there is a country that wanted to give us \$600 million—I know that when you are a beggar, you cannot be a chooser—but to swallow radioactive material for \$600 million is indeed something that I cannot even put a name to. It is unacceptable to us. It is all the more serious when the polluters attempt to ship these dangerous wastes to countries that do not have the technology and the resources to deal with them. This is immoral and dangerous and should be resisted at any cost. I ask all of you at this conference to use all of the

influence you can muster to make sure that our poor countries are not polluted in this manner, pollution that will indeed take us back and stop us from realizing our vision.

Excellencies, ladies, and gentlemen. When I look around this hall I see a great assembly of intellect and talent. I see a people determined to improve the lot of the majority of humanity, those who go to bed hungry or sometimes have no bed to go to, those children who are stunted due to malnutrition, and those who starve to death for lack of food. I see a people determined to breathe cleaner air and to drink better water. Above all, I see a people determined to leave their mark as servants of humanity.

I have no doubt that the deliberations here will, in time to come, be recognized as one of the landmarks in the enhancement of the well-being of all humanity.

I thank you very much for your kind attention. And, please be the disciples for all of humanity, both men and women, to enable us to participate equally for the protection of our planet for sustainable development. I thank you.

WHO WILL GO HUNGRY? SCENARIOS FOR FUTURE GLOBAL AND REGIONAL FOOD SUPPLY AND DEMAND

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Introduction

Today I am going to talk to you about the paradox posed by the emerging world food situation. Findings from IFPRI's global food projections to the year 2020 show that the world will continue to have two distinct realities—on the one hand, wealthy countries together with a number of rapidly growing developing countries that will enjoy low food prices and food surpluses or affordable imports; and on the other hand, poorer, slowly growing countries that, if present policies continue, will make little progress toward improving food security or reducing malnutrition. However, the projections also indicate the potential for significant improvement in food security in most developing countries if national and international institutions increase their efforts on behalf of broad-based agricultural and economic growth.

I am going to make five main points in this presentation. I will note these now and then expand on each one in the course of the presentation.

- (1) The aggregate global food supply/demand picture is relatively good. Food production in the world will grow fast enough that world prices of food will be falling.
- (2) However, despite this overall ability of the world's productive capacity to meet effective demand for food, there will be a worsening in food security in Sub-Saharan Africa, and only slow

improvement in food security in much of the developing world, including most of South Asia.

- (3) Additional cuts in investment in agricultural research and development, which are now being contemplated by national governments and international development agencies, would lead to a sharp reduction in food production and a worsening of malnutrition in the developing world.
- (4) However, if instead, national and international development institutions increase investment in agricultural and economic development, broad-based gains in calorie availability and large reductions in malnutrition can be achieved.
- (5) As the debate over foreign aid continues in the United States and elsewhere, it is worth pointing out that developed countries gain from public investment in developing-country agricultural and economic development because faster growth enhances agricultural exports from the developed world.

Before presenting the results, I will briefly describe the projections model we are using. Results are generated using IFPRI's global food model, which we call IMPACT. I would not have time to adequately describe the model, but a paper is available outside that presents the model in detail. We utilize IMPACT to make projections for a number of important out-

comes: (a) country, regional, and global production and prices of crops and livestock; (b) food supply/demand balances and imports or exports; and (c) per capita consumption of food and calories; and (d) the number of malnourished children in the world.

All models are simply tools to aid us in our understanding of a particular problem, and IMPACT is a useful tool because it provides us with a consistent framework to test the effect of different policies and different rates of crop productivity growth, and income and population growth on long-term food balances and food security. IMPACT covers 35 countries and regions, which account for virtually all of world food production and consumption, and 17 commodities, including all cereals, roots and tubers, meats, and dairy products.

The model is specified as a set of country-level supply and demand equations. Each country model is linked to the rest of the world through trade. Growth in crop production in each country is determined by crop prices and the rate of productivity growth due to agricultural research, irrigation, and other investments. Demand is a function of prices, income, and population growth. In order to explore food security effects, we also project the number of malnourished preschool children in developing countries as a function of per capita calorie availability, social expenditures, female education, and access to clean water.

Baseline Results

The first set of results that I will show you are from what we call the baseline scenario, which incorporates our best assessment of future growth in income and population growth and in productivity growth for crops and livestock. Broadly speaking, the baseline productivity projections assume that the already reduced rates of public spending on agricultural research in the late 1980s and

early 1990s will be maintained.

Let us move on to the first results, which relate to point one—that the aggregate global food supply/demand picture is relatively good. Production growth will be sufficient to keep world food prices on a downward trend. The projected decline in real world prices of meat and cereals is shown in Figure 1. The values shown are indices of the real world price, with 1990 values equal to 100. As you can see, cereal prices are projected to drop by nearly 20 percent by 2020 and meat prices by about 10 percent.

The decline in prices is accompanied by increasing world trade in food, with the developing world as a group increasing its food imports from the developed world. This can be seen in Figure 2 showing cereal supply, demand, and trade of developing countries. The net cereal imports of developing countries will double by 2020, reaching 183 million tons.

These increasing trade flows are a positive development if they simply mean rapidly growing economies are producing food when viable and importing food when this is cheaper. This situation characterizes much of East and Southeast Asia. However, increased imports spell trouble elsewhere, for example in Sub-Saharan Africa. In this region, cereal imports are projected to triple, from 9 million metric tons in 1990 to 27 million metric tons in 2020. Sub-Saharan Africa will not be able to pay for these growing imports. The international community will need to devise appropriate combinations of financing and food aid to bridge these food gaps in Sub-Saharan Africa for the foreseeable future.

But let us turn to the truly critical problem that I mentioned in my second major point. Despite the overall ability of the world's productive capacity to meet effective demand for food, there will be little improvement in food security for the poor in many regions, particularly in South Asia and

Figure 1—Projected real world prices for cereals and meat

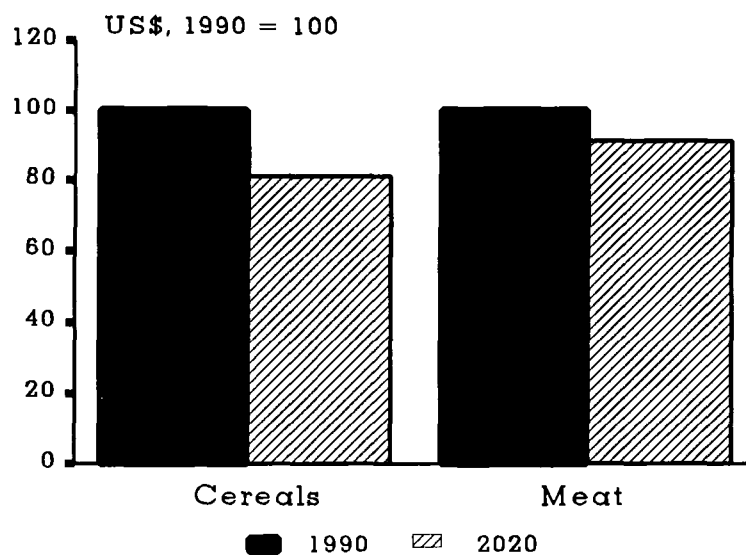
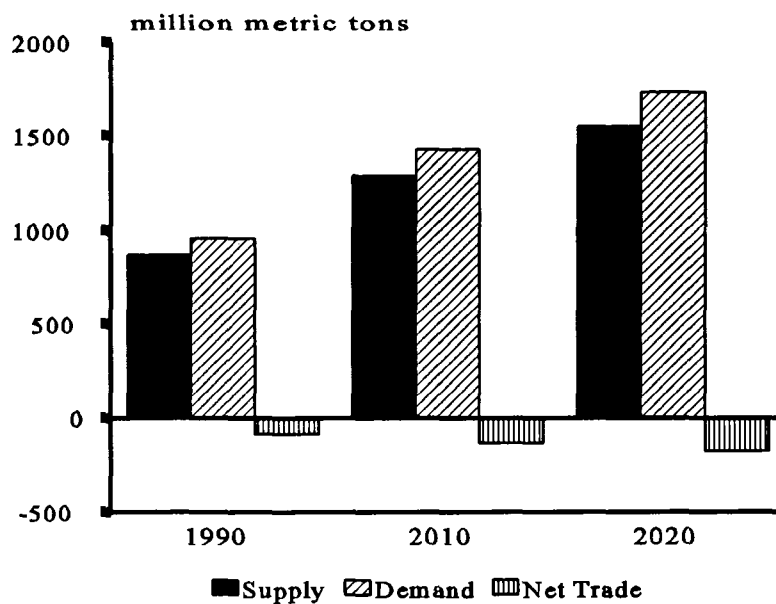


Figure 2—Cereal supply, demand, and net trade, developing countries: Baseline scenario (1990, 2010, and 2020)



Sub-Saharan Africa. This is shown in Figure 3, which translates per capita consumption of all foods into average per capita calorie availability. The slide shows the historical (1970-1990) and projected per capita calorie availability for food in the developing world and in South Asia and Sub-Saharan Africa.

The results show that there is virtually no improvement in per capita calorie availability for Sub-Saharan Africa. More progress can be seen for South Asia, where per capita income growth does outstrip population growth. But even here, there is no real closing of the gap between South Asia and the rest of the developing world.

These trends in calorie availability translate into a pretty bleak projected future for food security and nutrition. This point is driven home when you look at Figure 4, which shows the number of children under 5 years of age who were malnourished in the recent past and the projected future.

South Asia is home to more than one-half of the world's malnourished children. There has been a slow improvement over time in South Asia, mainly in the last decade due to the gradual decline in growth in the population of children aged 0 to 60 months. In Sub-Saharan Africa, the picture is worse. There is an increase of 14 million in the number of malnourished children. Even with relatively abundant food in the world, there is not enough growth in effective per capita demand for food in Sub-Saharan Africa to improve the food security situation.

The baseline results illustrate the paradox: declining world food prices coexisting with sustained or increasing malnutrition in much of the world. That is our best assessment of where the world food situation is headed. To give you a better feeling for what drives these aggregate results, I will describe two fundamental global trends in supply and demand, and then point to two important regional developments.

On the demand side, rapidly increasing

urbanization, changing tastes and preferences, and rising income are causing a shift to more diversified diets with higher per capita consumption of meat, milk and milk products, fruits, and vegetables, and lower per capita consumption of cereals. Thus, in China and much of Southeast Asia, per capita consumption of rice is already falling, and rates of growth in per capita cereal consumption are declining even in South Asia. This dietary transition, which is ongoing in much of the developing world, reduces demand pressure on basic food staples.

On the supply side, we project a small decline in the rates of growth in crop yields compared to the already reduced rates of the last decade. However, if investment rates in agricultural research are maintained, we do not see an acceleration of this yield decline. Additional yield increases in farmers' fields will be produced by conventional plant breeding for perhaps the next decade. As exhaustion of gains from conventional breeding begins early in the next century, further yield growth will be generated as conventional breeding is combined with widecrossing, transgenic crosses, and other tools resulting from biotechnology research.

The first regional trend that I would like to highlight is that the two giants in the developing world, China and India, will not put severe pressure on world cereals markets. China's net cereal imports are projected to increase from 13 million metric tons to 27 million metric tons, almost all wheat. India is projected to remain essentially self-sufficient in cereals at effective market demand. But these results are dependent on maintenance of research investment levels. In-depth studies for China and India under the 2020 Vision Initiative show that declines in research investment could lead to more than doubling of China's cereal imports and to Indian cereal imports of 25 million metric tons, which would put more

Figure 3—Per capita calorie availability

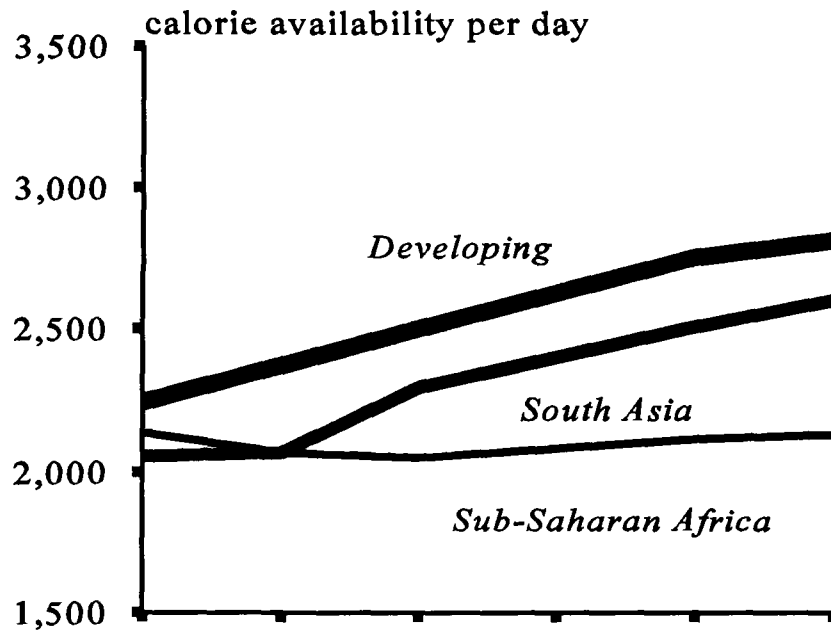
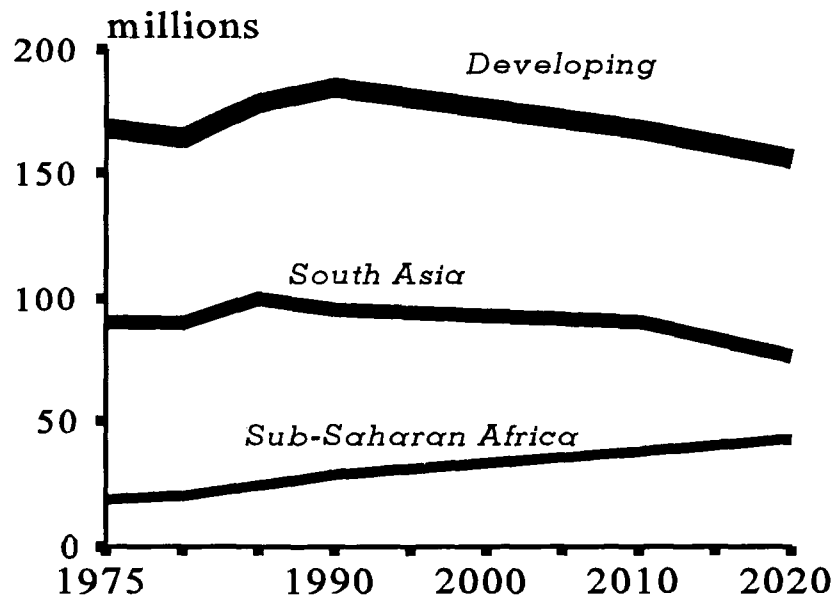


Figure 4—Number of malnourished children (0–5 yrs old)



significant pressure on world food markets.

A final underlying trend worth noting is the projected dramatic shift of Eastern Europe and the former Soviet Union (FSU) from big cereal importers to substantial exporters. Removal of food subsidies and other price distortions, combined with sharp income declines, have already resulted in falling cereal consumption in these regions. The impacts of these changes will be intensified over time as feeding efficiency improves in the livestock industry and a projected gradual recovery will cause production growth to outstrip demand growth. These developments will enable Eastern Europe and the FSU to shift from major net importers of cereals, with combined imports of about 31 million metric tons in 1990 to a net exporter of nearly 15 million metric tons in 2020.

These underlying trends point to an illuminating question: What could make our baseline projections wrong? More specifically: (1) Are there policy failures that could make the global food situation worse, resulting in rapid increases in malnutrition?

(2) Conversely, given the seeming persistence of malnutrition in the face of declining food prices, is there in fact any hope that improved policies and increased investment in agriculture and economic development could make a real impact on malnutrition?

Alternative Scenarios

We explore these questions in three alternative scenarios. The first is low population growth, which utilizes the United Nations' low population projection rather than the medium projection used in the baseline.

The second scenario is a low investment/low growth scenario. This scenario includes: First, a 25 percent reduction in nonagricultural income growth; second, reduction in crop productivity growth

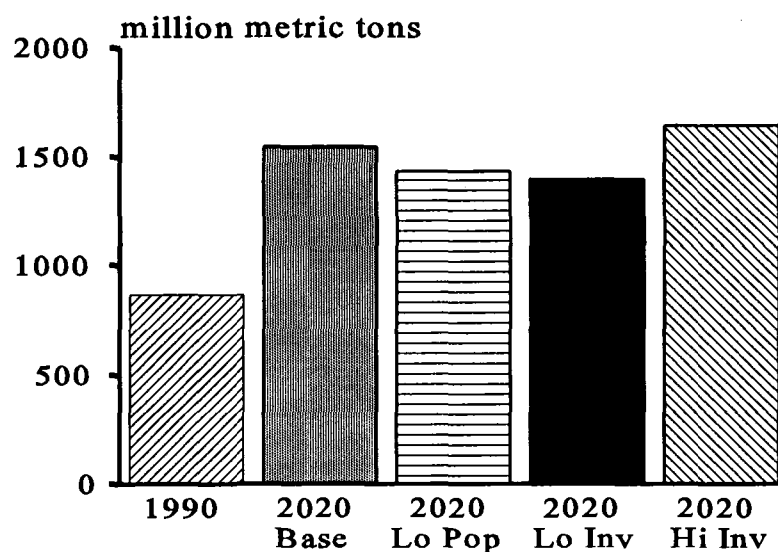
resulting from elimination of public investment by international donors in national agricultural research systems and extension services in developing countries; and a phase-out of direct core funding of the international agricultural research centers. This would amount to an annual cut in research expenditures of about \$1.5 billion, which is not a large budgetary savings spread across all the developed countries. Finally, this scenario also incorporates, a reduction in the investment in health, education, and sanitation leading to a worsening of projected indicators of female education, access to clean water, and social expenditures of about 20 percent by 2020 relative to the base case.

The third alternative is a high investment scenario. This scenario postulates, first, a 25 percent increase in nonagricultural income growth in developing countries; second, an increase in public investment in agricultural research of about \$750 million annually: roughly three-fourths to national research programs and one-fourth to international research programs; and third, an improvement in indicators of female education, access to clean water, and social expenditures of 20 percent by 2020.

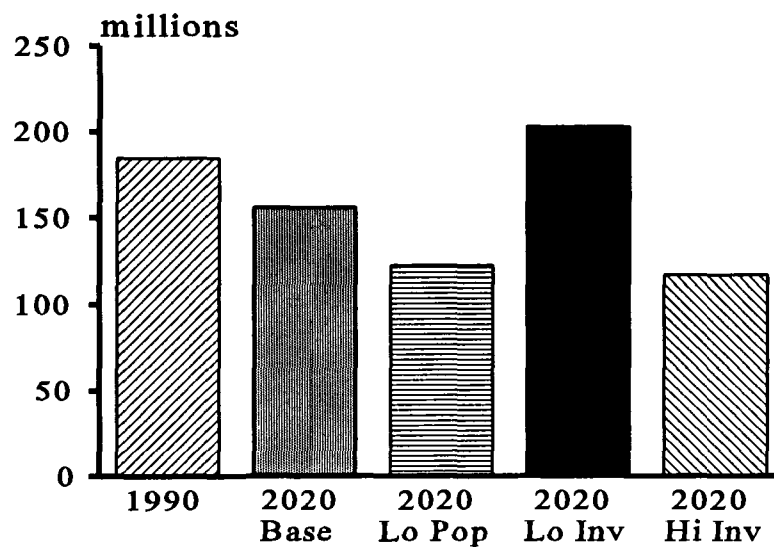
Figure 5 shows the impact of alternative scenarios on cereals production in the developing world. The low population scenario has a surprisingly large effect on cereals production, but the explanation is actually simple. The decline in demand pressure due to lower population drives down prices, leading to lower crop areas and yields. Population growth rates have a powerful effect on the ability of developing countries to feed themselves. In Sub-Saharan Africa, a drop of just one-third of one percent in population growth rates would cut cereal imports nearly by half in 2020.

The figure also shows the highly negative effects of reduced public investment on developing-country food production, with production of cereals dropping by 10 percent

**Figure 5—Cereal production in developing countries
Various Scenarios, 1990 and 2020**



**Figure 6—Number of malnourished children (0-5 yrs old)
Developing countries, 1990 and 2020**



or 150 million tons. The hardest hit are the major staples, wheat and rice, which suffer the biggest declines in productivity from the reduction in public research investments.

The high investment scenario, in contrast, shows that annual cereals production in the developing world would be about 100 million tons higher by 2020, as a result of increased spending on agricultural research.

How do these changes in population, production, income, and prices ultimately affect malnutrition? These results are shown in Figure 6, which compares the projected number of malnourished children under the different scenarios. The impact of a slowdown in population growth on food security is powerful. Working through both a direct decline in the population of preschool children and indirect decreases in prices and increases in per capita income, the low population growth scenario results in a drop in the number of malnourished by 34 million compared to the 2020 baseline.

Compare next the low investment scenario with the baseline: low investment and slower growth adds 47 million children to the ranks of the malnourished compared to the baseline projection for 2020, leading to an actual increase from 1990 levels. This increase is concentrated in South Asia and Sub-Saharan Africa, where the prevalence of malnutrition is already high.

On a more encouraging note, this figure also shows that a sharp reduction in the number of malnourished in the developing world is, in fact, possible: the high investment scenario reduces the number of malnourished in 2020 from 184 million in 1990 to 117 million in 2020, an improvement of 67 million.

But this progress requires three forces at work: increased income growth to generate effective demand for food; expanded investment in agricultural research to boost productivity to meet growing demand at reasonable prices; and higher expenditures on health, education, and nutrition, to translate

effective food demand into nutritional improvement. Such efforts will require increased national and international commitment to agricultural and economic development.

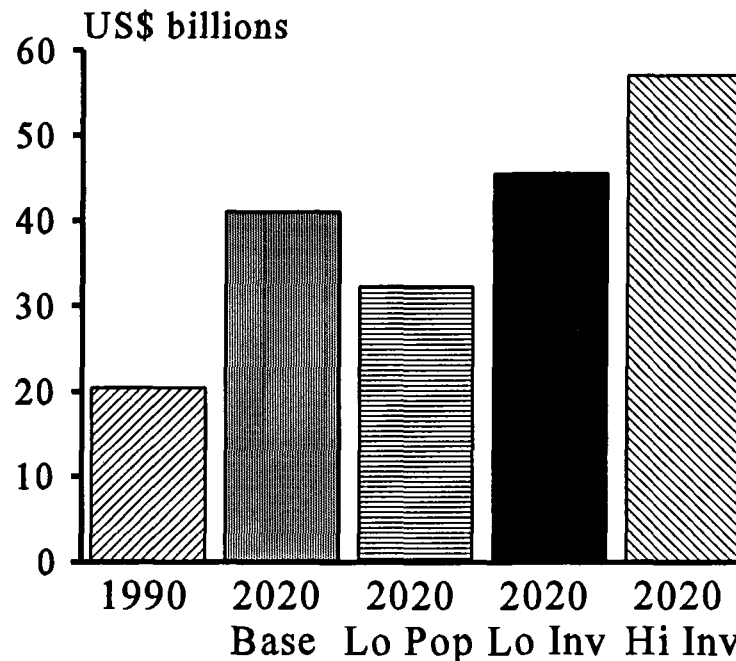
This increased commitment, at least on the part of the international community, may not be as painful as many seem to think. The final point I want to make is that the developed countries also gain from increased investment in research and faster growth in the developing world.

Figure 7 compares the gross value of food exports from the developed countries under the baseline and the alternative scenarios. Under the low population growth scenario, the gross value of exports is lower by nearly \$9 billion, reflecting the reduced overall demand for food.

The alternative investment scenarios tell an interesting story. If we first compare the value of exports for developed countries under the baseline and low investment scenarios, it can be seen that the value of exports from developed countries is a little higher under the low investment case. With reduced domestic production, developing countries rely a bit more on food imports. This result could be used to argue for a "beggar-thy-neighbor" approach to development spending by the developed world, in which reduced development spending could increase exports from the developed countries.

However, the fallacy of this argument is shown by further comparison with the high investment scenario. This scenario results in an increase in the value of exports from developed countries of \$16 billion relative to the base case, and \$11 billion relative to the low investment case. Under the high investment scenario, the volume of cereals exported by the developed countries is virtually the same as under the baseline scenario, while the volume and value of meat exports increases dramatically due to rapid income growth in the developing countries. Increased international investment

**Figure 7—Export value of agricultural commodities
OECD countries, 1990 and 2020**



in agriculture and improved growth in developing countries would be beneficial for agricultural exports from the developed countries.

Conclusion

The results presented here show that, although world food prices are likely to decline in the future, national governments and international donors face huge challenges in improving food security in the developing world. There is likely to be very little improvement in food security in much of the developing world, and actual increases in the numbers of malnourished children in Sub-Saharan Africa.

If, instead, public investment in agricultural research continues to decline, the

relatively favorable aggregate food situation would be significantly worsened and the already bleak nutritional picture made even worse. A lessening of investment in agricultural research and development by national governments and/or international development agencies would lead to reduced food production in the developing world, and reversal of world price declines and a sharp worsening of malnutrition in the developing world.

But the results shown here also indicate that significant progress can be made in increasing food availability and reducing malnutrition around the globe if faster economic growth is to be coupled with increases in public investment, both in direct agricultural research and in health, nutrition, and education.

THE COEXISTENCE OF GLOBAL FOOD SURPLUSES AND FAMINE: POVERTY'S ROLE IN THE FOOD EQUATION

NANCY BIRDSALL

Vice President

Inter-American Development Bank

I would like to begin by commending the organizers for putting together this conference. As a development banker, I and colleagues struggle constantly not to be overwhelmed with immediate problems, but to keep our eyes on the medium-term challenges, knowing that on certain issues what we do today matters greatly for our children and grandchildren. The issues being discussed in this meeting certainly fall into that category.

I have one fundamental point to make and three additional points that build on the fundamental one. The fundamental point, a point that must be kept on the table, is that the hunger issue is a poverty issue. In one direction, hunger probably contributes to poverty, for example, by reducing available energy for manual labor. In the other direction, and even more important from the point of view of policy, poverty is the root cause of hunger. As Mark Rosegrant just emphasized, hunger in the future is less likely to be the result of insufficient production than of low household incomes that reduce effective demand. (I should note here that I am talking today about chronic hunger—which affects an estimated 700 million people—and which is distinct from the famines that receive considerably more global press but in fact affect fewer people, and indeed have diminished in frequency and scope as a result of successful national and international efforts to respond quickly when famines threaten.)

The correlation between hunger and

poverty has been well documented. South Asia and Sub-Saharan Africa have the highest percentage of poor—almost 50 percent in 1990—and the highest percentage of hungry people—25 percent in South Asia and 40 percent in Sub-Saharan Africa. The relationship over time also holds. In Latin America and Sub-Saharan Africa, poverty rose between 1985 and 1990; the incidence of hunger also rose. In East Asia and South Asia, poverty fell, and so did hunger.

So my fundamental point today is that a strategy to combat chronic hunger boils down to a strategy to combat poverty.

Let me state the three additional points and then discuss each one.

- First, strong economic growth is one of the most effective means of reducing poverty. Economic policies, including macro policies, that facilitate this growth are thus an important part of any strategy to combat poverty and hunger.
- Second, strong economic growth is not enough. To reduce poverty, we must worry not only about growth itself, but about the pattern of growth, and must aim for growth that benefits everyone, that lifts all boats. Agricultural policy is one of several critical policies that affect the pattern of growth and thus affect the extent and depth of poverty.

These first two points are illustrated in Figure 1. The right side of the figure reflects the idea that reducing poverty reduces hunger (and vice versa). To the left is reflected the idea that economic growth reduces poverty

and that good macroeconomic policy contributes to economic growth. Finally, the chart captures the idea that good agricultural policy serves not only as an input to agricultural growth, and thus economic growth, but also can have a direct effect on poverty.

- Third, in reducing poverty and eliminating hunger, opportunities matter more than transfers.

Now the first point: the relationship between poverty and economic growth. As Figure 2 shows, in general, the faster an economy grows (represented by the bars on the right side of the graph), the larger the declines in poverty (represented by the bars on the left side of the graph). Of course, changes in the distribution of income over time will affect the strength of this relationship and in certain cases, particularly in the short run, economic growth and declines in poverty may be inversely related. However, the experience of developing countries over the last three decades is that economic growth is in fact necessary for the reduction of poverty. Though growth is not sufficient to reduce poverty, without growth, reduction of poverty has proved to be virtually impossible.

How then can a country achieve sustained economic growth? For many countries, a period of structural adjustment is a necessary first step. This adjustment, associated with recession and cuts in public social sector spending, is often held responsible for expanding and worsening conditions of poverty. The real question is not what happened with adjustment, but what would have happened without adjustment. Would the poor have been better off? Would the poor have benefited from less adjustment and less growth? The answer is almost certainly not. For example, inflation is one of the worst enemies of the poor. In Latin America, the fundamental cause of the declines in real wages during the 1980s, which hurt the poor, was not adjustment but the high inflation that preceded adjustment efforts. Similarly, ad-

justment measures have reversed other policies that hurt the poor by limiting the demand for labor, the only real asset of the poor; typical policies that favor capital and hurt labor are trade protection, overvalued exchange rates, and credit policies that direct or subsidize credit to large capital-intensive sectors. Reforms that reduce real appreciation of exchange rates are particularly likely to help the rural poor, who can benefit from increased international demand for agricultural products at competitive exchange rates.

Of course, structural adjustment is almost always recessionary in the short run, implying employment and wage declines and reductions in public services. The poor are likely to be affected adversely by these changes, and compared to other groups can least afford the losses. But the story is complicated by two dire facts. First, and ironically, initial conditions in the world's poorest countries are often such that the poor lose relatively little when public expenditures are cut simply because they benefited little in the first place, for example, from health and education programs. Second, the poor are generally last in line, figuratively if not really, and pay high prices for goods that are rationed. In Tanzania, the elimination of the state monopoly on food crop marketing led to sharp declines in the real consumer prices for maize, rice, and beans between 1985 and 1987; even in 1992, food prices for poor urban consumers were below levels of the early 1980s.

None of this is to say that we should be sanguine about the design of adjustment programs and of macroeconomic policy in general. Economic reforms can and should be better designed so as to protect the poor, and even more to ensure attention to improving opportunities for and the productivity of the poor. The point I want to emphasize here is that adjustment reforms can be consistent with good social policy and that good macroeconomic policy is consistent with good social policy.

Which brings me to my next point, eco-

Figure 1
Impact of Policy on Poverty (Hunger)

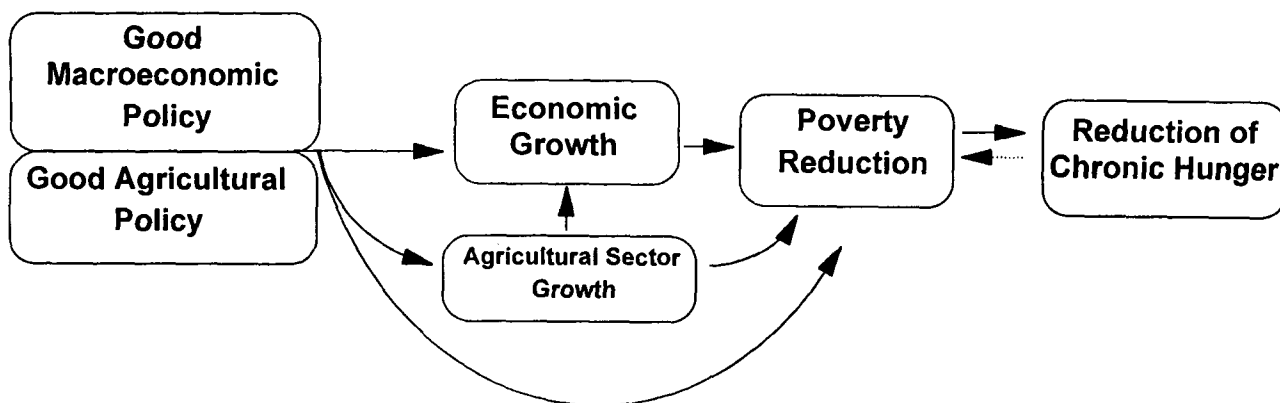
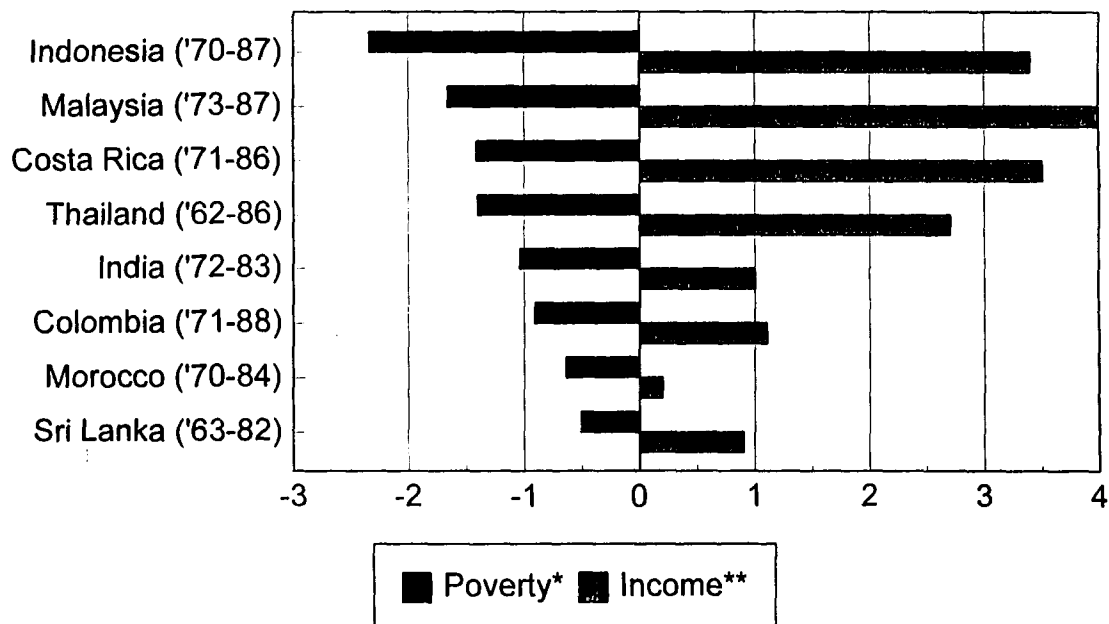


Figure 2
Economic Growth and Decline in Poverty



*Decline in poverty is measured as the average annual reduction in the headcount index (percentage points).

**Economic growth is measured as the annual growth of mean income or expenditure (percent).

Source: World Bank, *World Development Report* (1990)

economic growth alone is not enough. Whether or not the poor benefit from growth depends a great deal on the pattern of that growth, which depends in turn on the nature of the economic and sectoral policies that support it.

Clearly, economic growth in certain countries has resulted in much larger declines in poverty than in others. Much has been said in recent years about the experience of countries of East Asia, which have enjoyed high rates of growth, relatively low rates of inequality, and rapid declines in poverty. This success in both economic and social terms can be attributed to the particular pattern of growth in these countries—a pattern that emerged, at least in part, because of programs and policies that brought the benefits of growth to all segments of the population, including the poor. The specific components of this "shared growth" (a term used in the World Bank's recent study of the so-called East Asian Miracle) have varied from country to country. However, three areas of policy seem to have been fundamental: an export push that created high demand for labor, a universalist approach to public social and infrastructure investments, and a relatively level playing field for agriculture. I would like to speak today on this last ingredient—agricultural policy—because of its special connection to the problem of hunger.

In the fast-growing economies of East Asia, direct and indirect taxation on agriculture has been lower than elsewhere in the developing world. In the last three decades, many governments in other regions favored manufacturing and hurt agriculture by overvaluing currencies and protecting domestic industries that manufacture agricultural inputs and the goods purchased by rural households. The overvalued exchange rates that resulted from restrictions on manufactured imports reduced the domestic currency proceeds of agricultural exports.

Figure 3 compares direct and indirect taxation of agriculture across countries. The top portion shows taxation—the further to the left, the higher the taxation. Taxation has been higher for three decades in Pakistan, the Philippines, and Sri Lanka than in Korea (where agriculture is now protected) or Malaysia. Thailand's level of agricultural taxation was relatively high in the 1960s and 1970s, but was reduced in the 1980s. In the Philippines, taxation rose in the 1980s.

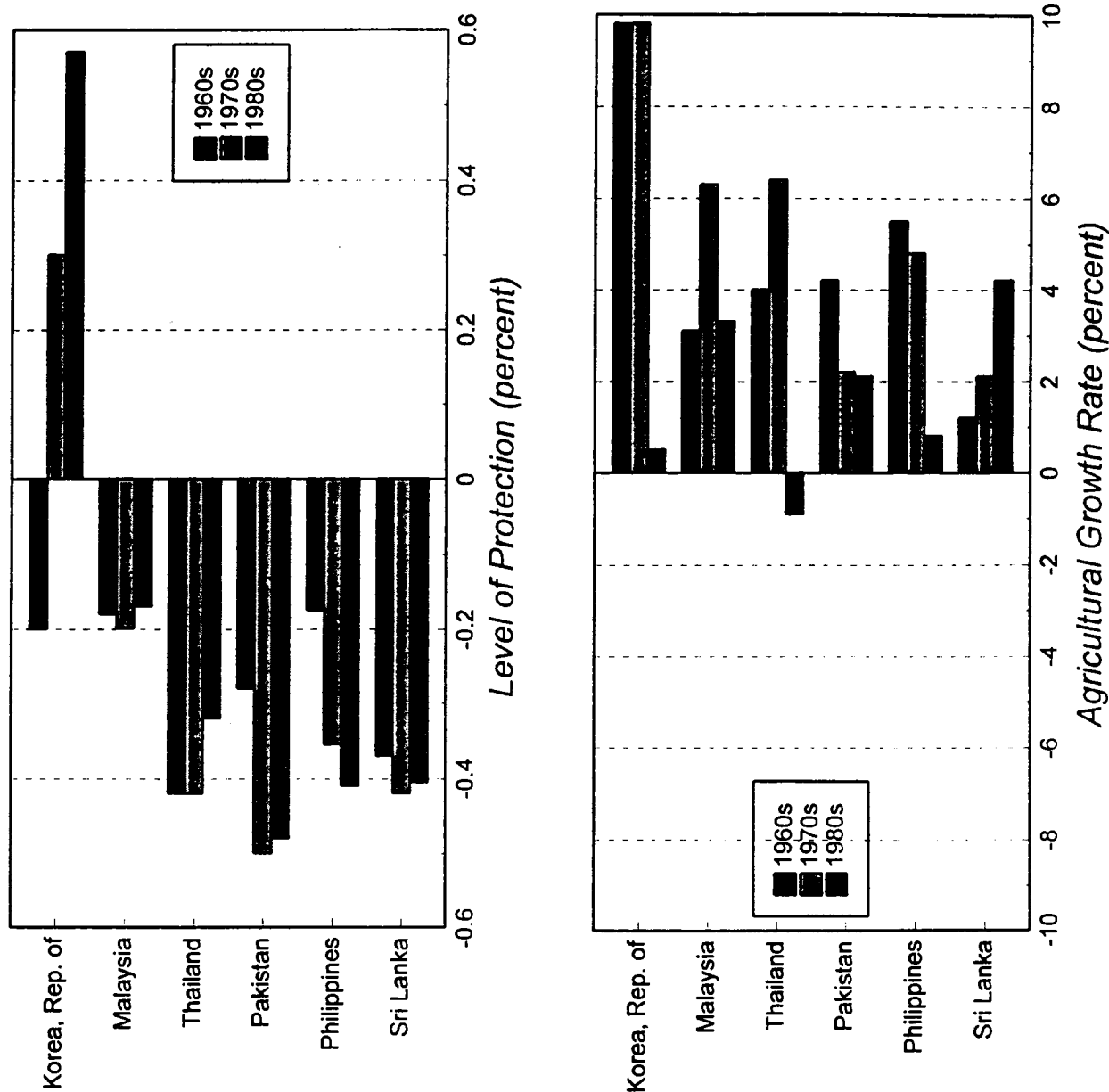
The bottom half of the figure shows agricultural growth. Low taxation of agriculture has been clearly associated with high growth in that sector. This is true across countries and within countries over time. Korea, with the lowest taxation, has had the most impressive growth success. In the Philippines, growth fell in the 1980s when taxation rose.

Finally, across regions for the period 1965–88, we find that the region that has had the highest agricultural income and productivity growth is not surprisingly East Asia, with growth rates one percentage point higher in every single year than in other developing regions. East Asia is, of course, also the region that has had the highest economic growth overall and the fastest reduction in poverty. These associations are not merely coincidental.

Why was growth in agriculture so important for reducing poverty in a region that we tend to think of as an industrial success? First, there is a direct link between agricultural development and poverty, for the simple reason that a majority of the poor live in rural areas and their lives tend to be closely tied to agricultural production. Thus, agricultural development brings increased income and employment for the rural poor. Better economic opportunities in rural areas also make labor less plentiful in urban areas, thereby improving the economic opportunities of the urban poor as well.

Second, higher income in the rural and

Figure 3: Intervention and growth in the agricultural sector, selected East Asian countries and decades



Source: World Bank, *The East Asian Miracle*, 1993.

agricultural sectors also means higher demand for the agricultural inputs and consumer goods that then stimulate the growth of labor-intensive nonagricultural output. In Taiwan, for example, in the 1950s and early 1960s agriculture, not manufacturing for export, was clearly the "leading sector" and roughly 60 percent of the increment to aggregate demand was domestic. More generally, among Asian countries, there is a strong positive correlation between the rate of growth of the agricultural sector and the rate of growth of the nonagricultural sector. The relationship suggests that the multiplier effects of agricultural growth on manufacturing, construction, and services are large: a 1 percent increase in agricultural growth is associated with a 1.5 percent increase in the growth rate of the nonagricultural sector, implying that the faster agriculture grows, the faster its share of total output declines. Moreover, because the relatively simple manufactured inputs and consumer goods demanded by rural residents are generally more efficiently produced with labor-intensive techniques, the employment effects of these increases in demand are amplified.

So good agricultural policy and a dynamic agricultural sector are not only good for growth, they are good for the poor directly; and through growth, they are likely to reduce poverty indirectly.

The links between poverty, agriculture, and the environment, which have become increasingly evident as more and more poor are forced to use more and more fragile areas of land, only serve to strengthen the need for close attention to this sector.

What then, in addition to macro and structural reforms that avoid penalizing agriculture, can governments do to support the agricultural sector? The key issues are well known and many are being addressed here: research and development in yield-increasing and environmentally friendly production technology, increased access to credit for small farmers, provision of strong extension services and technical assistance, etc. All of

these will directly or indirectly enhance the productivity of the rural poor, reducing poverty while simultaneously augmenting growth.

The third and final point, we cannot expect transfer programs and short-run safety net programs, which can make sense and certainly should be incorporated into adjustment programs, to bear the full burden of addressing the problem of poverty. We must focus on improving opportunities. If there is one lesson that East Asia teaches us, it is the importance of creating a level playing field for the poor—ensuring that the poor have the same opportunities as the nonpoor. In East Asia, this was done via a universalist, or saturation approach to public investment in infrastructure and in basic social programs, including in rural areas. Rural areas, where the poor are concentrated, have been especially favored in East Asia. Consider the case of electricity. In the early 1980s, the ratio of the rural to urban population benefiting from electricity was 1 to 2 in Thailand—not too bad compared to 1 to 5 in Brazil. Similar comparisons can be made for investments in rural roads and water. Even more important has been the emphasis in East Asia on universal access to basic education and health services, again including in rural areas. The universalist emphasis in the face of scarce resources meant governments had to concentrate their resources at the lower, more basic levels of services where unit costs are lower, and where, of course, the poor are more likely to benefit.

These basic investments constituted opportunities, not transfers; they reinforced East Asia's "level playing field" approach to agriculture, ensuring that the rural poor were able to both participate in and benefit from the region's rapid economic growth. This emphasis on opportunities, not transfers, is obviously consistent with dignity of the poor and with an emphasis in all development programs on investments, including investments in people, as key to sustained growth.

Let me conclude by restating the funda-

mental point and the three additional points I wanted to convey today. First, the fundamental point is that poverty is the cause of hunger. Second, economic growth is critical to reducing poverty, thus policies that promote growth are central to combatting poverty and hunger. Third, economic growth alone is not sufficient, the pattern of growth matters too; this means especially avoiding policies that directly or indirectly penalize

agriculture. Finally, while transfer and other compensatory programs can help to combat poverty and hunger, they are no substitute for improving the opportunities of the poor. Improving opportunities for the poor—guaranteeing the poor a level playing field—is really what sustainable development is all about.

Thank you very much.

THE DEPLETION OF NATURAL RESOURCES: THE IMPACT OF FOOD

GORDON CONWAY

Vice Chancellor

University of Sussex, United Kingdom

Our food is not conjured out of thin air, it is won by skillful people from a rich diversity of natural resources. We have inherited land and the variety of plants and animals it supports, sunlight and other forms of energy, a relatively benign climate, and abundant sources of water and nutrients. The skill lies in inventing and perfecting appropriate technologies to exploit these natural endowments on a sustainable basis.

This challenge is not new. Varro, a Roman landowner of the first century B.C., defined agriculture as "a science, which teaches us what crops are to be planted in each kind of soil, and what operations are to be carried on, in order that the land may produce the highest yields in perpetuity." Writing in the next century, Columella clearly understood the fundamental importance of nutrient cycles in achieving sustainability. Soil, he insisted, does not become infertile simply because it grows old, but because "the trees, cut down by the axe, cease to nourish their mother with their foliage." However, he continued, "we may reap greater harvests if the earth is quickened again by frequent, timely, and moderate manuring."

What has changed since Roman times is the power of our technology. It has allowed us to feed a population that is 50 million-fold larger. Yet, because of the way technology is used, we are depleting at an alarming rate the natural resource base on which our food production depends and causing damage of a kind unknown before.

The arithmetic of our loss is a familiar

litany. We are running out of cultivable land. In Asia, the amount of cropland per person will decline to a microtenth of a hectare by the year 2020. Our primary forests are being destroyed at a rate of about 16 million hectares each year and, in our oceans, most fish stocks are being rapidly depleted, largely through overfishing. The global fish harvest has declined from 90 million tons in 1989 to 84 million tons in 1993.

Of equal, if not greater, significance we are destroying the planet's biodiversity. An estimated 15 percent of the world's plant and animal species could become extinct by 2020. This represents not only a loss of useful organisms, for example, the predators and parasites that provide natural control of our pests, but more fundamentally a destruction of the world's treasure trove of DNA. Genetic engineering holds out the promise of combining, in new and exciting permutations, the genetic stock contained in our plants and animals to provide novel sources of materials, energy, medicine, and food. If we continue to deplete that stock, we will seriously deprive ourselves of solutions to our growing problems.

In addition to this quantitative loss, we are gravely affecting the quality of our natural resource endowment. Globally, nearly 2 billion hectares of soils (17 percent of all vegetated areas) have become degraded through water and wind erosion, loss of soil nutrients, salinization, acidification, pollution, compaction, waterlogging, and subsidence. Most, but not all, results from inappropriate agricultural

practices. Lack of terraces, failure to replace nutrients and organic matter, and excessive irrigation or drainage damages arable land. Range-land is degraded by overgrazing, often as a result of the breakdown of indigenous institutions capable of managing common property resources.

Agriculture is both the culprit and victim of pollution. Heavy fertilizer applications are producing nitrate levels in drinking water that approach or exceed permitted levels, and pesticides are producing resistance and resurgence in pest populations and high levels of human morbidity and mortality.

Agriculture is also a growing contributor to global pollution, producing significant levels of methane, carbon dioxide, nitrous oxide, and ammonia. Individually or in combination, these gases are contributing to global warming, the depletion of stratospheric ozone, acid deposition, and the build-up of ozone in the lower atmosphere. All of these consequences have a potential effect on food production. For example, heat and water stress may result in yield reductions, especially in the low latitudes, where most of the developing countries are situated. By contrast, in the middle and high latitudes, the combined effect of temperature increases and the direct physiological effect of increased carbon dioxide (CO₂) are likely to result in higher yields. But there are many unknowns: one consequence of global warming may be a greater incidence of extreme weather conditions with unpredictable effects.

Just as the consequences of depletion and degradation are complex, so are the causes. Poverty and hunger often lead to desperate strategies for survival, and attempts to meet basic needs often take precedence in the short-term over longer-term sustainability. But the blame should not be placed on the poor and hungry. Considerable damage is caused by the irresponsible exploitation of resources by

the rich.

In practice, destruction often results from conflicts over resource use. Small farmers and large landowners cut down forests to make way for crops and livestock. In our coastal zones, particularly in the wet tropics, conflicts arise between intensive fisheries, rice production, and the natural productivity of mangrove and other swamp forests. And worldwide, there is growing competition between agriculture and natural resources, on the one hand, and expanding urbanization and industrialization, on the other.

More fundamentally, the causes lie in inappropriate systems for resource management, unresponsive institutions, short-term national and regional policies, and a lack of economic mechanisms that will adequately value natural resources in relation to all their potential uses, now and in the future.

The complexity of the challenge we face is daunting, yet it has to be tackled. Abandoning technology is no answer. We cannot return to Roman methods of farming but we can, as the Romans did, use ecological principles to inform how we apply technology. A case in point is the application of biotechnology. Through genetic engineering, we have the potential to develop crops and livestock that are resistant to pests and diseases; that can compensate for mineral deficiencies and withstand salinity, toxins, and drought; and that can make more efficient use of sunlight, water, and nutrients. By these means we can increase productivity in the face of dwindling natural resources. In particular, genetic engineering can help to reduce the costs of production. A nitrogen-fixing rice plant, for example, would greatly reduce the need for fertilizer application. But such potential can only be achieved if we use the new technologies wisely, in the light of sophisticated ecological and physiological knowledge.

The way forward, I believe, lies in the development of integrated natural resource

and agricultural management (INRAM) for those who like new acronyms. There is a model for this in integrated pest management (IPM)—an approach that is nearly forty years old and is tried and tested. In essence it combines modern technology, the application of synthetic, yet selective, pesticides and the engineering of pest resistance with natural methods of control, including agronomic practices and the use of natural predators and parasites. The outcome is sustainable, efficient pest control that is also often cheaper than the conventional use of pesticides. One outstanding example, among many, is the IPM developed for rice pests in Indonesia. Research has shown that the damaging outbreaks of the brown planthopper on rice often are due to the pesticides, which kill off the spiders and other natural enemies of the planthoppers. Under IPM, farmers are trained to recognize and regularly monitor the pests and their natural enemies. They then used simple yet effective rules to determine the minimum necessary use of pesticides, so reducing the average number of sprayings to one per season, while simultaneously increasing yields by over a ton per hectare.

We now have to translate the success of IPM to a larger scale. In essence, the key lies in combining natural with artificial ways of management. For example, to achieve higher yields, we cannot rely solely on organic nutrients. In Africa, in particular, we will have to greatly increase the use of synthetic fertilizers, but in combination with organic nutrients so ensuring the soils can sustain the high yields.

As IPM has shown, participation by farmers and recourse to local knowledge, local culture, and local ecology is also crucial to success. In recent years, there has been a breakthrough in the design of techniques that involve farmers in decision-making. Under the title of Participatory Rural Appraisal (PRA), simple, yet powerful, methods have been developed that encourage farmers to analyze design and manage

agricultural systems in partnership with research scientists and extension specialists.

One outcome of such analyses is a reminder that food security is not solely a result of food production. Rural households may achieve security by growing their own food, but in many ecological and socio-economic situations, the harvesting of forest and other natural products, either alone or in combination with food production, may be a more sustainable strategy for achieving food security than food production alone. Natural resources can provide crucial sources of employment and incomes. Integration of agriculture and natural resources is thus frequently a key to food security. (There is not enough time for me to give illustrations of INRAM, but I have appended two practical examples drawn from my experience in India. We will have time tomorrow to discuss these and other examples.)

The challenge at this conference is to strike the right balance between pessimism and optimism, sufficient to move the world to immediate action. The problems I have described are awesome. If we do not solve them, hunger will grow dramatically. The way forward, I believe, lies in harnessing the power of modern technology, but harnessing it wisely. We need a new Green Revolution, one that will be as productive as the past revolution, but will be environmentally friendly and, hence, sustainable. I and my colleagues in the CGIAR Vision Panel have called this a "Double Green Revolution."

Such a revolution will depend on natural and social science, and technology, of a high quality. This will not arise naturally, nor as a result of market forces. It cannot be left to private investment. There is a crucial need for governmental vision and substantial public investment. My optimism flows from what is technologically possible, my pessimism from whether governments, developed and developing, will provide the necessary leadership.

Appendix: Two Examples of Integrated Natural Resource and Agricultural Management

The first concerns small scale irrigation. In the state of Tamil Nadu in southern India are numerous tank systems. The tanks are small reservoirs that are filled during the monsoon rains and then used by the villagers to irrigate crop fields. In the past, the maintenance of the tanks and the irrigation canals was the responsibility of government authorities but, since independence, the systems have progressively fallen into disrepair. A current aid project is attempting their rehabilitation by hiring contractors who work to a blueprint; not surprisingly this produces inappropriate and excessively costly solutions. As an experiment, villagers are being given a grant directly and encouraged to design, plan, and manage the rehabilitation themselves. So far the results are very encouraging. The villagers are showing a high degree of competence and inventiveness, and the outcome is systems that the villagers feel they own and to which they are committed.

The second example is the process of joint forest management in India. Much of the government forest land is highly degraded, the trees are cut down and the

ensuing scrub and grassland is overgrazed. Government authorities are powerless to stop the degradation, and local people feel no sense of responsibility. Joint forest management, pioneered by the state of West Bengal, involves a partnership between the Forest Department and local villages. Each village is given rights to both timber and nontimber products and the responsibility of management according to their own priorities. Again, the experiment is working well. Forest cover in the affected regions of West Bengal is growing rapidly, the aims of the Forest Department are being achieved, and the income of the villagers is growing. Women, in particular, are benefiting from a steady flow of income from such products as firewood, oils and seeds, silk, and leaves for plate making.

Both experiments are still in their early stages. They have been helped by the sensitive advice of technical experts in the government departments and from social scientists in universities and NGOs. Inevitably difficult questions still have to be addressed, particularly with regard to the ecological, economic, social, and institutional sustainability of the approach. But they provide welcome pointers to the directions INRAM has to take.

INTERNATIONAL PERSPECTIVES ON HUNGER AND THE ENVIRONMENT

KLAUS-JÜRGEN HEDRICH

*Parliamentary Secretary of the Ministry for
Development Cooperation (BMZ),
Germany*

Starting Point: Cooperation Between Government and Parliament

Today, shortly before the close of the second millennium by our calendar, it has almost become a truism to say that we all live in one world. Regrettably, however, the actions of governments, and indeed of each and every one of us, indicate often enough that we have not taken this understanding of a single world completely to heart yet. In my capacity as Parliamentary Secretary of the Federal Ministry of Economic Cooperation and Development (BMZ) responsible for liaison with the German Parliament, the Bundestag, it is one of my primary tasks to keep a constant eye on the balance of interests between development in the Federal Republic of Germany and at the international level.

The concern among the German population and within the European Union (EU) regarding global hunger and the environment is strong. That is reflected in the very high level of private donations and fundraising, DM1.4 billion in 1993 (or a donation of DM17 per capita) in addition to the DM11.5 billion ODA in 1993 (DM143 per capita), in total DM12.9 billion (DM160 per capita).

In view of this willingness to assist, it should not be concealed, however, that there is a risk that against the background of the many crises and disasters that have predominated during the last few years, the success

that has beyond doubt been achieved—for example, that today an additional 1 billion people are being fed—will not be acknowledged sufficiently.

Generally speaking we must be in a position at all times to furnish the German Parliament and the public—not only in Germany, but also in many other parts of the developed world—with evidence that in future we will be in a position to tackle the eminent challenges with the necessary will and the right policies with the prospect of success. What kind of message should we, as decisionmakers, be delivering to the public?

Let me give you two examples from German bilateral cooperation:

Example 1

Brazil, the country where annually nearly 8 million hectares of rainforest are converted into unstable, erodible farmland, does have alternatives: such as farming the Varzeas (alluvial lowlands) where the water of the rivers can be used for rice production. This potential was pioneered by German-Brazilian bilateral cooperation.

Within the "Pro-Varzeas National" project, it has been proven that up to 9 tons of rice per hectare can be harvested. Our Brazilian partners have achieved convincing results, while the German contribution of DM250,000 annually may be regarded as seed money only. The measured impact shows about 875,000 hectares of land newly cultivated, providing 250,000 employment opportunities on 60,000 private farming enterprises and food production amounting to 5.3 million tons per year. In this way, the pressure on the rainforest has been

reduced considerably.

The conclusions are that an increase in food production can be related to environmental protection in a win-win setting of up to 30 million hectares for Brazil as a whole.

Example 2

The effects of the 1973/74 drought in the Sahel seemed to confirm the current belief that excessive livestock density leads to overgrazing, causing irreversible damage to the rangeland. This was the context in which an innovative model for the management of pastoral resources was set up in 1981 around the deep well at Widou Thiengoli, in the Forlo region of Senegal. The aim was to fight desertification and to allow the woody vegetation to recover. With support from German development assistance, a strategy was founded on the principle of controlled grazing in enclosures being partly placed in private hands. The resulting enclosed area covered around 20,000 hectares.

From the lessons learned, it has been proven that environmentally sound and effective livestock farming in a pastoral system can be implemented. However, external support is needed to encourage local communities to maintain and further develop this knowledge and its acceptance.

Future Perspectives

During the next 10 to 15 years, especially in Africa, and also in the poorer regions of Asia, food deficits will substantially increase due to further population growth and due to the lack of additional cropping areas. It is envisaged that the world population will grow by 100 million people annually. This process demands an annual increase in food production of 2.0 to 2.5 percent, most of which has to take place in the developing countries. According to the Food and Agriculture Organization of the United Nations (FAO) estimates, the food deficit will reach a level of 160 million tons per

year by 2010, which is twice as much as today.

During the same period, the ecological limits on the use of water and land will become increasingly apparent. Inappropriate use, especially of marginal and sloping areas, will reduce agricultural land by 25 percent by the year 2010, if present trends persist.

Tropical forests continue to be destroyed in order to establish new cropping areas even at an accelerated speed—at present about 15 million hectares are being deforested annually. On the other hand, if only one hectare were transferred to sustainable agriculture, this could save 10 hectares from deforestation. This has considerable importance with regard to the most important challenge for future development cooperation.

Increasing food production while conserving natural resources is the key element to global food security, poverty alleviation, and environmental protection.

The necessary substantial increase in food production requires innovations in agricultural practices, in farming methods, and in the use of production factors such as seeds and planting materials. Similarly important for any success is a political and economical framework supportive of sustainable production increases. In this respect, demand-led agricultural research strongly geared to applicable and appropriate results is a key factor.

What Are the Strategies for a Donor Like Germany?

Poverty alleviation, education, and training as well as environmental protection are fundamental issues in our bilateral development policy. Agriculture is of crucial importance in meeting these challenges.

A diversified strategy has been adopted for our development cooperation in the field of agriculture and rural development,

- As far as food and the natural environment are concerned, main areas of investment have been chosen to sustain food security and development:
 - rural development projects with ecologically and economically balanced production programs to ensure sustainable use of the natural resource base;
 - the policy dialogue with its emphasis on a sound institutional, economic, and political environment for ecologically and economically viable agricultural production;
 - the dual system in vocational education being extremely helpful in building up technological competence and skills to manage the agricultural sector and to carry out ecological assessments;
 - agricultural research, as Germany is one of the founding members of the Consultative Group on International Agricultural Research (CGIAR), we have been able to maintain our level of support in 1995—our contributions to the CGIAR system now well exceed a total of DM420 million. We also support the strengthening of the national agricultural research systems (NARS), since these are so important with regard to the adaptation of results and innovations from more strategic research;
 - efficient extension service as an essential tool for the transfer of appropriate technologies and innovations; and
 - coherence between agricultural and development policies requires substantial strengthening, nationally as well as internationally.
- Strengthening of and capacity building for institutions and organizations, including the elaboration of institutional frameworks linking public administrations, nongovernmental organizations, private-sector companies, and

grassroots organizations to effectively coordinate market-driven activities in the agricultural sector. Forty percent of our bilateral assistance is allocated to projects and programs in the field of rural development (approximately DM1.4 billion per annum).

The greatest challenge for developing cooperation today is to secure through sustainable agriculture an economic basis and the fundamentals of survival for a growing world population over the long term.

In recent years, structural adjustment processes introduced in many countries have led to basic changes in both economic and organizational respects.

German development assistance will concentrate in the future on the conceptual development of the following five strategic cornerstones for agriculture-led development:

- a political and economic situation favorable to an increase in sustainable agricultural production;
- access to land titles and ensured rights to cultivate land;
- an efficient agricultural market and pricing system, both for inputs and outputs;
- access to financial support and credit, especially for farmers with limited land resources; and
- establishment of guidance and advice for sustainable agricultural production systems.

What Are the Conclusions for a Donor Country Like Germany?

Agriculture is still the backbone for social and economic development in many parts of the world, especially in countries with few resources. Thus, agriculture and rural development remain areas of primary importance.

In order to meet our global challenges, it is essential to realize the different elements

of the strategy I mentioned.

The strengthening of the agricultural sector on all levels: policy, research, training, and farmers' participation are indispensable.

In our view, food security, which is closely related to population growth, must stand at the forefront of all our efforts. Food security on both national and household levels is dependent on food production, storage, and trade (including export and import) as well as on distribution. Fair and well-balanced access to food very much depends on sufficient income and purchasing power for all sections of the population as well as an efficient basic infrastructure.

In view of the considerable sums at stake in the area of food aid, only a close meshing of agricultural development with food aid/food security programs will meet the requirements of developing countries. In this way, German development cooperation will be able to contribute its fair share to solving the core problem of the next century in close cooperation with our partner countries. I am convinced that we shall succeed.

BAL RAM JAKHAR

Union Minister of Agriculture, India

Dr. Per Pinstrup-Andersen, director general of IFPRI; distinguished delegates; ladies; and gentlemen!

It is, indeed, a matter of great pleasure for me to be here with you today. I am grateful to the organizers for having invited me to share with you some of my views on both the existing and emerging issues, having long-term direct influence on our agriculture.

Changing Food Scenario

On the agricultural front, India has moved from food scarcity to food surpluses in the last three decades. This could be possible due to the cutting edge of science, coupled

with fast adoption of technology by the farmers, and above all the government decision to accord a high priority to agriculture by making large planned investments in infrastructure (e.g., irrigation, power, credit, research, and extension). We have also followed an effective price policy for producers, while at the same time protecting the interest of consumers.

As a result, we witnessed the Green Revolution, and subsequent agricultural growth increased both the physical and economic access to food. The net availability (per capita per day) of foodgrains increased from 395 grams in 1951 to 466 grams in 1993, despite the rise in population from 360 million to over 850 million in the same period. All this increased availability has come about by the massive increase in the domestic food production rather than imports. Imports, in fact, came down from 2.6 million tons per year during the 1970s to 0.44 million tons during the 1980s. India has now about 30 million tons of buffer stock, and more recently is contemplating exporting foodgrains. Unlike in the past, crisis situations of droughts or floods are now considerably well managed without any panic or large-scale imports. On the contrary, India faced successfully the worst drought of the century during 1987/88, which speaks of resilience of Indian agriculture.

Access to Food

The increased economic access to the food is to be seen in the decline in the real price of food over the period on account of rapid growth in productivity, particularly in wheat and rice. Both producers and consumers have shared this gain. Poverty alleviation programs like Integrated Rural Development Program, Rural Landless Employment Guarantee Program, Jawahar Rojgar Yojna (Employment Program), and others of the government also increased the economic access to food. Further, the supply of food

through public distribution system at relatively subsidized rates has also protected the interest of our consumers.

Lately, there is also a substantial change in the consumption pattern away from cereals in rural and urban areas and in all income classes. Cheaper sources of calories are replaced with dearer sources (coarse cereals to wheat; cereals to noncereals like vegetables, fruits, milk, meat, egg, etc.). Thus, our present strategy for diversification is not only demand-driven, but aims at "household nutrition security." As we are approaching the twenty-first century, I find a large number of projections/predictions of future scenarios from different part of the world on different issues. Some of these are very encouraging, while at the same time some project a very bleak picture of the future. One such study predicts a shortfall of 45 million tons of foodgrains for India in the year 2030. This, in my view, is a very misplaced and pessimistic observation. As we are a developing country and are making steady progress on the economic fronts, which is gradually enabling more people to rise above the poverty line, and thereby increasing the economic access of the people to purchase high value commodities like milk, meat, vegetables, and fruits. This may reduce their dependence on foodgrains. It would be appropriate if such projections are made in terms of the per capita calorie requirement and calorie intake.

The slow employment expansion and the upward trend in cereal prices since the mid-1980s have affected the food entitlement of the poor. Structural change in the consumption patterns will further aggravate hunger and nutritional deficiency of the poor. Since raising the real income of the poor is a slow process, the role of the state in providing government support for the public distribution system, safe water, better housing, mass education for reducing the wasteful consumption becomes critical. The fact remains that, despite all these gains, India still has over 300 million impoverished

people. Their welfare and upliftment above poverty line is our major task presently.

Projection for the Future

On the basis of assumption in per capita income growth, population, pace of urbanization, distribution of income, the effective demand for food is expected to be around 207.5 million tons by the year 2000. At this effective demand, India's agricultural trade position is expected to be sound. This, however, ignores the large number of poor people who are unable to purchase all the food they need. The future demand for foodgrains is also expected to be enhanced by the increased opportunities as a result of domestic economic reforms as well as the General Agreement on Tariffs and Trade—World Trade Organization (GATT/WTO) agreement.

During the period 1995–2000, production of foodgrains is expected to grow at an annual compound growth rate of 2.6 to 3.0 percent, which is close to the growth achieved in the recent past (2.9 percent) and lower than that envisaged in the Eighth Five-Year Plan of 1992–97 (3.9 percent). In the long run (2000–2020), growth of foodgrains will depend on the level of technology in hand and its adoption. In this endeavor, use of hybrid technology, especially in rice, sorghum, pearl millet and maize, varietal enhancement, and biotechnology would offer great opportunities. Fortunately, during 1994/95, we have for the first time exceeded our annual target of 185 million tons by achieving 186.4 million tons of foodgrains.

Moreover, there is little new land or water to enhance both the production and the productivity, as natural resources are being threatened due to increased environmental degradation. There is also a concern now about the sustainability of one of the most productive rice-wheat cropping systems, covering around 10 million hectares. It is also noticed that, in some areas, there is decline of water table, whereas in others

there is its rise along with salts. Almost 48 percent of the geographical area today is threatened by one or other soil degradation/erosion problems, which need to be arrested as a national priority.

Towards A Second Green Revolution

From the above, it becomes clear that India will have to follow in the future the Green Revolution pattern of agricultural advance, following in particular the well-defined ecological ground rules. The proposed new agricultural policy of the Government of India addresses these issues adequately, where sustainability issues aiming at increased productivity and profitability are receiving pinpointed attention. It is reported that the ongoing economic reforms and inclusion of agriculture in GATT will improve the terms of trade for agriculture, and thus encourage greater private investment. Along with this, additional public investment will be made in rural infrastructure, irrigation, agricultural research and extension, farm credit, and education and health of the rural people. Public expenditure on agriculture being allocated to input subsidies will be strictly targeted to the needy. Proper utilization of public investment will be ensured and priority investment areas will be identified and supported in the future.

It is planned to have the next green revolution from our 67 percent rainfed areas. We have contemplated to convert grey areas into green. These are the areas where rural poverty and hunger are also concentrated, and where the nexus of poverty, population growth, and low agricultural productivity are leading to the greatest degradation of our natural resources.

Investments in the backward regions will also have a more positive impact on poverty reduction and environmental benefits than concentrated investments in more favored regions had in the past, which were then

necessary to increase food production. Moreover, the technological options for increasing the productivity growth in rainfed regions are now greater than earlier. In the light of plateauing of yields in many favored regions, the efficiency losses from diverting more public resources from favored regions to backward areas may not be that high. In fact, some of the rainfed areas have comparative advantages for horticulture, fisheries, and livestock in the new economic environment, and peoples' preference to consume products from these enterprises reinforce an increased demand for their products.

Strengthening the National Agricultural Research System (NARS)

India fortunately has one of the largest and institutionally matured agricultural research systems in the world. With all the concerted efforts, NARS for research alone has 49 research institutes, 30 national research centers, 10 project directorates, and several all-India coordinated research projects/networks. There are 27 state agricultural universities and one central agricultural university under the Indian Centre for Agricultural Research (ICAR) in the northeastern hills complex. Cumulative scientific manpower of these institutions and universities is about 30,000.

In view of very high rate of returns to the investment in agricultural research and extension and the contribution of agricultural research and extension in reducing the real cost of production, the level of investment in agricultural research will be stepped up from the present 0.3 percent to a minimum of 1.0 percent of agricultural GDP in the near future. But it will be an agroecological, region-specific program, rather than project-based with a bottom-up approach, making it more responsive to the farmers' needs. The vast network of Krishi Vigyan Kendras, our front-line agricultural extension centers (numbering around 250), will be utilized to

translate relevant agricultural research into farmers' practices. New biotechnologies to save on chemical inputs and conservation of water and soil in dryland areas will be given high priority in the next two decades.

Investments for improving irrigation potential need to be raised. Highest priority is being given to maintaining existing irrigation facilities and to completing all the projects already started. Conjunctive use of water, coupled with proper drainage, will minimize the problem of waterlogging. Involvement of water users in the maintenance and effective use of irrigation systems are other areas where our attention is presently focused. It is in this context that we envision having massive investments in sprinkler and drip irrigation systems to improve water use efficiency.

Similarly, fertilizer use has to be stepped up in different areas. Balanced use of fertilizer is being given due attention. Fertilizer subsidies will now be strictly targeted and measures to improve the efficiency of fertilizer use are being considered.

Agriculture as an Industry

Agriculture in India is no longer only a means of subsistence. It is now getting recognized as an industry. To make it a buoyant industry, massive investments in rural infrastructure are needed to integrate production-processing-marketing. Also the domestic markets need to be integrated with international markets. Power, roads, ports, and markets are to be developed further. Our experience is that such infrastructures, which are hardcore in nature, will not be developed by the private sector. Obviously, the state has a specific role in this. Quality control should also be an inbuilt mechanism in the production and trade of commodities. We have specific plans to expand this activity on a large scale.

We are in the process of making institutional changes to suit the changing needs in order to ensure required agricul-

tural development. Cooperative laws are being examined to make them cooperative companies to take care of the emerging agribusiness sector. The private sector is being invited to involve itself in different production, processing, and marketing activities. The role of nongovernmental organizations (NGOs) as supporters, lobbyists, catalysts, and innovators is appreciated, and we are involving them on a large scale. We are also encouraging the farmers to organize themselves to take care of maintenance and management of public utilities created by the state in the rural areas. An agribusiness consortium has been established to encourage young entrepreneurs for on-farm and off-farm employment opportunities.

Concern for the Environment

Agriculture centers around integrated use of natural resources, viz. soil, water, climate, and the biological diversity, and energy is provided in the form of sunlight to keep the system mobile. This constitutes, in fact, a global life support system with a complex web of biotic and abiotic components, utilized by man for obtaining different types of requirements. Therefore, if the biosphere or any component thereof is destabilized beyond a limit of tolerance, the intricate and integrated system of dependencies is thrown out of gear and the cumulative effect ultimately endangers the functional viability of the entire system.

The environmental changes are a natural phenomena, but the rate at which they are taking place at the present time is a cause of concern. Environmental degradation is multidimensional and needs to be addressed through diverse disciplines such as ecology, economics, sociology, engineering, politics, ethics, and others. Mounting worldwide accelerated exploitation of resources in the name of development led to the convening of the United Nations Conference on Human Environment in 1972, where our late former

Prime Minister Mrs. Indira Gandhi observed that environment cannot be improved in the situation of poverty. Ensuring food security may remain halfway in terms of benefits unless issues like poverty and population are simultaneously addressed. In such situations, ecology and conservation should not work against the interest of the poor and the developing nations to bring improvement. The motivation for development and safeguarding of the environment should converge and not conflict, thereby rejecting the false dichotomy between environment and development.

Poverty is degrading both humans and the environment. Our national environmental issues are very vast. Development policies are placed at times on conflicting objectives: on the one hand, it is the pressure towards liberalization and export production, and, on the other, the pressure to reduce detrimental environmental impacts. The specific concern at this juncture is to identify new paradigms critical for the required success. Development should be both an innovative and liberating force and an ally of social justice. We must ensure strengthening of our social fabric through overall growth of agriculture.

For required development and protection of the environment, the main tasks are integrated land, soil, water, and forest management; pollution control; development of nonpolluting and renewable energy resources; waste utilization through recycling, conservation of biodiversity, slum removal, and development of healthy human habitats; environmental awareness; education; population control; and above all the combined will of the government and the people to bring about a harmonious development through rehabilitation and optimization of our environment.

The environmental problems and policies need coordinated appraisal as they are inextricably enmeshed in their impacts, value orientation objectives, and attainments. Corrective and ameliorative measures must

be initiated and pursued vigorously so that the society respond, effectively, if the evidence of serious consequences crops up. There has to be an honest and sincere international cooperation in the exploitation and conservation of natural resources based upon quality and economic justice for all countries. With the stipulations of the biodiversity convention, we must aim for a national policy that is effective *in situ* and *ex situ* conservation of our genetic resources ensuring principles of equity and common heritage of mankind.

Our Expectations

To sum up, India is a vast country with many challenges. Our development experience has made us wise enough to convert these challenges into opportunities. I am very optimistic that India will soon come out of the clutches of diminishing poverty and hunger, and emerge as a country in the region with a higher human development index. In a predominantly agrarian society, we hope to progress towards prosperity using the principle of sustainable agriculture and overall rural development. This being our ultimate goal, we hope to achieve it successfully by the year 2020.

Once again, I take this opportunity to thank the director general of IFPRI and the organizers for having invited me to participate in this important conference, especially at a time when we all are gearing ourselves to move into the twenty-first century. Hopefully, our younger generation will have a brighter future than possibly what we had during the last five decades. Thank you.

DONALD BROWN

Vice President, International Fund for Agricultural Development, Rome, Italy

While our topic is an international pers-

pective on hunger and environment, I will approach this primarily from what we in the International Fund for Agricultural Development (IFAD) believe is the perspective of poor rural people, especially in Africa.

I want to say right from the outset that we must be concerned about the increasing doubts being expressed about the usefulness of development cooperation—and the tightening in resources available. In my view, we must be able to demonstrate that development efforts will have a direct and effective impact on the problems of hunger, poverty, and the environment. If we do not, our ability to do what is right will diminish. In these terms, the need for a meaningful 2020 Vision is greater than ever.

One of the questions you are debating is whether production trends can lead to global and national food security. From the point of view of poor rural people, what counts is "household food security," the ability of individual households to produce enough of the right kind of food, or earn enough to buy what they need. Global, even national, food security is not enough if a large part of society is denied adequate food. What do we need to do to support household food security while protecting the environment?

While not always recognized, poor people have full respect for the problems of the environment. They seek solutions that can meet their current consumption needs, while protecting land and water resources for their children. The much maligned slash-and-burn system is, after all, a basic approach to conservation. Unfortunately, it is also an approach that is less and less able to attain its conservation objectives as population increases reduce fallow periods and forests are destroyed before they have time to recover. Poor rural people, trying to survive in a rapidly changing world, place first priority on assuring their families are fed. To be able to deal both with today's food needs and tomorrow's conservation, they need help in adapting to change.

This suggests a need to address simul-

taneously methods for increasing current production while introducing conservation measures—and there clearly are ways to do this. In fact, most cultures have traditional practices that have this specific objective. The actions of development agencies might often be better directed if they could enlarge understanding and usage of such traditional practices, rather than promoting approaches that are beyond what farmers are willing to do. This emphasis on broadening traditional techniques has been a major theme of IFAD's Special Programme for Africa, which has enlarged understanding about ways and means to modernize water harvesting and other production/conservation methods.

By emphasizing enhanced traditional technology, I do not want to suggest that we drive ourselves into a cul-de-sac with limited opportunities. But we must start by recognizing that most poor rural people rely on familiar patterns based on risk aversion strategies that assure survivability. We cannot expect them to move abruptly to new technologies at higher risk. Thus, there is need for a dual approach—building now on strengthened traditional production/protection systems while also introducing—over the longer-term—higher input, more technically advanced systems.

With regard to Africa, there is need to map a research agenda that fits the continent's objective conditions. That means more and better research on African crops under African conditions. It means respecting the typical social conditions of African farmers. We must recognize that production will remain largely small scale and relatively labor intensive. The agenda must be oriented to African agriculture rather than agriculture that just happens to be in Africa; and it should not simply attempt to modify in Africa practices achieved under very different conditions. Specifically, it must be responsive to the perception, and open to the participation, of smallholder farmers. What poor farmers

ask for is not generally the same as is called for by better-off farmers, nor necessarily what researchers may think is best.

I would stress here that I am not talking only about the perceptions of men farmers. There is an increasing number of women-headed rural households, and agricultural services must respond to their particular requirements. Even in households where husband and wife work together, research and extension must meet the individual and different needs of each, and fully recognize women's key role in food production.

My 2020 Vision, therefore, calls for policies based heavily on combined production and conservation technologies aimed at household food security to overcome poverty, with emphasis initially on improved but low-risk technologies, but open to the time when farmers become more confident and are more willing to move towards higher risk and higher technological processes.

All of this underlies the importance of another process that is under way—reexamining the role of the CGIAR research institutions and how they can be more responsive. As for IFAD, we strongly support closer ties between the CGIAR members and the national agricultural research services, since in the end it is the latter that must deal with the reality of smallholder farmers' perceptions.

I urge that this process of review, as well as IFPRI's search for the 2020 Vision, will accept my main plea—"PUT POOR PEOPLE FIRST."

If we can do that and if we can really shape our concerns with agricultural development and policy within a framework of helping poor people make a better life for

themselves, we can have a significant impact on the global problems of poverty and environment. A failure to reduce poverty and strengthen the environment will mean a withering away of support and resources. That is something the world cannot afford.

In IFAD, we are planning a demonstration that there are solutions to poverty and environmental problems. Drawing inspiration from the World Bank's 1993 Hunger Conference, IFAD is organizing another Conference on Hunger and Poverty to take place in Brussels in November of this year. To revive support for development we intend to show that we know how to overcome poverty. The Brussels Conference will make clear that effective approaches have been developed and are working, that a substantial body of successful practices have been tested by NGOs, by international institutions, and by bilateral donors. We will argue that there are prospects for a more global and comprehensive approach using existing knowledge, while searching for new avenues. What we aim at is to bring together more effectively NGOs, international financial institutions, and governments to look at what has really worked and to build networks of information exchange on successes and failures. The IFPRI 2020 Vision will become an integral part of this conference since IFPRI is on its advisory committee and that committee will be discussing the Vision later this month. We are convinced that the Brussels Conference can contribute significantly to the very objectives we are talking about here—an international perspective on how to deal effectively with hunger, poverty, and the environment.

THE WORLD'S POPULATION IN FLUX: ISSUES AND PRESCRIPTIONS TO 2020

MARGARET CATLEY-CARLSON
President, The Population Council

Good afternoon. I want to talk about population, in the sense of what the trends are. I want to talk about what is going on, population and some food and food policy crossovers, talk about what we can do, whether there is any magic in the closet that we could possibly pull out to help us in this, and then talk a bit about what we must do.

But the first thing we should start with is this IFPRI publication entitled, "Population and Food in the Early 21st Century." Sixteen pages devoted to population and 223 pages to food. A very balanced document, is it not? Yet, if population were not growing, we would be having a totally different kind of conference. We would be talking about the fact that there are still a billion poor people on earth, and that those billion have a good deal of undernourishment and malnourishment, some of them for income reasons, some not. We would not be talking about this enormous need that we all feel, that has brought people from all four corners of the globe here to talk about the coming food shortage, if there was no population issue.

So how come we have a book that is one-fifteenth devoted to population and all the rest of it devoted to food? Well, part of it is because there are a lot of food experts involved here and therefore it is a good opportunity to talk about this. What I am going to do is to turn you all into population experts because there is certainly an imbalance in the attention of food and the population. So that is my task. You must

all solemnly promise that you will leave this room as population experts, as well as food experts. I do not think that is too difficult because I will leave with you some very simple messages.

The first one is twofold. It is absolutely true that the world's population 25 years from now is quite predictable, and as far as we know quite unchangeable. If you are 50 or younger, and male, you have a pretty good chance of being there. You can be up to 55, maybe 60 and female, and you will still have a pretty good chance of being there. And as far as we know, anybody who has a good chance of being there is not offering to leave. This is the whole root of the population problem. Nobody wants to get off the planet once they are here.

The parents of the babies that will be born in 2020 are here, or they will be born in the next ten years.

And the grandparents of those that will be born in 2020 are already with us in the single largest generation of teenagers that has ever been on the planet, one billion creatures in blue jeans.

So we have the largest generation of teenagers that has ever been on the planet. They will be the grandparents of those that will be born in 2020. The parents are with us, they are toddlers today. And you and I will still be here, too, and that is, of course, the root of the population dilemma. It is that all of us will still be here at that time, and so therefore population is not that difficult to understand. Those that are here now will still be here, and there will be new ones who will have arrived.

What we do in that next 25 years will make all the difference to the world, and

quite literally to the fate of the planet, and to the next 25 years after that.

Most observers believe that, in the year 2020, world population will be somewhere between the low and medium population forecasts for 2020, about 7.1 billion to 7.4 billion. But look what happens in the 25 years following 2020. The low, medium, and high diverge by a full 2 billion people, from 7.9 billion to 11.9 billion in the year 2050. This is worth very serious attention.

So, yes, we are agreed on what the population is going to be in 2020. Yes, we all agree there is not a lot that can change this. In fact, I said to the organizers, "Did you choose that year because there is not a lot that can happen between now and then to change things?" They said, "We would never do that." But the important thing is that what we do this decade and next will make all the difference between what happens from 2020 on, and whether we will be talking about drastic food shortages in that timeframe, or whether we will be talking about a kind of world in which the problems we have been discussing are much more manageable.

How we approach the world's food issues can have a major impact on both population trends and on the reasons why we worry about global food supplies. Why? Because we have a choice of investments: demographic growth, reproductive health, poverty, soil health, and soil technology. But some of these, and this is key, affect food production, family nutrition, income, population growth; and some of them even affect all of them at the same time.

These are the investments we have to find, and this has to be what this meeting endorses. We must uncover the fundamental nature of the problem, i.e., increasing population. If we were not looking at population increases in the world, we would not be talking about this enormous challenge facing us. We have to keep a vision of the world we want to create, and we have to keep a vision of the world we want to avoid

as we choose our investments.

So these are the two messages and they are both of extraordinary importance. But, as Vice President Speciosa said this morning, one cannot just walk into someone's house and tell them how many children they ought to have. Therefore, the population conundrum is more than having ideas about how many children people ought to have and that is what I will explore now—the causes and roots of population growth and what can be done about it.

You would be awfully upset if anybody came and talked to you about population and did not start out with numbers because demographic stargazing, celestial number crunching is always the start of a good population speech. So I will start there.

There are a lot of us around. Every day when I am giving a speech, the last thing I do before I leave the office is walk over to the United Nations Population Fund's clock on my desk. The world's population this morning at nine o'clock was 5,755,406,869, which shows you the virtue of precision without accuracy. The world's population is more than halfway between 5 and 6 billion. The most important thing is that population growth is very far from finished. Depending on what we do in the next 10 years, it will continue to grow to a number between 8.5 billion, and the almost unimaginable worst-case scenario of 15 billion. The fastest growth is now.

It took a million years of evolution of life forms to reach 1 billion people on earth. This growth now happens in a decade. It will happen this decade. It will happen the next decade. The third one is still up for grabs and that depends on investments that we make now.

The great concern is that we cannot produce food for this number without severe environmental implications. Both environmental and ethical issues arise as we crowd out other species and irreversibly change soils with the habitat of rivers. We worry about the cost of depleting the world's

hydrocarbon reserves. That raises intergenerational transfer issues that are very troubling. And of course each human being, no matter how frugally we live, and most of us do not, currently consumes water, soil, and fossil fuels and accounts for stress on the environment.

I hope everybody in this room, and I am sure you do, appreciates that some people put a lot more stress on the environment than others, specifically those that come from the north and the west. I think it is always worth remembering that we must always account for the environmental impact in many, many dimensions.

Bangladesh has a population of 120 million, a 2.4 percent increase a year, probably down a little bit now. That is 25 times the rate of increase in the United Kingdom. British residents consume 35 barrels of oil; the Bangladeshi use three. If you are an American, you consume more than the British. If you are Canadian, you consume more than Americans. So you must always run these calculators in a multidimensional sense. Or, if multidimensionality is not your game and you want the simplest mathematical model ever invented, I will give it to you now.

There are 75 Africans per automobile and 2.5 North Americans. For every 150 Africans that are born, you get two more cars. For every 150 North Americans, you get 60 more cars. If you cannot think of pollution in any other terms, there is a very simple mathematical model for you. The different levels of prosperity and consumption are of course what make the difference on the planet, not simply the number of people that are there.

We had a good deal of discussion this morning and this afternoon on the poverty crossover. I agree with Nancy Birdsall that the root cause of hunger is generally poverty, although there are a lot of variables there. But poverty has key interactions with food availability and with the development process. Low income reduces both demand

and ultimately supply.

There are very poor countries that have made better choices about investment in human resource development. So we find that the population is growing fastest where people are poorest.

The biggest problems can be found in countries where 40 to 50 percent of the population is under the age of 15. In these societies, all of which have very low GNPs, development does not just happen. In a society at a low level of per capita wealth, technological development and efficiency cannot hope to provide schools, health services, or jobs for half of its population if its economic growth level is always less than its population growth level. And that is the fundamental difficulty of development happening with high levels of population growth.

The lines are very complex. There have been countries that are very poor, but have managed to achieve development objectives. There have been countries that are very poor and have managed by social investment, to achieve lower levels of population growth. So none of these relationships depend simply on growth in population. But we do know that there are complex and abiding relationships between them.

In addition, we know that the one billion people on earth living on a dollar or less per day, or perhaps more important, the two billion people on earth that are living on two dollars or less a day, are exactly the people where this maximum population growth is going to take place. We are no longer simply looking at countries, regions, or subregions. We are looking at almost a Fourth World.

If we look at the demographic transition that happened first in Europe, then in North America and is now happening in most of the developing world, there is almost a Fourth World of the one or two billion people still living in massive poverty where high fertility becomes a reasonable and logical choice for them in their particular

life circumstances.

The population and poverty crossover is a difficult one, but it is evident. During the first three years of this decade, Africa's GDP grew 2.1 percent annually. This was less than half the average for the developing world as a whole, but it was growth. When set against the rising rates of population, the per-person growth becomes negative, a 15 percent decline in per capita income between 1980 and 1992.

It is the same thing with food production. African food production actually increased at a rate of 33 percent in the 1980s, but it did not keep pace with population growth, so the per-person production actually fell by 2 percent.

This is why it is the rate that is important. As Vice President Speciosa said this morning, many African countries see themselves as being underpeopled, and so the task is not for you or for me to say what the ultimate population of any African country should be. The task is to examine together what the rate of population growth is doing to the task of trying to find a development pattern that encompasses education, that encompasses getting children to clinics, and that encompasses better family health and better nutrition.

Above all, poverty elimination is not rocket science. There is enough research, there are enough examples. We know enough to do something about poverty, and we should put this at the top of our agenda. It will only be through eliminating global poverty, which I believe can be done, that we will start to move away from high fertility.

So those are some of the reasons we worry about high fertility: the environmental implications, the ecological implications, and the crossover with poverty. Above all, the level of fertility that is adding a billion people this decade, one billion the next decade, and maybe one billion the decade after has some staggering human implications.

In the developing world alone, about 50 percent of conceptions are unplanned, between about 25 and 40 percent of all pregnancies are not wanted. More women die in India in one week from maternity-related conditions than in Europe in an entire year, and 150,000 pregnancies are terminated every day by induced abortion.

The consequences of high fertility are not just that more food is needed in a specific area. When you look at this on the level of the family and you look at this on the level of women, men, or parents, you see that this has some very traumatic conditions indeed.

What on earth is going on? What is causing all of this? What we are talking about are characteristics of the demographic transition. It is unique. We are the generation living through this. It never happened before, and it will never happen again. It is a unique event in human history.

What is the demographic transition? It is a term used to describe the change from high birth rates and high death rates, where a very high percentage of the population dies in the first five years of the normal life span, probably of infectious diseases. The evolution is towards societies with low birth rates, low death rates, and most death occurring in the last 10 years of normal life expectancy. Every society on earth is making that transition. It is not a question of "we" and "they." It is not a question of cultural changes. It is not a question of anything other than where societies are in this transition.

Nine countries on earth have finished this transition. For the moment they have more death than births in their societies, although that will change. But to imagine that societies are entirely different is to misunderstand the nature of this process. This demographic transition is underway everywhere, in the developing world as well as in the developed world right now. The rate differs, but the phenomenon is the same.

And it is in all of our interests to accelerate that transition because we will bring closer the year in which the planet will have its peak population. Then we stop worrying about feeding more and more and start worrying about distribution of food, or increasing the overall quality of food.

Let me give you some examples of why that is the case. Nigeria has just under 100 million people now. It will grow to 600 million if its fertility were to stabilize in 2040. The number would be closer to 350 million if stability were achieved in two decades, by 2010. The demographic transition is an amazingly powerful force because it shows that population increases exponentially until the point in the transition is reached when the society starts to move towards low birth rates and low death rates.

I remember being in Bangladesh when the Minister of Health there told me that if they missed their goal of population stabilization by one single generation, the difference would be 70 million people. And he looked at me and he said, "How many countries have 70 million people?" And I said, "Not so many." And he said, "Well, you are beginning to understand what the issue is for us."

If we had all the time in the world, or a larger planet, we could wait the process out. As traditional societies change from subsistence and agricultural-based economies to modern industrialized countries, the desire for family size usually drops to two children during the demographic transition proceeds. But this transition may take quite a long time, so it is worthwhile to discover what we can do to accelerate it.

This conference is about food, agriculture, and the environment, so I am not going to repeat what has been said here, with three exceptions. You have heard that theoretically there is certainly enough food available to feed the world now and probably will be enough in the year 2020, but speaker after speaker has said there is a threefold problem. First, poverty or family income.

The purchasing power to buy the food is a more important constraint than food availability is now, or will be in the year 2020. So the existence of poverty is now, and will be, the main constraint to food availability.

The second one is family nutrition. One of the speakers very properly said that income is not all that is involved. The availability of food may well be less important than the community and family distribution of food.

And the third one: food production is an important path out of poverty for many families. Improved food production levels will therefore mean improved nutrition and improved family income.

How well do these three areas correlate with the demographic transition? In other words, can anything be done about population growth, improving family income *and* nutrition?

It is important to recognize the value of hastening this demographic transition. If a society is at high levels of birth and high levels of death and has a lot of death in the first five years, people are not achieving their maximum potential. Children are dying. If people live to their full potential and die towards the end of their life expectancy, you are creating a society where more people are living towards their maximum potential and where the birth rate drops. So this is a positive thing to do, and it also accelerates this transition towards lower birth rates.

What are the three demographic imperatives that move us in this direction? Family size has already fallen this century, from six children per family to below four, all over the planet. Contraceptive prevalence, below 10 percent a few short decades ago in all societies, is now above 70 percent in the industrialized world and above 50 percent in the developing world. (Sixty-five hours worth of global military expenditure pays the bill for all of this enormous change.) Developing countries pay two-thirds of the cost and people will pay more, so this is a re-

volution which is not only on the way but is affordable and can be accelerated. But how do we accelerate it?

The person that articulated this model is Dr. John Bongaarts of the Population Council, who is referred to in the book I mentioned earlier, which although it gives far too little weight to population, at least credits it well to the work of Dr. Bongaarts, so I recommend it highly. He has given us a model to look at the determinants that will accelerate this fertility change.

The first place we have to look is unmet need. We have this enormous change that has happened, the declining family size, declining fertility rates, increasing use of contraception, and yet according to reliable surveys, in country after country we find that still more women and their families would have postponed or averted their last pregnancy had methods been available to them. This does not mean that children are unwanted or unloved, but it does mean we have a global opportunity. In addition to those now using modern contraceptives, women around the world would have preferred to delay or avoid about 25 to 40 percent of all the pregnancies that take place. About 120 million more women would use contraceptive services if they were available. So if you care about getting more food to feed people in the world, the first line of reasoning ought to be to make sure at least those families that would prefer to postpone or avoid their next fertility have the means of doing so. And as I say, the current costs amount to about 65 hours of global military expenditure. So we are not talking about enormous amounts of money. That is the first real measure that we have which will make the difference.

But we are only about 60 percent of the way there. Fertility could be well above replacement levels because desired family size is still higher than two in virtually all of the developing world. An extensive survey program in 27 countries in Asia, Africa, and Latin America in the late 1980s found no

countries that were yet moving towards the desired family size of two. Why is that? As Vice President Speciosa said, find out why family size is as it is. We find that the desire for the numbers of children in Sub-Saharan Africa have a desired family size of about six, while in most countries in Latin America, Asia, and North Africa, average desired family size is between three and four.

The preferences for high fertility often relate to social and economic insecurity. Underlying these are the fundamental causes of high birth rates in African population.

Infant mortality is key here. Families will not reduce the number of births that they have until they are sure that the births that they do have will result in surviving children. That is one of the keys to eliminating some of the risk factors that promote high fertility.

Women, who know that they have a very good chance of being widowed and must be supported by their children, will not reduce the number of children that they have. Women who can only inherit through their sons and expect that there is a high probability of widowhood will not reduce the number of children they have.

Women without access to a cash economy cannot offset those two factors that I have just mentioned.

Children can be valued for their hands or for their heads. If you cannot send children to school and if there is no probability of children going to school, you will have a large number of children because you are going to be valuing them for the output of their hands and not for the output of their heads.

And so all of this starts to work together in terms of what women's expectations are and therefore what fertility decisions women make.

Vice President Speciosa gave a very compelling example of the literacy group that very soon started to ask about family planning, because those women started to

believe that there was an alternative future available for them.

Where women are valued only for their fertility, they will be very fertile. Where girls and women have a say in their own future, their family fortunes and decisions, fertility changes. Girls' education is the principal way of accelerating all of this. Another way is better access to credit for women, more entry into the cash economy, microcredit, increasing the productivity of women, extension services particularly geared to women.

So, two forces: Number one, the need to meet the unmet need and the unmet demand that still exists because the world has changed quickly, but services have not yet reached out to all the people that need them. Secondly, the need to help families meet some of the personal insecurities and family insecurities that drive them towards the desire, the reasonable desire, for large numbers of children. We need to change the family dynamics so that the desire for a smaller number of children is a reasonable economic desire for that family.

But the third megaforce with which we must contend is this: If from 1995 on we have waved a magic wand and every woman in the developing world has 2.1 children, the global population would still increase to 7.3 billion. This is called "population momentum," and it is a very powerful demographic force.

If the first birth in all developing countries could be delayed by five years, global population would stabilize at 6.1 billion rather than 7.3. It is not going to happen, but I want to use that to show what a very powerful force this is.

Later marriage in many societies could have a significant demographic effect with the introduction of many new contraceptives. In other words, teenage pregnancy has a demographic effect as well as an often devastating human effect.

How do we do this? That can be done simply by extending the existing service

network. It is possible to imagine the kind of measures that could be taken through social investment to increase the security of women. We know something about literacy classes, access to microcredit, agricultural extension programs targeted at women. But how on earth do we change population momentum when we have already acknowledged that there are a billion teenagers on the planet, and we know that these billion teenagers will become men and women—the parents of tomorrow?

Well, it is not that easy, but the constituent elements are the same: education, law, the access that women have to the tools that can change their lives, alternative future for young girls between the ages of 14 and 19. Can the societies that they live in envisage anything for them in those years other than simply fulfilling a fertility intention.

The closest thing to a magic tool that we have for all of these things is girls' education. And it helps bring together the themes of this conference.

Let me just give you some researched examples of the impact that girls' education has on the dual themes of this conference.

Let us start with family nutrition. Children between age 3 and 35 months who are underweight occur in 25 percent of cases if the mother has no education, about 6 percent if the mother has secondary education. The infant mortality rate is more 80 per 1,000 births to women with no education, 20 to 40 per 1,000 for women with secondary education in exactly the same socioeconomic conditions.

In Guatemala, it takes 15 times as much spending to achieve improvement in child nutrition when income is earned by the father rather than the mother. In other words, one-fifteenth of the income raised by the mother will have the same increase in child nutrition as a fifteenfold increase by the father. Family income is the key to global nutrition. Women's wages rise by 10 to 20 percent for each year of schooling.

Fertility. In Africa, women with seven

or more years of schooling marry five years later than women with no education. In Asia, Africa, and Latin America, women with seven or more years of schooling have two to three less children than women with three years of schooling.

So this is where these things come together. If we want to increase agricultural productivity, if we want to increase family nutrition, if we want to increase the probability that family income will translate into nutrition, and if we want to increase the probability that education will result in more income that will result in a higher demand for food, we must look at the role that women play in the economy and we must look at the educational opportunities that are given to women.

Clearly we have to focus on meeting the unmet need for contraception around the world. It is key, and it is cheap. But just as clearly, we have to demand that girls' education and microcredit programs have a higher priority in national programs all around the world. We have to become enemies of the quick fix.

We have to choose investments that accomplish several goals. It may be theoretically faster and more attractive to go after a technological fix, but it is better in the long run for the 130 million children not now in school, to recognize that two-thirds of them are girls.

Now each and every one of you has been converted into population experts as well as food supply experts, so I expect you to go home and examine the corollaries this conference has brought forth. And remember that there are some things that count above everything else. Thank you very much.

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I am most grateful to IFPRI for having invited me to this conference and for giving

me the opportunity to address this most distinguished assembly.

In this brief presentation, I shall attempt to share some of my thoughts and broad perspectives on the contrasting demographic scenarios in developing countries and identifying some possible policy directions. My objective is to indicate the complexities of the population issue and to highlight the most promising approach for population policy for the coming decades. I shall be using India as the empirical background for my observation with brief references to some other neighboring countries. I believe the general conclusions should have implications for wider regions of the developing world also.

Most of the statistics on which I base my observations are from census, sample registration, and other surveys. I also draw upon some of our studies based upon primary data. As is well known, estimates and projections often vary in their magnitudes but what is important is the broad directions they indicate. I shall attempt to focus upon some of these observed patterns. I have been involved in two recent workshops related to the 2020 Vision—one at the country level for India held at Kalyani where I am located, and another at the South Asia level organized at Kathmandu. My observations here are mostly based upon the deliberations at these workshops. Because of restrictions on time, I shall only present broad findings of studies conducted at my Institute and also at other places. For details of data and analysis, I shall be happy to respond to specific questions.

You might have already noticed in the IFPRI report that, in South Asia region as a whole, population growth rate has shown a declining trend. Individual countries, however, are at different stages of demographic transition. For example, Sri Lanka has almost reached replacement rate of population growth, Bangladesh and India seem to be on the verge of a declining trend for fertility, mortality, and population growth rates, while Nepal and Pakistan still have high population growth rates.

India, with the largest share in the region's total population, had a fairly stable growth rate during 1961 to 1981. During 1981 to 1991 growth rate declined, with both birth and death rates declining.

Based upon this trend and also upon some assumptions, India's population, currently about 900 million, has been projected to grow to somewhere between 1.25 and 1.40 billion by 2020. This size and accompanying changes in the age and locational patterns of the population will have obvious implications for food, agriculture, and environment by 2020. These are being dealt with by others at the conference.

Deriving my concern from the belief that a much faster decline in the growth of population would have been desired, I try here to explore the major features behind such slow, though promising, rate of decline in the overall national rate of population growth.

One of the most striking features of the population scenario in India is that the overall national picture masks a wide diversity across regions and population components. Understanding the factors behind these complexities could be a basis for policy intervention. Effective policies have to address this issue much more urgently now than ever before.

To illustrate, while India as a whole and most states of the country have experienced decline in population growth rates, such declines have been impressive only in a few states [e.g., Kerala, Gujarat, Karnataka], whereas some of the major states (e.g., Madhya Pradesh, Maharashtra, West Bengal) have registered significant increases in growth rates.

Another problem lies in classifying, for policy purposes, countries and regional units into clear stages of demographic transition or development. Let me again illustrate with reference to some major Indian states.

India can be broadly classified into three broad types of demographic development.

First, Type I: we have the clear case of

Kerala with low birth rates (CBR=18), low death rates (CDR=6), low infant mortality rates (IMR=16), and a below replacement rate of growth of population (NRR<1.0).

Second, Type II: we have a set of states where the relevant indicators show beginnings of the process of demographic transition with declines in birth, death, infant mortality, and growth rates. These states are also relatively more developed both industrially and agriculturally.

Third, Type III: at another end we have some populous states where almost all the above indicators—birth rate, death rate, infant mortality rate, and growth rate—are in the range of about double those of Kerala.

However, such classifications might gloss over some important questions. For example, in Tamil Nadu, we have almost a near replacement rate of reproduction that should put it along with Kerala. At the back of it, however, lies a relatively low fertility (TFR=2.5) accompanied by a relatively high infant mortality rate (57). How does one explain this coexistence?

Also in the state of West Bengal, the urban sector has shown a near replacement rate of growth with low fertility (TFR=2.2), again accompanied by a relatively high infant mortality rate (IMR=70). But, when the rural sector is considered, West Bengal's picture changes sharply pushing it back down the demographic development scale, quite behind the stage attained by Kerala.

One has to contend with a wide range of variation in demographic indicators even within the restricted units of states. The problem in aggregative analysis for sensitive policy formulation in such cases is highlighted sharply by an example from the recent National Family Health Survey report in India. It contains information on two selected "backward" rural districts of West Bengal (Maldah, Murshidabad) showing that they have birth and death rates about 30 percent higher than those of the state as a whole. [CBR and IMR of these two districts are 33 and 97 as against the state averages of

26 and 71, respectively.]

The population scenario for South Asia may also be visualized by referring to Sri Lanka on the one hand, displaying characteristics very similar to Kerala's (Type I) [except that Sri Lanka's CBR is still somewhat higher (CBR=22) than that of Kerala], and on the other hand, Nepal, with features broadly similar to the demographically less developed states of India (Type III).

The broad and unsurprising conclusion from this brief review is that even within regional, national, and subnational units, characteristics of population changes vary widely, calling for policies sensitive to such variations. But how to explain these variations and advise policy? The Indian National Family Health Survey provides some useful clues. It shows that, despite a much smaller variation in the knowledge of modern family planning methods across states, the percent of those women actually using such methods varies widely. If family size is treated as determined by voluntary decisions, the question would be: what are the determinants of such decisions? Numerous attempts have been made to answer this question, but the problem is that answers have perhaps been even more numerous.

Here I would propose a point to explore. Among the states of India, there is wide variation in rates of literacy, and what is more, the variation in the numbers of literate women for each thousand literate men range from a mere 338 in Rajasthan to as high as 965 in Kerala. This has a high correlation with the levels of demographic development. If the number of children is a voluntary decision and that decision is made within the family, it might be useful for policy to focus upon intrafamily allocation of decision-

making authority. Although methodological problems, including the problem of joint movements of determining factors might render it difficult to offer accurate indicators, studies almost universally show that education is the single most powerful determinant of decisionmaking authority.

Studies have also shown that public investments in primary and maternal health care facilities have remained underutilized in areas where women are relatively less educated. Some studies show that, while technological developments in agriculture have resulted in increases in total employment and household income, women have been often displaced from the labor market and pushed back into household activity. Education could provide these women with access to alternative economic opportunities and strengthen their motivation and ability to use resources for improving the quality of life while retaining the size of the family. Many studies, including some conducted at our Institute, have shown that women's education induces higher investment in the health and education of children. This does not imply that investments in health, family planning, and economic development are to be downplayed, but it is the educational level of the women in the family that is most likely to render these investments useful for lowering population growth and raising the welfare of the individual and society.

To conclude, issues related to population change are varied and extremely complex, often calling for a package of policy instruments. Our proposition is that the instrument with the highest potential private and social return is investment in women's education, health, and entitlement.

IMPROVING NATURAL RESOURCES TO FEED THE WORLD: PREREQUISITES FOR SUSTAINABLE AGRICULTURE

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Introduction

Good morning, ladies and gentlemen. I would like to invite you to take a look at this satellite image of the Earth. Nearly half of the earth's land area is under ice, in rock, desert, high mountain, or under pavement. The rest—the part that is most biologically alive—serves as *habitat for most of the world's plant and animal species, including humankind*. Few people realize that over half of this habitable area is already being used for crops and pasture. The rest is mostly unsuitable for crops, although farming is expanding into these areas nonetheless.

What this means is that what happens to agricultural land—and its component soil, water and vegetation resources—will have real consequences in 2020, not only for food production, but also for the earth's natural environment. In my presentation today, I will touch on some of the reasons why all of us here should be worried about the growing conflict between agricultural growth and the health of the environment. I will argue that hope for the future lies in developing an agriculture that itself contributes to environmental health. Then I will share a few examples where this objective is being achieved. Finally, I will draw some policy lessons from these "success stories," which may serve to guide future action towards environmentally sound agricultural growth.

Agriculture-Environment Conflict

There is good reason to be concerned about the future. As food demands grow, so does pressure on the land resource. Since World War II, land degradation in Africa, Asia, and Latin America has reduced the quality of almost half of their cropland, and nearly a quarter of their pasture. A total area of cropland and pasture larger than the country of Argentina has gone permanently out of production.

Degradation takes many forms. Soil is being lost through water and wind erosion, land is becoming salty or waterlogged under poorly managed irrigation, soil nutrients needed for crop production are being depleted, and natural vegetation and habitat are being destroyed. Critical "hot spots" for land degradation in 2020 are projected to cause major environmental problems in Southeast Asia and Latin America, to threaten food supplies from irrigated regions in South and Southeast Asia, and to threaten food security for the poor in many parts of the world, particularly in South and West Asia and in Africa.

It is, in fact, technically feasible to rehabilitate most types of degraded lands. Poverty, lack of technology, low land values, and many other factors, including inadequate policy, currently restrict the ability of farmers to do so.

The expansion of agricultural land also plays a key role in the loss of forests. During the decade of the 1980s alone, the total area of forest and woodland cleared was about the size of Zaire. Estimates

suggest that by 2020 deforestation will result in the loss of between 3 and 28 percent of all of the world's plant and animal species.

Equally important, the quantity and quality of our water resources are influenced by agricultural use. At least 80 percent of all the fresh water that is diverted from rivers, underground aquifers, and other sources in developing countries is now used for irrigation of crops. With increasing demands for domestic, industrial, and agricultural uses of water, conflicts over water are predicted to emerge as a major problem by 2020.

The Challenge and a Few Success Stories

Despite the likely strains on the environment, IFPRI research clearly shows that the food security for people living in the tropics and subtropics in 2020 will depend upon greatly increased domestic agricultural production. This is true even if we assume large increases in imports. The great challenge before us, then, is to reconcile the competing demands for food, natural resources such as forests and water, and species protection, with our shared and finite supply of land.

This challenge is no easy one, and other speakers at this conference may express an understandable pessimism about our capacity to achieve this goal. I would like to take this opportunity, however, to share some of the "success stories"—those areas where we have made progress in increasing agricultural production while improving water use, reversing agricultural land degradation, and enhancing biodiversity.

My first two examples illustrate improved water use in agriculture. In Chile, the government changed the old system of distributing subsidized irrigation water. The new system distributed water by giving farmers water rights, which they could trade to one another or to nonfarmers at a market

price. This innovation led farmers to use 22 percent less water on their fields, for the same output of fruit crops. Enough water was freed up, under this system, to irrigate another quarter of a million hectares of crops. This water savings would have been enough to supply the domestic water needs of the entire population of Mexico City every year. Chile's area in fruit farms quadrupled, and the country became the world's largest fruit exporter. Because they provide strong incentives to conserve water, systems to price water properly could not only help to allocate more irrigation water to uses outside agriculture by 2020, but also help to prevent the future spread of water-logging and salinization.

In Zimbabwe, local farmers have begun to use the low-lying areas near the head of water drainage systems called "dambos" for small-scale irrigation. IFPRI research found that the highly flexible and efficient indigenous dambo system produced higher crop values on each piece of farmland, and higher output for each unit of water used than the formal, irrigation schemes downstream. Costs were lower and production more intensive. Farmers used these sensitive water resources in a careful way that preserved most of their environmental benefits. Crop yields were ten times higher in the dambos than in the nonirrigated fields. Farmers were thus able to meet their growing food needs without cultivating a larger area of fragile drylands.

Now let us look at some examples of improved land use. The steep tropical hillsides of the Philippines and Thailand, often located on public lands, are highly susceptible to erosion and degradation. They are increasingly threatened by deforestation and more intensive cropping under unsustainable farming systems. NGOs in these countries have helped farmers to develop new techniques that raise productivity without degradation. Farmers in some regions are now planting strips of crops on the contour, between strips of permanent vegetation like

grasses, tree crops, or hedges. They limit the amount of tillage, use mulches to protect the soil, and use nitrogen-fixing trees in their fallow. Such practices not only increase and diversify crop production, they also reduce erosion, protect the watershed, and relieve the need for farmers to continuously deforest new land. As millions more people are expected to depend upon hillside farming by 2020, the spread of such systems will be essential to food security and resource protection.

My last two examples show how farming innovations can also enhance biodiversity. In the East African highlands, contrary to common belief, tree cover on farms has increased parallel with increased population densities. Farmers are highly receptive to planting new tree species with their crops, where this meets their economic needs. Small-scale farmers in one impoverished region of Kenya more than doubled the total number of farm trees to nearly 400 per hectare. Although four species accounted for almost half of the trees grown, another 163 species were also grown. This great diversity of indigenous and introduced tree species, interspersed within the crop fields and pastures, enriched the habitat for other plants and animals as well.

In Costa Rica, an environmental organization has promoted the establishment of farm windbreaks. These are tall rows of trees that slow the wind as it moves across crop fields and grazing areas. The effect of these windbreaks has been to increase the productivity of commercial dairy and coffee production significantly. A recent study demonstrated that those windbreaks are also acting as "biological corridors," that is pathways that link the small patches of remaining forest in the farming areas. This permits the survival of many forest species that would otherwise be threatened by a shrinking habitat. Expansion of such systems throughout Central America could help to avert the dramatic loss of biodiversity predicted for this small region by 2020.

Policy Lessons

These examples illustrate the potential to increase farm production while sustaining or improving the environment. From the success stories, we can identify six key policy lessons. First, local people need to have a stake in the quality of the natural resources, if they are to protect or improve them. Farmers planted trees in East Africa, for instance, mainly to provide new income sources and meet subsistence needs; the environmental benefits were secondary. By helping farmers invest in natural resources, policymakers can promote economic development, as well as environmental goals.

Second, rather than depend on government directives, local people were encouraged to work together to solve problems and manage their own natural resources. As a result, they were able to come up with solutions not obvious to outsiders. The government can facilitate or support local processes. Zimbabwe's dambo irrigation system, for example, was an innovation of local people, who organized themselves to provide sustainable water use in their community. Local innovation and cooperation will be critical in many other areas, such as integrated pest management, erosion control in watersheds, and management of common property resources.

Third, regulations on the use of land and other resources were flexible, allowing for adaptation to local conditions. In the hillside success stories of the Philippines and Thailand, official regulations that restricted crop production in steep lands were modified when sustainable cropping systems were developed. For 2020, there will need to be major changes in the regulatory framework, not only for watersheds, but also for tree harvesting, irrigation, and protection of biodiversity reserves.

The fourth policy lesson is that farmers and communities had secure rights to land, water, or forest resources, and there were institutions in place to settle disputes over

resource use. Farmers in the Southeast Asian hillsides, for example, invested most in the permanent crop plots where they had secure land rights. Increasing scarcity of resources to 2020, together with multiple users, will call for major institutional changes in property and access rights, and conflict resolution.

Fifth, governments placed a value on natural resources that reflected their real scarcity. The introduction of water pricing in Chile led to more efficient water use, and eventually to higher farm incomes. Changes in pricing of forest and agricultural land could also improve use of these resources by 2020. Lifting of subsidies on environmentally degrading inputs, such as pesticides, could also help reduce their inappropriate use.

Finally, there was public investment in research to understand, and ultimately enhance, the relationships between agriculture and the environment. In East Africa, for example, researchers helped to find and select more productive trees that grew well with crops. In Thailand and the Philippines, NGOs worked together with farmers to develop and test hillside farming innovations. The research agenda for 2020 is full indeed, ranging from the application of biotechnology to develop pest resistance in crops, to reduce use of pesticides, and to ecological research on how to maintain biodiversity in different agricultural systems.

Conclusion

These experiences, and others, show that transition to an environmentally sustainable, increasingly productive agriculture can be a reality. Surprisingly, participants at the 2020 Vision workshop on land degradation were optimistic that we could make significant progress in reversing land degradation trends in the developing world by 2020, even though they identified many new problems likely to emerge by then.

But such progress will certainly not

happen by magic. People like yourselves—leaders in the agricultural and environmental communities—need to be willing to seek creative solutions together. The right kind of policy support can bring us closer to the 2020 Vision. The challenge will be to mobilize the necessary political and civic will in your countries, to advance this agenda as a central concern. Another 2.5 billion people will be living on the earth by 2020. We can afford to sacrifice neither the food production potential, nor the environmental integrity of our agricultural lands.

REUBEN J. OLEMBO

Deputy Executive Director

United Nations Environment Programme

Ladies and gentlemen, good morning. I have a small apology to make, which I hope you will accept. Originally I think the planners had expected Ms. Elizabeth Dowdeswell, the Executive Director of United Nations Environment Programme (UNEP), to be here to deliver these remarks, and I think she was planning to do so for quite a long time, but only three weeks ago she came to my office and said, "I am sorry I cannot, because the Secretary-General has asked me to do something else. Would you take on the task?" But she did not tell me what the task was all about, so I had to think about it, and consequently unlike my colleagues who have been here thinking about 2020 for more than two years, I have thought about it for only three weeks. So I am going to be a bit less profound, I believe, than I would have done otherwise if I have had the time to look at everything.

But nevertheless, this is a pleasure for me because this is a subject that has occupied more than 20 years of my professional life, and so I can pick up one or two things.

What I thought I would do, and many of

you have probably heard me speak about this elsewhere, is to follow up very quickly on a serious, excellent introduction and the statement that Professor Conway made yesterday, and I would like to ask one simple question: If we are optimistic, as I think the examples show, are we in a position to bring about that 2020 Vision in which concern for the environment, natural resources, and agriculture are actually in equilibrium and indeed will we have sustainability on our doorsteps by 2020?

My honest answer is "Yes." From what people are doing in the fields themselves, we can be proud; we can move there. But from what we are doing as scientists ourselves, I am not so sure. Therefore, I want to state quite clearly, categorically, one of the things that I think is going to be required from researchers and from policymakers and from leaders in general to move to the 2020 Vision is a shift in thinking, a shift in paradigm, and a shift in institutional makeup.

Essentially what I am saying is that research will now have to be focused into interdisciplinary, into multidisciplinary, into teamwork, into synergistic exercises, rather than research that goes on to single factor issues, because the very theme of sustainability indicates quite clearly not any one discipline has a monopoly of knowledge, and that indeed we need to pool all the resources to bring this about.

Now, the reason why I said all of that about policymakers is because policymakers have not learned to integrate. That is why I was very keen to hear what the Vice President of Uganda said when she was making her opening remarks. Many of the things she said actually are problems that arise because decisions are constantly taken in isolation. Policymakers tend to do that.

I think I have reached the point where I can say when I am asked to make a policy decision on biodiversity, I do it in isolation from water resources. I do not think of the water resources as being part of what is the policy decisionmaking. But if you think

about it, you will find behind the scene that even water, vegetation, and land go together, but one never gets one single type of policy.

So my first statement is to state quite categorically that we probably have to require reorientation in our research approach and research institutions in order to tackle the requirements of sustainability. Of course, you will say this is happening in the CGIAR system, and we are glad for that. What I am saying is that what is happening in the CGIAR system should become the norm now, and not become the exception.

I have, in my paper, given some examples of how people are moving towards this kind of approach. I have indicated quite clearly in the paper, which I hope I can complete and can get circulated, that you will have to pool all the knowledge from all directions—ecological, scientific, social, cultural, legal, technological, and geographical—and take care of the geographical peculiarities. And within that, you will need to make a conscious decision that not any one single system can work everywhere, so in fact what the researchers are going to give us are options rather than single solutions to each of the problems. And the reason why options are important is because of what Sara Scherr just said that in the end sustainability is brought about by the people and not by governments, and therefore people must have options and their cultural biases must allow them to make a decision that is in conformity with what they require. I think that is the only way that you will solve a problem. I do not think you can say, "Here it is. Take it or leave it."

So research of that type is required, and I have buttressed my paper with several examples. In fact, very strangely enough, IPM is on top of that list, but I would not talk about it. It has been talked about twice already.

I have already also indicated in my paper an interest in a conceptual framework. Let me just say a little about that one

because since we are talking about moving towards a system that has to be brought about as quickly as possible, there are some conceptual difficulties, but we are not alone in finding that we have conceptual difficulties.

There is a very interesting research piece, which I hope can also find its way into agricultural practices, that is under way and spearheaded by the Scientific Committee on Problems of the Environment (SCOPE), who never were thought of as contributors to agricultural progress but they have good scientists who are thinking of major ecological issues and are thinking of the scientific problems with regard to sustainability. They have come up with an interesting research project called "The Sustainable Biosphere."

In that project they take seven large ecoregions of the world, four of which are in developing countries. They are going to try a policy analysis, not just isolated cases like hill farmers, but asking questions why hill farmers in East Africa and hill farmers in terrace farming in the Philippines and so forth will make a difference. And hopefully with those kinds of policy analysis, they may come up with some conceptual frameworks upon which one can move towards this integrated, holistic, interdisciplinary research that combines natural resources concern and sustainability.

And of course you also know that at the World Bank, the Chairman of the CGIAR has been engaged in an interesting study that I hope will move us forward on the question of sustainable indicators. You will require those if you are going to measure your goals towards sustainability. And I am hoping that in time, and just in time before 2020, we will have robust indices coming from that study that will enable us to say whether we are moving in the right direction by 2020.

A third point that I would like to make is to return to this biodiversity thing. On Monday I read the *Washington Post*. I think you know this town is in a foul mood with

regard to international development and anything that we can do to disabuse those who believe that the concept is dead I think is good for the world. I saw this *Washington Post* article on Monday, and there were gentlemen, I think they were all gentlemen, unfortunately there were no women, who were up on the Hill trying to protect this small amount of money that the Americans spend on foreign aid and that causes so much political hue, as if they were spending all their dollars on foreign aid.

There were two or three gentlemen who spoke quite well. They were speaking about biodiversity. One of them was representing Archer, Daniels, Midland (ADM), one of the giants of American corporate farming, and he was talking about diversity. And I thought, "how could these agribusiness people talk about diversity in an even more eloquent way than I myself who have been looking at the whole thing for 20 years?" But the people are making connections. They are making connections.

The other one was representing Ciba-Geigy. I think the representative was not there, but a letter was read, and they are making the connections—the letter mentioned the globality of the system, how protecting biodiversity in a little corner of South America or on the hillsides of Kenya has direct consequences for American agriculture, and how because American agriculture (as we were told a day or so ago) belongs to 2 or 5 percent of the people, and the rest are not doing it, it is critical for them. Large-scale agriculture will not be able to protect that biodiversity—mass biodiversity, I am talking about—the same way as the small-scale farmers who are our concern for 2020. And I was impressed by that argument.

Of course, the thing they did not say was that their own practices and the sustainable practices in the North are causing depletion of biodiversity underground, which we forget. We forget about the biodiversity underground. We are talking about biodiversity only above the ground. But they

explained the biodiversity underground, which is critically important. I was hoping one of them was going to say that they would try to do something about this biodiversity underground, which is forgotten because it is underground—for the benefit of the small-scale farmers who are not getting rich. The factors, the production factors of fertilizer, herbicides, who must use the resources in their *in situ* situation to build them up to a position where the agriculture can be sustainable, and I think that will depend on what we do about the biodiversity underground.

If we can find a system by which these agroforest, agrobusiness people are also interested in packaging the biodiversity underground in such a way that nutrients can be brought back again, the same way they do with the bees, culturing the bees in order to get pollination, then I think the biodiversity is integrated above mass, above the ground, and down and below the ground.

That is what I thought was very interesting and I thought I should still speak about it because biodiversity for me represents one of the best conceptual frameworks for integrating the various needs of sustainable development, not just agriculture, not just genetic resources or plants and animals we see today, but everything else that goes with it.

So I have chatted a bit, but my feeling is that the examples we have now indicate that if we reorganize ourselves; if we take the challenges, particularly in research, the thrusts in researching directions; if we believe in synergism; if we believe in cooperation; and if we believe in listening to the local expertise and experience, then we have a chance. It is 25 years until 2020, and 25 years may be a short time. But it is sufficient to make a difference. After all, we cannot go back on the theme of sustainability.

It was exactly three years ago that the political leadership gave it their blessing and that is the matrix in which we have to work

and that is the matrix in which we are going to bring about this vision of 2020.

Thank you very much.

LESTER BROWN

President, Worldwatch Institute

I would like to commend you, Per, and your colleagues for this 2020 Vision. There is, I think, in the field of agriculture and international development a desperate need for leadership, and I think that with this concept of a 2020 Vision you are helping to establish the framework within which to look at the issues and also to look at the goals that we want to set for the future.

There are two sources of food in the world today: oceanic and land-based. Most of the discussion here has been about land-based sources, and I would like to look for just a minute at oceanic food sources because there are important relationships between the two food-producing systems.

The world's fish catch, as most of you know, increased dramatically from 1950 until 1989, going from 22 million tons to 100 million tons, increasing almost fivefold. Per capita seafood consumption in the world, as a whole, went from 9 kilograms in 1950 to 19 kilograms in 1989. It was a remarkable period of expansion, but it has now come to an end. The marine biologists at FAO in Rome believe that. All 17 oceanic fisheries are now being fished at or beyond capacity. We probably will not go beyond the 100-million-ton catch that we achieved a few years ago. The result is that we are now faced with a decline in per capita seafood consumption for as far as we can see into the future, for as long as population growth continues.

Already the per capita seafood catch since 1989 has declined by 8 percent and that decline is probably going to continue. As it does, seafood prices will rise. Our index of seafood prices at the international level shows a real rise in seafood prices of 4

percent per year over the last decade.

There was a time in this country when people, who could not afford meat, ate fish. That is no longer the case. If you go into a local fresh seafood market here, it is hard to find anything under \$4.00 a pound, and it may be \$7.00, \$9.00, \$11.00, \$14.00 a pound. You do not find many poor people in these seafood shops.

The point I want to make here is that we have experienced a rather dramatic reversal in both the per capita supply and prices, one that is going to continue for sometime. And as it does, it is going to put more pressure on the land. Just to put these seafood catch figures in perspective, 100 million tons of seafood is roughly equivalent to the world production of beef and poultry combined, so it is not an inconsequential contribution to the world's food supply.

During this period, the last four decades, the catch has been expanding by 2 million tons a year. If we had to get that from grain-based sources, either broiler production or aquaculture for example, then we are looking at 4 million tons of grain per year. The point is that the contribution that was made by the oceanic food system has now come to an end and all future increases in the world food supply have to come from land-based sources. I do not think we have done a sufficient job of integrating that into our food models.

I want to say that I agree entirely with the thrust of the 2020 Vision statement. I think it is headed in the right direction. It is focusing on most of the right things, but I think it lacks an appropriate sense of urgency. And I think one of the reasons that we (the world in general) are somewhat complacent on the food front is because we rely on economic models that are used by the FAO, the Bank, and now by IFPRI, which do not capture the biological dimensions.

The Bank, for example, is very straightforward in describing their projection techniques. They say they take the wheat

yield in a country in 1960 and in 1990, draw a line between the two, and extrapolate it into the future. And the rationale is that the past is the only guide we have to the future; therefore, this is the only way of projecting.

It is true that the past is the only guide we have to the future, but the past is filled with a body of research literature in biology demonstrating S-shaped growth curves. Any biological growth process in a finite environment will eventually conform to that S-shaped growth curve, whether that is the oceanic fish catch, rice yield per hectare, or what have you. And I think this is lacking in the modeling process. It is interesting to contrast the results of the models used to project world food supply and demand with the statements coming from the various scientific bodies that contain many natural scientists—for example, the National Academy of Sciences, or the Union of Concerned Scientists, with its world scientists' Warning to Humanity, a statement that was signed by more than 100 Nobel Prize winners.

So I think, I personally sense a much greater urgency than is reflected in the document.

Let me talk now very briefly about some of the key resources viewed at the global level.

First of all, cropland, and here I am going to use grainland because it is a more precise measure. It is very difficult now to expand the world's grainland area. There is not a lot of fertile new land in the world waiting to be plowed.

When grain prices rose back in the 1970s after the Soviet wheat purchase, grain prices doubled and we expanded the cultivated area (the area in grain worldwide) by about 8 percent. We have now lost almost all of that increase and we are back to about where we were in the early 1970s. Much of the increase came in the former Soviet Union, much in the United States.

In the former Soviet Union, the erosion of that land was so severe that most of it has

long since been abandoned. In this country, we had a more formal approach to try to save that land, and we put it in the Conservation Reserve Program. But the loss of or the scarcity of cropland is, I think, becoming an increasingly severe constraint on efforts to expand world food production. I have the feeling that this is an area where we should not rely on the market to decide what cropland to save and what to permit to be converted to nonfarm uses. I think we need to take this issue much more seriously than we are, perhaps using the model that the Japanese have used in protecting their cropland, which has been one of the most successful in the world.

The second issue is soil, specifically topsoil. Over long periods of geological time, we have accumulated a thin layer of topsoil and that is really the basis, not only for agriculture but for civilization itself, and we are gradually losing that topsoil. We estimate that we lose maybe 24 billion tons a year. That is roughly the amount of topsoil on Australia's wheatland. In this country, the U.S. Department of Agriculture (USDA) reports that we have cut our soil erosion losses from 4.1 billion tons in 1982 to 3.1 billion tons in 1992, and that is entirely the result of the Conservation Reserve Program. So we have made some important progress in reducing soil losses in this country, but the world as a whole is still losing enormous amounts.

There was a story of one of our astronauts meeting the President of Madagascar and he said, "Oh, yes, I know your country. It is the one that is bleeding into the ocean." And from space you could see the rivers in Madagascar carrying topsoil out into the ocean. You could actually see it.

Another example is the scientists at Mauna Loa Observatory in Hawaii, where they collect the CO₂ samples and record changes in atmospheric concentrations of CO₂. They also analyze those air samples for dust content. Each spring they can now tell within a matter of days when spring

plowing starts in northern China because of the windborne soils that cross some 1,500–2,000 miles of ocean.

I cite these as examples. If you trek around the highlands of Ethiopia, you see the abandoned villages, abandoned because the soil is gone. Only rock is left. There is not anything to support even subsistence-level farming. You see some of these things in the Andean countries in Latin America, just to use a few examples.

My own sense is that we need a world plan of action to stabilize our soils and to arrest the loss of topsoil—a world plan of action similar to the plan of action that came out of Cairo to stabilize population.

Another resource, water. Various people touched on water as a resource. Water tables are falling in all the key food-producing regions of the world. Whether it is in the southern plains of the southwestern United States, several states in India including the Punjab, and much of northern China, water tables are going down.

Human demand for water, mostly for irrigation, is simply exceeding the recharge rate of the aquifers. Water scarcity is spreading—competition is growing between cities and farmers for water supplies.

I have family on ranches in Weld County, Colorado—north of Greeley and east of Fort Collins. Three years ago, an agent came in and bought the water rights in a large area of the county, offering farmers prices they could not decline. And it was only after he bought all the water rights that it was discovered he represented Thornton, Colorado, a small town that is a bit northwest of Denver, almost a suburb of Denver. This is Thornton's water supply for the early twenty-first century.

In the agricultural regions surrounding Beijing, farmers are now banned from the reservoirs. Beginning last year they were banned from using that water for irrigation. The reason is that all the water is needed for the residential and industrial needs of the city itself. That story is being repeated

hundreds of times around the world, as water is being pulled away from agriculture.

It seems to me that we have reached the point where we ought to be thinking about investing in water efficiency in the same way that in the 1970s we started investing in energy efficiency. I think water scarcity is going to be an issue that is just going to keep becoming more and more important as a source of economic change and a source of political conflict. It needs far more attention than it is getting.

Fertilizer: We do not think of fertilizer as a natural resource, but the capacity of crops to use fertilizer is a natural characteristic. What we are now discovering is that existing crop varieties in many countries in the world simply cannot effectively use much more fertilizer than is now being applied.

World fertilizer use went from 14 million tons in 1950 to 146 million tons in 1989, and has dropped since then. This was the engine driving the growth in world food production that led to that doubling in the grain harvest between 1950 and 1980, a remarkable achievement. But now, since 1989, fertilizer use has dropped from 146 million tons to 121 million tons last year. Now, most of that drop is in the former Soviet Union because they are simply overusing fertilizer. But in this country, for example, farmers are using less fertilizer now than a decade ago, simply because crop varieties will not use more fertilizer. In Europe fertilizer use has leveled off.

So this is another issue I think that needs more attention. If fertilizer is not the engine driving the growth in food production in the future, what will be?

Another point related to these points is in the past when scarcity has developed, prices have risen. They rose dramatically in 1972/73. After the Soviets cornered the world wheat market, grain prices doubled and the market responded. Farmers put in more irrigation wells. Farmers used much more fertilizer. As food prices went up,

fishermen invested in more fishing trawlers. Those things used to work well, but today rising food prices that led to additional investment in fishing trawlers would simply hasten the collapse of oceanic fisheries.

Drilling more wells, irrigation wells, where water tables are already falling, is only going to hasten the depletion of aquifers.

Using more fertilizer now just does not make a lot of difference. And as the world is beginning to run into these natural constraints, whether it is the sustainable yield of fisheries or the sustainable yield of aquifers or the capacity of crop varieties to use more fertilizer, China is emerging on the scene as a potentially massive importer of grain.

As analysts, those of us who work in agriculture and in projecting world food demand, we have no experience by which to deal with the scale of the growth in demand that is occurring in China today. The growth rates over the last four years: 13 percent, 13 percent, 11 percent, this year probably 10 percent. You multiply these out and you see that the Chinese economy has expanded by 56 percent in four years. Much of that increase goes to diversify diets, specifically for more pork and poultry, eggs, beef, beer. All these products require grain. So we are seeing an enormous growth in demand for grain in China. We estimate this year it is going to import 16 million tons of grain at a minimum. It could go higher.

Meanwhile, on the supply side, the rapid industrialization that is driving China up the demand curve at such an extraordinary rate is chewing up cropland at a phenomenal rate. USDA estimates, and we at Worldwatch agree with them, that the grain production in China this year will be less than it was in 1990. That is to say, we may already be seeing a situation where the loss of cropland is overriding the rise in land productivity, leading to an absolute decline.

If you disaggregate, you see that happening much more rapidly with rice,

which is to be expected, because the most rapid industrialization is in the southern provinces, which are the rice-growing provinces. But wheat and corn have also each peaked in the last couple of years and are beginning to decline.

So we have a situation of a potentially massive deficit developing in China. Grain prices in China rose 60 percent last year. They have risen further during the early months of this year. I think it is only a matter of time until rising food prices in China become everyone's rise in food prices.

Land scarcity in China will become everyone's land scarcity. Their water scarcity will become everyone's water scarcity. Because China is part of an integrated world economy, its scarcities now move across borders in the form of trade.

The final point I want to make is that in the 2020 Vision Statement we concentrate on agriculture, but I think we need to recognize the urgency of stabilizing world population. I think we need to recognize that the world's fishermen and farmers are now having trouble keeping up with the growth in population, and as we see it at the Institute, the responsibility for achieving an acceptable balance between food and people in an environmentally sustainable way now depends more on family planners than on farmers or fishermen. And I think we might want to make that point known and emphasize the importance of implementing the World Population Plan of Action that came out of Cairo, the goal of which is to

stabilize the world's population much sooner than would otherwise be the case if the normal projections unfold.

It was ironic that last week, when we were releasing our first estimates of world grain carry-over stocks, which indicate that they will drop to 53 days next year, the lowest level on record, Congress was slashing the International Family Planning Assistance budget. There seems to be a total disconnect between what we see happening in the world and what was happening on the Hill. So I would second Dr. Olembo's call for all of us to become more active, to speak out more on the issues, and to try to introduce a sense of reason and some sense of long-term responsibility for our short-term political actions.

I think filling the family planning gap is terribly important. It is inexcusable that there are 120 million women in the world today who want to limit their family size but lack resources, lack access to the services to do so. I think, as other speakers have noted, that we should be educating young females in the Third World as though our future depended on them because I believe it does.

I think the food-population-environment complex of issues that the 2020 Vision deals with is the most important in the world today. Leaders are judged historically by whether or not they respond to the great issues of their time. This, I think, is the great issue for our time, and I commend you at IFPRI on the leadership you are demonstrating with this 2020 Vision. Thank you.

TECHNOLOGY'S CONTRIBUTION TO FEEDING THE WORLD IN 2020

PETER HAZELL

*Director, Environment and Production
Technology Policy Division, IFPRI*

The twentieth century has seen revolutionary changes in technology that have dramatically transformed the way we all live. We are all aware of the impact of the car, the computer, the airplane, and television to mention but a few. But the revolutionary impact of modern science on our food supplies is not widely understood. In fact, it is a well-kept secret.

How many people know that world cereal yields have increased more in the last 40 years than they did in the whole of previously recorded history? In my own country, England, it took nearly 1,000 years for wheat yields to increase from 0.5 to 2 tons per hectare. It has taken only the past 50 years to climb from 2 to 6 tons per hectare.

This is a story that can be told around much of the world. The application of modern science to agriculture through research has increased yields to levels that were considered unimaginable only a generation ago. These changes have been so dramatic that they have even been called a Green Revolution. As a result, the threat of starvation, a stark reality throughout human history, has now been banished for most of us, despite a doubling of the global population in the past half-century.

Regrettably, these advances have not yet been equitably shared throughout the developing world (we still have many malnourished people), and some types of agricultural intensification have led to serious

environmental problems. These limitations pose major challenges for the future and deserve urgent attention. But in our preoccupation with these problems, we should not ignore the dramatic successes that have already been achieved. Nor should we overlook the factors that were responsible for the past gains, for therein lies the key to future success.

In this brief presentation, I want to do three things: First, to explain why agricultural research has paid off so handsomely in recent decades; second, to identify the key challenges for agricultural research as we look ahead to year 2020; and third, to suggest policy actions that need to be taken now if agricultural research is to continue to be successful. I shall pose these issues in question form.

Question 1: Why has science paid off so handsomely in agriculture in recent decades?

There are basically two reasons. First, because modern science brought new research tools and materials to agriculture that opened up whole new frontiers for improving yields. These included breeding methods to improve the biological capacity of plants to respond to water and nutrients; improvements in fertilizers and crop management practices; and new ways of controlling weeds, pests, and diseases. It is not that farmer inventions had not been historically important, e.g., they accounted for much of the growth in English wheat yields until the late 1800s, but that yield increases from farmer inventions alone were too slow to meet rapidly escalating food needs.

These scientific advances greatly increased the profitability of intensive farm-

ing, leading to large investments in irrigation and dramatic increases in the supply and use of fertilizers, herbicides, and pesticides in many regions.

And the second reason for the success of agricultural research is that because the use of key inputs was so low before modern technologies were developed, there was a large additional gain in yields as input use was cranked up from low to high levels.

Question II: As we look to year 2020, what are the key challenges for agricultural research?

Let me suggest three. The first challenge is to maintain the yield gains that have already been achieved, and to establish these on a more environmentally sound basis. There is nothing automatic about maintaining current yields. Pests and diseases have an amazing capacity to adapt to changing farming practices, to overcome carefully bred resistance in plants, and to acquire immunity against pesticides. A great deal of research is needed just to keep abreast of these adaptations, to maintain rather than increase yields. At the same time, more research is needed on developing biological alternatives to the chemical control of weeds, pests, and diseases.

The second challenge is to further intensify Green Revolution areas. Now that farmers in these areas are already using high levels of modern inputs, future gains depend on additional improvements in plant varieties, in the quality of inputs, and in management practices. As conventional plant-breeding approaches reach their limits in raising the biological potential of plants to give higher yields, modern biotechnology will become increasingly important in opening up new yield-increasing opportunities.

The third challenge is to improve the productivity of rainfed farming systems that benefited little from the Green Revolution. These areas lack irrigation and are subject to weather risks, especially drought. They are very diverse areas in terms of their agro-climatic conditions, ranging from areas with

high agricultural potential to marginal areas with fragile resources such as desert margins and steep hillsides. Rainfed farming areas predominate in many of the poorer countries, for example, most of Africa and 70 percent of the total cropped area in India. Increasing yields in these areas can also help address some of the worst poverty and resource degradation problems.

The research challenges in rainfed farming areas are quite different from those in irrigated areas. Fragile soils, climate risks, and poor infrastructure make many of these areas unsuitable or uneconomic for modern input-intensive farming. While improved crop varieties are needed, especially with greater plant resistance to droughts, pests, and diseases, research is also needed to reduce soil erosion, to capture and utilize more moisture in the soil, and to generate and recycle organic sources of plant nutrients. This will require research on integrated farming systems involving crops, trees, and livestock. Such problems are very complex and are not easily resolved through conventional agricultural research approaches. New approaches are being developed, and these rely much more on the active participation of local farmers in the design and execution of research. These approaches will be particularly difficult for agricultural research systems that operate in a top-down manner and are not particularly responsive to local needs.

Question III: What must we do to ensure that agricultural research can meet these challenges?

As things now stand, there are serious questions about whether the national, regional, and international research systems that serve the developing countries currently have the capacity to rise to the challenges ahead. During recent years, these systems have been reduced in size and effectiveness through declining financial support, they are often out of the loop on modern biotechnology research, and many need major institutional reform if they are to respond to

the needs of rainfed farming systems.

Given the key role modern biotechnology will play in the future, it is particularly alarming that only about 10 to 15 percent of the resources going into agricultural biotechnology research are focused on the problems of developing countries. Moreover, most of this goes to a few large countries including China, India, and Brazil. Africa gets less than 2 percent of the total financial resources spent on biotechnology. In fact, more biotechnology resources may be going into developing synthetic substitutes for Africa's tropical exports such as cocoa and vanilla than into the food production problems of Africa. This could lead to alarming consequences for Africa's export earnings.

The current decline in public support for agricultural research will not be adequately offset by private-sector investment. The private sector will only undertake research when it can make a profit by selling its products to farmers. This leads it to focus on the problems of commercial agriculture and higher value crops. The private sector has little or no incentive to work on the problems of small-scale farmers growing basic foodcrops, largely for home consumption, or to address many of the environmental problems in agriculture.

Publicly funded research will remain key to meeting the three challenges that I have described, particularly in the poorer developing countries. IFPRI's research shows that the economic payoff from public investments in agricultural research are high with annual returns in the 20 to 100 percent range. On economic grounds alone there is, therefore, a good case for increased investment in agricultural research, and this does not even consider the social benefits that agricultural research can generate through helping to reduce poverty and environmental degradation.

The 2020 Vision calls for countries to immediately increase their annual expenditure on agricultural research to 1 percent of

the value of agricultural production, with a longer-term target of 2 percent. These levels of expenditure also need to be supported by efficiency gains obtainable from more judicious setting of research priorities and by appropriate institutional reforms to promote more participatory approaches to research with farmers.

But the last message I want to leave with you is the urgency of implementing these changes. Agricultural research involves long lead times. It typically takes 8 to 10 years to develop an improved crop variety for release, and often 15 to 20 years for technologies to move from first inception to widespread impact in farmers' fields. This means that the food surpluses in many countries today are due to agricultural research investments made two or more decades ago. It is a frightening thought that whether the world will be adequately fed in 2020 depends critically on the investments in research that we make today.

HUBERT ZANDSTRA

Director General

Centro Internacional de la Papa

As the director of an agricultural research institute operating in the developing world, I often get the feeling that Malthus and Lester Brown are *ex-officio* members of my board. You do not need to be a scientist or a pundit, however, to see the pressures that are building up in developing countries to produce more food. It is also unnecessary to be a member of Greenpeace to understand the environmental price that we are paying for agriculture. With each new day, environmental damage caused by farming makes it more difficult to produce the food that we will need by the year 2020.

As you have heard yesterday, the world is a bit better fed today than it was in 1960 mainly because of new technologies that have helped to increase food production in developing countries. I am not suggesting

that we take comfort in this fact, but I am saying that thanks to new technology we have been able to at least meet the minimum food requirements over the past 25 years. I also am convinced that new technology will play a major role in answering our questions about food and environmental problems in the years ahead.

Today, the quantity and quality of technologies leaving agricultural research centers, especially in the developing countries, might surprise you. For the first time in history, scientists can now tap into a vast reservoir of genes that are stored in more than 50,000 crop samples covering some 3,000 different species held in international genebanks. Many of these accessions are capable of producing extremely high yields under high-stress conditions and are already helping farmers to produce bigger crops with fewer chemicals.

Efforts are also under way to collect and safeguard highly useful, but neglected crops such as quinoa, amaranth, and some of the lesser-known Andean root and tuber crops. Although we know very little about these commodities, many scientists believe they hold the answer to some of our important food production problems.

We are also taking steps to upgrade genetic conservation programs and to ensure that researchers have better access to wild germplasm. Part of this effort includes rescuing older crop collections. We now have the ability, for example, to resuscitate degenerated plant collections and even bring back collections that were once thought to be unsalvageable. What this means is that the genetic building blocks needed to theoretically feed a population of 8 billion people in the year 2020 are already in place, but I do believe that it is at least technologically feasible to do so.

Moreover, we do not need to wait 25 years to get things moving. With existing technology, it should be possible to boost developing-country food production several percentage points each year for the next 10

years or so. The tools at hand include root and tuber crops, which can easily produce 75 to 100 tons of food per hectare, roughly twice the grain equivalent of the best cereal crops. For example, because of successful breeding for early maturity, large-scale potato production is now taking place between Asia's high-yielding rice and wheat crops. This simple adjustment to the region's predominant cropping system is significantly boosting food production and farmgate income per unit area.

We are also in a position, technologically speaking, to greatly reduce pesticide use. Pest management techniques are now available to cut pesticide sprays by 50 percent in most instances and up to 90 percent in selected areas. Within five years, farmers in the Sahel will have access to new insect-resistant varieties of millet that can eliminate annual crop losses of \$100 million. We also have the genetic material available to reduce fungicides and even to eliminate the herbicides used to control parasitic weeds.

We expect to see production increases from veterinary science. Improved herds of cattle that carry natural resistance to tsetse-fly infection should greatly expand meat and milk supplies in Africa's poorest countries. The access to animal power will also increase crop productivity in large areas where agriculture is mainly dependent on human labor.

Research on animals has already led to the introduction of deep-rooted pasture grasses into vast areas of South America. These African grasses are removing an estimated 2 billion tons of carbon dioxide each year from the atmosphere and are improving the fertility of an estimated 1 million hectares of marginal soils.

As in the past, however, the largest increases in food production, and the most environmentally friendly ones, are likely to come from plantbreeding programs. Within five years, we can expect to see significant increases in the production of a range of basic food crops. Researchers in the Con-

sultative Group system, for example, are predicting increases in conventional lowland rice yields of 25 percent. Should they succeed, Asian rice production would grow by an estimated 100 million tons annually, roughly enough grain to feed 400 million people.

We can also expect significant increases in plantain and banana production. New disease-resistant hybrids are currently in the development pipeline that should eliminate the need for fungicide sprays and increase production by an amount sufficient to feed 75 million people.

In addition, we expect to see significant advances in seed production, a basic requirement for productive agriculture. With potatoes, for example, we now have the technology to replace the two tons of tuber seed needed to plant a hectare with a mere 50 grams of botanical seed. With botanical seeds, which are derived from the flower of the plant, we are literally putting seed production into the hands of the farmer. We estimate that this and other new technologies will more than double potato production in developing countries, an increase in production sufficient to feed an estimated 150 million additional people.

Within a decade we will also begin to see not only larger harvest, but also crops that are decidedly richer in essential vitamins and minerals. Science has already developed wheat varieties that are twice as good at extracting iron from the soil and passing it on to consumers. This work will directly benefit more than a billion people who suffer from micronutrient malnutrition.

As food systems change to include more meat, we need to draw on a wider variety of food sources. More emphasis on food utilization techniques will be needed to respond to these opportunities.

Each of the technologies that I have mentioned were produced by conventional means using research techniques that farmers have employed for thousands of years. Most of the progress made has come

about by combining human intellect, by the unique powers of human observation, and through painstaking labor.

As a scientist, I have come to realize that our best hope for the future rests not just in our ability as researchers to innovate, but in our ability to communicate, to work together, and to take into account the wisdom of traditional food producers.

I am also encouraged by the fact that we now have the technology needed for scientists from many different countries, and from different disciplines, to work together. At my center, as at many others, research networking, promoted through better electronic conferencing is improving coordination and teamwork and is making it possible to drastically cut the time required to provide new technology to farmers.

Just as Malthus could not have imagined the impact that New World crops such as potatoes and maize would have in Europe, or the impact that the Green Revolution would have in the 1970s and 1980s, it is hard to imagine the impact that a combination of molecular biology, better electronic communication, and a healthy respect for the wisdom of our farm ancestors could have in the year 2020.

From the point of view of a biological scientist, the possibilities for feeding the planet are quite considerable. To realize these possibilities, however, will require strong support from research, policies that favor intensified and environmentally-friendly agriculture, and some rethinking of conventional wisdom.

Today's conventional wisdom holds that success will come from a relatively small number of foodcrops, mainly cereals. Assuming that all of the technologies now in the research pipeline will actually succeed, we still run the risk that we will not be able to meet demand 25 years from now. I therefore suggest that it would be worthwhile to test conventional wisdom and take a closer look at some of the lesser-known foodcrops.

Many of these commodities, including most root and tuber crops, produce well below their yield potential, and their production can be readily increased. If we continue to think just in terms of traditional commodities now producing close to their yield potential, we may well be limiting our ability to respond to future food challenges.

As a bridge player, I know the value of trump cards. As an agricultural researcher, I want to make sure that the next generation of farmers has as many trumps as I can possibly give them. With enough technological trumps, a recommitment to agricultural research, and a finesse or two in the area of conventional wisdom, it should be possible to realize our vision for 2020.

GORDON SITHOLE

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In looking at technology's contribution to feeding the world in 2020, one is mindful of the main areas of dissension between researchers, which are: (a) whether there are productivity-enhancing agricultural technologies on the shelf in Africa; (b) whether technology diffusion is a success or failure; and (c) what is the necessary development strategy for feeding the world in 2020.

This paper examines evidence of the potential for sustainable technological development in southern Africa with particular reference to Zimbabwe. The underlying trends are illustrated with reference to maize, a crop of central importance to the majority of people in this region. There are two main "bright spots" discussed. These are germplasm improvement and general technology development and diffusion.

Technology Development and Diffusion

Germplasm Improvement

Available evidence suggests that linkages

have been established between research, technology diffusion, and productivity improvement particularly on maize on the large-scale commercial farms in the region. Zimbabwe, for example, has a strong, private-sector breeding capacity. Germplasm development has a long and successful history, and there is strong international support for the development of improved plant materials. However, there has been less attention placed on the vast majority of low-input, low-resource, smallholder maize producers whose potential was demonstrated soon after independence by their virtual takeover of overall maize production. As shown by Stanning (1988), corroborated by Rohrbach (1988) in reporting results from an excellent growing season in both high potential regions and less favored areas of Zimbabwe, household food security is precarious. In a drought year, in the less favored areas, 60 percent of households needed to buy maize during the year. These results are consistent with evidence from Malawi and Kenya where there are examples of rapid, albeit unsustained, growth in overall smallholder production.

The maizes grown until the early twentieth century in this region were typically small-statured, flinty types. A breakthrough in maize breeding in Zimbabwe, Kenya, and South Africa was achieved in agroecologically better regions with very little consideration to the characteristics required by smallholder farmers. This breakthrough came from field trials of dent materials from the United States, based on the assumption that dent maizes have a higher yield potential than flints. Despite evidence to the contrary, there was very little breeding work on flint maize in the early 1980s. The relevance of such trials to conditions faced by smallholders was thus questionable.

However, from the mid-1980s, researchers in Zimbabwe began to focus maize breeding more on the requirements of the low potential areas. There is currently promising work on prolific maize varieties that can produce two ears at low populations and a single ear at higher ones. Two varie-

ties (i.e., R201 and R200) have already been developed for the low potential areas. There have also been several recent releases such as ZS107 and ZS233 although their uptake is still very low. These maizes have proved successful in improving short-term productivity. What is now required is to encourage the improvement of long-term smallholder productivity by complementary advances in crop husbandry and management.

General Technology Development and Diffusion

Policy in many African countries has for many years been based on the assumption that there is adequate and appropriate technology on the shelf. For smallholders, the problem was considered one of acceptance and delivery, rather than the suitability of the technology itself. This assumption led to considerable investment in extension and inputs for smallholders in Zimbabwe, Malawi, and Kenya. However, despite a promising start, the uptake of credit and fertilizer has declined and fertilizer use appears to be concentrated on a small minority because of problems of supply, lack of effective distribution networks, and appropriate fertilizer recommendations.

To increase national and regional productivity, there is the need to develop crop technologies around the efficient use of relatively low levels of fertilizer use rather than the attainment of high yields based on high fertilizer inputs. The question of how to address the problems of soil fertility under smallholder conditions is less well defined in most of Africa than that of variety development. There are numerous examples in Africa indicating problems of maintaining the productivity of soils under continuous cropping regimes, even when supplementary inorganic fertilizers are added. Historically, African agriculture has relied on a complex mixture of livestock, trees, and crops for the maintenance of soil productivity. Nitrogen is a limiting nutrient and many soils in southern Africa are deficient in phosphate,

sulphur, and zinc. Only potassium is present in sufficient quantities for maize production. Another problem is the increasing acidity of many of the soils.

The use of inorganic fertilizers is now a major focus of soil fertility and agronomic research in Zimbabwe. Studies have concentrated on fertilizer type, application limits, timing, methods, and interactions between different nutrients. There is a good understanding of maize-nutrient requirements and critical periods of growth. Fertilizer recommendations have been developed from trials conducted on different soil types. With some of the potentially highest-yielding germplasm in the region, smallholder productivity could significantly improve in the long term if fertility, agronomy trials, and input use recommendations address the long-term smallholder problems satisfactorily.

Zimbabwe is unique in the region in having a professional public-sector extension system, which was highly effective throughout the 1980s. Kenya and Malawi run similar extension systems. In Zimbabwe, the stage has now been reached when it is necessary to review the type of extension approach to ensure that fertilizer and other cropping recommendations are frequently updated and can generally cover a wider area and relate to local-specific soil types. A number of smallholder schemes (e.g., tobacco commercial farm settlement schemes) are being set up to enable smallholders to have access to professional advice and soil analyses to assist in the revision of fertilizer recommendations. The long-term impact will be that when a smallholder gets access to inorganic fertilizer, he will have some guarantee of its appropriateness for the crop grown and for the type of soil it is put on.

Conclusions

The issues highlighted above are clear examples of the general thrust towards a smallholder-led agricultural strategy for feeding the region in 2020. The general lesson from Zimbabwe and the other

successful agriculturally productive countries in the region is that, while technological development is important, long-term progress requires complementary advances in the more intractable problems of crop husbandry and management. The relative neglect of these difficult areas has held back the emergence of cost-effective agricultural technologies for smallholders.

INTEGRATED PEST MANAGEMENT IN THE ANDES

CÉSAR CARDONA

Entomologist

Centro Internacional de Agricultura Tropical

In the Andean Zone, the challenges of achieving food security, reducing poverty, and halting environmental degradation are closely intertwined. To illustrate, I would like to share with you the findings of recent work on the control of bean insect pests in Colombia, Ecuador, and Peru.

A severe problem of pesticide abuse has arisen in these countries against the background of a complex socioeconomic fabric. Over the last several decades, the region has undergone rapid urbanization. About 70 percent of its population now lives in cities. Among the people remaining in rural areas, poverty is almost endemic.

Production of beans and other crops could offer rural people an alternative avenue of escape from poverty. Urbanization has generated a large demand for these crops. The region's consumption of beans, for example, is expected to exceed supply by 30 percent in the year 2000. Given this strong demand, farmers should be able to make a decent living through more intensive crop production.

Many are trying hard to do exactly that. Throughout the Andean Zone, farmers have transformed mountainous landscapes into a patchwork quilt of small, well-tended plots. Large numbers of growers have adopted

modern crop varieties and the use of agrochemicals to better meet the demands of urban markets.

But this escape route from poverty is filled with hazards. Our studies document one of the principal dangers: the emergence of a "chemical culture," which poses a serious threat to human health and the environment.

Dr. Darío Córdoba, a noted toxicologist in Antioquia, Colombia, has documented the rising incidence of death and injury from pesticide intoxication. Our own surveys show that 13 to 30 percent of farmers in the study area have suffered illness from exposure to these products within the last 10 years.

Detailed analysis of environmental impact was beyond the scope of our research. But we did learn that excessive pesticide use has upset the balance between certain insects and their natural enemies and has raised the risk that pests will develop resistance to chemical controls. In a worst-case scenario, these tendencies could result in the collapse of crop production in many places.

The path farmers believe will lead them away from food shortage and poverty could, ironically, turn in the opposite direction, making both problems much worse.

To avoid this outcome, we must begin slowly to change the chemical culture. This is no small challenge, because the overuse of pesticides, like any other aspect of culture, is now customary.

Rather than apply these chemicals occasionally to ward off actual insect threats, farmers spray regularly on a calendar basis to provide insurance against the possibility of damage. In some areas we studied, farmers spray about as often as they go to Mass, once a week, with an average of 11 applications during a single growing season.

As a result, insecticide use has become remarkably commonplace. In the Oriente Antioqueño, for example, farmers refer to spraying as "bathing the crop." There and in

many parts of rural Ecuador and Peru, the backpack sprayer is an ordinary household item, just like the radio or blender.

Apparently, the chemical culture even demands a rite of passage. A farmer living near Loja, Ecuador, said recently, "I became a man when I could first stand up under the weight of a 20-liter backpack sprayer." For him, the price of manhood was to suffer insecticide poisoning at the age of 14.

The Andean Zone's chemical culture is reinforced by habit and rooted in fear. Understandably, farmers panic at the thought of losing a bean crop. To change their habits, we must alleviate their fears, and the enemy of fear is knowledge.

In 1992 and 1993, during the first phase of a project funded by Canada's International Development Research Centre (IDRC), we had three primary goals: to document farmers' current circumstances and practices, to determine the status of major pests, and to develop ecologically sound control measures that farmers would be likely to adopt.

Some of the knowledge we acquired proved astonishing to the farmers who helped us learn. For example, we found that the greenhouse whitefly, which growers perceive as a major threat, is not generally serious enough to warrant heavy insecticide application. Farmers continue spraying against this pest because of their bad experience with it during major outbreaks in the late 1980s.

In contrast, farmers do not spray at all to control leafhopper, even though it can reduce yields by as much as 40 percent. Growers are misled by the main symptom of damage from this insect, yellowing of the leaf margins, which they interpret as a sign of soil infertility.

One pest we studied, the leafminer, is essentially manmade. Until 1980, it was regarded as a minor pest of beans in Latin America. But continuous use of insecticides has destroyed its natural enemies, allowing

pest populations to expand.

In addition to getting to know the farmers' enemies, we identified various weapons that can better enable them to combat these pests. For example, by destroying crop residues, farming communities can remove a primary means by which whitefly and leafminer infest neighboring crops. Simple traps, made of yellow plastic sheeting coated with engine oil, further reduce populations of these insects. In some cases, the solution is simply for farmers to do nothing and let natural enemies keep pests in check.

By adopting such measures, which we refer to collectively as integrated pest management, farmers can reduce insecticide applications by as much as 60 to 70 percent. They cannot, however, stop using these chemicals altogether and still get reasonably good yields.

A more realistic goal is to provide farmers simple means by which they can determine when insect populations have reached levels that justify pesticide application. Learning to make such judgments requires that farmers make an important leap from the simple adoption of inputs to the acquisition of knowledge.

But farmers will make little use of this knowledge unless they are committed to change. In our experience, the best way to secure commitment is for farmers to participate meaningfully in research. For that reason, in Phase 1 of the IDRC project, we conducted many of the studies on specific control measures in close contact with farmers. And in Phase 2, begun this year, our main purpose is to refine and promote these measures through on-farm trials. In those experiments, individuals and groups of farmers are the key players.

Even at this early stage, we see encouraging evidence that participation does give rise to commitment. In one study, for example, we placed bean crop residues in cages and with farmers' help counted the emerging insects. The results indicated that

the bean plants remaining on one hectare can harbor up to 181 million whiteflies. Not surprisingly, communitywide destruction of residues is one of the practices that farmers have adopted most easily.

I am further encouraged by the dedication of the staff from local institutions cooperating with us in the IDRC project. Ing. Gloria Guzmán, for example, an agronomist working in Antioquia, has gained a reputation for never letting farmers down when she has promised to make a visit or hold a meeting. Ing. Maria Teresa Ramón, a mother of four, sets out before dawn every working day to visit remote farms in the arid, mountainous region around Loja, Ecuador. This has earned her the farmers' respect in a culture where *machismo* still limits a woman's role.

Such people are my main source of hope that, with time and continued support, farmers in the Andean Zone will overcome fear through knowledge and supply a bountiful harvest for the year 2020 without threatening their own health or that of the environment.

As one farmer in Antioquia said recently, "We love our land—what we give to it, it always returns."

USING GENETIC MAPS AND MARKERS TO INCREASE RICE YIELDS

SUSAN MCCOUCH

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Cornell University*

I am here to address the question of how we are going to achieve the Double Green Revolution that has been alluded to several times over the course of yesterday's and today's discussions. I come to you as a biotechnologist, but I am also in the Plant Breeding Department at Cornell, and I have worked closely with the International Rice Research Institute (IRRI) during the past

five years. What I am going to outline for you today is a new strategy that we think looks extremely promising for applying some of the tools of molecular genetics that have already been developed in our labs and elsewhere. These tools are called molecular maps and markers, and they are used for mapping the genes along with the chromosomes of rice. We are using them in a rather daring project aimed at increasing rice yields 15 to 20 percent in the next four to five years. We have initiated the project and we have some exciting preliminary results.

I want to walk you through some of the arguments and the basic genetics that are the basis for the approach so that you can follow the logic and so that you will believe me. I think that sometimes people who do not work in biotechnology think that biotechnology is a question of inventing genes. In fact we do not invent genes, we find them in nature. We use them in ways they have never been used before. But in fact we do not concoct them in testtubes. What I have to describe to you today involves a braiding together of three basic elements. They are the following: (1) a set of biotechnology tools that we have developed, i.e., genetic maps and markers; (2) the germplasm resources we need as plant breeders, the naturally existing genetic variation that is the raw product we use to build our new, high-yielding rice varieties; and (3) a new concept or paradigm for international plant breeding that I think will find wide application in a variety of crops other than rice, though my example today will be rice.

The concept is based on collaborative networks. It leaves the national programs in the driver's seat. The national program scientists are the ones who have to actually generate the new varieties. Laboratories, like mine at Cornell, will be one of the drivers behind the applications of these new molecular tools that enable us to accomplish our goals in a more efficient and rapid fashion. What we are aiming to do is to

achieve our protected yield increase in the next four to five years as a pilot project. But that is only the beginning. What we are suggesting is a strategy that we think is renewable. It is a recyclable, sustainable strategy, and we hope that by demonstrating that it can work, we are providing a concept that can be applied to increase yields incrementally by about 3 to 5 percent per year over the next 15 to 25 years. As biotechnologists, this is our contribution, a technical piece of the greater puzzle that will come together in the year 2020.

South Asia is home to approximately half of the world's poor and, as you know, the major food item in the region is rice. However, rice yields have not kept pace with population growth over the last 20 years. We need to address the question of how biotechnology can allow farmers to achieve higher yields.

You have heard about the super rice, the new ideotype developed at IRRI. What I am talking about is different. Our strategy turns classical plant breeding on its head. It will never replace traditional plant breeding, but it complements it in a very novel way. Our strategy lays a new foundation for addressing the question of increasing yield.

Now, what is a molecular map? A molecular map is a series of DNA markers that we have lined up one after the other and that allow us to create landmarks along the chromosomes. It serves a geneticist much like a roadmap serves you when you need to get to a location. We developed a rice map at Cornell. There are 12 chromosomes in rice. Each is littered with little marks along it, those are our roadmarkers. They allow us to locate genes along chromosomes.

On Chromosome 1 is the *sd-1* gene. This is the semidwarf gene that was primarily responsible for the enhanced yields of the Green Revolution. We are now working with a much larger and more complex array of genes, and they have become increasingly accessible using this molecular map. Traditional breeders had to

rely on the availability of a phenotype—meaning they could see a characteristic in a plant. They made crosses between plants that had desirable characteristics and selected offspring that provided a combination of the best features of both parents. A key to traditional plant breeding was that you had to see the characteristic that you wanted to select. You had to see it in the parent, otherwise you could not work with it.

Using molecular markers, we are actually able to harvest high-yielding genes from low-yielding plants. In other words, we are finding genes that are completely masked, they do not appear to contribute to the original phenotype. A traditional breeder would not have looked to a wild species that yields less than 1 ton per hectare for high-yielding genes to improve cultivated rice. This was simply not done. However, in classical crosses between genetically divergent lines, breeders see and have always seen transgressive individuals that outperform both parents. You, yourself, as a human being know that your offspring do not look, in any predictable way, like your parents. This is because there are so many genes in an animal or a plant, and they recombine in very unpredictable ways. What we are doing is starting with high-yielding, cultivated lines that are locally adapted in specific regions throughout the world and crossing them with wild species to acquire high-yielding genes that boost the yields of our already best-yielding types. I will show you a few examples.

This work has been pioneered by a research group at Cornell University headed by Steve Tanksley whose work on developing molecular maps and markers for tomato is well-known. They have taken a small-fruited wild species called *Lycopersicon pimpendifolium* and crossed it to a high-yielding cultivated tomato variety, and by introgressing genes that came from this small-fruited wild species, they have achieved a 20 percent increase in fruit size. This is being converted into yield increases, and

after three years of a five-year project, they have some high-yielding lines that are being tested in four different locations around the world. The tomato project has the support of private companies interested in releasing these varieties because they out-produce anything available on the market today.

We are taking this same approach with rice. Based on the work we have done with our molecular map and markers on rice, we have an idea of the genetic diversity encompassed in the genus *Oryza*. Based on our estimates, the *Indica* rice gene pool represents about 15 percent of the available genetic diversity and the *Japonica* gene pool represents about 10 percent. Most breeders work within either the *Japonica* or *Indica* germ pool. Together these cultivated subspecies represent only about 25 percent of the genetic diversity that is available in wild and unadapted germplasm. A wide array of germplasm is stored in our gene banks throughout the world, and we are suggesting that this represents a very rich source of genes that can be used to augment the yields of our cultivated rice varieties. The reason these genes have not been captured and used before is that we cannot easily detect their presence. They are not visible, per se, in the parents, but when we make our crosses we do see them segregating in the offspring. What was not feasible before was to identify and capture the genes that produce this yield augmentation and move them into a background that was acceptable both in terms of quality and agronomic performance.

The way that plant breeding is typically conceived of is as a funneling process. About 7,000 to 10,000 years ago, our ancestors confronted wild species that are the ancestors of modern rice. Within these wild species are many, many genes that are potentially useful in agriculture. The domestication process itself was the first funnel. Some of the wild species were collected, used, and domesticated over time by our ancestors who carried them in their migration throughout Asia. Modern breed-

ing has further reduced the genetic variation that is available in the cultivated gene pool. However, all of the genes in cultivated rice originated from low-yielding wild ancestors. So the premise of our thesis is not that far off. These genes have not been created, they have just been concentrated in modern varieties. What we are planning to do is go back to the original source of genetic variation. We have it collected in our gene banks. Wild species of *Oryza* represent a practically untapped source of genetic variation that we have not exploited because previously we did not have the tools that would allow us to do it efficiently.

I want to give you a very preliminary set of results, to show you that the work I am talking about is under way. What we have done is to select three wild species, including *Oryza rufipogon*, which is believed to be the ancestor of cultivated rice, *Oryza glaberrima*, which is the species which is cultivated throughout Africa, and *Oryza barthii*, which is an even more distantly related wild relative. We started with an accession of *Oryza rufipogon* that yields less than 3 tons per hectare in our experimental plots in China. We crossed it with V20B, which is the most widely used female in the high-yielding Chinese hybrid varieties. Looking at the offspring from this cross, back cross-2 population, we see that some of the lines are yielding well above either parent. We just received the yield data from our Chinese collaborator, and it clearly shows that by crossing this wild, low-yielding parent with the cultivated parent, some yield advantage can be expected. As a point of reference, hybrid rice technology in China and more recently in India has achieved approximately a 20 percent yield increase over the best inbred varieties. Breeders have done this by bringing together genetically different, unrelated parents and producing an F1 hybrid. Hybrid rice technology represents one of the hopes for achieving future yield increases throughout Asia.

But there are two problems with hybrid

rice technology: (1) the seed has to be reproduced every year. If farmers save their own seed they do not get the yield advantage in subsequent generations, so there is financial and a logistical problem that makes it difficult to conceive of the appropriateness of hybrid rice for widespread dissemination in South Asia. We aim to produce non-hybrid, inbred rice so that farmers can save their own seed, and we aim to outyield the best hybrid rice in China today. This is being done in collaboration with the Chinese father of hybrid rice, Long Ping Yuan and his program at the Hunan Hybrid Rice Institute. Professor Yuan is collaborating actively because it would be a tremendous contribution if they could achieve that kind of yield increase in an inbred. The average yield of the most widely planted hybrid variety in China is approximately six tons per hectare in farmer's fields. That represents the 20 percent increase over the best inbred, which was about 5 tons. So China has in fact achieved a 20 percent yield increase over their best inbreds. We hope to beat the yield of 6 tons per hectare and are aiming for 7 to 8 tons in farmers' fields in China. The results I have shared with you today are from the first generation that we have evaluated in the field, derived from a cross where we have taken genes from this low-yielding wild species.

There are several individuals with yields all the way up to 10 and 11 tons per hectare. Those individuals have the yield, but they do not have the quality yet. What we want and expect to do within two years using the molecular maps and markers is to harvest the yield genes, mark them, and put them into the genetic background of an agronomically acceptable variety. We will then put multiple yield trials in various locations in China.

The importance of this work is twofold. First, we will be utilizing genetic variation that exists in our germplasm banks, which we have hoarded away for safekeeping but

which we have never had a reliable way of accessing. We somehow always know that that was the key to the future productivity, but we did not have a distinct strategy that allowed us to get at that germplasm and use it. Our strategy will increase the genetic diversity of cultivated rice and reverse the trend towards diminishing the gene pool, which has only negative consequences in terms of crop production. Second, this strategy is very flexible. It can be used not only with rice, but with other major food crops. It has potential to be practiced in a decentralized manner. In the national program, scientists choose their best elite variety in whatever ecosystem they choose. It conforms to their cultural, biological, and economic needs. We then use this approach to intercross genes from wild species using the technology that we developed at Cornell. We expect to be able to give them the capacity to increase the yields of their own varieties while holding on to the individual characteristics that make each variety different. In this way, it is a completely different approach than centralized breeding. It is renewable, we believe it is sustainable, and we have initial data providing evidence that it will be productive.

The problem is we do not have funds. And I think it is probably important to make this point at the end because research funds are not available in general. We have a very specific program with good strong preliminary objectives and data, and we are based at a U.S. university. However, when we contact U.S. Department of Agriculture (USDA), they say they do not have money to invest in this kind of global project. There are very few funding opportunities, and so I would suggest that another thing we need on our agenda is a pool of competitive funds for people who are interested in applying biotechnology to address the issue of how we are actually going to achieve this Double Green Revolution. Thank you.

THE MARCH OF MALNUTRITION TO 2020: WHERE ARE THE SOLUTIONS?

LAWRENCE HADDAD

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Distinguished visitors, ladies and gentlemen, friends and colleagues, Washington, D.C., is a place in which one often hears the exasperated expression, "Yes, yes, but what is the bottom line?" Let us not forget what the bottom line is in this conference. The bottom line is malnutrition. Malnutrition is a fundamental outcome and cause of poverty. It is a mirror against which a society can measure its progress.

So far, this conference has emphasized the need to avoid complacency when it comes to investing in sustainable agriculture. This is a critical first step, but by itself it does not guarantee substantial movement towards the 2020 Vision of significantly reduced malnutrition. In addition to giving farmers the opportunity to feed the world's population today and tomorrow, we need to give people the opportunity to earn enough money to buy that food and the opportunity to use that food for growth and development. Good nutrition rests upon these three fundamental pillars—food production, food access, and food use—and my presentation today will touch upon all of them.

First, I want to make it clear that the numbers of malnourished children in the developing world are growing, and that the numbers are more loaded than ever. Second, I will discuss some trends that threaten to worsen these malnutrition numbers as we move towards the year 2020. We have already heard about many of these trends: sustainable food production, popula-

tion, and poverty, for example. But the trends I would like to discuss with you here are not included in this list. In fact, from the perspective of 1995, they may not seem to have much in common with malnutrition, but, if unchallenged, they may well have profound impacts by the year 2020. The three trends are urbanization, the growing competition for water, and the spread of HIV/AIDS. Third, using some of the research findings from IFPRI's 2020 Vision Initiative, I will highlight actions that can be taken now to alter these trends and to neutralize their negative nutrition impacts.

Unfortunately then, as we near the end of the twentieth century, we have not yet turned malnutrition into an anachronism. Malnutrition in children today is an important predictor of the malnutrition in adults in 20 years' time. But, for nearly half of the children in the 60 or so least-developed countries, being born is a shock from which they will never recover. In these countries, nearly all of which are in South Asia or Sub-Saharan Africa, out of every 1,000 children born alive, 112 will die before their first birthday. Another 48 will die before their fifth birthday. Of the remaining 840, 300 will be significantly underweight. As school-aged children, they will be less able to learn in school. As adults, they will earn less income and accumulate less wealth. Only the remaining 540 children will emerge relatively unscathed.

The absolute numbers of malnourished children in the developing world continue to increase. In 1980, there were 164 million moderate and severely underweight pre-

school children in the developing world. By 1990, there were 184 million. Think about that number, ladies and gentlemen, 184 million. This is more than twice the number of preschool children, *total*, in North America, Japan, Europe, and the former Soviet Union.

Trends in the overall number of malnourished children do, however, hide notable regional successes. For example, the number of malnourished children in Southeast Asia has fallen from 23 million to 20 million between 1980 and 1990. Absolute numbers also mask the small decline in the percentage of preschool children that are malnourished. In 1980, 38 percent of developing-country preschoolers were malnourished, and in 1990, that number was 35 percent. This still means that, for every two well-nourished children, there is a malnourished child waiting in the shadows.

In the light of recent research, these numbers are more troubling than ever. A Cornell University study suggests that malnutrition is a more important factor in child mortality than was previously thought. The new research shows that 56 percent of preschool-child deaths are due to malnutrition's predisposing effects. This means that, in high-infection environments, even the milder form of malnutrition can lead to death. The malnutrition straw does not have to be very heavy to break the preschool child's back. For this reason, large nutrition programs, often serving hundreds of thousands of people, need to monitor their impacts on the milder as well as the more severe forms of malnutrition.

It is now clear that the linkages between death, malnutrition, and infection are stronger than were once thought. An IFPRI 2020 Vision study found the same to be true of the linkages between food consumption, diarrhea, and malnutrition. The multicountry study found that the effects of food shortages on child malnutrition are much worse at high levels of diarrhea. We know that diarrhea can be prevented by better

access to nonfood factors such as clean water, adequate sanitation, and garbage facilities. Among households that have the ability to feed themselves, these nonfood factors are critical boosters when it comes to turning food consumption into good nutrition, and we need to pay more attention to them.

Of the trends that may worsen these numbers as we move towards 2020, I would first like to discuss urbanization. In five years' time, half of the developing world will reside in urban neighborhoods. Urbanization under increasing prosperity and urbanization under worsening poverty have very different impacts on malnutrition, and I will address each situation separately.

Under increasing prosperity, urbanization leads to changes in diet that cannot solely be explained by changes in income and prices. Many changes in diet are caused by changes in occupation and lifestyle. 2020 Vision research shows that in China, Taiwan, and the Philippines, these lifestyle changes are about half as powerful as income growth in affecting diet change. This suggests that a neglect of these lifestyle shifts will generate poor predictions of food demand and food prices at the country level. If that country accounts for a large proportion of global food demand, the result could be poor predictions at the global level too.

One of the most important of these lifestyle changes in diet is the increased preference for high-fat foods. 2020 Vision research shows that obesity in developing countries, including China, is on the rise. Obesity due to overconsumption is an important risk factor for the cardiovascular and other chronic diseases that are closely linked to adult mortality. For this reason alone, governments should pay more attention to food labeling legislation and improved nutrition education. Moreover, the costs to governments of preventing overconsumption today are far less than the costs of treating it later on. More importantly, however, the health-sector budgets for the treatment of

these so-called "diseases of affluence" tend to be at the expense of budgets that address undernutrition, especially in poor rural areas.

When urbanization occurs in the context of deepening poverty, however, its impact on malnutrition will be more direct. We know how crucial a low-infection environment is for turning food consumption into good nutrition. But urban slums are high-infection environments. Studies have shown that, in densely populated urban areas, up to 90 percent of food cooked and sold on the streets is contaminated with fecal matter. Moreover, sewage is not disposed of, it is ubiquitous. Perhaps most importantly, the quality of water being consumed by many in the developing world is worse than that of industrial effluents in the developed world.

The second trend is the growing competition for water. Water is a unique resource—it is directly essential for both crop production and the production of human health and nutrition. Some even define water as a food. But access to water, and to clean water in particular, is becoming harder to obtain. Less than 1 percent of the global water supply is available as fresh water. Already 0.8 of that 1 percent is consumed for agricultural purposes. As population increases and as urbanization occurs, the competition for water between agriculture and health will intensify. This makes it imperative to invest in strategies that raise the productivity of smallholder agriculture, thereby improving rural incomes and slowing down urbanization under poverty. This is one of the main themes of this conference, and we have already heard about many of these strategies.

More specifically, however, this intensification of water use makes it imperative that water is properly valued. Most of the disputes surrounding water rights and water management ignore the domestic demand for water—that is, water for drinking, cooking, washing clothes, and bathing. Typically, water for these uses is not treated as a high

value product. This can lead to paradoxical situations. For example, IFPRI research in Pakistan indicates that deep wells for men's use in agriculture often take from the same water source as shallower wells that women depend on for agricultural and domestic use. The deep wells make it more difficult, and sometimes impossible, for women to draw water from the shallow wells. Women's reduced access to water means they have to spend more time in water collection and less time in agricultural production and child care. Time for child care is a critical input into good nutrition, but recent IFPRI research on male-female activity pattern data from seven developing countries indicates that women already spend between 1 and 3 hours per day in water collection.

Water management authorities and water-user groups need to internalize the idea that water is *important* to the production of good health as well as to the production of a good harvest. The increased involvement of women in water management groups—be they run by local governments, NGOs, the communities themselves, or the private sector—is one way to strike this balance. In addition, researchers need to work with water management authorities on ways to maximize the nutrition impact per unit of water allocated, whether it is to agriculture or more directly to health.

The third trend I would like to discuss is the spread of a disease that affects—and is affected by—improved food security. That disease is HIV/AIDS. 2020 Vision research finds that, in 1990, 15 of the world's poorest countries accounted for more than 50 percent of the world's AIDS cases, despite representing only 3 percent of the world's population. In these countries, at least, AIDS is no longer just a public health problem, it is a development problem.

Although there is precious little quantitative evidence on the impacts of HIV/AIDS on food security, evidence from the front lines in Eastern and Southern Africa makes it clear that productive capacity is being

decimated. As one Malawian farmer told us, "it is hard to produce anything when the path from the field to the graveyard is so well-worn." Ironically, while HIV/AIDS places food security at risk, it can be slowed down through improved food security. New research indicates that malnourished mothers, who are HIV-infected, are more likely than well-nourished mothers to transmit HIV/AIDS to their newborns. The implications are clear: first, agricultural research and technology development has to take into account the impacts of HIV/AIDS on the supply and productivity of labor. Second, public health investment has to reflect a willingness to acknowledge HIV/AIDS before it becomes something too big for governments to simply sweep under the carpet. More research into the economic costs of AIDS is also necessary to generate the information governments need to allocate scarce public funds in the most cost-effective manner.

My talk today has then emphasized three things. First, the numbers of malnourished preschool children are still increasing, especially in Sub-Saharan Africa. Second, three trends (urbanization, increased competition for water, and the spread of HIV/AIDS), if unchallenged, threaten to substantially worsen these numbers. Third, there are actions that governments, NGOs, donors, communities, and researchers can take to control these trends, and you will hear much more on these actions from Kalanidhi Subbarao and Julia Tagwireyi.

As I implied at the beginning of my presentation, preschooler malnutrition may not have the top billing at this conference, but it has the bottom line. It is a bottom line that represents a deficit—a deficit in human and natural resource terms. As well as being a place interested in the bottom line, Washington, D.C. is also famous for its deficit reduction plans. I have mentioned some of the components of such a nutrition deficit reduction plan—as have the speakers in previous session, as will the following two

speakers. In fact, it is the business of this conference to generate such a plan, and to generate the vision that gives the plan meaning. Failure to act now will have negative consequences for the children of 2020; and we know that those consequences will be with us well beyond the year 2020.

Thank you.

KALANIDHI SUBBARAO

Senior Economist

The World Bank

Lawrence Haddad has underscored the point that increasing food production (supply side), while critical, is not enough; the produced food needs to be demanded by the poor if it is to result in reduced malnutrition. He emphasized the access to food and its proper use. He also drew attention to lifestyle changes in diet that might trigger responses in allocation of public resources away from programs to combat under-nutrition. These tendencies are already in evidence in some countries.

In the coming decades, with most developing countries embarking on labor-absorbing growth and human capital investment, the incidence of poverty may be expected to fall, at least in some large countries. However, the expected increases in income and the reduced incidence of poverty need not make us complacent on the need for public action on the nutrition front, for two reasons. First, research suggests that the responsiveness of nutrient intakes to incremental income growth, while generally positive, is extremely low, so that improved incomes and reduced poverty alone are not likely to result automatically in dramatic improvements in nutrition. Second, research based on panel data has also confirmed the long-term adverse effects on productivity and earning potentials of individuals severely malnourished in childhood, so that one could now clearly make a "public good" argument for devoting public re-

sources for direct programs to improve the nutritional status of children.

Given the overwhelming need for public action, I would like to take the issue of public allocation of resources a little further, focusing in particular on three aspects: (1) the adequacy, equity, and efficiency of public resources devoted to combatting malnutrition; (2) program design and delivery, including targeting aspects; and (3) the implications of the emerging tendencies in nutritional inadequacy for public action.

Adequacy, Equity, and Efficiency of Public Spending for Combatting Malnutrition

It is difficult to quantify how far away a particular country is from what it "should" be spending on combatting malnutrition. However, if the criterion of need as reflected by the prevailing levels of undernutrition is accepted, then clearly the current levels of public spending on nutrition-related initiatives is inadequate in many developing countries. Yet it is important to raise the question: does more public spending necessarily lead to better outcomes in terms of improved nutritional status? I would argue that quality of public spending is as important as the quantity of spending, particularly in countries currently spending a large quantum of resources on programs whose nutritional impacts are at best dubious.

In this context, it is easy to cite examples of countries where populist but expensive programs, such as poorly targeted food-related interventions, have been introduced at election times. I have, myself, examined the case of India in some detail and showed how in the past in one large state, Andhra Pradesh, expansive, open-ended food subsidy programs (like a rice for Rs 2-a-kilo scheme) were introduced in 1986/87 costing the state government nearly 10 percent of the budget outlay. In the same year, a targeted school meal program was extended to cover all students whether malnourished

or not, which again escalated budgetary expenditure. Both schemes together crowded out some critical investments in infrastructure that eventually hurt the poor. Moreover, the programs could not be sustained, and one was eventually withdrawn a couple of years later. Despite this experience, I now learn that the same type of open-ended programs have again begun to play a major role recently in electoral politics of the country. Similar experiences can be cited from a number of other countries. All this suggests that merely expanding the quantum of spending on food and nutrition interventions is not enough; we ought to pay attention to the quality of spending, and carefully evaluate how much impact the programs are actually having on the nutritional status of vulnerable groups.

A related issue is equity in spending. This issue is more relevant in large countries with federal structures than in small, homogeneous countries. In such countries as India and Brazil, the levels of undernutrition typically vary a great deal across provinces and between rural and urban areas. Again, examples exist of countries where public spending on nutrition in the aggregate has improved, but the impact has been minimal owing to highly inequitable spending across regions and between rural and urban areas. I noted gross interprovincial inequity, as well as rural/urban inequity in spending on food and nutrition interventions in India, the Philippines, and also in some Sub-Saharan African countries. One reason why this happens is that the regions/provinces where the proportions of undernourished are high are also the provinces that are generally resource-poor. These regions find it difficult to raise enough taxable resources to finance programs, especially when the need for spending on critical infrastructure is also great in such provinces. The problem is likely to be exacerbated as countries move towards decentralized structures, with local bodies and provinces assuming greater (fiscal) responsibility for health, education,

and nutrition. Numerous solutions exist, and many countries are trying a variety of innovations to augment the financial resources of poor regions with matching grants, block grants, and so on from the federal governments.

The importance of quality and equity of public spending on nutrition initiatives is more urgent now than in the past. Many developing countries are undergoing serious fiscal disequilibrium and are, therefore, attempting to restructure their public expenditures. Resource constraints are real and cannot be wished away. After all, households make more efficient decisions in times of scarcity; so should nations.

In view of the above considerations, the first point I wish to stress is that we ought to emphasize not merely augmenting the total public resources going to nutrition programs, but focus only on *better quality*, and *more equitable spending* if the 2020 goal of reduced malnutrition is to be reached.

Program Design and Targeting

How can public spending be rendered more equitable and of better quality? Projects such as the Tamil Nadu Nutrition Project (TNNP) in India and the Iringa Project in Tanzania have demonstrated that designing a program involving the communities can greatly reduce costs and ensure sustainability. A principal program characteristic of TNNP was growth monitoring, which was used for ensuring entry into, and exit out of, the program as children graduated from a malnourished condition to better health. It was also used as an educational tool. Recent evaluations of TNNP have examined the question: are women internalizing TNNP messages so that the program can be eventually phased out without the loss of nutrition or health status? Analysis of available indicators such as the extent of breastfeeding shows that all the indicators are moving in the favorable direction, implying that the program is most

likely to bring about permanent behavioral change. Program design that emphasizes a reduced dependence on feeding and an increased focus on educational tools that bring about behavioral changes in mothers, as well as changes in environmental factors, can greatly contribute to longterm cost-effectiveness of nutrition programs.

Targeting of the program to the neediest individuals can be done by other means as well. Geographical targeting (locating the service centers in areas with the highest concentrations of undernourished population) is a method followed by many countries successfully. Another method adopts a life cycle approach to service integration: the services are targeted to women of reproductive age as they go through the reproductive life cycle. The approach begins with a household-level targeting strategy aimed at meeting the large unmet need for family planning. Through the educational and promotional outreach activities, local community health workers (midwives in some countries) try to identify poor women of reproductive age and their children at risk and focus the services on them.

In sum, the second point I want to stress is that it is important to target programs to the needy, involve the communities, keep costs down, design programs in such a way as to induce permanent behavioral changes and ensure sustainability, and not just as income transfers, and thus realize better return-per-dollar invested in nutrition support.

Unless the above considerations are kept in mind, more spending alone is not likely to achieve the goal of improved nutrition.

Nutrition Transitions and Policy Perspectives

Countries and regions do experience gradual changes in nutritional status as the underlying country economic, social, and other conditions change. Some countries, and some regions within large countries, have been able to reduce *severe* malnutrition by a

combination of income growth and targeted food supplementation programs, but are unable to make a dent in *moderate* malnutrition. Indeed, one can observe that in some countries, while the incidence of severe malnutrition is falling, that of moderate malnutrition is increasing. Even in some TNNP blocks, the percentage of moderately malnourished children has either remained unchanged or has risen.

If adequate resources are devoted and targeted program efforts continue, it is possible to speculate that, in the coming decade, severe malnutrition may decline. However, moderate malnutrition may be expected to persist in many countries. One problem is that moderate protein-energy malnutrition (PEM) is not easily visible to the untrained eye. Children suffering from moderate PEM are subject to different types of risks depending on where they live (living in areas of unprotected water supply or in areas with piped water; living in mountain areas or in coastal communities reachable only by water) and depending on demographic factors (being an infant with closely spaced siblings), or income-related factors (being the child of a landless laborer), and so on. A combination of factors—including household food insecurity, poor environmental health, and poor caring practices such as poor weaning practices—all contribute to moderate PEM. The multiple causes of moderate PEM, and the differences in risk factors, have important implications for policy. Evidence suggests that moderate PEM is unlikely to respond to income growth or even feeding programs; educational efforts in caring practices will also be critical. Clearly, more data and evidence is required to analyze the responsiveness of moderate PEM to alternative interventions.

Imparting nutrition, health, sanitation, and environmental education would require more intangible inputs in programs. The unit costs of administering intangible inputs could be higher than delivering a tangible

input such as food supplementation. All this suggests that countries would need to invest more, not less, as severe malnutrition declines but moderate malnutrition persists.

Another priority for the coming decade is the control of micronutrient deficiencies. Research again suggests that micronutrient deficiencies are prevalent in countries and regions where the poverty ratio is not necessarily high or average incomes are not necessarily low. Therefore, micronutrient deficiencies are not likely to disappear with faster economic growth or reduced poverty incidence. Moreover, the debilitating effects of these deficiencies for productivity in general and women's health in particular are so severe that public action cannot be delayed any further. Several countries have set goals for reducing iron deficiency in women and for virtually eliminating iodine-deficiency disorders and vitamin A deficiency by 2000, but public programs and spending levels have generally lagged far behind intentions, notwithstanding the low cost with which these deficiencies can be controlled. Some countries are taking this issue seriously. China will iodize salt in its national iodine-deficiency control program, which is projected to save 1.1 billion person-days of lost work each year. Guinea is using primary schools to distribute micronutrients. Given the low cost of these interventions and the high payoffs in terms of reduced burden of global disease, the returns to resources invested in the control of micronutrient deficiencies are clearly the highest among all nutrition interventions.

I hope the above three messages—a focus on quality and equity in spending; a focus on sustainable program design; and the need to augment overall spending even as severe malnutrition falls and moderate malnutrition and micronutrient deficiencies persist—will help in dovetailing an overall strategy for reducing nutrition deficits by 2020.

Thank you.

JULIA TAGWIREYI

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Distinguished guests, ladies, and gentlemen. On the one hand, mine is a very difficult task: following two very good speakers. On the other hand, they have made my job a little easier in that I will not dwell too much on the definition of the nutrition problem. I think they have done an excellent job of doing that, and I also noticed Brief No. 6 has an excellent summary.

I shall not pretend to have the answers on the solutions, but will share with you what I see as the potential for a successful march, if I am to set the theme for this panel discussion.

I tend to have a very optimistic view of life, and my colleagues before me paint a depressing picture, which indeed it is, but I do not think it is insolvable. So what I will try and share with you, and I thank IFPRI for inviting me to indulge in my dreams in terms of what I see as the potential for addressing the solutions. I will also share what I feel are the limitations because indeed there are limitations—some of them have been mentioned—and maybe what is needed, or what is already in place is to try and minimize these constraints.

Coming from Sub-Saharan Africa and clearly understanding that the situation there is perhaps worse than in any part of the world, I think the world nutrition situation has indicated this, clearly protein energy malnutrition is a major priority problem for us. Evidence does suggest that even with a most optimistic scenario the trends are not very good, and our goal of meeting the goals set for the year 2020 frankly are a bit difficult.

The food question, the food situation, the food security situation, which this conference is primarily about, may be part of the solution, but I believe there are other solutions as well. And now the emerging evidence that seems to suggest that

childhood malnutrition may actually be contributing to some of the problems that we used to call problems of affluence, but I do not think that is so, the diabetes and cardiovascular diseases, those are some of the major causes of death in adults in developing countries now. So we now are caught between two very serious problems with a resource base that is fast diminishing.

And I think Lawrence did an excellent job of highlighting some of the potential priority problems that will only exacerbate a bad situation in Sub-Saharan Africa.

I agree with the urbanization issue. For us, for example, in Zimbabwe the recent preliminary data on the demographic health survey in 1994, where in the past we have indicated that protein energy malnutrition is worse in the rural areas, now seems to show the trend is reversed, and we are trying to find out why. Is it the economic situation? What is happening there? So there are some disturbing changes that are already taking place in some of our countries.

The AIDS issue needs attention, yes, I agree, but I think I need to bring to the attention of this group that, in spite of the AIDS pandemic, as we sit here now, more children are still dying from things we can prevent, things we know how to control, things we have the technologies for preventing: common infections, diarrhea, and measles. I appreciate the concern, but we have the technology now, and we can prevent those things. I think it is a sad testimony to a society that has solutions to those problems to allow them to continue.

The water issue is assuming even greater importance in my part of the world with the recurrence of droughts. As I stand here now, my country is in a serious drought, as are other parts of southern Africa. This is no longer something we can sweep under the carpet. We thought they were just coming now and again, but they seem to be recurring more often, and the fear of famine and all the diseases related to lack of access to water and food is a real

problem with us.

And I might just add here, while it may be relatively easier to access resources for relief activities, it seems a little bit more difficult to access resources that help countries to prepare to reduce their vulnerability to drought and recover so that the next drought finds them in a stronger position. This is something we need to redress. Maybe if you help us to help ourselves to be stronger, the call for food relief may become less and less as time progresses.

I think the last speaker focused a lot on the planning, programming, and targeting issues. I do not think I can do justice to that. I concur with a lot of the views he has expressed on the need to form a committee for planning.

Now, there are limitations to addressing nutrition, and I think part of the problem has been the inappropriate framework for addressing the nutrition problem. There has been a lack of conceptual clarity—I am quoting a colleague and friend of mine, and I like that expression—a lack of conceptual clarity in defining the underlying problem. I think traditionally nutrition has been viewed as a health problem, a problem for the health sector. It is for them to solve alone, those nutritionists with their little cooking pots. We, the agriculturalists, deal with the big issues. We provide the food. You tell the people how to eat it and that is how we collaborate.

While it is acceptable that the basic root cause is poverty, I think the underlying causes that Lawrence and Kalanidhi Subbarao mentioned are crucial, and that food security and health care are part of the underlying problem. Already you see the dimensions of what you have to do to address the problem more holistically. It is calling for different sectors to work together, not just health, which after all is there to treat. Traditionally, that was the focus of health. And this really speaks to the heart of development. I think that lack of clarity has caused us problems in the past

in dealing with the problems, and it has limited the institutional capacity for dealing with the problems.

If you think that the health problem is treated like a disease, which has to be treated when it occurs, and yet the cost of treating it is much more expensive than trying to prevent it, I think the recognition that the people themselves affected by the problem have a role to play in finding the solution has not been part of the agenda. We have the answers to most people's problems, and we go and give them those solutions. I think more and more if we look at the large-scale community nutrition program (I am talking now of my own experience), one is always amazed at the resourcefulness of the community in terms of articulating what their needs are and addressing the problem.

What, then, is the potential for a successful march on malnutrition? Frankly, I think the potential is very high, especially in these times. I think never before has nutrition received such attention, globally and nationally, as well as political commitment. In fact, there is an enabling environment that has been created by activities like the World Summit for Children, which has eight distinct goals to which governments have committed themselves.

Yes, I know the resources may not be there, but the fact that they have committed themselves to addressing those goals is far more than what has been in the past, and I think there is room for feeling that there is hope.

The recent International Conference on Nutrition (ICN), which produced a plan of action to which most of us are committed, and seriously committed, is bringing people together to develop national plans to help us to assess our own situations, find out what it is we need to do to address the problem much more holistically. We have established a mechanism that at least allows us to now make linkages with sectors that we

were not dealing with in the past.

In my own country, we have set up a task force. We have had to revisit the whole question of nutrition in terms of whether it is appropriately housed, whether we are doing the right things, and how do we bring in a broader participation? This is not a job for just a few government sectors. How do we bring in the NGOs and the private sector into this whole movement towards solving the problem?

I think the ammunition to deal with the problem is available. In spite of the rather gloomy picture, we have a number of experiences, they may not be large scale, but they are there, which show that there are successful nutrition programs in the world.

Zimbabwe has had an experience over the 10-year period where communities themselves were assisted in assessing their own nutrition programs, defining what the strategies are, and getting technical support and resources to help and implement the program. They have a sense of ownership, and they have concern for the children, and the program is sustainable because they feel it is theirs.

So there is ammunition out there, and we need to use it and focus on better programs, which the last speaker talked about. We know, for example, that investment in the social sectors, even in the absence of adequate economic growth, can actually lead to nutritional improvement.

Children cannot wait for that increase in economic growth in most countries, and something has to be going on while we are waiting for that glorious day when we will all have good incomes in our countries. So it is possible by judicious investment in health and in education to also be fighting malnutrition.

Some of the work the Sub-Committee on Nutrition has carried out, in particular trying to find out how and what makes a program work, what are the ingredients for nutrition improvement, I think these are lessons we have learned that we are in a better position

to apply. So all is not gloomy out there. There are some useful lessons we can apply.

I think there is also a renewed recognition and acceptance that planning and research need to be more responsive to nutrition program needs.

This may sound obvious, but it is not as obvious as it appears: in fact, there is a lot of research and nutrition training on some very strange, obscure nutrients, when some of us involved in planning programs are grappling with bread and butter issues of how do I make this work, or how do I target better? If I had answers to those problems, maybe I could do a better job, but maybe that kind of research does not find room in the clinical journals. People want to publish in recognized journals. Maybe it is too easy, but we require those easy solutions to the problems. I think one of the initiatives that is currently supported by the Sub-Committee on Nutrition is trying to refocus on how to strengthen skills and how to strengthen training of those who are implementing programs so that they can do what they are doing better, and how can we make sure that applied research is fed back to the program so that we have better programs emerging. I think these are things we can do. We can rearrange, make minor readjustments to what we do, and we may have bigger gains in terms of nutrition outcome than we previously had.

There are no magic bullets out there. And I wish I could say there were. I think nutrition has to be seen, as Lawrence says, not only as an indicator of development, but also as a contributor to development. It is not something that is going to go away. It is something we have to build in as part and parcel of normal development. We have to be looking out for it. So do not look for nutrition programs that will go away. They have to be part and parcel of the policy agenda of the country because how are we measuring progress? Is it just increasing GNP? Or is it quality of life? And if we are measuring quality of life, nutrition is an

excellent indicator.

So it is not something short-term; investments in nutrition are long-term. I am not coming here to tell you that in five years all will be over. Once you have it on board, this is something you are looking out for in perpetuity because quality of life in our societies is a goal we should have, and nutrition is that indicator.

So it is not a short-term investment that you can parcel off and move on to a new venture. It has to be viewed as an integral component of development. Frankly, the burden of malnutrition in a world so richly endowed is costly and unacceptable. I guess it is more challenging and it becomes more necessary for us to be better focused and deliberate in our efforts to address the problem. It is not going to solve itself. This theory that when you alleviate poverty through economic adjustments, nutrition will be taken care of. It is not true, and some of those children cannot wait that long.

Society's ability to feed itself in a manner that promotes healthy, productive lives will be a measure of this development. Of what use is increased GNP if it cannot be translated into quality of life?

Inadequate child nutrition is not only a problem in itself, but a risk factor contributing to the disease burden of the world, and the global community has to take some collective responsibility for the problem. The interdependency between the developed world and the developing countries demand that both worlds join hands in addressing the problem.

How, then, do we march on malnutrition as we confront the years ahead towards 2020? I think the current process, the current enabling environment facilitates a lot of action. Some of us who have been working for over 20 years were beginning to feel that all was lost, but frankly the climate out there is very conducive.

I think the themes of the ICN and the goals that were set through the World Summit for Children help us to focus. It is

no longer a bottomless pit where you are trying out this, trying out that. There is a lot of work that has gone on to define what are the ingredients.

Improving household food security is important, but I would like to suggest a broadening of the definition. I think in the past we looked at food security in terms of the calories and the cereals, and from what the previous speaker mentioned, the micro-nutrients. Let us look at the holistic food-basket, not just the cereals.

Prevention and management of infections as a strategy is known. No new research is needed there. It is just where to apply the knowledge that is known and the resources to back that well.

Promoting breastfeeding may seem like a minor issue, but there you are tackling the micronutrient problem, the child nutrition problem, in one fell swoop by preventing and controlling specific micronutrients, promoting appropriate diets and healthy lifestyles. So the strategies are out there.

The political commitment that exists in many countries needs to be nurtured and fostered in this endeavor, and the role of the international community and the communities who are themselves affected by the problems is critical. There has to be a partnership involving everyone, everybody having an equal role. I do not have all the answers. Neither does the donor community nor the NGOs. But I believe together, collectively, we have a chance.

On the whole question of institutional capacity, especially for Sub-Saharan Africa, frankly we do not have enough bodies, enough people, enough institutions to grapple with the problem. But the support we require is the kind of support that helps us to help ourselves. Help us to do the job ourselves so that maybe in 2040, when we meet here again, we can be talking of a march that was victorious and that brought the fruits we all desired.

Thank you.

TOWARD A CONSENSUS FOR ACTION

PER PINSTRUP-ANDERSEN

Director General

International Food Policy Research Institute

Tuesday morning I presented IFPRI's 2020 Vision and I described some major challenges to achieving the Vision. Since then, we have discussed many of the issues related to food, agriculture, and the environment. Now, how do we make the 2020 Vision a reality? This morning is dedicated to identifying the steps required to achieve the Vision—in other words, to finding the answers.

Here I will offer IFPRI's six-point program of action for achieving the 2020 Vision. Our four regional collaborators will follow and propose visions for their regions and present the actions necessary to achieve them. Then the views of the United Nations Development Programme and the World Bank will be presented. At the end of the morning, we should have a sense of where consensus lies on the Vision and the actions that support it. In fact, I believe we have already moved a long way towards a consensus for action. Much of what I will say has been proposed during the last two days.

In identifying the specific actions for meeting the 2020 Vision, we at IFPRI began with a broad look at the direction the world must take. The 2020 Vision will be achieved only if broad-based economic growth is accelerated, particularly in the poorest developing countries. Such growth must involve agriculture. In the poorest developing countries, agriculture employs three-quarters of the workers, generates nearly half of national income, and produces more than

half of all export earnings. It is true that global food supplies are sufficient to meet current market demand, but this is not a sign that we should reduce investment in agriculture. Many people still go hungry, and the agricultural sector offers tremendous opportunities for accelerating economic growth and reducing poverty and hunger in both rural and urban areas.

The 2020 Vision also requires that research, technology, infrastructure, and competitive markets be put to work to reduce the costs of producing and marketing each unit of food. Sound practices for managing natural resources must be adopted to assure that more intensive farming methods are sustainable, to prevent or minimize environmental degradation, and to maintain biodiversity. The poor, especially women, must gain greater access to productive assets, markets, employment, education, clean water and sanitation, primary health care, and reproductive health care services. Women must also be given a greater voice in decisionmaking at all levels. The conditions that lead to involuntary migration and displacement of people, such as civil strife, armed conflicts, poverty, and environmental degradation, must be addressed.

On the basis of this general assessment, we at IFPRI, together with the International Advisory Committee and many other individuals and institutions, identified six areas of action required to achieve the 2020 Vision. I will only mention highlights here today. Details appear in the 2020 Vision statement.

First, developing-country governments must be strengthened to undertake activities best done by governments. The international development community, as well as national governments the world over, must depart from the popular view that weak government or no government is good government. NGOs and the private sector cannot achieve the 2020 Vision alone.

Current efforts to reform the public sector threaten to weaken the ability of governments to do what they must do. Governments must, for example, maintain law and order. We were told several times by our colleagues attending the 2020 consultations for Africa and Latin America that improved security and personal safety in rural areas were prerequisites for achieving the 2020 Vision. Governments must also establish and enforce property rights jointly with local communities. Lack of clearly defined and enforced property rights and lack of access to property on the part of the poor are critical obstacles to achieving the 2020 Vision.

Governments must establish and enforce regulations, standards, and measures in private-sector markets and promote competition in these markets. A successful transition from state-run agricultural markets to efficient and effective private markets depends on competition, and it is the role of the state to assure that the conditions necessary for competition are present. Governments must also invest in or facilitate private-sector investment in agricultural research and rural infrastructure. Lastly, governments must maintain an appropriate macroeconomic policy environment and seek further international trade liberalization.

As developing-country governments strengthen their ability to fulfill their proper roles, they must let go of activities best done by other groups in society, such as private enterprises and NGOs. NGOs are playing an increasingly important role in areas relevant to the 2020 Vision. Governments should therefore seek to collaborate with

them and should help ensure that they are carrying out their new responsibilities effectively.

Second, developing countries must invest in poor people. If they are to increase their capacity to earn a decent living, the poor need access to employment, productive resources such as land and credit, basic health care, and education. Widespread poverty, food insecurity, malnutrition, and poor health are not just morally unacceptable; they are a deplorable waste of resources. Eliminating these problems is essential to achieve the 2020 Vision and should take top priority in low-income developing countries. In addition, through legislation and other incentives, governments should help empower women to gain gender equality.

Third, developing countries must increase agricultural growth. Doing so is the most efficient way of alleviating poverty, protecting the environment, and generating broad-based economic growth. Raising agricultural growth will require strengthening agricultural research and extension systems. The private sector can meet only some of the research needs. Much of the research with the greatest potential benefits for society is best conducted by the public sector, for private companies cannot capture enough benefits to make investment worthwhile. Private-sector agricultural research is virtually absent in low-income developing countries with food deficits.

Each country must decide how much money to allocate to agricultural research based on its own priorities and options. However, if the 2020 Vision is to be achieved, low-income developing countries must sharply expand their investment in agricultural research. A minimum target of 1 percent of the value of agricultural output is appropriate for most low-income developing countries, with a longer-term target of 2 percent.

This national agricultural research must be supported by a vibrant international ag-

ricultural research system that undertakes research with large international benefits. These benefits include research results that are applicable across boundaries. Current investment in international agricultural research is grossly inadequate to provide the support needed by developing countries and must be increased if the 2020 Vision is to be achieved.

Although more research is needed for all ecoregions, research needs to be increased on "low-potential areas"—those areas with fragile soils, limited or irregular rainfall, and many poor people. I will say more on the importance of these areas shortly.

In the industrialized countries, molecular biology and biotechnology research are producing exciting breakthroughs and significant gains for agriculture. However, with some exceptions, the advances in biotechnology for agriculture are bypassing developing countries. This research focuses on temperate-zone agriculture, and most of the results are irrelevant to the agricultural problems of the developing world. It is urgent that modern molecular biology be brought to bear on developing-country agriculture.

Fourth, we must make agriculture more productive in ways that are sustainable and adopt sound management practices of natural resources. A large share of the world's poor, food-insecure, and malnourished people live in areas with unreliable rainfall, fragile soils, and degraded and deforested land. We cannot achieve the 2020 Vision without large investments in these areas by both governments and the private sector. At the most basic level, alleviating these problems must involve giving local groups greater power to manage natural resources. Government policies should also create incentives that make it worthwhile for communities and private groups and individuals to invest in and protect natural resources.

Many specific natural resource management problems require the attention of

governments and NGOs. Let me mention three here: declining soil fertility, excessive use of pesticides, and inappropriate use of water.

In many developing countries—including most of Sub-Saharan Africa—soil fertility is low and getting lower. To reverse this situation, farmers must apply plant nutrients from both organic and inorganic sources and must adopt better soil management practices. In view of the magnitude and seriousness of the soil fertility problem and the high costs of fertilizers in most of these areas, government help is clearly needed. Government policies will need to provide incentives for farmers to increase their use of both organic and inorganic fertilizers and to adopt better soil management systems. Such policies will include clear property rights, access to credit and improved crop varieties, investments in transportation facilities, and well-functioning markets for plant nutrients. But in many places the problem is too urgent to rely on these solutions alone. To raise fertilizer use immediately in areas where it is most needed, the only viable solution may be for governments to help farmers pay for the fertilizers.

While fertilizer use has been too low, pesticide use has been too high. As concerns mount about the environmental and health consequences of chemical pesticides, developing countries must pursue alternatives to excessive use of pesticides. The most promising solution is integrated pest management, which combines biological controls, such as natural predators of pests, with limited applications of chemicals. Integrated pest management has been implemented for rice in Southeast Asia with great success. Now it is time for national governments and international donors to support research and extension that will extend integrated pest management to other crops and regions. At the same time, governments in developing countries must take other steps as well, such as removing pesticide subsidies, investing more in research on

safe and environmentally sound alternatives to chemical pesticides, and retraining research and extension staff to work more closely with farmers.

Finally, growing national, regional, and local water scarcities pose serious threats to agricultural production, human health, and the environment. Worsening water shortages could also lead to civil and international water wars. Such conflicts are already brewing in the Middle East, North Africa, and South Asia. One solution is to develop new water resources. National governments should invest in carefully selected, economically efficient projects to capture surface water and to sustainably exploit groundwater.

But developing new water resources is expensive, and many have harmful environmental consequences. Therefore, countries should focus most of their attention on using water more efficiently in agriculture, industry, and urban areas. This will require changing policies that currently allow farmers, factories, and city dwellers to misuse or overuse water at little or no cost, to the detriment of other users and the environment. To encourage all users to economize on water, national governments must reform distorted price incentives and reduce or remove subsidies on water. Policies should also give secure water rights to users. A good example of this relates to irrigation. Management of irrigation infrastructure should be turned over to water user associations, because well-defined water rights will provide incentives for these groups to use water more efficiently. Policy reforms should establish better and more flexible ways of allocating water between users. Such reforms should develop and disseminate improved technology for supplying and delivering water. They should create incentives for private groups to invest in water and water infrastructure.

Fifth, food marketing systems must be improved in low-income developing countries. It is too expensive to get food from

the farmer to the consumer. To reduce this cost, governments should invest and facilitate private-sector investment in rural infrastructure such as roads, electricity, and telecommunications, and they should promote competition among private traders. It is essential that developing countries phase out inefficient state-run firms in agricultural markets and, following more privatization, that the public sector identify its proper roles in the agricultural markets. Small-scale traders, transporters, and processing enterprises are crucial to developing competitive and efficient markets for agricultural goods. Governments should facilitate the development of small-scale credit and savings institutions to serve these groups.

Sixth, foreign assistance should be made available to countries that have demonstrated a commitment to reducing poverty, hunger, and malnutrition and to protecting the environment—goals embodied in the 2020 Vision. Foreign assistance can provide only a small fraction of the financial resources that will be needed to achieve the 2020 Vision. But these resources are crucial. They must be allocated in ways that effectively complement national and local efforts. To improve the effectiveness of aid, each recipient country should develop a coherent strategy for achieving its goals related to food security, poverty, and natural resources, and should identify the most appropriate uses of foreign assistance.

The amount of international development assistance required to support the action I have described will exceed the development assistance currently available. Therefore, both donor and recipient countries must renew their efforts to ensure that whatever assistance is available is put to the best possible use. This assistance should focus on four areas:

1. Activities with large international benefits, such as international agricultural research and alleviation of global environmental problems;

2. Investments in items with high social payoffs and long-term benefits, such as primary education, primary health care, nutrition programs, agricultural research, and physical and institutional infrastructure;
3. Programs to foster more efficient and effective use and allocation of resources shared by more than one country, such as water; and
4. Efforts to assure that low-income developing countries realize their fair share of the benefits from international trade liberalization.

The six actions we recommend for achieving the 2020 Vision can be summarized this way: Governments and civil society should invest in poor people, agricultural productivity, sustainable use of water and other natural resources, and improvements in agricultural markets.

Time is running out. Already over 1 billion people live on less than a dollar a

day, 800 million people go to bed hungry, and over 200 million preschool children are malnourished. Business as usual will result in increased poverty in Sub-Saharan Africa and an unchanged, still severe, poverty situation in South Asia. It is not ethical or wise for the world to continue to harbor such poverty. There is tremendous human suffering associated with these numbers, and the productivity of starving, malnourished people is low, to say the least. The 2020 Vision will not be achieved unless the productivity of poor people is increased and their access to employment enhanced.

2020 Vision research shows that the earth's natural resources can support 8 billion people by 2020. However, unless action is taken now to slow natural resource degradation, the earth's carrying capacity will weaken, and a time may come when our children will look back and wonder why we did not take action when natural resources were still sufficient to feed the world in a sustainable way.

REGIONAL VISIONS AND REQUIRED ACTION

SUB-SAHARAN AFRICA

BABA DIOUM

Coordinator-General

*Conference of Ministers of Agriculture of
West and Central Africa*

Introduction

It is an honor for me to speak on behalf of the African researchers, technical experts, and policymakers who participated in a workshop organized in December 1994 in Saly Portudal, Senegal, to discuss the challenges facing the food, agricultural, and environmental sectors of African countries towards the year 2020. The workshop was jointly organized by the International Food Policy Research Institute and the Conference of Ministers of Agriculture of West and Central Africa, which I have the privilege to represent at this conference. I will address three main issues in my presentation. First, I will review the main challenges facing African countries in the areas of food, agriculture, and the environment as we move towards the year 2020. I will then discuss the strategic options in the same areas for the next 25 years. Finally, I will summarize the key critical choices African countries will have to make for 2020.

What Are the Challenges Facing African Countries in the Areas of Food, Agriculture, and the Environment?

It is currently estimated that one out of two Africans, or roughly 250 million people, subsist on per capita total incomes of less

than a dollar a day. Furthermore, about 30 million preschool-aged children are estimated to be malnourished, a number that will triple by the year 2020 unless strategies to reverse the current trends are adopted. No other region of the world is raising more concerns in terms of the future of agricultural development, poverty, and food security. Solving Africa's poverty and nutrition problems will be extremely difficult unless the rapid rate of growth of population is brought under control.

To give you an idea of the seriousness of the challenge facing African countries, aggregate cereal demand and supply balances for African countries—assuming our best estimates of trends in economic, agricultural, and population growth—show a significant increase in the required cereal imports by year 2020. The likely difficulties in financing these levels of imports would lead to a significant deterioration of the food security situation in Africa.

A rapid growth scenario assumes a 50 percent faster economic growth and a slower population growth in African countries. Even in this case, African countries will still have to rely on imports to satisfy a significant part of their food needs. Despite the assumption of faster growth under this scenario, the absolute number of malnourished children to increase from the current 30 million to about 40 million, even though their relative share declines from 29 to 21 percent of the child population. If the present trends were allowed to continue, the number of malnourished children would skyrocket to 45 million, or 26 percent of the child population.

Most poor people and malnourished

children live in rural areas and have to rely on agriculture as their principal livelihood. In addition to being the primary source of food in rural areas, agriculture is a major source of the foreign exchange needed to finance food imports for urban areas. Yet, growth in Africa's agricultural sector has been largely disappointing over the last 15 years, despite the existence of pockets of good performance in certain commodities, markets, and countries.

The reasons for the generally poor showing of agriculture in Africa involve policy and structural factors, and both of these have internal and external components. Developments in global agricultural markets and other spheres of the international economy cannot be left out of the explanation for the recent stagnation in Africa. But we also have to ask ourselves why policies actually followed in most of our countries differed so greatly from the ones needed to face external constraints and improve economic performance.

Fundamental changes are required in the way our economies operate and in the way we manage them. These changes are well within the technical and economic capacity of most African nations. The questions we have to ask ourselves are the following:

First, whether African governments will adhere to the need to effectively set poverty alleviation and food security as a top priority; second, whether they will undertake the necessary efforts to mobilize the required resources to achieve progress; third, whether they can agree to adopt the policy and institutional changes necessary to meet the challenge facing most African nations as they move into the next millennium; and fourth, whether outside partners are ready to follow these priorities in setting up their own programs towards Africa.

What Are the Strategic Objectives African Countries Need to Achieve by the Year 2020?

The future prosperity and political stability of African nations depend on our ability to bring about sustainable growth in agricultural production, reduction in the rate of growth of our population, and effective protection of our natural resources. The costs of failing to achieve these objectives are such that African countries hardly have any other alternative, unless that means continued stagnation and despair would be even worse than that of the past 15 years. The priority objectives African countries have to focus on for the year 2020, as identified at the regional workshop in Senegal, are the following:

First, significant reduction in the number of the absolute poor over the next 25 years; second, elimination of chronic malnourishment among children; third, accelerated agricultural growth to achieve a rate of at least 4 percent; fourth, stopping the process of rural environmental degradation; and fifth, lower average rates of population growth below the projected 2.5 percent by 2020.

It is clear that if significant reduction in poverty is not achieved, the stability that is required for a peaceful and sustainable development in Africa will be severely compromised. Since nearly 90 percent of Africa's poor live in rural areas, poverty reduction strategies should focus primarily on raising rural incomes through increases in agricultural productivity. In the short to medium term, poverty may need to be attacked more directly, for example, through food-for-work schemes and other targeted public work programs. If these programs are used to improve rural, social, and physi-

cal infrastructure, they will also contribute to the agricultural growth objective. More important, Africa must make the necessary efforts to protect its 30 million malnourished children. The question here is less a question of capacities than one of political will.

However, achieving the above growth and poverty alleviation objectives on a sustainable basis with an average population growth rate of nearly 3 percent annually is a real challenge. Despite the fact that the scope for lowering population growth rates in the short to medium term is limited, African countries have to act now to ensure long-term impact.

What Are the Choices African Countries Will Have to Make for the Year 2020?

African governments will have to make certain choices if they want to achieve the growth and poverty alleviation objectives presented here. The most critical choices that need to be made now are the following: first, we have to improve the quality of governance, in general, and of agricultural policies, in particular; second, we have to substantially increase public investment in agriculture in order to meet the investment needs of an accelerated growth process in that sector; and third, we have to set up programs to reach and include the poor and the malnourished.

Effective rural participation and greater consistency in agricultural policies are necessary to induce increased private investment in the agricultural sector. In addition to mobilizing private resources in the rural economy, financing the growth and poverty alleviation objectives will require our governments to reallocate budgetary outlays and to significantly increase the level of public investment in the agricultural sector. The reallocation of budgetary outlays would also allow African countries to take more direct and immediate actions to combat poverty and child malnourishment, beyond

the short-term impact of agricultural growth.

Let me now close my presentation with a final remark. For once, African researchers, policy analysts, and practitioners have carried out an uncomplacent diagnosis of Africa's agricultural sector. The diagnosis is clear, and so are the alternatives: Either to turn Africa into more than a marginalized continent that is hardly capable of effectively using the emergency aid it receives; or face up to the challenge and fight to feed a growing number of Africans by the sweat of their brows and the optimal use of the continent's human and natural resources.

ASIA

SARTAJ AZIZ
Senator, Pakistan

The shared vision of a world free from hunger and poverty by the year 2020 will depend largely on the prospects of achieving comprehensive food security in Asia, since about 60 percent of the world's poor and malnourished, estimated at 1.1 billion in 1990, live in Asia.

Economically the developing countries of Asia can be divided into three main groups as follows: (1) the four tigers: Hong Kong, Korea, Singapore, and Taiwan, which have per capita GNPs ranging from about \$7,000 per year to about \$16,000 per year; (2) four rapidly growing middle income countries: Indonesia, the Philippines, Malaysia, and Thailand, with per capita GNPs ranging from about \$700 for Indonesia and the Philippines to about \$2,800 for Malaysia; and (3) the low income countries of South Asia: such as Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka, as well as China. None of these nations has per capita GNP in excess of \$400 per year. In these countries, therefore, poverty is still a pressing concern. It

is important to note that only a generation ago, i.e., in the late 1950s, the wealthy countries of East and Southeast Asia had poverty levels close to the levels prevalent in South Asia today. They have, therefore, blazed a trail for South Asia to follow, by showing that it is possible to make the transition from poverty to relative affluence in one generation.

Food Security Outlook

Per capita incomes have grown steadily in the past 25 years. Gross domestic product (GDP) for the region grew at rates ranging from 3 percent between 1970 and 1980 to 5 percent between 1980 and 1992, while population growth rates averaged about 2.2 percent for the region during 1980 to 1982. Per capita incomes are likely to go on increasing because population growth rates are falling throughout the region.

Asia has seen, by historical standards, a dramatic growth in its food production. In the 25-year period, from 1966 to 1990, wheat production has been growing at 5.7 percent, rice production by 2.3 percent, and maize production by 4.5 percent per year. Remarkably, the bulk of these dramatic increments have come from higher yields, which have improved at an annual rate of 4.25, 2.3, and 3.4 percent respectively. Thus, in Asia as a whole, food production has outpaced the growth of population.

Recent years have also seen a sharper increase in the production of meat, milk, and eggs in response to the demand for a diversified foodbasket in the wake of rising incomes. Between 1982 and 1990, meat production in Asia has increased by an annual average rate of 6.2 percent, milk by 7.7 percent, and eggs by 5.2 percent (comparable rates for the period 1966–74 were 4.0, 2.8, and 2.8 percent respectively). Thus, on the whole, in most countries of Asia, but particularly in the low income countries of South Asia, per capita food availability has risen and at the same time

the production and consumption of meat, milk, and eggs has increased at a very rapid pace in the past 25 years.

These gains in the production of food in Asia have come with the advent of the Green Revolution in the late 1960s, particularly for wheat and rice. The infrastructure for research and extension has expanded in almost all countries and there has been impressive progress in the production and use of fertilizer. Investment in irrigation, particularly the exploitation of groundwater through tubewells, has also been a major factor because the new high yielding varieties of wheat and rice can produce satisfactory results mostly in combination with assured irrigation.

The food security outlook for the next 25 years is not likely to experience the remarkable progress achieved in the past 25 years. In fact, some recent studies, notably the Carrying Capacity Study of the World-watch Institute, has made very gloomy predictions about Asian food prospects in the future. "After nearly four decades of unprecedented expansion in both land-based and oceanic-based food supplies, the world is experiencing a massive loss of momentum. The backlog of unused agricultural technologies is shrinking, production of seafood and livestock is approaching its limits, demand for water is pressing against the limits of the hydrological cycle, additional fertilizer in existing varieties has little effect on yields, many countries are losing cropland at a rate that exceeds the rise in land productivity, and social disintegration is undermining efforts to increase food production."

This study forecasts, on the basis of these factors, that the gap between grain production and grain consumption of six large Asian countries will increase from 17 million tons in 1990 to 340 million tons by 2030 (Bangladesh, 9 million tons; Indonesia, 12 million tons; Pakistan, 26 million tons; Iran, 32 million tons; India, 45 million tons; and China, 216 million tons).

Other projections are not so alarming. IFPRI's projection prepared for this Conference forecast that net trade in wheat in Asia (excluding Japan) will increase from 27 million tons in 1990 to 61 million tons in 2020, and that in rice from 7 million to 11 million tons. India may have surplus in both wheat and rice by 2020. Bangladesh will have a wheat deficit of about 4 million tons, together with a likely rice surplus of 1.4 million tons. Indonesia may have a wheat deficit of 3.8 million tons, but will be self-sufficient in rice. Pakistan and China face larger grain deficits, but not as large as those predicted in the Carrying Capacity Study.

These less pessimistic projections are based on two main assumptions. The first arises from the fact that the production potential of new technologies introduced in the 1960s and 1970s has not been fully realized. With the communication revolution now taking place around the world, it should be possible to extend these technologies to much larger areas in the future, thus raising agricultural yields, particularly in wheat and rice.

The second assumption springs from the expectation that growth of world population, which has slowed down from 2.1 percent in the 1960s to 1.7 percent currently, will continue to slow down to 1.4 percent or even lower. Developing countries in which population growth is not decelerated, and concerted efforts are not undertaken to spread the available technologies, will obviously face harsher choices.

Poverty and Hunger

The challenge of providing food security to everyone living in Asia is compounded by the sheer size of the poor population living in Asia. The availability of cultivable land is also relatively limited for a growing population. The world population is expected to increase from 5.8 billion in 1995 to 8 billion by the year 2020 and for Asia from

3.4 billion to 4.8 billion.

According to UNDP, *Human Development Report of 1994*, India, Bangladesh, and Pakistan were among the ten developing countries with the highest number of poor people in the world. In 1992, India ranked first with about a quarter of the world's poor. These numbers are growing because of population growth. It is projected that, by the year 2020, India and Pakistan together will have a population greater than that of China. In fact, India is projected to become the world's most populous country in the early part of the next century. For all the countries of South Asia, except Sri Lanka, the population in 1990 was over 50 percent larger than in 1970. As a result, population density has increased in all countries, in many cases putting enormous pressure on the resource base. Bangladesh in particular has one of the highest population densities in the world at 763 people per square kilometer.

Each country in the region is in a different stage of demographic transition; with Sri Lanka almost at the replacement rate of growth, India and Bangladesh on the road to declining fertility, and Nepal and Pakistan still in the high growth stage. While there has been migration to the cities in these countries, their populations remain predominantly rural. In 1990, over 70 percent of the South Asian population was still living in rural areas, and it is here that most of the poor are located.

A major obstacle in increasing crop yields is the preponderance of small farmers in most Asian countries. Small farmers often do not have access to assured irrigation, nor can they afford modern inputs. As a result, the average yield of a typical small farmer is generally one-half to one-third of medium and large farmers. Major constraints in expanding agricultural production and reducing poverty in the next 25 years are, therefore, social and institutional.

Because of these factors, and notwith-

standing the impressive gains in food production, poverty and malnutrition will remain widespread in Asia, particularly in South Asia.

The ability of the human body to convert food into nutrition depends on a number of factors, especially access to safe drinking water. Now, nearly half of the rural population in South Asia does not have access to safe drinking water, with a slightly lower proportion in urban areas. However, there are also success stories. Bangladesh did particularly well in providing access to safe water to about 80 percent of its population by 1990. The limited data on access to sanitation indicate that levels of access are generally low and, like the availability of clean water, show a pronounced urban bias.

Low levels of literacy, especially among women, in the region are now a major stumbling block to the success of any strategy to ensure food security, since uneducated women have lower caring capacities, and this in turn affects the nutritional status of infants and children.

The Kathmandu workshop organized by IFPRI in preparation for this conference emphasized the need for according high priority in the food security programs to policies and actions that will provide safe drinking water, improved sanitation, and primary health care.

The Challenges Ahead

Agricultural growth has a crucial role to play not only in ensuring that food is available, but also in ensuring that the poor have access to food by providing employment, and hence the means to buy food. If agricultural production is to continue to grow in the South Asian region over the next 25 years, three challenges must be met. First, these countries have to sustain and if possible improve upon the average annual agricultural growth rate of 3.3 percent achieved in the past two decades. Second, a major part of the incremental

growth must come from higher productivity obtained by a wider application of improved but not necessarily new technologies. This would enhance their comparative advantage and competitive position in the world market. Third, the policy shift in favor of agriculture, and within agriculture in favor of small farmers, must be sustained and strengthened.

To increase the chances of successfully meeting these challenges, simultaneous and mutually reinforcing improvements need to be brought about in the following three areas: (1) positive and sensible economic policies, especially concerning agricultural trade; (2) the creation of appropriate institutions covering the whole range of inputs and services required by the agricultural sector; and (3) profitable but environmentally sound agricultural policies. If any one of these factors is missing or inadequate, progress would be difficult or inequitable.

What is the likelihood that these challenges will be met in South Asia? The potential for bringing more land under the plough has largely been exhausted. Therefore, increases in output will have to come largely from an increase in yields. As already mentioned, an encouraging factor in this endeavor is that the potential of the new technologies introduced in the 1960s and 1970s has not been fully realized. There is still considerable scope for realizing the full potential of these technologies because in most countries only 20 to 30 percent of the farmers have been able to fully adopt to the new technological packages. A recent study in Pakistan showed that percent average yield gap—that is, the difference between potential yields under experimental conditions and the national average yield—was 82 percent for cereals, 78 percent for sugarcane and pulses, 68 percent for oilseeds, 67 percent for vegetables, and 61 percent for cotton and fruits, respectively.

Recent advances in communication technologies offer the prospects of many new and bold approaches in extending the

application of these technologies to a much larger proportion of farmers. The benefits of these technologies have so far been confined to areas with assured water and to crops like wheat and rice. It is important to diversify the research to cover crops suitable for arid and semi-arid areas and to search for integrated pest management systems that reduce reliance on chemical pesticides. It is difficult to take agriculture progressively towards a science-based, high-yielding sector if the bulk of the population is unable to read or write as is the case in several South Asian countries.

The importance of the agricultural sector was recognized by many developing countries during the food crisis of the early 1970s, and this was reinforced by the debt crisis of the 1980s. Policies towards agriculture are still being reviewed and redirected. This could, if continued and extended, have a very favorable impact on agricultural production. This trend would be strengthened with the improving international environment for agricultural trade. Developing countries that have achieved sustained economic growth in the past three decades have been, in general, countries where the rate growth of agriculture production exceeded the population growth. The growing awareness of the importance of the growth linkages between agriculture and industry has led to an emphasis away from industry-led growth to one where both sectors are acknowledged to be equally important and complementary. Studies have found that for every 1 percent increase in the agricultural growth per capita there is an associated 1.5 percent increase in nonagricultural growth per capita. The emphasis must now be on following development strategies that maximize labor intensity, make the maximum contributions to balance of payments, and strengthen backward and forward linkages. Without a rapidly growing agricultural sector, such a strategy is difficult to follow.

Another important area deserving high

priority in the allocation of public funds is the areas of agricultural research and agricultural extension. Carefully planned expenditures on productivity-increasing agricultural research accompanied by programs to disseminate its results is one of the most effective means of improving the comparative advantage in international trade. The alternative of providing subsidies is both costly and inefficient. The case of Pakistani cotton is well known, where investments in productivity-increasing research led to a 120 percent increase in yields over a ten-year period. The international evidence on this is extensive: countries that have made sizeable investments in agricultural research and extension along with investments in irrigation and rural infrastructure have made impressive gains in agriculture productivity.

What Needs To Be Done

It is clear from the foregoing that the objective of providing comprehensive food security in Asia is a formidable challenge and is not likely to be achieved by the year 2020 for the entire Asian population.

However, a more realistic target will be to reduce the level of undernutrition and malnutrition by at least 50 percent, in the next 25 years. Even if this more modest target is achieved and the proportion of poor and malnourished population is reduced from 20 to 10 percent of the total population, there will be, in absolute terms, at least half a billion malnourished people in Asia by the year 2020.

In most countries of East and Southeast Asia, it should be possible to virtually eliminate poverty and malnourishment in the next 25 years, but the real challenge lies in South Asia and China, which together account for almost 70 percent of Asia's population.

What needs to be done will obviously vary from country to country, but there are certain common strategies and policies for food security that most Asian countries can

and should follow.

In the short and medium run:

- Innovative programs to extend high-yielding technologies to a much larger proportion of the cultivable area. This will require extensive use of radio and television to supplement the work of extension workers and community-based services for the supply and use of credit and other inputs and improved marketing, particularly for small farmers.
- Larger investment in small-scale irrigation and improved water management. Since the scope for expanding cultivable area is limited in most Asian countries, the existing water resources must be used much more efficiently to increase cropping intensities and to diversify into higher value crops.
- The adoption of macroeconomic policies that are at least neutral to agriculture. In other words, hidden discriminations against agriculture should be eliminated. This is absolutely essential to harness gains from enhanced investment in agriculture and to realize the full potential of new technologies.
- Better design of food security programs. Most of the existing programs ignore the intrahousehold distribution aspects and target only on individuals or some target groups in special need. There is a need to introduce and strengthen household and intrahousehold food security programs for the poor and disadvantaged based upon effective policy research.
- Actions to improve maternal and child health and nutrition and policies to improve access to clean water and proper sanitation. These are crucially linked to the overall health and nutritional security of a population.
- The design and implementation of effective safety nets to protect the poor and vulnerable over the short term during periods of structural adjustment and economic liberalization.
- Surveys and studies to build up and

strengthen policy relevant databases, especially for the analysis of poverty, malnourishment, health, and environment. The existing databases are extremely inadequate for effective policy research and reform.

In the medium to long run, there is a need for the following policies and actions:

- Agricultural research programs that focus on generating technologies to enhance employment, income, and access to basic needs. This will have the added benefit of generating employment in the nonagricultural sector as well, because of linkages between the two sectors.
- The promotion of environmentally sound technologies, such as drip irrigation to increase water-use efficiency, community forestry and agroforestry, watershed management, and farmer-managed irrigation systems to achieve both increased productivity and sustainability.
- A drastic increase in investment in education, with special efforts to improve educational levels among women.
- The implementation of effective land reforms in order to address the problems of inequality and poverty caused by landlessness.
- The dismantling of policies that lead to environmental degradation. These include expansion of irrigation without drainage or with inefficient distributory channels or providing unwarranted subsidies on irrigation water.
- Expanding trade in food products, both within the Asian region and with the rest of the world. One area in which immediate progress is possible would be to liberalize trade in feedgrains. The compensation of agro-exports has diversified recently towards rice, wheat, fruits and vegetables, and processed foods. Liberalization in trade and exchange rate policies, favoring exports

from the agricultural sector, should be expanded. Trade controls, including quotas and taxes, need to be relaxed, and the infrastructure has to be developed to increase the efficiency of trade flows.

Conclusion

The response of the international community to the food crisis of the early 1970s was overwhelming and produced dramatic results. It led to a sharp increase in overseas development assistance and technical assistance for agriculture and the setting up of organizations such as the International Fund for Agricultural Development (IFAD). It led to major international research efforts based at the International Rice Research Institute (IRRI) and the Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), which focused on rice and wheat, and it led to the creation of IFPRI. Several countries in the South Asian region were able to make substantial investments in agricultural development and to reassess their development priorities.

In the 1990s, the awareness of the international community of the immensity of the tasks ahead has been amply demonstrated by the priority given to the three global summits that have laid out the issues in terms of the environment, population, and the social agenda. The present conference has given these issues a much sharper focus by moving agriculture and food security to center stage. The issues are now well defined. The question now is: "How do we implement them?" The actions needed by the global community in the period between 1995 to 2020 must be identified specifically as part of the 25-year agenda with adequate international mechanisms to monitor progress on a systematic basis. Our guiding principle in this endeavor should be: "Sustainable livelihood should be accepted as a basic human right for all citizens by the year 2020."

LATIN AMERICA

EDUARDO J. TRIGO

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As we look toward 2020, it is unlikely that Latin America as a region will face a severe food crisis during the next two decades. But millions will continue to go hungry and malnourished. Poverty will continue to grow, and the environment in the cities and in the countryside will continue to deteriorate. All of this in spite of the richness of the region's agricultural and natural resources and the great potential of its peoples.

The region presents itself as a puzzling contradiction. It has 23 percent of the world's arable land, 46 percent of its tropical forests, 31 percent of its fresh waters, and a substantive proportion of the world's biodiversity, yet it has only 8 percent of the world's population. Despite this wealth of natural resources, a growing number of countries in the region do not produce enough food to feed their people, 45 percent of their population is poor and almost 60 million people do not get enough to eat. The region, as a whole, has gone from being a major player in the international agricultural markets to representing only a minimal fraction of the international food trade. Current projections show that, by 2020, the region will be a net importer in all but one or two of the major commodities.

The vision developed by the participants in the regional workshop for Latin America points to the reversal of these conditions. They envision a situation where extreme poverty, hunger, and severe malnutrition have been eradicated; where income, wealth, and opportunity are more evenly and fairly distributed; and where all citizens enjoy a more healthy environment. They also envision that the region will become a net positive contributor to the global food balance, while at the same time it conserves and enhances its natural resources.

On the basis of past performance, this vision may not sound realistic. In the past, a misunderstood conception of modernization spurred the state to try to guide development and misdirected the potential of the region's resources. Government policies often discriminated against agriculture and drained needed resources from rural areas. They favored urban industries and those who lived in the cities. This set the stage for rising poverty in rural areas and for the overexploitation and degradation of natural resources as millions of small farmers struggled to make a living.

But the group that met at Cali felt that the dramatic economic, political, social, and institutional transformations under way in most of Latin America hold the promise of reversing these tendencies and unleashing the potential of its resources and making the vision a reality.

More responsible fiscal and monetary policies, trade liberalization, deregulation, privatization, and decentralization are providing a new set of incentives for private initiative to emerge and assume a more important role in development, and are setting the basis for increased efficiency in resource use and for better economic performance. At the same time, the renewed strength of democratic institutions is creating the basis for increasing the responsiveness of the political process to the will of the people. The likelihood of success in achieving our vision depends on the ability of the region to generate broad-based growth in this new context by relying on environmentally sound economic activities and technologies.

Sustained economic growth is a key in any future strategy. Only with growth will the alleviation of poverty and hunger on the scale required be possible. Increases in food production alone cannot solve hunger and poverty. We must generate enough employment for the people in the urban and rural areas so they can earn enough to buy the food they need. Agricultural development is central to achieving these objectives.

In Latin America, agricultural production is 10 percent of the economy if considered alone and more than 30 percent if taken together with agroindustry, and about 25 percent of the population—up to 50 percent in the poorest countries—still live in rural areas and depend on agriculture as their major source of employment and income. Since so many of those who depend on agriculture are among the poorest of the poor, it is almost evident that promoting agricultural growth is probably the most efficient and democratic way to spur the needed economic growth. At the same time, scientific and technological developments in fields as diverse as biology, microelectronics, and information are rapidly broadening opportunities for a more effective and efficient use of natural resources in agriculture and food production. The challenge is how to exploit these opportunities in a way that ensures a more equitable distribution of incomes and the sharing of the benefits among all those involved, including women and indigenous people.

Taking these considerations into account, I want to highlight four general areas of action that are required to turn our vision into a reality.

First, we must review the way we approach agricultural development and redirect efforts on a spatial basis. Efforts to develop rural areas and alleviate rural poverty should look not only to agricultural production and agricultural producers, but to the whole complex of economic and social activities based in rural areas. If poverty is to be reduced, hunger conquered, resource degradation stopped, and migration from the rural areas reversed, we need to go beyond traditional visions and look at the whole complex of economic and social activities located on the rural space. The issue is income generation and that means not only improving access to productive inputs, like seeds and credit, but also improving the efficiency of other components of the food and

agricultural system as well. Transportation and communications linking production areas to the markets must be better developed, and the development of income-generating alternatives to agricultural production, such as agroindustry and other nonagricultural activities in rural areas and intermediate cities should become key priorities for public and private investment.

Still, it must be recognized that agricultural growth can only alleviate, not eliminate, poverty. For the poor who remain in the rural areas, social assistance must be directed to them as part of a social, and not an agricultural, strategy.

International agencies and bilateral aid organizations can play a strategic role in working together with national governments and the private sector to design and implement a new generation of projects and investment activities based on this perspective.

Second, there is the need for a massive effort at institutional innovation. The emerging political and economic conditions suggest that, in the future, the process will be increasingly subject to the dynamics of the market rather than guided by specific policies. In fact, this is already occurring. Government reform and structural adjustment have severely weakened existing institutional frameworks, and sectoral policies are now subsidiary to broader macroeconomic policies. If the existing positive elements of this transitions are going to be effectively exploited, new institutions and priorities for public intervention must be developed. This is not to say we should go back on current economic, political, and institutional reforms. Market mechanisms, and stable and transparent macroeconomic policies, must be preserved as the essential elements shaping the necessary adjustments in production patterns, but new policies and institutions are needed to induce those adjustments in a way that also achieves social and environmental objectives.

Many of the needed changes are already under way as an integral and natural compo-

nent of the forces working to strengthen the democratic process. However, the institutional innovations needed to address the interlinked problems of poverty and resource degradation are not so readily apparent. We cannot expect market mechanisms alone to achieve growth, equitable income distribution, and resource conservation simultaneously. To achieve this convergence, we need a new generation of institutions that bring together individual, institutional, and social objectives and behaviors and set the stage for a more equitable and sustainable development path. The participants in the Latin American workshop identified several areas that should be given priority in this search. Two top priorities are the development of a new framework for public-private sector interactions, and a greater decentralization of policy and program design and implementation and of control over financial resources. The growing consolidation of democracy in the region has brought renewed strength to its civil society, and there is an urgent need to set the stage for capitalizing on this new situation. Decentralization is essential not only to allow people to participate in the making of the decisions that affect their lives, but to ensure that local institutions are congruent with community needs and locally available resources. Together with this, other priorities include the reconceptualization of property rights to ensure that people have access and control over the resources they need for their development, and new forms of market regulation to prevent and correct market imperfections and noncompetitive behaviors that distort resource use and have negative impacts on income distribution.

There is still little agreement about what the nature of these institutions should be, with many rightly arguing that there are no recipes applicable to all situations. Successful arrangements will be those that respond to the needs and idiosyncrasies of each particular case. But the need for these

institutions is urgent and a public, active debate must be undertaken right away.

Third, we must make a significant effort to develop new technologies. By itself, of course, technology is not the solution to the problems of poverty and degradation. Past experiences painfully show that, if the policy and institutional environments are not right, technological efforts go mostly to waste. Once new policies and institutions are in place, however, new technological alternatives become a necessary condition to achieve our goals. The kind of production and income increases required can be achieved only through a massive effort at productivity improvement. In the past, intensification has been equated with resource degradation. In today's scientific and technological environment, however, if properly managed, this intensification process should not conflict with better environmental and resource management situations. Existing indigenous knowledge offers a great, still-untapped potential, and there is already evidence that "win-win" technologies that increase production while protecting the environment are a concrete possibility in many situations. The new biotechnologies, as well as other knowledge-intensive technologies, such as management techniques, informations, and new means of communication also offer great potential, but we must set the stage for accessing and properly exploiting them.

The region has significant capacities to this purpose, but in recent years existing institutions have been severely weakened and investments have been drastically reduced. This is true not only at the national level but also at the international level, where donor assistance and externally supported research and development programs have been severely reduced. To reverse this condition, not only are additional financial resources needed, national governments and international institutions should also undertake a substantive review of existing institutional frameworks to make them more compatible with the new scientific, political, economic, and social environments in which

they have to work. The current initiative by the Inter-American Development Bank to create, together with the countries, an endowment fund to support agricultural research activities in the region, represents a good example of the kind of innovations needed in this area.

Finally, we must improve the human resources of the region. This issue permeates all those other issues, as much of the region's lack of progress in achieving growth and reducing poverty, as well as the weakness of their democratic systems is rooted in a historic lack of investment in human resources. Whether we are talking about improving the capacities of the poorest of the poor to earn a living, more prudent use of natural resources, improved agricultural productivity, or better nutrition and family planning, we are talking about improving not only the economic capacity of the region's people, but also their capacity to effectively participate in the social and political processes.

Increases in incomes and more efficient distribution of food will help ensure that people have access to enough food. Along with this, better education, better health care, and clean water as well as specific policies directed toward maternal and child care will improve nutrition and the productivity of all people.

This is a critical area where the government and the private sector must work together, for in the final analysis, the attention we give to people will be the most important determinant of whether or not we live in a better world by the year 2020.

WEST ASIA AND NORTH AFRICA

ADEL EL-BELTAGY

Director General

International Center for Agricultural Research in the Dry Areas

Introduction

It is a pleasure to have this opportunity to

present a few key perspectives on the future of food in the West Asia and North Africa region (WANA), with Morocco in the west, Pakistan and Afghanistan in the east, Turkey in the north, and Ethiopia and Sudan in the south.

WANA is characterized by high population growth, expected to more than double by 2020, low and erratic rainfall, limited areas of arable land, and severely limited water resources for the development of irrigation. There are very few possibilities for expansion of farming areas on irrigation. More efficient and sustainable uses of these limited resources must be found.

Over these three days we have heard galvanizing evidence supporting the need for agricultural development and the dangers of complacency. My aim is to convince you of the importance of what must be done to face the challenge of WANA's escalating food gap.

Poverty, Agricultural Employment, and Migration

Poverty in many WANA countries is masked by averaging the poor with the rich. Consider Libya, Oman, and Saudi Arabia—examples of the major oil exporters with small populations—we find large disparities between these and the remaining WANA countries. These oil exporters with only 7 percent of the region's population represent the region's highest per capita GNPs, averaging just over \$5,500, which, even so, is only a quarter of the per capita GNP of industrialized countries.

The remaining 93 percent of WANA's population has far lower incomes. The western stereotype of the "rich Arab" represents a small proportion of the total population in WANA. The three most economically disadvantaged states of South and East WANA (Sudan, Ethiopia, and Pakistan) have per capita GNPs of only \$300, less than one-eighteenth that of the oil-exporters with small populations. The

remaining countries of WANA have an average per capita GNP under \$1,600, less than one-tenth that of the industrialized countries.

There is more absolute poverty in rural than urban areas. Even though infrastructure in the rural sector has improved in the last 20 years, there has not been a proportional increase in employment or poverty alleviation. Egypt, Jordan, Lebanon, Pakistan, Syria, and Yemen are the major suppliers of labor to the oil-exporters with small populations; the Gulf countries employ 3.5 million nonnational workers. Turkey and North Africa account for the majority of the 5.3 million people from WANA living there.

But these are only small proportions of WANA's population. Economic disparities will continue to fuel the migration push from rural to urban areas and from poor to rich countries.

WANA's agriculture employs large parts of the population; nearly 50 percent, for example, in Turkey and Morocco. And women contribute about half the agricultural labor, well above their share of the total labor force.

Food Consumption and Production

Most protein in human diets of WANA comes from plant sources—cereals mainly, with some pulses. In sharp contrast, people of industrialized countries take their protein predominantly from animal sources. Diets have improved in most of WANA over the last two decades, but still lag well behind in quantity and quality of protein. Dairy and poultry production are on the rise in WANA, but are still far behind those of industrialized countries. Deficiencies of micronutrients in diets of women and children can have permanent negative effects on the quality of life.

Egypt is almost totally dependent on irrigation, while this is not the case for the

majority of WANA countries, which rely mainly on rainfed agriculture. Grain production has just kept pace with population growth in Egypt, benefiting from research results and policies aimed at putting these to good use. Per capita consumption of all grains has increased, while pulse consumption has held constant. Income growth and concessionary pricing have enabled the importation of grains for food and feed to fill the gap.

The role of pulses in human diets is greater than their small quantities suggest due to their high protein and energy contents and their use in diets of the poorest people as substitutes for animal products. Faba beans, lentils, and chickpeas enhance the value of cereal-dominated diets as they provide complementary essential amino acids and minerals. Pulses are "the poor man's meat."

Our projections of Egyptian grain production in 2020 are based on the five-year average around 1990. Four assumed rates of production growth, and the UN's population projections, allow us to imagine upper and lower limits for per capita production in 2020. Sustaining a 3 percent yearly production growth rate to the year 2020 would be enormously challenging. A zero growth rate, on the other hand, is possible but positive rates of production increase must be expected. Respectable 2 percent growth is achievable but will require concerted technological and policy advances.

In addition to grains (and pulses), Egypt produces and consumes fruit, vegetables, edible oils, meat, dairy products, and eggs. Consumption of all foods has risen on a per capita basis. Assuming no change in per capita consumption of all foods from that in 1990, domestic production must grow at well over 2 percent annually to close Egypt's food import gap by 2020.

Egypt's approach has been to seek the best economic balance of crops by allowing their prices to match the world market. Research has been enhanced by active

partnerships with the IARCs; in particular with CIMMYT on wheat and maize, with IRRI on rice, with ICARDA on food legumes and cropping system resource management, and regional cooperation (Nile Valley Regional Program) and with the International Service for National Agricultural Research (ISNAR) and IFPRI on research organization and agricultural policy, with CIMMYT/ICARDA on wheat, with CIMMYT on maize. There have been important positive impacts on productivity in these areas.

Other countries of the region are far worse off than Egypt. Pakistan, Afghanistan, Sudan, and Ethiopia, for example, import little grain though their population growth has outpaced production growth. Their per capita consumptions were lower in 1990 than in 1970. The 1990 per capita consumption of all grains was about half of that in Egypt. In such countries, increases in per capita consumption over the 1990 levels are sorely wanted. Per capita consumption, however, is a function not of want or need but of effective demand, and is directly related to income.

In complete contrast, Turkey's per capita production of grain is nearly double that of Egypt. With abundant rainfall, good soils, and policies promoting private investment in agriculture, Turkey is the only substantial net exporter of grain in WANA. Like any other commercial, exporting country, however, Turkey is under no obligation to feed other countries of WANA having poorer agricultural resources. Most analysts include Turkey in the WANA aggregate; as I will show you, this has the effect of overstating the region's productive capacity.

If per capita consumption of all grains remains constant at 1990 levels to the year 2020, and the UN population projections come true, we should expect a total aggregate grain consumption of about 217 million tons in 15 WANA countries by that time. Here, I am talking of absolute

amounts, totaling only 15 countries of WANA proper; this is without the burgeoning populations of Sudan, Ethiopia, and Pakistan.

The grain gap in 1990 was of the order of 27 million tons. If the rate of production growth can be sustained at 2 percent per year to 2020, the 15-country grain gap will increase to 70 million tons.

Now, if we exclude the "production-powerhouse" Turkey and talk only of a 14-country WANA aggregate, the 1990 grain gap was about 33 million tons. This deficit will easily reach 86 million tons by the year 2020. Again, this is a conservative estimate that assumes no growth in per capita income or consumption.

Assuming grain will cost only \$100 per ton, 86 million tons of grain per year will cost \$8.6 billion, no less than 30 times the size of the annual budget of the CGIAR system! To visualize the quantity of 86 million tons of grain imports for WANA in 2020, imagine a railroad train 12,000 kilometers long (assumes 3 x 3 x 15 meter rail cars and 0.8 bulk-density of grain).

The challenge facing these "grain-importing WANA countries" is formidable indeed: How to sustain production growth? How to achieve income growth sufficient to fill the remaining grain gap with imports? And how to do both while sustaining the natural resource base?

Natural Resource Stewardship

Despite the scarcity of water in WANA, many countries have poor water-use efficiency. Open access to aquifers by private wells is common. Water harvesting and supplementary irrigation are alternatives for increasing and stabilizing yields of crops grown in rainfed areas.

Inheritance traditions and land tenure laws have caused land fragmentation, hindering productivity and resource stewardship.

Rangelands in WANA, covering about

30 percent of the land and providing a third of the diet of some 300 million small ruminants, are typically open to unrestricted grazing and are badly degraded. Traditional grazing management, which integrates crop byproducts and rangelands, is under serious stress.

Soil and desirable plant species have been lost or diminished over large areas of WANA. This is where some of the world's most important cereals (wheat and barley) and legumes (lentil, chickpea, and forages) originated and where the wild relatives of these plants are found. Continued degradation of the natural resource base in this region is of grave consequence for all humanity.

Large rainfed farming areas of WANA, producing at levels below their economic potentials, can benefit from technological innovations. Improved varieties of cereals and food and feed legumes can be managed in crop rotations for the highest and most stable farm incomes. Increases in research support should aim to capture the large potential gains from better farm management.

Global Economic Integration and Food Security

Wise use of natural, human, and capital resources in each country will allow agriculture to contribute most fully and sustainably to food security. This will mean dropping the uneconomic goal of food self-sufficiency in favor of economic self-sufficiency. Given the fluctuating nature of rainfed farming, optimizing the storage and importation of grain stocks needs to receive greater attention in the future.

WANA countries that are increasingly dependent upon food imports will find their food bills rising as developed countries reduce production and export subsidies under GATT.

Greater integration with world markets will become more urgent. Investments in human capital, natural resource manage-

ment, research, and technological development are essential.

The following need to be generated through research: (a) enhancement germplasm (increased yield/quality of food and fiber) using genetic engineering and biotechnology; (b) environmentally sound technology and agromanagement systems for water resource management (optimization of on-farm, water-use efficiency; soil erosion biocontrol; integrated pest management, etc.), using remote sensing, computer expert systems; (c) new policies, and adoption of traditional ones, which are environmentally friendly and will enhance agricultural development and management of natural resources in a sustainable manner; and (d) new methods to enhance technology transfer through effective extension systems (using computer expert systems).

Let me list a few areas where international public goods will result from agricultural research in WANA:

- Genetic resources (biodiversity) of major food crops;
- Improved germplasm adapted to dryland farming conditions;
- Agromanagement techniques for dryland

farming, including:

- improved water-use efficiency,
- improved management of rangelands, and
- improved management of small ruminants;
- Policies and practices for the sustainable management of natural resources applicable to dryland farming; and
- Enhanced institutional and human resource capacity for dryland farming development.

It is no coincidence that ICARDA's mandate is focused on these areas of need for strategic research aimed at yielding public goods and human capital for the sustained benefit of mankind. Partnerships with and among NARS of WANA are a key to success, and essential for bringing resources and critical masses of research skill to bear on the issues. This will require concerted efforts of national agricultural research system (NARS) with the IARCs and the other advanced research centers around the world.

The challenges to agriculture and natural resources of WANA are tremendous, and the world must face them now.

A GLOBAL VISION AND REQUIRED ACTION

ANDERS WIJKMAN

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United Nations Development Programme

Ladies and gentlemen, first, let me express my full appreciation for the "2020 Vision Initiative." To bring together such a variety of experts to discuss the future of food production has resulted in a much better understanding of the very complex problems facing us in the areas of food, agriculture, and environment. If there has been any weak point in regard to the process, it may be that we should have involved more fully the representatives of the many millions of small farmers in the South whose future we try to address to such an extent. We very seldom see small farmers in conferences like this, which of course, means that their perceptions of the problems and their reality is missing.

I guess the main reason for the traditional neglect of the small farmers is that agriculture has been turned into a highly mechanical system of production. Hence, most interest has been on high-productive areas and large farm units. What is evident from this project and from work done by others—for instance, Gordon Conway and Robert Chambers and his colleagues—is that much more attention must be paid to the small farmers.

If the developing countries as a group are to be able to feed a rapidly growing population, huge investments in agriculture are needed, both in high-producing areas and in less productive areas.

A key to success in regard to farming in less productive areas will be the extent to

which the small farmers participate in developing the requested policies. A new kind of planning has to take place, starting with the farmer and her family.

The social, cultural, and political setting into which new production systems are being introduced are of critical importance. The question must be put: Are the problems that the proposed technology is designed to address really the problems as seen by the local farmer? Are they his or her priority? If not, we can be sure that no real ownership will be felt.

In this context, it is important to take into account the experiences of traditional systems that most often are well adapted to local conditions. This is a point addressed in particular to the research community that too often in the past has demonstrated neglect, if not arrogance, toward traditional knowledge systems.

The small farmers and their situation will be the main concern of FAO and UNDP in the new partnership on "sustainable food security" that we have agreed upon recently. For us the main objective for the coming years is not simply to increase food production but to try to contribute to food security. Already today there are almost 1 billion people in the world who go to bed hungry, who simply lack the means to purchase enough food. Many of these people live on subsistence farming, but the yields are too low to provide them with enough calories and/or to enable them to sell part of the produce to gain some income.

The background for the FAO/UNDP initiative on "food security" quite understandably is the very inequitable way in which food supplies are distributed. In most

low-income countries, lack of adequate food is a problem for a majority of the population. In such areas, there is a pressing need for more resilient farming and agroforestry systems that can support higher yields without accelerating resource degradation. Through capacity building, through creating enabling environments, through the provision of small-scale credit schemes, through investments in food storage as well as technical advice—provided in ways that will reach women—we hope to contribute to food security and, thus, to the overall objectives of the 2020 Vision.

The environmental aspects of food production are of special importance. Far too long have we looked upon the soils as being part of an industrial system, being able to deliver higher yields year after year. Today there is clear evidence that this very mechanistic view is no longer possible. However, in my experience there is still many within the agro-industrial establishment who continue to do "business as usual." They believe that land beyond repair is no problem as there will be plenty of solutions to compensate for this. In my view, such opinions are dangerous and irresponsible.

The management of living systems is different from manufacturing. There are limits to growth and there are certain eco-principles that have to be followed.

The 2020 Vision Initiative does give a lot of recognition to the environmental aspects of farming as well as coastal management. However, let me add a few points of special importance.

Agroindustry by and large has been very productive up till now. The reasons are a combination of technology development and high inputs of minerals, pesticides, and fossil fuels. Since the environmental costs rarely have to be accounted for, the net result has been positive.

However, I think everyone understands that ultimately there is a limit to such a system: first, because fossil fuels will become scarce; second, because of pollution pro-

blems; and third, because present systems overlook the need in the long-term perspective to close the loops of nutrients and organic material. As presently applied, modern farming technologies lead to a gradual depletion of the humus content of the soils, so important for fertility.

This problem will, of course, be exacerbated by the fact that more people will move into cities. Then the closing of the ecocycle, by bringing back the residual materials to the soils, will be more difficult. Part of the problem can be compensated for by fertilizers, but only part. This issue of nutrient recycling is most often forgotten. It is time to address it.

An issue closely linked to this one is the biodiversity of soils. Every cubic millimeter (mm^3) of soil contains a great number of organisms. Our understanding of how these living things interrelate is poor. This represents a great challenge to science, but also to the biodiversity convention.

Seen from an overall perspective, what is very much needed to tackle the complex problems addressed at this conference are integrated solutions.

History has demonstrated that "sectoralism" is not sufficient to deal with today's challenges. We therefore need to look not only at the aggregate supply of food but also at the important role of governments, income, and land distribution at household livelihoods and dietary needs, at food distribution and water, at women's status and their opportunities, at fertility and population pressures, at access to water and energy, at investment in human resources and social development, and at the protection and the regeneration of the resource base for food production. In planning for sustainable agricultural development, we must take account of the entire rural life situation—the ecology and natural resources, the socio-cultural environment in the community, the policies, prices, services, and infrastructure that affect rural prospects. We need a larger vision.

The role of women in agricultural production has often been ignored, wrongfully so. Statistics suggest that between 50 and 80 percent of all food production, processing, and marketing is in the hands of women. Women carry a multiplicity of functions in the whole agriculture and food environment complex. On the one hand as producers and traders, on the other as consumers and food preparers who determine the way in which farmers and families find adequate nutrition. Policymakers, researchers, and development planners cannot leave out women from any level of activity that moves us towards the twenty-first century.

Much more could be said in relation to the many important problems dealt with at this conference. I have chosen to focus attention mainly on "food security" and the small farmers, on some environmental issues, and on the important role played by women.

Representing UNDP, this is natural since our primary focus is poverty reduction. With our limited resources we can only deal with part of the agenda. However, there are of course many other issues where UNDP as an institution cannot sit idle, where we have to feel responsibility both in terms of advocacy and resource mobilization.

Agricultural research is one of utmost importance, not the least in developing countries, we hope to be able to continue providing support to the Consultative Group on Agricultural Research (CGIAR) and its centers, and will push for a closer link between CGIAR centers, national research centers, but also extension services that can serve as a two-way channel of communication, briefing the voice of the farmer into the research agenda, as well as bringing the results of that research to the farmer.

Reference has been made to the need for a "Double Green Revolution." We fully support this. Much greater attention must be given to the environment and natural resources, including water. I guess all of us

are very much concerned about the emerging water crisis in many regions.

Another area of high importance is of course coastal management. The majority of the poor take their animal protein from the sea. Given pollution and eutrophication of coastal waters, there is a great risk that this important food resource will be less available. All efforts must be undertaken to build capacity in developing countries for the proper management of their coastal areas.

In parallel with technical cooperation programs and national interventions, an increasingly globalized world calls for better global policies and a global outlook at development and growth. The world agricultural market is going through transformation. Worldwide trade in farm products is liberalizing in line with global liberalization trends. This is likely to increase agricultural exports for many developing countries. At the same time, new global trading rules and systems can cause new problems:

(a) It is likely to favor increased monocultural production in the South. The problems related to so-called "Banana Republics" are well-known today and have in many cases demonstrated an unsustainable base for countries to build on. Vulnerability to world markets (prices, export opportunities) is tremendous, not to mention the threat to the natural resource base resulting from conventional production standards. For instance, as long as the environmental costs of production are not included in the market prices, there are little chances for sustainability! This, by the way, is a point of enormous importance not only when discussing agriculture. Even more so when discussing transportation, energy, and chemicals.

(b) Another problem relates to food imports. Most African countries are still net food importers. Recent GATT agreements in the Uruguay Round have forced producers in the north to reduce export subsidies. Before this measure can bring about increased food production in the south,

many net food importers will in the short run face anew hardship, malnutrition, and maybe even famine resulting from shrinking national budgets and less foreign currencies.

(c) Last, but not the least, let me once again raise the issue of closing the cycle of nutrients and organic material. This will be an even greater problem in a world where trade with farm products will grow rapidly. If ultimately the main objective is to bring back to the soils the residue materials—feces and urine—well, the longer food has to travel, the more difficult this will be. I have no solution to this—trade is important, but we must not overlook fundamental ecological principles.

Research and targeted technical cooperation can only take us so far. We have to continuously assess the global picture and respond to the global forces affecting our everyday life. We need to ensure appropriate macroeconomic policies, and to revisit trade and investment policies based on food security for all.

Food security is a complex concept requiring the involvement of many partners and a true multidisciplinary approach. UNDP, through its many coordinative mechanisms and network of field offices at the country level, is well placed to take a lead role in coordinating the design and implementation of more comprehensive food security programs.

Finally, let me say a few words about development cooperation. I know I am taking a risk since any attempt on my side to defend the United Nations (UN) and its development work may be looked upon as pure self-interest. However, I believe strongly in the importance and the need for development cooperation. It would be dishonest not to share my concern with you on this point.

When looking at the colossal problems facing this planet, in terms of poverty, growing population, environmental degradation, and so on and so forth, I simply cannot understand the current mood of

questioning development cooperation. Some contend that trade will resolve the poverty problem. Others say that private investments will do the trick.

Yet when analyzing the problems carefully, we know that trade is not enough, that many less developed countries (LDCs) will benefit little—if at all—from the free trade agreements. We also know that private investments are concentrated in some 20 countries in the South. LDCs get a tiny share. Furthermore, we know that many of the problems we are discussing here today, like reaching the small farmers, bringing about education and social services, providing reproductive health, protecting the environment—all these interventions are things that the private sector does not feel responsible for.

Hence, it is neither trade nor aid, but both! It is neither markets nor government, but both!

The conferences in Rio, Cairo, and Copenhagen brought new insights in regard to the need to rethink development, to integrate environment and economics, to empower women, to bring about education for both boys and girls, to focus on growth with equity and so on.

Analysis is one thing. Action is quite another. We need to go from words and from noble declarations to action.

UNDP is ready. We are undergoing a lot of change. We have become more focused and are addressing the very issues called for by Rio, Cairo, and Copenhagen.

I can only hope that the political will and public support will emerge again. A very decisive role in all this no doubt is played by the media. Coming to this country for the first time, I am amazed how little the American public knows about the world outside the United States.

There is no way we can hide the widening gap between the haves and the have nots. There is no way we can hide the problems of environmental degradation, of soil erosion, and of water shortage. All

these problems concern us all, whether we live in the United States or in Africa.

The main motive for development cooperation, seen from the eyes of a Scandinavian, used to be solidarity. This motive is of course still valid. But there is yet another strong reason, namely self-interest. If we do not recognize the challenges posed by poverty, population growth consumption patterns, as well as environmental degradation today, the world of tomorrow will be a difficult place for all of us to live in.

The technologies exist to respond to most of the problems facing the planet. What has to catch up is our ethics. Let us do what we can to create awareness and mobilize public support to make the world a better world for all!

ISMAIL SERAGELDIN

Vice President

*Environmentally Sustainable Development,
The World Bank*

Your Excellencies, Distinguished Colleagues, I am honored and delighted to be here today. I commend the director general, Per Pinstrup-Andersen, and the staff of IFPRI for their decision to organize this visionary program of inquiry into the future of the human family. Together with others in the international community they have drawn attention to major challenges that cry out for a response if we are to ensure that life in 2020 and beyond will provide security in the broadest sense to this world of ours. I applaud the interest that those of you in this audience, and your concerned colleagues elsewhere, have shown in the cause of sustainable human development. In that same spirit, I very much appreciate the opportunity to share with you some of my thoughts and concerns.

I have carefully followed your deliberations, read the draft of studies produced in preparation for this conference, and been

actively engaged in some of the preparatory events leading up to it. I have done so from a combination of vantage points and perspectives, both as the World Bank's Vice President for Environmentally Sustainable Development and as Chairman of the Consultative Group on International Agricultural Research (CGIAR).

Both organizations are engaged in supporting or contributing to programs directed at alleviating poverty, reducing hunger, and, overall, improving the lives of the poor. But I do not stand before you only as a representative of the World Bank or as the ambassador of the CGIAR System. I stand before you as a caring citizen of the world who is profoundly convinced that discourse and deliberation about development must extend beyond the limits of statistics, theories, methodologies, and carefully balanced proposals. These are important—indeed, even crucial—considerations. We must go beyond them, however, because our business is people.

Failure to act will affect people—many millions will remain hungry, malnourished, and in poor health. Millions of children will die. Those consequences of inaction can and must be prevented.

My friends, for the past several months and, in a more focused way, over the past few days, your task has been to define a vision of sustainable human development for the year 2020 and recommend measures by which that vision can be achieved. You have been aided in this task by perceptive sectoral and regional analyses. Based on these, your conference document has defined 2020 Vision as that of a world in which all members of the human family have access to food, are blessed with good health, and benefit from the judicious management of natural resources. This Vision, the document argues, can be achieved if a number of requisite measures are adopted in time.

These measures are presented as six entry points for action. Let me encapsulate them: effective developing-country gover-

nance; enhanced productivity of the poor, leading to greater income generation; strengthened agricultural research and extension systems in developing countries; intensified sustainable agriculture and natural resource management; the development of markets; and expanded as well as more efficient international development assistance.

To these, I, like Anders Wijkman of UNDP before me, would add the full involvement of the poor, the farmers. For progress, real progress, lies in empowering the poor, the weak, and the marginalized to become the producers of their own bounty and welfare, not the recipients of charity or the beneficiaries of aid.

These actions are proposed as essential means for providing the human family with its needs, while protecting for future generations the natural resources on which continued growth depends. The message of the 2020 Vision exercise is that unless we act now, we will court dire economic, social, political, and economic consequences by 2020.

Who can deny that this approach is built on a firm foundation of rationality, common sense, and good judgment? I doubt that any part of what is broadly described as the international development community will find fault with that enumeration of action points, or with the prescriptive details spelled out in support of the actions proposed. For myself, I accept them fully and sympathetically. I endorse the technical validity of the 2020 Vision analyses and the appropriateness of the recommendations. I am perturbed, however, that while the approach to the 2020 Vision is rich in acuity it sorely lacks passion.

We do not need to be as fatalistic as some of our colleagues who fear that the human habitat, fragile and under persistent attack, is rapidly approaching irretrievable destruction. Nor should we join the complacent who believe that the necessary technology is or will be available and that

through private effort and the magic of the market the vision will somehow be realized.

We do need to be aware, however, that these can be matters of life and death, of war and peace. We do need to communicate these facts to others with the sense of urgency they demand.

We do need to point out, again and again, that our goal is not the validation of some set of projections or the fine-tuning of developmental theories but the liberation of the deprived and disadvantaged—our fellow human beings—from the demeaning grip of extreme poverty and hunger.

The defining terms of that goal are immensely less poverty by 2020 than abounds today; a healthier, better nourished, human family; reduced pressure on natural resources; and people-centered policies for sustainable development. People-centered, my friends, that is the crucial factor, and that must be at the very core of our vision.

In the nineteenth century, some of the most sensitive people in society declared that slavery was unconscionable and unacceptable, that it degraded the free as well as the slaves, and that it must be abolished. They were called the abolitionists. Today, extreme poverty and hunger in a world that has the means to feed its people is unconscionable and unacceptable. We must carry out the struggle against hunger with the same single-minded devotion as the abolitionists of the nineteenth century fought successfully to abolish slavery. We must become the new abolitionists.

Consider, as you carry forward the suggestions and proposals before you, how much the current trends in the world belie the presence of the political will to tackle the problems addressed by these proposals. That is the paradox of our times. We live in a world of plenty, of dazzling scientific advances and technological breakthroughs. Adventures in cyberspace are at hand. The Cold War is over, and with that, we were offered the hope of global stability. Yet, our times are marred by conflict, violence,

debilitating economic uncertainties, and tragic poverty.

Today,

- One-sixth of the human family goes hungry and malnourished.
- 1 billion people live on less than a dollar a day, most of them lack any security to access to food, the most basic of basic needs.
- About 800 million people are food insecure.
- 1 billion people do not have access to clean water.
- 1.7 billion people have no access to sanitation.
- Those last two figures together result in 2 to 3 million eminently avoidable infant deaths a year.
- 185 million children under the age of six are seriously underweight.
- The gap between rich and poor continues to widen. The share of global income obtained by the world's poorest 20 percent has dropped from 2.5 percent in 1960 to 1.3 percent in 1990.
- Hundreds of millions of poor farmers have difficulty maintaining the fertility of the soils from which they eke out a meager living.

It is not just farmland that is at risk. Marine fisheries are grossly overexploited. Water is becoming scarcer as underground aquifers are drawn down faster than their natural recharge rate. Deforestation is still very much a problem. The global challenges of desertification and climate change and potential loss of biodiversity demand redoubled efforts. Agriculture must be transformed to promote sustainable food security for the billions of poor and the food insecure in the world. The urban poverty and environmental challenge in the developing world is unprecedented, as the urban populations of the developing countries treble over the coming generation. Poverty and environmental degradation go hand in hand, for it is the poor who suffer the con-

sequences of desertification and live the misery of unsanitary conditions.

To this stock of problems, we are adding a flow of new challenges due to population growth that is averaging 90 million persons a year, and which with vigorous action today may be stemmed so that the world population stabilizes at some 8 billion, rather than 10 or 12 billion.

The illustrative examples I cited earlier are realities that will present the international community with a series of interlocking challenges over the next three decades: to provide increased employment and thereby income for a rapidly increasing work force in poor countries; to produce adequate supplies of food at affordable prices to feed the hungry and improve the diets of billions as well as meet the needs of some 90 million more people every year; to achieve higher yields on land already under cultivation with methods that preserve the productivity of the natural resource base without further endangering the life support systems of land, water, flora, and fauna that are already under stress; to produce levels of overall growth that will improve the human condition in developing countries; and, to reach those who are currently not being reached.

All these problems can indeed be addressed, but they require a strong reinforcement of positive trends and a Herculean effort to reverse the trends of complacency and indifference. We all need to work hand in hand to confront such challenges. We need to have strong and vibrant institutions devoted to these challenges, working in an intense collaborative effort, scaled to the size of the challenge at hand. We need a renewed and fully endowed CGIAR so that the international agricultural research it supports can contribute to promoting sustainable agriculture for food security in the developing countries. We need to forge and strengthen the potentially positive link between improved environmental stewardship and accelerated growth in developing coun-

tries. We need to bring together individuals and institutions—nongovernmental, governmental, and intergovernmental—in a combined effort dedicated to the maxim that people matter.

The Bank is fully committed to decisive action in the many areas encompassed by the 2020 Vision. Poverty alleviation is at the heart of the Bank's mission. Increased growth is the fastest route to the reduction of poverty, and wide-ranging efforts are being made to help poor countries achieve their targets. Growth must serve the entire community. So the Bank emphasizes human development.

Last year, the Bank committed some \$2 billion to education, with a special focus on girls' education, and \$1 billion on health and nutrition programs. Bank lending for population and reproductive health activities was \$423 million last year. Half of all projects supported by the Bank have components aimed at benefiting and empowering women, up from only 10 percent five years ago. Also, the Bank is now the largest external financier of environmental investments in the developing world. Its portfolio of environmental loans exceeds \$10 billion—up from \$2 billion six years ago. Agricultural lending stands at some \$4 million annually. The Bank's role has been very significant in supporting the CGIAR in its efforts to serve as a catalyst of sustainable agricultural growth. There is technical consensus on what needs to be done. The instruments are available, and so is the knowledge for a frontal assault on the roadblocks to progress.

By an unfortunate irony, however, while confidence in the analytic foundations that underpin development efforts have steadily improved and these foundations are today stronger than in the past, the development enterprise itself—a vital and indispensable endeavor in global terms—is under attack. We cannot allow that attack to succeed, for if the challenges of today are not confronted, the world will experience increased poverty,

hunger, and malnutrition, especially in South Asia and Sub-Saharan Africa; greater stress on the environment; and a slowing down of the momentum of development achieved so far.

Many today question the need for overseas development assistance (ODA). Private capital flows, they claim, will take care of whatever needs to be done. They point with justified satisfaction to private sector flows of \$180 billion last year. But what kind of a triumph was that when 80 percent of the flows were concentrated in 20 countries, and hardly any reach the poorest, least developed countries? Mexico showed the volatility of dependence on the portfolio investment part of private sector. Moreover, the private sector will only do certain things. The need for public goods is implicit in the 2020 Vision. Even the private sector, to operate, needs the public framework to make the magic of the market function. Let me be quite clear about this. We do not need less government, but better government; we need to temper the ruthless, allocative efficiency of the market with a caring and nurturing state.

The view is also expressed that trade will take care of all developing-country problems. This argument ignores the reality that poor countries are ill-equipped to function as trading partners. Conversely, the record shows that countries helped to stand on their feet by aid do, indeed, engage in enhanced trade. Clearly, therefore, we need both aid and trade. Aid is enlightened self-interest. It is, in fact, a form of joint security for rich and poor alike.

Unless the challenges are addressed wisely and expeditiously, poverty and hunger could lead to social disruption, political destabilization, and environmental destruction, with local and worldwide implications. Prudence, if nothing else, cries out for the challenges to be met. Even more important in human terms, however, is that to ignore these challenges is to consign over 1 billion people to lives of permanent wretchedness.

This is inconsistent with any definition of human decency.

And yet, against this backdrop, some of the rich want to turn their backs on the poor. Selfish concerns seem to displace enlightened self-interest, for we are all members of the same human family. We all reside downwind or downstream of each other. The very idea of development cooperation between north and south is being assailed. So, while we can all be justifiably proud of what we have achieved in conceptual and operational terms, we must redouble our efforts in the face of diminished development assistance budgets, on behalf of all the dedicated and successful efforts of so many in the developing countries. We must not allow the failure of politicized aid that was labeled development assistance, or the occasional failed project of the past, to overshadow the success stories achieved by so many developing countries. We must find ways to support them and to build on these successes to achieve the 2020 Vision. We must join forces with friends and allies to roll back the tide of doubt that threatens the world's development enterprise.

If we fail, the worst hit victims will not

be development institutions and the dedicated men and women within them. The real victims will be the weakest in human society—the poor, the hungry, the unemployed, and the marginalized. Even more victims will be the future generations who will inherit polluted waters, unhealthy air, parched fields, and eroded soils.

Will we shrug off human deprivation as inevitable, or will we strive to help the weakest among us? Will we accept the cynical view that we are not responsible for future generations, or will we try to act as true stewards of the earth? I can tell how this audience will respond, but that is not enough. We must press our concerns on those who do not yet realize their significance. We must convert others to the cause of committed action to achieve the 2020 Vision. For this is more than ever before the time for a united front of the caring. Together, then we can think of the unborn, remember the forgotten, give hope to the forlorn, and reach out to the unreached. By wise actions today, let us together lay the foundation for better tomorrows. Therein, lies the challenge of the 2020 Vision.

CLOSING REMARKS: A SUMMING UP

KEITH BEZANSON

President

International Development Research Centre

Thank you very much, David. I am pleased you began by acknowledging the difficulty of this task. It has been a very lengthy, very rich, very deep, and very broad discussion. In trying to sum up all of this, I must say that I have been confronted with a genuinely daunting task. I spent a couple of hours this morning reading over the IFPRI papers, reading over my own notes of the discussions and questions of the last few days. I spent a little time in a public library refreshing my mind and I am now going to enter into the deep water of trying to provide a summary, knowing that the danger in deep water is that one can drown.

The 2020 Vision

Let me begin by reminding us of what the IFPRI 2020 Vision is. It is stated in the very first sentence of the first paragraph of the 2020 Vision paper, and it reads as follows:

IFPRI's 2020 Vision is a world where every person has economic and physical access to sufficient food to sustain a healthy and productive life, where malnutrition is absent, and where food originates from efficient, effective, and low-cost food and agricultural systems that are compatible with sustainable use and management of natural resources.

Now that, as they say, is a mouthful—a very long sentence and a very complex sentence. So, let us break it down a bit because there

are in that Vision statement four very basic elements. They are: (1) food security, (2) food affordability, (3) nutrition adequacy, and (4) all within a sustainable environment. So broken down, a complex sentence has four very simple and fundamental components.

There Is Nothing Remarkable About the 2020 Vision

What is, therefore, remarkable about this Vision? What is remarkable about it is that it is entirely unremarkable. Its characteristics are its simplicity and the fact that there is absolutely nothing new in it.

Indeed, the mythologies and symbols that have characterized all recorded civilizations are included in this Vision. Our language is riddled with references to words and concepts that are identical to or derive from those four factors. Some examples would be: "land of milk and honey"; "the bread and wine of life"; "the God Pan of nature and its bounty," and so on. In one form or another, Thanksgiving has been celebrated in every society that has ever been recorded and has been celebrated with food. And, I looked up this morning in the Book of Deuteronomy, chapter eight, the following phrase: (You will find)... "a land wherein thou shalt eat bread without scarceness, a land of wheat and barley and vines and fig trees." That land was, of course, the promised land of the Old Testament.

So, the first point that I want to make is that, far from being new—with all respect to IFPRI and those of us on the Steering Com-

mittee—the 2020 Vision is not new at all. It is really nothing more than a restatement of one of the most universal, most fundamental, and most widespread aspirations of the human species—an aspiration that almost certainly goes back to the very dawn of prehistory.

Why, Then, Do We Need a 2020 Vision?

This being said, then, let us ask the obvious question: Do we now need to have a 2020 Vision if (a) it is nothing new and (b) what we have produced goes back to the beginning of time? Here I think, in this meeting, there is a consensus and a strong consensus shared by all. That consensus is perhaps best set in the context of two recent global conferences:

- the 1992 Rio Conference on Environment, which brought to global public awareness—to a greater extent than before—critical issues of the environment; and
- the 1994 Cairo Conference, which brought to that same public mind the issue of the world's surging population.

Both conferences were designed to serve as wake-up calls against our human complacency about the state of our natural environment and our demographic timebomb. The 2020 Vision is a third wake up call. It informs the public mind of the pressing need for vast improvements in food productivity as the third pillar of the problems faced by humankind. For example, we have heard here in our conversations and read in the IFPRI documents that world cereal production must increase on a per hectare basis from the 1992 level of roughly 2,700 kilograms to over 4,200 by 2020 if per capita consumption is only to remain where it is today. But these are just numbers and words. Let us simplify it by stating bluntly that cereal production must double within the

next 25 years or we are going to be in a whole heap of trouble.

The 2020 Vision reminds us that it is these three interlocking issues—one, the need for greater food productivity; two, environmental degradation; and three, the high rate of population increase—that comprise the nexus, the intersect that together represent the most urgent problem facing humanity as we approach the twenty-first century. And, herein, lies the consensus of this conference, the consensus on the need for a restated vision, an ancient vision and an ancient wisdom applied to the year 2020, a vision that goes back to prehistory but that is essential for today and for tomorrow.

Two-and-a-half days ago, David Bell opened this conference by referring to "the dangerous complacency that we currently face on food security." Per Pinstrup-Andersen in his opening address stated bluntly that "if national governments and international organizations follow the policies and practices of the last decade, we will fail." Thus, the need for the vision. Thus, the appropriateness of the vision, and thus, the consensus that we have shared around it. Stated simply, we have agreed with the old Chinese proverb: "If we do not change directions, we will get to where we are going."

Of Cassandras and Pollyannas

Well, so far so good. There is consensus up to this point. But, from this point on, matters become more complex and consensus proves more elusive. This, I think, is for two reasons.

The first reason has to do with our nature as human beings and with the fact that we divide into camps of pessimists and camps of optimists—into Cassandras and Pollyannas. I did not detect in the conversations of the last two-and-a-half days any significant disagreements on substance, substance of where we are today, substance of what the global reality is, substance of the

challenges facing us. Neither did I detect any deep disputes over whether we have, as humankind, the tools with which to address our realities and our challenges. There appears to me, in fact, to be a broad consensus on the nature of the tools that we have as our natural endowment, the application of science, human skills, organization. The division is, therefore, not on whether what ought to be done can be done but on whether it will be done. And here the consensus is less certain; here we confront the Cassandras and the Pollyannas.

Now I think we know from human behavior that it is very difficult to convert an optimist into a pessimist, or a pessimist into an optimist. I am always reminded of the story of the psychiatrist who had two sons, one an incurable optimist and the other an incurable pessimist. And, being a good behavioral therapist, this psychiatrist wanted to modify the behavior of the pessimist. So, he waited until Christmas. And, for the pessimist, he bought every present conceivable for a young boy. There was nothing you could dream of that was not under the Christmas tree with the pessimist's name on it. For the optimist, he piled in the middle of the living room floor, beside the Christmas tree, a great pile of horse manure. When he came down the stairs on Christmas morning, he heard screams and shouts and songs of joy. And what did he confront? The pessimist was sitting in the midst of all of his new bounty looking sad, miserable, and upset. And the optimist? Why he was sitting in the middle of this great pile of horse manure, throwing handfuls of it into the air, singing, and laughing. The father was dumbfounded and said to the optimist: "Son, I do not understand, how can you be so happy?" And the optimist replied: "Dad, with all of this horse manure, there just has to be a pony!"

I think that our human behavior accords with this story. It is very difficult to teach an old dog new tricks.

Also, we have been influenced, some of

us profoundly so, by the failures of past predictions. We do not wish to be seen to be alarmist or to be wrong. Here we are reminded of prior claims that humanity was on a slippery slope to disaster—a disaster that never occurred. Over the past couple of days, we have been reminded of one of the most famous of those Cassandra predictions, that of Thomas Malthus in the eighteenth century. And, on the environmental side, we all recall those predictions of the 1950s and 1960s: Rachel Carson's *Silent Spring* and the thundering out of the Club of Rome of the limits to growth. The promises of the apocalypse failed to materialize.

These failures of the Cassandras of the past have served to justify a complacency about predictions made today saying that we are on the road to disaster. Scientists, technicians, and administrators have all, I think, become timid as a result of this. We hesitate to make dire and apocalyptic predictions lest we be ignored and lest such predictions again prove to be unfounded.

Now this creates a real dilemma for the 2020 program. If our shared conviction is that massive change is required if we are to move off the slippery slope, how is this message to be presented responsibly and credibly? To what audience should it be addressed for maximum impact? A lot of money has been spent on the 2020 Vision exercise; how, then, if it is to serve as a wake-up call, can it gain the attention that we believe it requires? The risk in being the Cassandra is in overstating the case and in being ignored. The risk in being the Pollyanna lies in reinforcing complacency. So here we have a most serious problem, the problem of building a broad and sufficient consensus beyond this meeting.

Let us ask, therefore, since IFPRI initiated this exercise, where IFPRI is, as an institution, on this issue. Well, in my view and judging from the final IFPRI document, like most good international organizations, it has come out exactly in the middle. It is on the fence and has not taken a clear and

unequivocal position on this.

And on this point, I would conclude that this meeting has provided IFPRI with some clear and unequivocal feedback. What has emerged from the conversations this week is, I believe, a strong convergence, if not a full consensus, on the fact that the IFPRI final document does not adequately reflect the strong sense of urgency others feel. This message was eloquently stated by Maggie Catley-Carlson, by Lester Brown, by Hubert Zandstra, by Brian Atwood, and by Gordon Conway. I think that Gordon may have said it most succinctly when he stated and I quote, "The challenge of this meeting is to strike the right balance between optimism and pessimism sufficient to move the world to immediate action." It is that need for immediate action and that sense of urgency that needs to be restated and needs to be strengthened in the work that IFPRI has done to date.

Complexity as a Barrier to Consensus

I said that there were two basic reasons why consensus has proved more elusive as we have moved through our conversation over the past two-and-one-half days. That second reason is that we have made our subject very, very, very, very complex. We have had graphs and charts and endless statistics on death rates, expected death rates, survival rates, expected survival rates, birth rates, anticipated birth rates, fish stock estimates and projections, data on fertilizer use, land use, land degradation, shifting patterns of consumerism, and so on. We even held an extended conversation on the difference between the severely malnourished and the moderately malnourished. I am not trying to be dismissive of all of this nor to level a severe criticism. The treatment we have given to the subject reflects, quite rightly, that this is a very, very complex equation with which we are dealing. Projecting 25 years from now is, at best, a perilous

business and reducing its complexity to simplicity would be dangerous. In this regard, we would, I think, all agree that IFPRI has taken the right course. It has tried to deal with the richness, complexity, and contradictory nature of our subject without succumbing to the temptation of oversimplification.

But, it must also be acknowledged that dealing with such complexity has not made consensus easier but more difficult. So the very need to apply the very best of scientific knowledge to our subject carries with it a high risk—the risk of inconclusiveness and, therefore, of inaction. By the way, this will also make it more difficult to answer some of the questions raised just a few moments ago about the media and whether it will transmit the needed wake-up call. My friend, Anders Wijkman, referred to this in his presentation. The media will likely want a soundbite that says that our human species is either on the road to absolute ruin or that we are okay and there is nothing to worry about. The soundbite needs the simplicity of a unidimensional Cassandra or a unidimensional Pollyanna. There are representatives of the media in this room; and, if they are listening, which I hope they are, I would underscore what Anders Wijkman said that the fifth estate has a serious moral responsibility to transmit to the public mind the urgent need for massive changes in our policies and practices with regard to food security. If the media are to do this, however, they, like us, must grapple with the enormous complexity of the subject, with its inherent contradictions, with its uncertainties, and with the lack of absolute knowledge.

Lessons for the International Development Community

If the 2020 exercise is a wake-up call to the public mind in its intent and purpose, this meeting has, I think, made clear that it must serve first as a strong wake-up call to those

of us who are in the development community. We, in the international development community, often refer to the responsibilities of others, or the lack of or lessening of political will as the reason for just about every failure in the world and to refer to the need for the private sector to assume greater responsibility. This has been part of our conversations here and is reflected in the IFPRI document. I think this conference should jolt our thinking back to reality. Continuing glib exhortations to political will is not helpful and reflects intellectual sloppiness and naivete. Political will forms around political constituencies. In most cases, it is strong public will that leads political will. The Vice President of Uganda reminded us of this reality in her session with the Steering Committee; she told us pointedly that politicians need to have forces behind them that move them in the desired direction. And this reminds us that there is far too easy a tendency within the international development community to refer to the lack of political will as if it were someone else's problem. Anders Wijkman told us bluntly, "It is our problem."

In this regard, our conversations here in Washington have made clear that the right questions for development organizations are not why are we not appreciated for all of the good work we do? Or why are we not valued to a greater extent? Or why is the money drying up? What I believe to be clear from this meeting is that the right questions are what can and should and must we do as a community about this, and what are the instruments and tools that we have at our disposal? Anything less amounts to a shirking of responsibility.

Equally, on the admonition to the role of the private sector and private investment, especially with regard to biotechnology, Gordon Conway, Anders Wijkman, and Susan McCouch reminded us (in the case of Susan with brutal candor) that the private sector is simply not going to take up much of the agenda required by the 2020 Vision. Much

of what is needed requires patience and major investments that will pay enormous dividends to humanity over a quarter-century, but which will not yield immediate and impressive financial dividends on a quarterly basis.

And this brings us to the fact that a fundamental, underlying issue to the 2020 Vision is that, in large measure, we are dealing not with private goods for private gain but public goods for public purposes. It also tells us that success will depend on the building of the public will to make this fact an accepted reality. So this meeting reminds us and reminds IFPRI, as the catalyst of the 2020 process, that glib exhortations to some amorphous responsibility of the private sector for future food security simply does not accord with the facts and that the task is to mobilize the public mind and the public will to this reality.

Thus, this conference entails a strong wake-up call to those of us who are in institutions of international development. We should not be permitted to deflect our concerns, our feelings of impotence, or our failures, with generalized appeals to either political will on the one side or private sector responsibility on the other. It is rather like that story of the French captain who was sent to the front to find out why the war was going badly and who, upon return, reported to Napoleon, "I have seen the enemy and he is us."

Getting Our Own Act Together—Building Constituencies

There has been broad agreement here on the imperative of building the constituencies that will be needed if the 2020 Vision is to have even the remotest chance of becoming a reality. That this will be a most complex undertaking goes without saying. No one institution can hope to do this and IFPRI certainly cannot hope to do this alone. Just a few moments ago, Joe Hulse referred with

particular and specific reference to the World Bank, but more generally and more importantly to all of us in this room, to the need for all of us to get our act together if we are to have any real impact on the human condition. In saying this, he reflected a theme that has emerged consistently from the conversation of the last two-and-a-half days. There have been strong and consistent calls to all of us to change our approaches to problemsolving by becoming more multidisciplinary, intersectoral, and cooperative. Now these are easy words. But what they mean is a "paradigm shift" on our part—a paradigm shift on the part of the CGIAR; it means putting the physical scientists, the social scientists, the social policy specialists, the NGOs, and so on, all together. It means giving up our compartments and our individual institutional or disciplinary approaches to "development."

Getting our act together—that is easy to say, but it will be very hard to do because it is neither in the tradition of the development community, nor (notwithstanding the good words of my friend, Anders Wijkman) is there a lot of evidence, even in this room or in this conversation, that we are genuinely moving in that direction. There are a few professional communities, I would submit, that reflect more what Americans mean when they say: "They talk the talk, but they do not walk the walk." Outsiders looking in at the development community must be reminded of the medieval philosophical debate over how many angels could stand on the head of a pin.

If this was a significant problem before, today it is a critical problem. Not so long ago, an international development official called Tibor Mende wrote the following: "The development experience is coming to an end. An important experience without precedent in modern history is coming to an end. It will have lasted much less than was expected. Born in the midst of contradictions, it dissipates itself in ambiguity. Its original noble intentions have been

progressively submerged by other considerations which inevitably have led to mutual recrimination and disillusion." Now that is a damning indictment. No doubt we all hope that Mende will be proved wrong. What we have heard in this conference, however, is a reflection of Mende's words, and we have taken them to be a strong admonition to us to get our own act together.

If we are to get our act together without abandoning the complexity and difficulty of our subject, we must find ways of communicating a clear and understandable message to ordinary people, to the poor and to the farmers. The Vice President of Uganda, in her introductory comments two days ago, pointed this out to us in very stark and moving terms.

Communication and Language

It must be acknowledged that development institutions are not effective communicators at that level. Let me—with deep respect—illustrate this with reference to this conference and, specifically, to yesterday's role-playing panel about the fictitious country of Abundantia. Without intending to, that panel discussion may have underscored our ineptness as social communicators. Allow me the presumption of pointing out that the subject of the panel discussion was food—food security and food policy—and yet there was not a single farmer on the panel! There was no representative of the poor, whether urban poor or rural poor. The closest the panel came to this was the student whose family were poor farmers. The other members of the large panel were representatives of interest groups and elites. The point is clear: if we are to succeed in communicating the 2020 Vision, we will have to find ways of building real constituencies. And that will mean ceasing to communicate so much among ourselves and communicating effectively at the level of people.

Success here will depend on doing something about our language. I have been

told by some participants at this meeting, who are not also representatives of international development organizations, that they did not quite understand everything that was being said: all of the specialized words, all of the technical terms, all of the statistics. And I think that is telling, so I pass that on in these summary remarks. It will be imperative in building constituencies and in transmitting the 2020 Vision that the message be packaged in a language that can be understood. And, in the development community, we have a dreadful tendency of using language that is understandable only to ourselves.

Jules Pfeiffer, the cartoonist, wrote a few choice words about this, from the point of view of the poor, and I would like to share his words with you. He said, "I used to think I was poor but then they told me I was needy. Then they said it was self-defeating to think I was needy. I really was deprived. But then they came back and said that deprived was wrong. What I really was underprivileged. And then they came back again and said that underprivileged was not accurate. I really was disadvantaged. Now I still don't have a cent but I have a great vocabulary."

Some Dilemmas

Now I want to point to a few dilemmas that confront us and that have emerged from this 2020 process and from the conversations of the last two-and-a-half days. Addressing these dilemmas will be integral to the great challenge of moving forward the 2020 agenda. The dilemmas I will list are not meant to be an exclusive list; they are merely illustrative of what has emerged from the 2020 process.

Dilemma one: The Double Green Revolution will be infinitely more difficult than the first Green Revolution, a point that was made by Gordon Conway and others. This Double Green Revolution is likely to test the limits of our science. It is likely to test the

limits of our technology, and it is certainly going to test the limits of our social innovation. We should be informed by the successes of the past, but should not assume its replication. What now confronts us is going to prove infinitely more complex and infinitely riskier than what went before. There is a clear consensus between the Pollyannas and the Cassandras of this conference that the outcome of the Double Green Revolution cannot be taken for granted.

Dilemma two: In addressing the Double Green Revolution there is a need for new and fresh thinking, and fresh thinking is in short supply. This dilemma was highlighted by many speakers and from comments and questions that came from the floor. We all know that the hardest part of new and fresh thinking—whether it is multidisciplinary, interdisciplinary, or intersectoral groups working together, integrating different kinds of knowledge—the hardest thing about new thinking is getting rid of old thinking. Albert Einstein said this some 50 years ago, "We cannot solve the problems we have created with the same thinking that created them."

Let me illustrate this with a somewhat glib reference to some of the thinking that has occurred here over the past couple of days. By my count, three references were made to that old adage, "Give a person a fish and he eats for a day; teach a person to fish and he eats for a lifetime." It would be unfair to make too much of this small example, but it nevertheless is an example of old thinking. And the truth is that it really does not apply today. Today, the adage should be modified to state, "Give a person a fish, and, at current market prices, he can trade it for gold; teach the same person to fish and you condemn him or her to a lifetime of unemployment and marginalization." We need fresh thinking, it is in short supply, and that is a dilemma.

Dilemma three: Alternatives to modern science may be necessary, and we do not

know what they are. This conference has made clear that the main gains in food production that we have witnessed since the Second World War have resulted from modern science. Its successes have been enormous. But these have involved high costs, high technology inputs, and an exponential dependence on technological fixes. Here the IFPRI paper, as some have pointed out, does not offer us much in the way of alternatives to this high science/high technology approach to increasing food security. IFPRI seems to accept the absence of alternatives. This may well be the correct assessment, but it is one that is causing a certain amount of anxiety, as we have heard from questions and comments over the past couple of days.

Maggie Catley-Carlson pointed this out when she referred to the Fourth World, to those living with incomes under \$2 a day, and to the corollary of the Fourth World, the fact that more and more people are moving onto marginal lands, to dry lands, mountainous areas, fragile rainforests, or fragile coastal zones. The first Green Revolution and modern science have little to say about significant increases in food production in these areas, yet attempts at those increases will be tried increasingly by threatened and marginalized populations. This is a dilemma.

Dilemma four: Will real food prices rise or will they fall? The work of IFPRI indicates that food prices will fall in real terms over the next two decades. But much of the conversation in this conference suggests strong disagreement with that conclusion. Projections for future lower prices result only from the mining of the natural capital of the earth, from the drawing down of that natural capital without either costing it or replenishing it. This is a point that Anders Wijkman made strongly just a few moments ago.

Lester Brown spoke eloquently to the same subject yesterday. He reminded us very forcefully of the complete inadequacy

of current economic models, and he told us that if the true cost of natural capital is brought into our economic models (i.e., internalized), then, far from falling in real terms, prices are going to rise. And, if that happens, it will certainly aggravate the distribution issue.

There are, in other words, serious reasons to doubt the validity of an econometric model that purports to demonstrate falling real prices of food over the next couple of decades. In this lies a major challenge to IFPRI and to all of us—a challenge to reject the currently inadequate tools of analysis, to go beyond the existing model, and to work toward the necessary internalization of the cost of natural capital. This will not be easy and it surely poses a dilemma. One thing, however, is certain and that is that success in this regard would influence dramatically any assessment of future food supply and food security.

Dilemma five: It is going to take time—a lot of it—and time may not be on our side. The benefits from what we talk about today or what we do today will take 10 to 20 years. This is historically verifiable. The dilemma, of course, is that the time may be insufficient. And the further issue is whether ways can be found to compact and compress that timeframe.

The final dilemma: Here I am going to break my own rule and use some dreadful, awful jargon—interdependent determinism needs to be taken into account and we have not done so. How do you like that one? Let me explain. There are so many things that have been recommended. Hundreds of actions have been urged across all fronts. All of them are important, but not all of them can be weighted equally, not all of them will yield an identical incremental benefit. Let me put this even more simply: there is a crying need for priorities and for a basis on which to decide priorities. Some factors have to be such that they will produce a much higher return to the needs of humanity than will other factors. The

task, therefore, is to identify those investments that will yield that combination, that configuration, of action that would result in the highest return, given that resources are certain to be constrained. The most significant weakness in the IFPRI process to date is that we have not addressed the issue of priorities or the means to arrive at them. That is clearly a most serious dilemma and must be addressed if the 2020 Vision is even to have a chance of succeeding.

Last year's *World Development Report* was on health, and I think it represented the first time the World Bank went beyond description to specific prescription. The Report dared to conclude that poor countries would have to choose from a menu of options, but that if they chose a certain, very specific combination, they would deliver the best possible health care for the vast majority of their populations at the lowest cost. Now the combination suggested by the World Bank is at this point nothing more than an informed hypothesis. But it is an hypothesis that provides guidance and merits testing—and urgent testing. We at IDRC, in collaboration with others, are now engaged in testing that hypothesis. Let me suggest that what is needed in the context of the 2020 Vision is that same precision in coming up with a hypothesis that can be tested. There were strong echoes throughout the conference to this effect.

By the way, if this is to be undertaken as the next necessary step in this process, it would appear likely from this conference that one of the highest areas for investment would be in education for women and girls. And, given that resources will certainly be scarce, this would mean, in turn, that other kinds of investment (including perhaps direct investments in international agricultural research) could fall to second-, third-, or fourth-level priorities. In the international development community, we are not very good at making those trade-offs, but that will prove to be an essential component of

whether we can get our act together, and this is certainly the challenge before us.

Conclusion

This has been a rich and challenging process. Much remains to be done, but it has proved to be a rewarding process. IDRC has been one of the sponsors of the 2020 Vision exercise, and I believe we reflect the views of all who have participated in stating that we are delighted with what has been accomplished and that we are indebted to IFPRI for the dedication and the professionalism of the work to date. The work has served as a wake-up call, beginning with a much-needed, wake-up call to our own community. The issue we are dealing with is clear. It is not new. It is an old and universal issue, an issue which is, as our good friend Ismail Serageldin said a few moments ago, at the very root of our humanity. At issue is not whether there will be food for some or for many or for all; at issue is whether civilized behavior shall endure and whether civilization itself shall survive. The 2020 exercise reminds us starkly that this cannot be taken for granted and that there is, accordingly, a need for great urgency—certainly much more urgency than is reflected to date in the IFPRI document. Therefore, urgency, urgency, urgency, and the unembarrassed acceptance of the need for passion on this because it is, after all, fundamentally the question of the endurance of our species and the endurance of civilization.

Let me end with a final quotation, one of my favorites, which I think can be embraced equally by those of us who are Cassandras and those of us who are Pollyannas. It is from Jean-Paul Sartre who said, "We may not be able to bequeath a better world to our children, but we must always live as if we could."

Thank you.

APPENDIX

*Gilbert H. Grosvenor Auditorium
of the National Geographic Society
1600 M Street, N.W., Washington, D. C.*

Agenda

TUESDAY, JUNE 13

7:30 **REGISTRATION**

9:00 *Morning Sessions:*
OPENING

*MODERATOR
David Nygaard, 2020 Coordinator, IFPRI*

WELCOME

*Gilbert M. Grosvenor, President, National Geographic Society
David Bell, Chair, IFPRI Board of Trustees
Speciosa Wandira Kazibwe, Vice President of Uganda*

9:30 **2020 HINDSIGHT, CHALLENGES, AND VISION**

THE PAST 25 YEARS: SUCCESSES, FAILURES, AND LESSONS LEARNED IN FEEDING THE WORLD

An Audiovisual Presentation

THE CHALLENGE FOR A 2020 VISION: EXTENT OF TODAY'S HUMAN SUFFERING AND A VIEW TOWARD 2020

Per Pinstrup-Andersen, Director General, IFPRI

11:00 **KEYNOTE ADDRESS**

J. Brian Atwood, Administrator, United States Agency for International Development

KEYNOTE ADDRESS

Speciosa Wandira Kazibwe, Vice President of Uganda

14:00 *Afternoon Sessions:*
TO THE YEAR 2020: THE IMPACT ON PEOPLE

WHO WILL GO HUNGRY? SCENARIOS FOR FUTURE GLOBAL AND REGIONAL FOOD SUPPLY AND DEMAND

Mark Rosegrant, Research Fellow, IFPRI

THE COEXISTENCE OF GLOBAL FOOD SURPLUSES AND FAMINE: POVERTY'S ROLE IN THE FOOD EQUATION

Nancy Birdsall, Vice President, Inter-American Development Bank

THE DEPLETION OF NATURAL RESOURCES: THE IMPACT ON FOOD

Gordon Conway, Vice Chancellor, University of Sussex, United Kingdom

INTERNATIONAL PERSPECTIVES ON HUNGER AND THE ENVIRONMENT

Klaus-Jürgen Hedrich, Parliamentary Secretary, Ministry for Development Cooperation (BMZ), Germany

Bal Ram Jakhar, Union Minister of Agriculture, India

Donald Brown, Vice President, International Fund for Agricultural Development

DISCUSSION

16:30 **THE WORLD'S POPULATION IN FLUX: ISSUES AND PRESCRIPTIONS TO 2020**

Margaret Catley-Carlson, President, The Population Council

Sudhin K. Mukhopadhyay, Director, Institute for Studies in Population, Agriculture and Rural Change, University of Kalyani, India

DISCUSSION

WEDNESDAY, JUNE 14

Morning Sessions:

9:00

IMPROVING NATURAL RESOURCES TO FEED THE WORLD: PREREQUISITES FOR SUSTAINABLE AGRICULTURE

Sara Scherr, Research Fellow, IFPRI

Reuben J. Olemba, Deputy Executive Director, United Nations Environment Programme

Lester Brown, President, Worldwatch Institute

DISCUSSION

10:15

TECHNOLOGY'S CONTRIBUTION TO FEEDING THE WORLD IN 2020

Peter Hazell, Director, Environment and Production Technology Policy Division, IFPRI

Hubert Zandstra, Director General, Centro Internacional de la Papa

Gordon Sithole, Chief Agricultural Economist, Ministry of Lands, Agriculture, and Water Development, Zimbabwe

TECHNOLOGICAL EXAMPLES

Integrated Pest Management in the Andes: César Cardona, Entomologist, Centro Internacional de Agricultura Tropical

Using Genetic Maps and Markers to Increase Rice Yields: Susan McCouch, Assistant Professor, Cornell University

DISCUSSION

Afternoon Sessions:

14:00

THE MARCH OF MALNUTRITION TO 2020: WHERE ARE THE SOLUTIONS?

Lawrence Haddad, Director, Food Consumption and Nutrition Division, IFPRI

Kalanidhi Subbarao, Senior Economist, The World Bank

Julia Tagwireyi, Director, Department of National Nutrition, Ministry of Health, Zimbabwe

DISCUSSION

15:45

FEEDING ABUNDANTIA: EXPLORING CRITICAL ISSUES IN FOOD SECURITY

A Role-Playing Panel Discussion of Food Security in a Hypothetical Developing Country

Susan Dentzer, Chief Economic Correspondent, U.S. News and World Report, Moderator

Moise Mensah, Benin, Former Assistant President, International Fund for Agricultural Development, Role: Leader of Abundantia, President Chakula

Teketel Forssido, Minister of Agriculture, Ethiopia, Role: Minister of Agriculture of Abundantia, Kenneth Kornu Kopia

Barber Conable, Former President of the World Bank, Role: Head of International Development Agency, Allen Assist

Frances Seymour, Senior Program Officer, World Wildlife Fund, Role: Leading International Environmentalist, Grace Green

Doug Bandow, Distinguished Fellow, Cato Institute, Role: U.S. Republican Consultant on Foreign Policy, Isidor Isolate

Steve Vosti, Research Fellow, IFPRI, Role: Agricultural Researcher and Consultant, Michael Maven

Barbara Torrey, Executive Director, Commission on Behavioral and Social Sciences and Education, National Research Council, Role: Population Activist, Mary Malthus

Urban Jonsson, Director, UNICEF Regional Office, Nepal, Role: Head of a Major International Relief Organization, Daniel Debacle

Blaine Harden, Staff Writer, Washington Post, Role: U.S. Journalist, Sam Scoop

Klaus Leisinger, Executive Director, Ciba-Geigy Foundation for Cooperation with Developing Countries, Role: Representative of Globchem Inc. in Africa, Robert Ridpest

Sarah Darghouth, Tunisian Student, International School, Role: Abundantia High

School Student, Imogen Innocent
Raquel Gómez, Coordinator, Colombia Program, Conservation International, Role:
Representative of a Southern Nongovernmental Organization, Sonia Socorro

THURSDAY, JUNE 15

Morning Sessions:

9:00

TOWARD A CONSENSUS FOR ACTION

Per Pinstrup-Andersen, Director General, IFPRI

9:30

REGIONAL VISIONS AND REQUIRED ACTION

SUB-SAHARAN AFRICA

Baba Dioum, Coordinator-General, Conference of Ministers of Agriculture of West and Central Africa

ASIA

Sartaj Aziz, Senator, Pakistan

LATIN AMERICA

Eduardo J. Trigo, Executive Director, Fundacion ArgenINTA, Argentina

MIDDLE EAST AND NORTH AFRICA

Adel El-Beltagy, Director General, International Center for Agricultural Research in the Dry Areas

DISCUSSION

11:00

A GLOBAL VISION AND REQUIRED ACTION

Anders Wijkman, Assistant Administrator, United Nations Development Programme
Ismail Serageldin, Vice President, Environmentally Sustainable Development,
The World Bank

DISCUSSION

12:30

SUMMING UP

Keith Bezanson, President, International Development Research Centre

12:45

CLOSING SESSION

