THE APEC ECONOMIC COMMITTEE
SYMPOSIUM ON

THE IMPACT OF EXPANDING POPULATION AND ECONOMIC GROWTH ON FOOD, ENERGY AND THE ENVIRONMENT

SASKATOON, SASKATCHEWAN, CANADA
SEPTEMBER 1997

SYMPOSIUM PROCEEDINGS

Dan Ciuriak, Editor

Asia-Pacific Economic Cooperation
November 1998

Published by the APEC Secretariat
438 Alexandra Road
#14-00 Alexandra Point
Singapore 119958
Tel: (65) 2761880
Fax: (65) 2761775
E-mail: info@mail.apecsec.org.sg
Website: http://www.apecsec.org.sg

APEC #98-EC-04.1
ISBN981-04-0600-2

TABLE OF CONTENTS

ANNEX 3: NOTES AND STATEMENTS SUBMITTED BY PARTICIPANTS

FOREWORD AND ACKNOWLEDGMENTS

Since its establishment by APEC Ministers in Jakarta, November 1994, the Economic Committee has undertaken a broad range of research and analysis in support of APEC's work both on trade and investment liberalization and facilitation and on economic and technical cooperation.

One of the most important tasks that have been assigned to the Committee is the APEC Economic Leaders' initiative on *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment* (FEEEP). At Osaka in 1995, Leaders agreed on the need to put this issue on APEC's long-term agenda and to consult further on ways to initiate joint action to ensure that the region's economic prosperity is sustainable.

The Economic Committee is advancing its work on this complex nexus of issues in conjunction with programs being pursued by a number of APEC Working Groups and Ministerial processes. These include, in particular, the Economic Committee's Task Force on Food, the APEC Energy Ministers and the Energy Working Group, APEC Environment Ministers and Senior Environment Officials, the Fisheries Working Group with respect to the fisheries aspects of food, the Marine Resources Conservation Working Group with respect to the marine-related environmental issues, and the Industrial Science and Technology Working Group which is advancing the Cleaner Technologies initiative which Environment Ministers had noted at their meeting in 1997 is relevant to FEEEP as well.

The Economic Committee's Symposium on The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment, that was held in Saskatoon in September 1997, made a major contribution to the Committee's work on this issue. It drew together over 175 delegates from all 18 APEC member economies, including representatives of all the APEC fora working on FEEEP-related issues, academics, government officials, non-government experts and businesspersons, for a wide-ranging discussion of the individual issue areas, the links amongst them, and cross-cutting themes.

The discussions at the Symposium and the messages that emerged from it contributed to the Committee's Interim Report on FEEEP that was delivered to Economic Leaders at their meeting in Vancouver in November 1997. Moreover, these discussions have created a rich resource base for APEC's FEEEP-related work in 1998 as this activity

enters a more policy-oriented phase to prepare for the Leaders' discussion of possible joint actions at their meeting in Kuala Lumpur in November, 1998.

While firm conclusions about many of the issues raised have yet to be reached, the cautiously optimistic tone emerging from the first round of substantive work in 1997, including the results of the FEEEP Symposium, is encouraging. At the same time, this first round of work has served to focus attention of Leaders on the importance of addressing in an integrated fashion the various issues relating to sustainability, including developing food systems, putting in place the capacity to meet rising needs for energy in ways that protect the environment and moving ahead resolutely on key environmental fronts. The emphasis placed by experts at the FEEEP Symposium on the importance of APEC member economies being adaptable in order to cope with changing circumstances and emerging constraints is a particularly important message that deserves further exploration. This directs attention to the longer-term significance of education, accommodation of technological change and institutional flexibility as well as adaptability as keys to sustaining growth and development.

The proceedings of the Symposium, which are set out in this document, will be of considerable interest to all those interested in international public policy responses to questions of sustainability. It is the hope of the Committee that this publication will contribute to the already vibrant international dialogue on these issues and stimulate further input from all sectors of society to APEC's further work in this area.

I turn now to the pleasant task of acknowledging and thanking, on behalf of the Economic Committee, the many people and organizations without whose combined efforts the Symposium would not have been possible.

The success of a Symposium in substantive terms derives from the contributions of the participants. The FEEEP Symposium drew together over 175 delegates from all 18 APEC member economies, including representatives of the APEC fora working on FEEEP-related issues, academics, government officials, non-government experts and businesspersons. The discussions were wide-ranging, engaged, and enthusiastic. It is my pleasure to thank all the participants who, through their various contributions as speakers, panelists, discussants, notetakers and engaged interlocutors, made this such a memorable and stimulating event.

Special thanks are due to Premier Roy Romanow of Saskatchewan, and through him to the people and government of Saskatchewan and the city of Saskatoon, for the warm welcome and gracious hospitality that was provided to the Symposium delegates. It is a special pleasure to thank the Premier for his personal engagement, in the best tradition of political discourse, on the political economy aspects of FEEEP, in his remarks.

A grateful note of thanks is also due to Minister Ralph Goodale of the Government of Canada whose interests in the Symposium reflect his role as Minister of Natural Resources Canada and the Wheat Board, in which capacity he chaired the APEC Energy

Ministers meeting that took place in Edmonton, Canada, in August 1997, his personal roots in Saskatchewan, and his political role as Minister in the Federal Cabinet for that province. Minister Goodale's professional interest in the subject matter of the Symposium is well illustrated by his remarks to delegates in opening the Symposium as set out in this volume.

To our keynote speaker, the Honourable Donald Johnston, who without hesitation accepted (and rose to!) the challenge of launching an international discussion on a subject the antecedents of which reach back as far as the venerable Malthus and yet in many ways is as new as the still unborn millennium to come, and in so doing interrupted his vacation, I add my personal thanks to those of the Committee. His keen interest since taking on his position of Secretary-General two years ago in encouraging stronger links between the OECD and APEC deserves the thank and sympathy of all those interested in the work of both organizations.

I should like to acknowledge, and indeed to highlight, the key role played by Federico Macaranas, John Merson, Michael Harcourt and Ippei Yamazawa who, as Chairs of the four Workshops, motivated and led the discussions in these breakout sessions, encouraged the horizontal thinking that is so essential to consideration of this particular nexus of issues, and cogently summarized the messages and reported them back to the plenary. The strength and clarity of the message from the Symposium back to APEC Economic Leaders is due to them.

I would be remiss not to say a few words about the Symposium as an event. From the first elegant strains of string quartet music that floated over the French gardens of the Bessborough Hotel during the opening reception on the delightful late summer's evening of September 1, 1997, to the haunting evening stroll to the sites of buffalo hunts past, whose echoes reverberate now only in the consciousness of the Plains Indians of the South Saskatchewan River, to the syncopated weave of energetic Dixieland jazz that greeted delegates as they emerged from the final plenary session, the Symposium unfolded effortlessly. Of course, it was anything but effortless. To Don Wilson, who organized the event in such a spectacular and memorable manner, and the many individuals who came together as a team to execute these plans flawlessly, goes the credit for making it seem so. These individuals include the staff of the Bessborough Hotel, the volunteers from the University of Saskatchewan, members of the Government of Saskatchewan and the City of Saskatoon, and staff from various Government of Canada departments and agencies, including in alphabetical order, Agriculture and Agrifood Canada, the Canada International Development Agency (CIDA), Environment Canada, the Department of Foreign Affairs and International Trade, and the Department of Natural Resources.

I gratefully acknowledge the financial support provided to the Symposium by the above-mentioned Government of Canada departments and agencies, the sponsorship of hospitality events by the Government of Saskatchewan and Innovation Place at the University of Saskatchewan, and our private sector sponsors Sasktel and the Saskatchewan Wheat Pool.

Finally, I should like to thank the small group of individuals who have supported me in my capacity as Chair of the Economic Committee for the last several years and who played many and varied roles in bringing the Symposium from concept to realization, including the compilation, editing and preparation for publication of these proceedings: Julie Gould, Director (Program) of the APEC Secretariat, Christine O'Connell of my office, and Dan Ciuriak, who has been my alter ego in much of this work and edited and synthesized the rich and varied material produced for and at the Symposium into the present volume.

John M. Curtis

Chair
APEC Economic Committee

Ottawa
November 1998

A MESSAGE FROM THE HONOURABLE ROY ROMANOW, PREMIER OF SASKATCHEWAN

On behalf of the Government of Saskatchewan, I take pleasure in welcoming you to our province and the City of Saskatoon for the APEC Symposium on *The Impact Of Expanding Population And Economic Growth On Food, Energy And The Environment*.

As you know, Canada is hosting the APEC Leaders' and Ministerial meetings this year and has declared 1997 to be *Canada's Year of Asia Pacific*. For its part, the Government of Saskatchewan has designated September as the month of Asia Pacific in the province, and we have a number of special events planned to recognize the economic and cultural relationships Saskatchewan has with the economies of the Asia Pacific region.

Saskatchewan is a province rich in natural resources with magnificent forests, grain and specially crops and value-added production, a significant oil and gas industry, and the world's largest potash and uranium production areas. Our provincial motto "*from many peoples' strength*" reflects our deep appreciation for cultural diversity. Saskatchewan people celebrate their unique cultural backgrounds at numerous festivals and events each year.

As one of our major cities, Saskatoon is emerging as an important centre of economic strength. It was established in the late 1800s and named after the Cree Indian word for an indigenous wild berry, which can be sampled in various forms during the course of your stay! Saskatoon is making its mark globally for its concentration of agri-biotechnology companies and its research and development activity, and has emerged as one of the top sites in the world for expertise in this sector, as exemplified by Innovation Place, adjacent to the University of Saskatoon, where Symposium delegates can learn more about our dedication to science and technology.

Again, welcome, and please enjoy your time with us. Saskatchewan is renowned for its hospitality and I know that you all will receive a warm reception and greeting during your visit. Bienvenue a Canada et a Saskatchewan

The FEEEP Issue

I want to commend you for undertaking the monumental task of addressing the interweaving themes and vital issues that form the subject matter of this Symposium. These issues, which will affect the future of billions of people and ultimately global stability in the years ahead, include:

- rising integration of international markets;
- the transition from predominantly rural to predominantly urban societies;
- population pressures;
- food security, and,

- environmental degradation.

Most APEC member economies have been successful in implementing the fundamentals of economic development. But this success in turn has created its own challenges, many of which are shared by Canada.

I believe that a common agenda within the region may be emerging, the key ingredients of which are.

- reducing poverty and achieving growth with equity;
- meeting growing infrastructure needs;
- developing the institutions for market economies;
- providing sound social safety nets;
- managing structural change; and,
- upgrading labour and environmental standards and management practices.

The Brundtland Commission's report, "*Our Common Future*", called for a new economic development path, one that sustained human progress not just in a few places for a few years, but for the entire planet into the distant future. By putting this agenda squarely before us, we are starting on a journey down that path.

In some respects it may seem ironic that a Symposium dealing with rapid population growth, food and energy scarcity and security, and the prospect of environmental degradation, is being held here in Saskatchewan, a province with a small and stable population, a substantial exporter of food and energy, and blessed, we think, with one of the best environments to be found on the globe. However, while the scale and context of the challenges faced in other parts of the Asia Pacific region may be different, we too face many of the challenges that have given APEC leaders cause for concern. And in responding to them, Saskatchewan has attracted the interest of many in the Asia Pacific who would like to share in our modest successes.

Agricultural Sustainability

Saskatchewan's agricultural industry is continually striving to develop techniques and technologies that work with and complement our semi-arid environment. More than sixty years ago, as we watched much of our topsoil blow away, we learned a harsh lesson. We realized that we must try to develop a sustainable agricultural relationship with our environment. As a result, we are today world leaders in dry-land farming technology, preserving precious topsoil for future generations through minimum and zero-till management practices, and by continually inventing new agricultural implements to enhance these dry-land farming techniques. Our close trading relationship with many APEC economies has allowed us to share this expertise with major agricultural producers throughout the Asia Pacific.

We are also exploiting many exciting new technologies to help our farmers minimize the negative impact on the environment. For example, Saskatchewan is a world leader

in agricultural biotechnology, a science that not only increases yields, but also develops insect and disease resistant crops – reducing the need for inputs that may be harmful to the environment. You will have a first hand opportunity to get to know this exciting industry when you visit Innovation Place.

On another front, Saskatchewan's potash industry – the largest in the world – is also working actively with agricultural partners throughout the Asia Pacific. Not only are we exporting a much needed plant nutrient – we are also working together with these economies to optimize its effectiveness. In the People's Republic of China, for example, we are at work with governments and farmers to dramatically increase yields through balanced fertilizer practices.

The Energy Challenge

Saskatchewan is also an important producer and exporter of oil and natural gas. However, many of our oilfields are technically difficult to access, and some have reached the end of their conventional lives. To address this challenge, our industry has developed horizontal drilling techniques that extend the life of these oilfields. Firms from Saskatchewan are now actively applying this technology throughout the APEC region.

In another innovative world-class technique, Saskatchewan's oil industry is now determined to use carbon dioxide to enhance and extend oil recovery within our oil pools. An important added benefit to this technology is that approximately twenty million tonnes of carbon dioxide – which would otherwise have been released into the earth's atmosphere as a dangerous greenhouse gas – will be trapped deep below the earth's surface. While far from eliminating concerns about greenhouse gas emissions, this is a good example of how it is possible to combine economic and environmental objectives.

Saskatchewan also has large reserves of lignite coal used largely for electricity generation. However the poor quality of this resource means we have had to learn how to effectively scrub the emissions to minimize their environmental impact.

As well, we have addressed the challenge of delivering electricity to a vast and sparsely populated geographic area. SaskPower, our government-owned power generation and distribution company, continues to serve as a model of efficient rural electrification.

Saskatchewan: A Growing Economy

These are a few examples of how people in Saskatchewan have responded to some of the challenging interrelationships that will be addressed in this Symposium and by so doing have grown and diversified our economy.

Our trade and investment links with APEC economies – which are our most important markets – have expanded and broadened. Saskatchewan used to be basically an exporter of wheat. Now it is an international partner in the agricultural biotechnology

sector, mineral resources, building products and environmental technologies. Saskatchewan is Canada's leading province in growth of value-added food processing industries, with much of this growth based on business links with the Asia Pacific region.

Investing In People

The great French writer, Victor Hugo, once wrote: "*Social prosperity means man happy, the citizen free, the nation great."*

We need to transform our economic prosperity into social prosperity if we wish to achieve greatness. We need to invest in the development of the minds of our people through education and training. We need to fight poverty and ill health wherever they exist – for these are clearly the causes of much of any economy's productivity challenges. And we need to find means to grow economically in ways that respect our collective responsibility for the environmental integrity of our planet. All of us need to pursue economic growth in a manner that is both environmentally and socially sustainable.

Because if we do not address these issues, we defeat the fundamental underlying purpose of economic growth – namely, to respect the dignity of humanity through improving the quality of life for all of our citizens, in this and future generations.

Given sufficient political will and financial resources, I contend that economic growth, fostered in part by the kind of regional trade liberalization on which we are now embarked, can be used to raise social and environmental standards around the globe. This is a process that some call "leveling up". I hope that this Symposium will place the concept of leveling up at the centre of your important deliberations.

Conclusion

In closing, I offer another quote from Gro Harlem Brundtland, who tells us in *"One Earth, One Future*" that: "*We need to develop a more global mentality as we chart our collective future, and we need not only firm political and institutional leadership, but also sound scientific advice*". By bringing together academic, business and political leaders from around the Asia Pacific region, you have gone a long way toward starting to chart that future. And although the subject matter of the Symposium is huge, I have every confidence that you will rise to the challenge.

Roy Romanow
Premier

FEEEP SYMPOSIUM PLENARY, SEPTEMBER 2, 1998: OPENING STATEMENTS AND KEYNOTE ADDRESS

Opening statement by John M. Curtis, Chair, APEC Economic Committee

Minister, Secretary General, ladies and gentlemen, I would like to welcome you to this first ever Symposium on *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment*, and to formally call this meeting to order.

I am particularly pleased to welcome everyone to this province of Saskatchewan, which in a sense symbolizes FEEEP itself. An agricultural province, which has been the wheat basket of Canada and is now diversified into granola, barley and other agricultural products as well as becoming a centre of bio-technology; a great energy producer, with oil and natural gas only a hundred kilometers or so to the west of this city of Saskatoon and uranium and potash to the north; and a great concern for the environment.

This Symposium is the first ever such gathering in APEC. We are crossing departmental boundaries, bringing together officials who are experts in their own areas of agriculture, natural resources and energy, the environment, economic growth, and population. And we have gathered together many people from many walks of life to develop ideas on how these areas come together. This is experimental and we are not sure how it is going to turn out. There are certain questions that we are posing and we await the outcome of the discussions to see what, if any, the answers might be. Leaders at Osaka have asked whether there are indeed problems of longer-term sustainability and how they as Leaders might, through joint policy actions, work to ensure sustained prosperity and economic growth and the reduction of poverty in this very vital area of the world into the next century.

I would like to now invite the Honourable Ralph Goodale, Minister of Natural Resources Canada, Minister Responsible for the Canadian Wheat Board and the Federal Minister responsible for Saskatchewan, to formally welcome you to Canada and to the Province that he represents.

Remarks by the Honourable Ralph Goodale, Minister of Natural Resources Canada, Minister Responsible for the Canadian Wheat Board and Member of Parliament for Wascana

On behalf of Prime Minister Jean Chretien and the Government of Canada, it gives me great pleasure to welcome the delegates to this Symposium on *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment,* to my home province of Saskatchewan, and to the City of Saskatoon. And to those of you from beyond our national borders, a hearty welcome to Canada!

Saskatoon is known as the "City of Bridges" and that is fitting for a meeting associated with the Asia Pacific Economic Cooperation forum, because "building bridges" is what APEC is all about: building bridges of friendship and collaboration, bridges of commerce and technology, bridges of common sense and common purpose, and bridges of vision to the future – to the 21st Century, the Pacific Century – which holds such huge potential for us all.

As Chair of APEC in 1997, Canada believes it is essential that we hear the views of all interested parties as we work to foster sustainable economic growth and equitable development in the Asia Pacific region. By bringing together delegates from throughout the APEC region, including academics, government officials, business leaders and non-government experts, this Symposium provides a first opportunity for an open, multi-stakeholder exchange of views on the complex inter-relationships among population growth, economic expansion, requirements for food and energy, and the associated pressures on the environment, issues which are critical to our collective future.

Encouraging such a dialogue is consistent with our goal of increasing APEC's interaction with Asia Pacific academics, business people, cultural groups, youth and broader civil society in 1997, which we have designated as "Canada's Year of Asia Pacific". As a Pacific nation, we highly value our economic, social, cultural and humanitarian ties with other APEC economies. And we recognize the need to work together for a better quality of life for people throughout the region.

I would like to commend Dr. Curtis and his colleagues on the APEC Economic Committee for organizing this Symposium and to acknowledge the work that has been undertaken by other APEC fora to help inform the debate, as well as the support of the APEC Secretariat.

The APEC region is expected to account for 60 percent of the world's population by the year 2020, compared to about 40 percent today. With this population growth will come tremendous opportunities for economic expansion. By the end of the decade, the region's share of world trade is expected to rise to 70 percent. By 2020, seven of the world's top 10 economies will be in Asia Pacific.

On the one hand, this economic and population growth will create opportunities for expanded trade and investment, industrial modernization, job creation, social progress and a better standard of living in all APEC economies and particularly among the more rapidly developing ones. However, economic and population growth of the magnitude anticipated in Asia Pacific also present us with a number of challenges to ensure that economic progress remains sustainable over the long term.

What impact will Asia Pacific growth have on the demand for food and energy, and on the environment? How should APEC economies, their governments and businesses cope with such challenges to ensure that we are not faced with shortages of food or energy or a degradation of our environment? These questions were raised by APEC Economic Leaders two years ago in Osaka, and they demand our continued attention.

Through the FEEEP initiative, APEC is bringing a focus to how we can ensure long-term sustainable growth and social progress in the region.

As Minister Responsible for the Canadian Wheat Board, and as a former Minister of Agriculture and Agri-Food Canada, I am well aware of the linkages between population growth and the basic ability of an economy to feed its people. And in my current role as Minister of Natural Resources Canada, I recognize that reliable supplies of affordable energy will be critical to sustainable economic growth in Asia Pacific. APEC Leaders have recognized that we must work together to prevent energy from becoming a bottleneck to economic growth, while at the same time we work to safeguard the environment.

The relationship between economic growth and food.

Without sustainable economic growth, many developing economies will continue to struggle to feed their people and to provide for their other basic needs. Conversely, unless people have access to an affordable and nutritious food supply, they will not be able to live healthy, economically productive lives. Faced with a fixed quantity of arable land available for food production, a limited supply of usable water, and the need to produce food in a way that is environmentally sustainable, we cannot underestimate the importance of technology in ensuring that we continue to supply the amounts and kinds of food needed and demanded by APEC consumers.

While technology provides some of the answers, it also presents us with additional challenges. For example, with important new technologies like biotechnology (for which Saskatoon has a world-renowned reputation for expertise, quality and excellence) we need to be both vigorous and vigilant. Vigorous – to ensure we reap the full advantages of increased productivity, greater crop variety, disease and chemical resistance, input cost savings and savings on fossil fuel consumption. And we must be vigilant – to be certain that all our processes and new products are safe, healthy and environmentally sound so that we can gain, deserve and maintain consumer confidence and trust in a rapidly changing marketplace.

But technology and innovation, in the areas of agri-food and energy production, processing and distribution, cannot on their own ensure that we meet this challenge. Canada believes that a well-functioning, multilateral trading system, in which markets are able to operate efficiently, is an important contributing element in sustainable food and energy production and distribution systems within APEC and around the world.

While there are bound to be special sensitivities and exceptions, Canada encourages all economies to move towards less distortionary and more market-oriented policies to allow world markets to respond efficiently and effectively to the rising and changing demand for these critical commodities. We oppose trade-distorting export subsidies and equally troublesome export taxes and sanitary and phytosanitary barriers which destabilize and undermine more open trade. The work of APEC in promoting trade and investment liberalization and facilitation is therefore vitally important.

Energy and sustainable economic growth

To focus for a moment on the issue of energy as a key prerequisite for sustainable economic growth, one of the most fundamental issues currently facing certain Asia Pacific economies is how they can develop the energy infrastructure needed to support their population growth and to achieve their economic potential. By some estimates, this will require expenditures of US$1.6 trillion over the next few years in the electricity sector alone.

This was one of the principal questions that APEC Energy Ministers addressed just last week, when we met in Edmonton. As host and Chair of that meeting, I am pleased to report that we made significant progress on a number of initiatives to improve the openness, efficiency and sustainability of regional energy markets in Asia Pacific.

We took steps to facilitate a key role for the private sector in developing the region's power infrastructure, since it is clear that governments alone cannot provide the needed investment capital. My colleagues and I endorsed a set of principles that are designed to attract business investment for independent power projects by ensuring openness and consistency in project tendering, evaluation, financing, tax treatment and so on. We also considered and approved another set of principles to promote the incorporation of good environmental practices into the development of power projects.

As well, we have agreed to promote the mutual recognition of accredited energy-efficiency testing facilities, which should enhance regional trade in energy-using products. This type of cooperation is crucial to ensure that developing economies have access to technologies that are already supporting sustainable economic growth in Canada and elsewhere.

The environmental implications

I can assure you that APEC Ministers are well aware of the complex relationship between energy, economic development and the environment. We know that energy will be the engine that drives economic growth in the region, but we are also acutely aware of the environmental implications of many forms of energy production and use, and we are moving forward in such key areas as enhanced energy efficiency, natural gas infrastructure and the consideration of renewable energy sources – all of which can carry environmental advantages.

Of course, the environment is also affected by the drive to expand food production in developing Asia Pacific economies. For example, the loss of vital forest ecosystems to essential agricultural use is an ongoing concern. And what impact will expanded food production have on the quality and quantity of water supplies in the Asia Pacific region?

These are not simple issues, and Canada does not pretend to have all of the answers. None of us do. But, we are committed to working with our APEC partners to ensure that the environment does not emerge as a loser as the region’s population and economies grow. By reducing threats to the earth’s resources and natural systems, we

can better sustain all forms of life. That means protecting our lands, our oceans and our forests, while ensuring that demands for energy are met.

Canada believes it does have some of the answers – or at least partial answers – to some of the food, energy and environmental challenges that APEC member economies face. Our energy industry is in many ways second to none in energy production and transportation, energy efficiency and renewable energy technologies. Our agricultural and agri-food industries are also among the most environmentally and technologically advanced in the world. There are many exciting opportunities for the Canadian natural resources sector to share its expertise and technology with partners in other APEC economies, contributing to business expansion and job creation in Canada, and to sustainable economic growth and equitable development in the APEC region.

Integrating the issues

Various APEC fora are doing a great deal of work to gain a better understanding of the challenges of sustainable development in the Asia Pacific region. The FEEEP initiative, however, is APEC's first effort to bring together experts from the academic, business and non-government communities to address these concerns in a more integrated way.

Your task is not a simple one, particularly given the complicated nature of the inter-relationships and the need to take a multi-disciplinary, long-term perspective. Good luck with your deliberations.

Remarks by the Chairman, John M. Curtis, Chair, APEC Economic Committee

Thank you Minister for those warm welcoming remarks and also for launching us on the substantive issues of this Symposium with the very cogent outline of the challenges that we face in our work and the many threads that we have to bring together over the course of these next few days.

May I turn now to our keynote speaker, The Honorable Don Johnston, Secretary-General of the Organization for Economic Cooperation and Development (OECD) in Paris. Mr. Johnston has had a long and distinguished career in Canada. He was Minister for ten years of a number of federal departments, including the Treasury Board where he was involved in the de-regulation and re-regulation of the domestic economy. As well, he served as the opposition critic for Finance, taking a very strong interest in international trade issues in that period. He has also practiced law, and taught at McGill University in Montreal. On June 1st, 1996 he assumed the position of Secretary-General of the OECD, the first non-European to head this very important organization which is also taking steps, as we are in the APEC family, to bring together some of the disciplines and policy work across territorial and intellectual boundaries. He is going to speak to us today on the issue of sustainable prosperity, building on the paper that he initiated upon joining the OECD, *Towards a New Global Age*. May I invite you to welcome the Honorable Don Johnston.

Keynote Address: The Honourable Donald J. Johnston, Secretary-General, OECD

What a pleasure and honour to be addressing this Symposium on the *Impact of Expanding Population and Economic Growth on Food, Energy and the Environment*. We have been challenged by the Symposium organizers to analyze bow these factors might evolve and interact in the Asia Pacific region over the next generation and beyond. These issues are very much at the heart of the work of the OECD, in the globalizing world economy.

The role of the OECD

But, before I address the specific issues on the agenda, I should say a few words about what we do at the OECD. I usually describe the OECD as a resource at the disposal of its members and, through them, the international community, to help shape the world economy and move future generations to a better world. Its mission, as set out in its Convention almost 40 yeas ago, is to achieve the highest sustainable economic growth and living standards for its members, to contribute to sound economic expansion in all economies in the process of economic development and to contribute to the expansion of world trade (and one might now add investment) on a multilateral non-discriminatory basis. In carrying out this mission, the OECD relies on dialogue and peer pressure in its role as a catalyst and pathfinder in international cooperation and development.

In more concrete terms, I believe a key role of today's OECD is to advance the process of globalization, ensuring that them is no backsliding on the trade and investment liberalization agenda and working to help the developing world to become fully integrated in the world economy. "Globalization" is one of the major challenges facing governments today – how to maximize the benefits and minimize the costs, not only within OECD member economies, but within the global community as a whole. In this endeavour, at the OECD we deal with economic issues in the broadest sense, much like APEC. This covers not only issues of macro-economic policy, trade and investment, but extends to most areas of government policy, including the topics on our agenda today of environment, food and energy.

In its work, OECD is also tackling a number of the priority issues on the international agenda such as, aging populations, electronic commerce, cryptography, corporate governance, regulatory reform and sustainable development. OECD member economies are also negotiating a Multilateral Agreement on Investment and a convention for combating bribery in international transactions.

APEC and the OECD

The OECD has often been described as being a “rich-man's club” and “Eurocentric”. If that were ever true, it is not the case today. There is a large degree of homogeneity in the OECD membership but it is not one that is easily defined in terms of dollars and cents. The per capita GDPs of OECD members range from US$3,000 to $33,000. The homogeneity lies rather in the shared values of open market economies, pluralistic

democracy and respect for human rights. As for the Eurocentricity claim, I would just point out that there are seven OECD economies which am also members of APEC – the host nation of this Symposium, Canada, together with the United States, Mexico, Japan, Korea, Australia and New Zealand. Over the last decade, the OECD has been globalizing. We have accepted five new members, including two of the APEC economies that I have just mentioned, Mexico and Korea. And we have developed close and constructive relationship with other non-members, including nearly all other APEC member economies.

As APEC is working to realize its goal of free trade and investment in the Asia Pacific region by 2020, at the OECD we are also moving forward the international free trade and investment agenda in a complementary way. The OECD's founding fathers saw greater economic interdependence and integration as the key to peace, security and prosperity. The OECD is the only living legacy of the Marshall Plan – whose 50th Anniversary has been celebrated this year – which first spelt out the message that the prosperity of each economy depends on the prosperity of its trading partners.

Since APEC and the OECD cover most of the same policy issues, it is not surprising that cooperation and closer contacts have been developing between us. Indeed, the first ever joint APEC/OECD event (together with PECC) took place in Vancouver in 1995 on the issue of the information highway. Now the contacts and cooperation between APEC and the OECD have spread and we are working together on issues as diverse as taxation, investment, human resource development and telecommunications. The cooperation on taxation issues, which was manifest in a joint symposium on taxation in Sydney last year, is a very concrete policy issue that has become increasingly important. The OECD has long been at the forefront in the development of tax treaties and design of transfer pricing rules, but concern in this area has grown as globalization has developed and the possibilities for "harmful tax competition" have been recognized.

In pursuing these joint endeavours. I believe that we have much to learn from APEC as well as much to contribute from the OECD's rich experience of the whole range of complex issues confronting modern economics. I can thus assure you that we at the OECD Secretariat very much welcome the growing cooperation with APEC.

The OECD's Linkages Studies

I have just mentioned that the OECD has been globalizing. In this context, we have been studying the relationship of OECD economies with the rest of the world, through our so-called "Linkages Studies". We are just now completing our second Linkages Study, which we bravely call "Towards a New Global Age". This examines the policy challenges for realizing a high performance scenario for the global economy as we look out to the year 2020. These include specifically policy challenges deriving from the impact of expanding population and economic growth on the environment, energy and food, the subjects of this symposium.

While experience shows that most forecasts are unreliable, demographic prospects are perhaps one of the more predictable elements. Population growth in the non-OECD area, especially in Africa and parts of South Asia, will account for virtually all of the increase in the world population, from 5 billion in 1990 to about 8 billion in 2020.

Experience has shown that rapid population growth threatens the sustainability of development and stability of societies. We also know that economic and social development tends to be the best form of population control and can thus make a major contribution to enabling economies to reach more sustainable population balances.

At the same time, increasing longevity is also contributing to population growth and posing new problems as the age structure of the population changes. Population aging will be an important policy issue in many APEC economies, including China and Japan. In Japan, for instance, the share of the population aged 65 and over, which was 12 per cent in 1990, may be over 25 per cent by 2020. As populations age, and the proportion of the elderly and retired increases, living standards will be put under pressure unless productivity growth picks up significantly and existing trends towards early retirement are changed. Fewer and fewer workers will have to support more and more elderly people, putting immense strain on social security and health systems. There will have to be rethinking of the roles and mix of learning, work, leisure and care over the course of a life span, through a shift in both policies and attitudes. The various public policy options which are available to deal with aging populations need to be examined today, if the increases in the elderly population that are just around the corner are not to develop into a major problem tomorrow. It is for this reason that the OECD Secretariat has been commissioned by the Member Governments to analyze the challenges and the opportunities facing our OECD societies through the aging phenomenon and to bring forward a comprehensive report for the Ministerial in April 1998.

A "New Global Age"

Fully realizing economic growth potential over the coming decades will depend in large part on governments. It requires leaders everywhere to seize the moment to harness what are unprecedented opportunities, especially in the developing world. In working towards their goal of free trade and investment in the Asia Pacific region, APEC leaders have demonstrated their commitment to moving towards an open trading system which can fully exploit those opportunities. Looking beyond APEC and other regional groupings such as NAFTA, MERCOSUR and the European Union, we need to address global trade and investment. Regional trading arrangements such as APEC must be open and serve as building blocks for the opening up of economies worldwide. Global free trade and investment are crucial for the realization of the OECD's vision of a "New Global Age", supported by macroeconomic stability and structural reform, including policy reform in the areas of the environment, energy and food.

But let me first set out our vision of a high-performing world economy over the next couple of decades. A dramatic increase in global prosperity would be in prospect. In the OECD area, living standards could be 80 percent higher than now, while those in the non-OECD area could rise by some 270 percent. This would put poverty, misery and

disease in many parts of the developing world on the fast track to eradication. Economic growth in the developing world would benefit through the transfer of capital, technology and know-how, combined with unfettered access to goods and services from OECD markets.

There would be a big shift in global economic weight, with the non-OECD share of world GDP increasing to more than 60 percent (from around 40 percent in 1995), and its share in world trade rising from one-third to one half. The enormous energy of the Asia Pacific region will be an economic locomotive in the realization of the "New Global Age" with continuing increases in its share of world trade and output.

This large increase in prosperity would, however, bring with it patterns and levels of production and consumption which would increase pressures on the environment and the demand for energy and food in ways which I will elaborate below. Dealing with these pressures will require cooperation from all of us. At the OECD, we firmly believe that high growth levels and sustainable development are both necessary and compatible given the right policy choices. Containing resource use and pollution outputs as real incomes rise will be one of the major challenges in the coming millennium in both the OECD and non-OECD areas. Let me now turn to the environment, energy and food in turn and spell out the nature of those challenges and the ways in which we should respond.

Environment

I turn first to the question of environment. The projected dramatic economic growth in the Asia Pacific region suggests that these economies will account for a growing share of local, regional and global environmental problems. It is not just a question of greenhouse emissions, on which I will touch later. There will be increasing pressures on the environment through rising volumes of hazardous wastes, increasing numbers of megacities, more intensive agriculture, timber and fisheries exploitation, and growing demands for fresh water resources.

However, analysis by the OECD and others indicates that globalization can have a generally positive effect on the environment, provided the appropriate set of policies is in place. In many areas, the policies necessary to achieve these outcomes will need to be reflected in sound multilateral arrangements.

Recent OECD analysis demonstrates that price mechanisms are among the most powerful tools for achieving better integration of economic and environmental decision-making. Eco-taxes are an obvious example. More generally, rationalizing distortionary taxes and subsidies, in particular in the energy, transport and agriculture sectors, can also bring about both environmental and economic benefits. For example, current agricultural subsidies amount to US$300 billion or 1.3 percent of OECD GDP; fisheries receive $50 billion; and annual coal subsidies in eight OECD economies amount to US$10 billion. Such subsidies lead both to the inefficient use of resources and serious environmental side effects that then need to he addressed. The most effective way to

deal with such problems is to get the prices right, ensuring that environmental damage is reflected in the price of the product.

In the past, many OECD economics adopted a "grow now – clean up later" approach, with damaging consequences for the environment and also for the economy over the longer term. Over time, there was growing recognition that this was not the way to go as economies faced increasingly higher economic and environmental costs dealing retrospectively with accumulated pollution and natural resource management problems. It is important that emerging economies do not follow the same path. Experience suggests that there can be significant "win-win" benefits in introducing early on coherent economic and environmental policies, underlining the point that there can be important synergies between economic growth and sustainable development.

Let me pass on to the energy issue, which is of course closely linked to the environment. A high performing world economy will be accompanied by substantial growth in fossil fuel consumption, mostly by non-OECD economies, particularly in the Asia Pacific region. The world could become dependent on oil supply from Middle East producers, which could be a source of market volatility. Experience has, of course, shown that technological progress could alleviate this effect by reducing exploration costs, and making other energy sources, such as oil sands, more economical. The International Energy Agency, which is part of the OECD family, is already in discussion with the larger economies in the Asia Pacific region about the holding of strategic oil stocks and coordinating policies for potential oil disruptions.

Fossil fuel use is closely linked with the global environmental issue of greenhouse gas emissions and the associated threat of global warming. Atmospheric emissions of $C0_2$ could double between 1992 and 2020, with an important share of the increase in emissions coming from China and other dynamic economies of the Asia Pacific region.

These projections do not take into account the aim of limiting the future growth of greenhouse emissions to 1990 levels as agreed by Annex I Parties under the United Nations Framework Convention on Climate Change. OECD economies have the opportunity at the Kyoto Conference in December 1997, and subsequently, to negotiate policies for limiting the growth of $C0_2$ and other greenhouse gas emissions. Satisfactory resolution of this issue will inevitably require much closer cooperation with the emerging economies in Asia.

It is of course unclear which among the currently available alternative energy sources might in the long run displace fossil fuels, or whether technologies not yet discovered will prove to be the answer. One alternative is nuclear power, which accounts for about 17 percent of the world's electricity generation. If concerns about safety and waste disposal can be resolved, this would pave the way for increased use of a resource with much less impact on global warming than fossil fuels.

I would now like to move on to the question of food. Population growth, rapid urbanization, income increases and dietary changes are likely to increase food demand substantially in the period to 2020. Eighty percent of the increased demand could

originate from the non-OECD area, with half of that coming from China and India alone.

This will put pressures on agricultural production, as most of the increases in production will have to come from yield increases. While there is great scope for increasing yields in Central and Eastern Europe, China, India, Latin America and Sub-Saharan Africa, important policy reforms will be necessary to achieve that.

In the case of China, rapid income growth will be the single most important factor driving long-term food demand. Our long-term projections show that China will neither "starve the world" nor return to being a large net exporter of grains. While it will become a more significant importer of grains and higher value food products, it also has the potential to export specific high-value products. Urbanization and income growth will be accompanied by a shift in consumer preferences towards consumer-ready food products and more meat products, with beneficial effects for exporters of those items.

OECD economies have a major role to play in ensuring sustainable agriculture by using the increasingly scarce resources of soil and fresh water more efficiently, by employing emerging technologies wisely and above all by avoiding agricultural subsidies which increase environmental damage. Nevertheless, the bulk of the additional food required to meet rising demand will have to be produced in those economies with rising demand themselves, by more fully exploiting their agricultural potential. OECD economies could become the world's biggest agricultural exporters, especially the low-cost producers in the Asia Pacific like Australia, New Zealand and, to a lesser extent, the US and Canada. To reap the full benefits of a truly global approach to achieving efficiency and sustainability in the production of food, considerably further progress in policy reform at all levels, including trade liberalization, will be necessary.

Some concluding comments

It has been a great honour for me to attend this meeting, it being the first time that an OECD Secretary-General has attended an APEC meeting. It has also been a great pleasure to share with you some of the conclusions that emerge from our “Towards a New Global Age” report.

Should the report give us cause to celebrate our future as we approach the 21st Century? As I wrote in the Preface to the report, the results projected for the year 2020 are surprisingly modest, especially as regards the developing economies. But the results foreseen are perforce based on a linear projection of existing technologies. History has proved such projections to be woefully inaccurate in most cases and with the virtual explosion of innovative technologies that touch every area of human existence, I am confident that the high performance scenario sketched out in the report will prove to be conservative.

So indeed we have reason to celebrate the potential of the global village, once a slogan, now a reality; but it will not be achieved without strong political leadership in every part of the planet. That leadership must recognize that the opportunities of globalization carry important responsibilities. Look at it this way: in each economy social progress

depends upon keeping in balance three poles of a paradigm, namely, economic growth, political stability (meaning good and predictable governance), and social stability which is well captured by the notion of social cohesion.

Our challenge at the OECD is to help members attain that balance. For example, if the benefits of economic growth are not equitably shared across society, social cohesion will be in jeopardy. If social cohesion deteriorates, economic growth will be placed in jeopardy – a concern in numerous OECD economies at this time where there is a growing resistance to global free trade and investment. History teaches that the progress of societies towards increased living standards and quality of life has always depended on maintaining that balance.

As we near the end of this millennium, it is clear that the paradigm must not only be balanced within sovereign nations, it must become global. Globally it is shockingly unbalanced! Over 1.2 billion souls live in abject poverty with less than US$1 a day to live on. As I commented in the Preface, "These are the fellow travelers in our village for many of whom death may be contemplated as a respite from the hunger, misery and squalor that has stalked them each day of their existence. The observation '...there but for the grace of God go 1...' takes on a chilling reality as the world shrinks..."

Enormous global opportunities but also global responsibilities: both require determined and well-focused multilateral cooperation and collaboration. Because the Asia Pacific region is seen as the economic locomotive for the foreseeable future, it must play a central role in meeting these objectives.

At their meeting in May this year, OECD Ministers welcomed the effective working relationships that OECD has established with other international organizations, both global and regional. They also asked that synergies with these organizations be fully exploited and unwanted duplication be eliminated.

As I said earlier, we at the OECD wish to contribute to the APEC process in any way we can. We cannot live in a world divided either through ideology as during the cold war or by wealth and poverty as we see it today. We all have to cooperate and work together to realize a "New Global Age" for the benefit of all and give meaning to the poem of Frank Scott which began: "The world is my country, the human race is my race."

Chairman's Remarks: John M. Curtis, Chair, APEC Economic Committee

Thank you very much Mr. Johnston for those remarks in which you introduced much information and many fundamental ideas, including the importance of balance which you highlighted at the end and which is vital for international discussions such as this. In particular, I am happy that you took aim at my own profession of economics in brining up the issue of linearity and reminding us that this discipline grew up based on the thinking and ideology of the industrial revolution, as a poor cousin of engineering, and must now become more of a social science and less linear to grapple meaningfully

with the key longer-run issues of sustainable and equitable prosperity. As an economist, I look forward to the cross-fertilization of ideas from politics, sociology, environmental studies and all the other areas represented here today.

THE PANEL DISCUSSIONS
AT THE OPENING PLENARY SESSION

The five panel discussions in the opening plenary session included:

- *a "scene-setting" review of APEC's FEEEP-related activities by representatives of the various APEC fora;*
- *a panel discussion of the driving forces behind FEEEP concerns, namely population expansion and economic growth; and*
- *panel discussions of the three key issue areas of food, energy and the environment.*

These panel discussions were intended to put the facts on the table in each of the issue areas. In the ensuing workshop sessions, these facts would be reviewed in a crosscutting sense through four "prisms": markets, technology, governance and the socioeconomic context. Subsequently, the concluding plenary would attempt to pull these the results from these "vertical" and "horizontal" discussions into a "holistic" view. This was the basic design of the Symposium.

APEC FORA PANEL

Remarks by the Moderator of the Panel, Ambassador Jack Whittleton, Executive Director of the APEC Secretariat

This first panel discussion will consist of scene-setting presentations by representatives of the APEC fora engaged on FEEEP in one way or another. The panelists include:

- Minoru Shibuya, Shuji Miyamoto, and Elizabeth Schick, the Co-Chairs of the Economic Committee Task Force on Food, which was formed explicitly for the purpose of examining the food aspects of FEEEP;
- Marshall Moffatt, representing the Fisheries Working Group, to provide a fisheries perspective on FEEEP;
- Ampan Pintukanok, Lead Shepherd of the Marine Resources Conservation Working Group, which is involved in a number of initiatives related to sustainability of the marine environment;
- Paul Ross, representing the Energy Working Group, who will provide an energy perspective on FEEEP, including the results of the APEC Energy Ministers meeting that took place several days ago in Edmonton, Canada;
- Larry Funnell, representing the Senior Environment Officials, who will provide an overview of APEC's environment agenda, and in particular the results of the APEC Environment Ministers meeting on Sustainable Development that took place in Toronto, Canada in June 1997;
- John Curtis, who will report on the approach being taken by the Economic Committee, which he of course chairs, to the cross-cutting aspects of FEEEP; and finally,

- Len Edwards, the 1997 SOM Chair, who will tell us about the expectations that Senior Officials have from this Symposium and the plans to bring the results forward to Leaders and Ministers at their meeting in Vancouver, in November 1997.

Report by the Co-Chairs of the Economic Committee Task Force on Food

Minoru Shibuya

Thank you, Mr. Chairman. I would like to outline the interim report of the Task Force on Food (TFF). The TFF has been examining the impact of population and rapid economic growth on the demand for, and supply of, food in terms of production, trade flows and stocks; processing and distribution; and agriculture-related environmental issues. The TFF is chaired jointly by Australia and Japan. It is sincerely hoped that this interim report will give this Symposium a good overview of the food issue in the APEC region and stimulate discussion, particularly in the Panel on Food taking place this afternoon.

In assessing future trends in food supply and demand in the APEC region in the medium and longer term, both quantitative and qualitative procedures have been used to develop a more comprehensive and complete view of the future opportunities and challenges facing APEC. Over the past decades, rapid economic growth, rising per capita real incomes, and population change have increased the overall demand for food, with marked differences in growth in demand for various food commodities and among members within the region. Economic growth, mainly in the form of rapid industrialisation, has also affected the region's capacity to meet changes in demand.

The following are the key issues of importance to be considered by policy makers which either arise from the above scenario or are not adequately dealt with in quantitative models. I refer to six points.

1. Projections show slow improvement in future food balances but not all food needs are met. Filling the gap between food consumption and food needs will involve reducing quality, improving food distribution systems, increasing food production and lowering the population growth rate.

2. The capacity to expand food production varies greatly in APEC. Agriculture will face a limited supply of arable land and stiff competition for land and water resources from industrial and residential users. Raising agriculture production costs. The increased negative impacts of environmental programs will also constrain growth in production. On the other hand, scope exists in some areas to use available land and water resources more efficiently.

3. The world has not reached biological or physical limits to food production but production growth rates are declining. Tapping the full potential of existing technologies and creating new production technologies will be critical, if growth is

to be sustained. As such investment in research, health, nutrition, education and extension must either come through the public sector or the private sector, it will be important to ensure an environment conducive to private investment.

4. Production is expected to shift to more efficient producers who increasingly produce for export. Several of these economies have recently cut their extremely high stock levels. If production becomes increasingly concentrated in a smaller number of economies, and if future grain stocks remain low, there could be some concern about the extent to which grain prices might fluctuate.

5. Population and food production pressures are increasing and there are strains on the environment. We need devices, therefore, to reduce these negative impacts and to promote and enhance positive impacts that agriculture can have on the environment. There is also a possibility that, over the very long term, global environment developments, such as green house effects, will have some impacts, either negative or positive, on food production.

6. Structural adjustment in rural communities that accompanies economic growth and development and trade liberalization involves resource movement out of agriculture. These movements can disrupt traditional societal norms and create welfare gains and losses for different sectors of the economy. These associated costs must be dealt with through the political process as economic growth continues and as APEC economies become more closely linked through market integration. Only when these costs, including all externalities, are incorporated can the full cost of change in an economy be accurately compared with benefits received from that change.

Thank you.

Shuji Miyamato

I would like to add one more point to the presentation made by Mr. Shibuya. The Task Force on Food report presented to this Symposium is only an interim report. The Task Force will continue to work for another year. We have so far done the analytical part of our work and, even as regards the supply and demand situation, we have very divergent views. But in the second year we have to continue on policy issues based on the findings in the analytical part. The final report of the Task Force is to be presented in the APEC meetings in Malaysia next year.

Thank you.

Elizabeth Schick

My colleagues Mr. Shibuya and Mr. Miyamato have made a very comprehensive presentation this morning, raising a number of issues that have been and are continuing to be addressed in the Task Force on Food and that will provide a very useful basis for the discussion in more detail this afternoon in the Panel on Food.

Thank you.

Report by Marshall Moffatt on behalf of the Fisheries Working Group[1]

The world's fisheries supply an important component of the world's food supply and an especially significant component of the Asia Pacific's food requirements given the importance of seafood in diets on the Asian side of the Pacific. Fisheries issues are thus central to the broader issues of sustainability and food security that are addressed by APEC under FEEEP and in other fora, including the United Nations and the WFS.

From the standpoint of fisheries, the FEEEP set of issues represents both an opportunity and a problem. The opportunity relates to the potential for the fisheries sector to provide a basis for economic growth and development, particularly in the developing economies in the Asia Pacific area. The problem relates to the fact that, in the fisheries sector, we are dealing with a renewable resource and the need to sustain the future productivity of that resource is a serious problem.

Supply projections developed by the Food and Agriculture Organization (FAO) show that capture fisheries will stagnate at approximately the current world production levels and that future growth of supply in response to increasing demand will depend on the growth of aquaculture. This raises an issue of food security, which has been addressed in two major international meetings over the past year and a half.

The first was an FAO conference sponsored by Japan in Kyoto which brought together approximately one hundred different economies review food security in fish products. At that conference, new ideas for making more effective use of existing resources and providing a basis for the sustainable development of aquaculture were developed. The Kyoto declaration is an important food security document.

The second was the World Food Summit in Rome, sponsored by the FAO, which moved forward on this agenda as well as in the areas of food security and the code of conduct for sustainable fisheries developed by the FAO, and in the UN Fish Agreement which clarifies the roles of coastal states and deepwater fishing nations in conserving and managing trans-boundary and highly migratory stocks. With these major

[1] Marshall Moffatt's remarks were presented on behalf of the Lead Shepherd of the APEC Fisheries Working Group, Ms. Mary Harwood, of Australia. Dr. Moffatt, Director, Department of Fisheries and Oceans of the Government of Canada, is Canada's representative on the APEC Fisheries Working Group and coordinator of a program of liberalization for the fisheries sector under the Early Voluntary Sectoral Liberalization (EVSL) initiative agreed by APEC Ministers and Leaders at their meeting in Vancouver in November, 1997.

accomplishments over the past couple years we certainly know what the fish-related FEEEP issues are and what we need to do.

The sustainability imperative relates both to fisheries management approaches for capture fisheries and the preservation of eco-systems, and to ensuring a sustainable basis for the development of aquaculture.

Trade liberalization can assist both sustainability and food security by getting market signals to the producers, in aquaculture in particular but also in fisheries. This can increase efficiency by providing a stronger commercial incentive to reduce the wastage that currently exists in both harvesting and processing.

Eliminating or at least reducing subsidies is another major area where benefits to sustainability can be achieved because subsidies tend to fuel over-capacity in the capture fisheries sector which in turn leads to over-exploitation and difficulties with sustainability.

To summarize, the linkages in FEEEP from a fisheries perspective are between economic growth, food security, environmental sustainability, and trade liberalization.

The priorities of the Fisheries Working Group in respect of these issues reflect the two main priorities of APEC: trade and investment liberalization and facilitation on the one hand and economic and technical cooperation between member economies on the other. Of the various activities currently underway in the Fisheries Working Group, three are of particular relevance to FEEEP.

At the last meeting of the Fisheries Working Group in Mexico in June 1997, Canada proposed a workshop on the linkages between economic growth, food security, environmental sustainability and trade liberalization to be held in conjunction with the 1998 annual meeting of the Fisheries Working Group.

Secondly, Japan has proposed a project, which a number of members of the Fisheries Working Group strongly support, related to demand and supply in the fisheries sector. This would be a sector-specific contribution to the demand/supply projections of the Economic Committee's Task Force on Food. The supply-side constraints and opportunities in the fisheries sector are extremely complex to analyze. It is not as simple as building an econometric model or analyzing supply from a purely price response basis, since conservation and a whole range of related issues enter into the picture. I think that this will be solid contribution if, as I hope, this proposal proceeds at the next meeting.

Thirdly, there are a number of trade and investment liberalization initiatives underway. The most notable is the recently approved Seafood Information System, which will operate in collaboration with the private sector to identify market and trade-measure-related information to facilitate trade. There is also a project to document and analyze the economic implications of various kinds of trade measures and HACCP Equivalency

and Training, which will help ensure that APEC member economies are able to meet the SPS requirements of major markets.

I have one final issue to note, which is not directly related to the work of the Fisheries Working Group. This is APEC's voluntary sectoral trade liberalization initiative. One of the sectors under this initiative is the fisheries sector. The approach being taken to trade liberalization in the fisheries sector is a balanced approach, which involves addressing each of these issues that I have been talking about earlier. We are hopeful that we will be able to build a consensus to proceed with that important initiative.

Statement by Ampan Pintukanok, Lead Shepherd of the Marine Resources Conservation Working Group

The Marine Resource Conservation Working Group (MRC WG), which held its 10th meeting on 26-28 May 1997 in Pusan, Republic of' Korea, is pursuing a number of projects relevant to FEEEP, including:

- integrated coastal zone management, including two workshops on integrated management of' semi-enclosed bays and the impact of destructive fishing practices on the marine environment;
- the management of red tide and harmful algal blooms in the APEC region;
- an inventory of' ocean industries in the APEC region; and
- development of an ocean model and information system for the APEC region.

A key contribution is the *Action Plan for the Sustainability of the Marine Environment* that was endorsed by APEC Environment Ministers at their meeting on Sustainable Development, in June 1997, in Toronto. The Action Plan focuses on the maintenance and improvement of the marine environment, the establishment of mechanisms for coordination within the region, and the development of linkages with multilateral organizations, multinational corporations and relevant domestic agencies. It also establishes a protocol for assessment of progress in meeting the following objectives:

- integrated approaches to coastal zone management;
- prevention, reduction and control of' marine pollution; and
- sustainable management of marine resources.

Tools used to accomplish these goals include: research; exchange of information, technology and expertise; capacity building, training and education; and public-private partnerships. The final section of the Action Plan specifies five "next steps" to be conducted within two years to further define coordination mechanisms, update the list of current and planned projects, identify their deliverable dates, gain high-level commitment to the plan, and develop links both within and outside of APEC.

Statement by Paul Ross, representing the Lead Shepherd of the Energy Working Group

This Symposium is very timely, taking place as it does only a week after the second meeting of APEC Energy Ministers, who met under Mr. Goodale's chairmanship in Edmonton on 27-28 August. The theme for the Ministers' meeting was *Energy Infrastructure for Sustainable Development.* In his earlier address, Mr. Goodale spoke about the outcomes of the meeting and I would like also to highlight some of the main points from the Ministers' discussion and the role of the Energy Working Group (EWG).

FEEEP issues have always been at the heart of the EWG's work program. Following its formation in 1990, the EWG recognized that the rapid economic growth of the newly industrialized economies would place considerable strain on the region's energy resources and this in turn would impact on the region's environment. So the EWG has always been concerned with meeting this challenge. The EWG's current program is based on the Osaka Action Program for energy, the directions of APEC Leaders on such matters as FEEEP, and instructions from Energy Ministers.

FEEEP was one of the items on the formal agenda that Ministers considered at Edmonton and, indeed, issues relevant to FEEEP permeated most of the discussion at the meeting. Ministers acknowledged that meeting the energy needs of the APEC region is a critical component in addressing the challenges of FEEEP, and emphasized the importance of sustainable energy development to the region's longer-term welfare and prosperity. They agreed that concerted efforts by the region's governments as well as improved partnerships with businesses and the wider community were needed in order to facilitate the development of an efficient and environmentally sound energy infrastructure and to improve energy security.

With regard to energy security, Ministers particularly acknowledged the work of the Asia Pacific Energy Research Center (APERC), which was set up in 1996 to develop a comprehensive supply and demand model for the APEC region to the year 2010. This work, which is to be completed by the end of this year, will provide a solid analytic underpinning for the future debate on possible policy actions in response to FEEEP. Mr. Yokobori and Mr. Tamang from APERC are here this week and I understand that Mr. Yokobori will be one of the panelists in the *Panel on Energy* later today.

Importantly, Ministers acknowledged a paper prepared by the EWG, entitled *APEC Leaders' Initiative on FEEEP: Contribution by the Energy Working Group* which I am pleased to formally present to this Symposium. This paper describes the work that is being undertaken in the EWG to meet the energy challenges of the region in an environmentally and socially acceptable manner, including: liberalizing and facilitating trade and investment; removing impediments to the efficient operation of energy markets; mitigating the environmental aspects of energy production and use; improving energy efficiency; promoting clean coal technologies; and encouraging new and renewable technologies.

The five main themes of the Energy Working Group are: Energy Supply and Demand; Energy and the Environment; Energy Efficiency and Conservation; Energy R&D and Technology Transfer; and Mineral and Energy Exploration and Development. These issues are addressed by the following expert groups under the EWG, which bring together technical specialists and business and private sector representatives:

- The Energy Supply and Demand group concentrates primarily on collecting and disseminating consistent data on energy supply and demand in the region and has an oversight role with regard to APERC;
- The Clean Fossil Fuels Group has the main interest of promoting the more efficient and clean use of coal which is central to the energy-environment linkages given the important place that coal has in future energy supplies in the region;
- The Energy Efficiency and Conservation Experts Group has a number of subsidiary bodies focussing on particular aspects of that work;
- The Renewed and Renewable Energy Group has a self explanatory mandate; and
- The Mineral and Energy Exploration and Development group is the most recently formed group.

There is also an ad hoc business forum that plays a role in providing business input into the EWG, and an electricity regulators' forum that was set up last year primarily to provide input into the work on electricity infrastructure.

Some of the additional work that Ministers assigned to the EWG at Edmonton were referred to by Minister Goodale earlier, including work to facilitate the development of natural gas supplies and infrastructure within APEC; to look further at the environmental aspects of energy infrastructure development; and to pursue further work in improving energy efficiency and cooperation in Energy Efficiency Standards.

This body of work has established a strong foundation for the EWG to make a significant contribution to the FEEEP initiative and, indeed, Ministers agreed that the EWG is already addressing the energy-related issues embodied in the FEEEP initiative and is well advanced in responding to them in many perspectives. The Working Group will continue to work at a consolidated APEC response to these important longer-term issues.

Report by Larry Funnell, representative of the Chair of the Senior Environment Officials

Thank you Mr. Chairman. I am pleased to be here to represent the APEC Senior Environmental Officials who have met on four separate occasions over the past year to prepare for the Environment Ministers meeting that took place two months ago in Toronto.

I am a relatively newcomer to APEC and, at my first APEC meeting I asked the question: "Where does environment and sustainable development fit in APEC?" After getting over the initial surprise to learn that there is no formal APEC working group on

environment – nor on sustainable development – I have been pleased to see that the APEC approach to integrating sustainable development does appear to work, and in fact it continues to improve in my view.

As you know, Leaders have directed that sustainable development be integrated into the work of all APEC fora. The results of the most recent analysis completed by the APEC Secretariat show that there are now some 40 sustainable development initiatives underway in APEC. Two significant characteristics stand out when you look at these initiatives.

- First, they cut across the APEC spectrum, being led by various Working Groups, including the Energy, Human Resources Development, Industrial Science and Technology, Marine Resource Conservation, Tourism and Fisheries Working Groups, to name but a few.

- Second, the initiatives invariably engage more than one working group – accordingly coordination and communication among these groups is alive and growing.

These characteristics of the APEC approach to sustainable development guided the work of Senior Environmental Officials as they prepared for the Ministerial meeting in Toronto. While recognizing that they perhaps have a special role in promoting environment and sustainable development activities in APEC, Senior Environment Officials also acknowledged the absolute necessity of effectively engaging other Working Groups in their activities.

APEC is a relatively young forum and an important part of its evolution occurred this past winter when all Working Groups and Lead Shepherds and Committee Chairs gathered in Singapore to discuss mutual interests and opportunities for synergy.

This proved to be a valuable session for Senior Environment Officials, providing us with the opportunity to refine our proposals for Ministers and to ensure that indeed what we put before Ministers complemented, and in many cases capitalized on, the work already underway in other APEC fora. The Singapore Joint Fora model hold promises as an on-going mechanism to review and coordinate APEC activities on sustainable development and other cross-cutting issues.

Early on in our preparations for the Toronto Ministerial meeting, we recognized the many parallels between the work on sustainable development initiatives and the FEEEP exercise. Indeed, we grappled with many of the questions that are on the agenda for the Workshops tomorrow. While we may have successfully answered some of the questions, many remain unanswered. Discussions on such issues as sustainable consumption and production patterns were definitely not concluded. We also touched on other issues such as carrying capacity, economic instruments and consumer choice.

So what did Ministers accomplish in Toronto when they reviewed the proposals of the Senior Environment Officials, and heard recommendations from business leaders, local authorities and youth from across the APEC region?

First they agreed that a strong message be sent to Leaders in November underlining that the principles of sustainable development be at the foundation of APEC's activities.

Second, they applauded and endorsed two sustainable development initiatives from individual APEC Working Groups, namely:

- *The Strategy and Action Plan to address Sustainability of the Marine Environment* developed by the Marine Resources Conservation Working Group and about which we just heard from Dr. Ampan Pintukanok; and
- *The Clean Production Strategy* developed by the Industrial Science and Technology Working Group, which promotes clean production in industrial sectors by identifying and expanding best practices and establishing a cooperative agenda for technology diffusion.

Third, Ministers endorsed the *Sustainable Cities Program of Action* to improve the quality of life in APEC's urban areas. The fourteen separate initiatives under this program of action fall into the following broad areas:

- encouraging investment which reflects sustainable development principles;
- integrating the agendas of all levels of government, the private and public sectors and civil society;
- learning from individuals through effective stakeholder engagement; and
- enhancing well-being by working to incorporate the poor and disadvantaged into the productive process.

Infrastructure also emerged as a key crosscutting theme in the sustainable cities discussions. The program of action includes initiatives relating to innovative financing and the "greening" of infrastructure to name a few. Work on the program of action is well underway.

In their closing statement, Ministers acknowledged the importance of FEEEP as a Leaders' initiative, and urged that environmental considerations continue to be addressed as a crucial crosscutting element of the initiative. Judging by the high level of interest shown by those of you with whom I have talked since arriving here yesterday, I am confident that their desires will be met. I look forward to hearing your views, and to reporting back to Senior Environment Officials on what I am sure will be a lively and productive three days in Saskatoon.

Statement by John Curtis, Chair Economic Committee

Since much of what would be pertinent for me to say at this time regarding the role of the Economic Committee on FEEEP was in fact set out in my letter of invitation to participants, I will limit my remarks to situating the Economic Committee within the family of APEC fora and to describing the collaborative approach that it is taking to the FEEEP initiative.

First, the Economic Committee is a relatively young Committee. It was established following the Ministerial Meeting in Indonesia, Jakarta, in November 1994 and had its first meeting in Fukuoka, Japan in 1995. So we are now into our third full year as a Committee. The Committee reports to the Senior Officials Meeting (SOM) and, pursuant to its terms of reference as endorsed by APEC Ministers, undertakes primarily analytic work, including in particular work on horizontal cross-cutting themes, of which FEEEP of course is a prime example.

Second, the Economic Committee has representatives from a very broad range of government departments and agencies. Indeed, the Committee is probably the most polyglot forum within the whole APEC family, with representatives drawn variously from foreign ministries, trade ministries, economic and social planning agencies, and finance and treasury departments. Through its sub-groups on food and infrastructure and ad hoc task forces on specific issues, the Committee also involves in its work people from environment ministries, agricultural ministries, public works agencies and others. Accordingly, people from a very wide range of backgrounds are part of the Committee and they contribute to the cross-cutting nature of the work that we undertake.

Third, the actual substantive work is undertaken on an entirely voluntary basis within the various member economies, often as part of various member economies' ongoing work. For example, in our work on trade, Japan and Singapore are heading up work on the impact of trade liberalization, while Chinese Taipei is spearheading the work on investment liberalization and subregionalism. In the case of the Committee's annual economic outlook for the region, this year the task force is being chaired by Korea, last year it was chaired by the United States and the year before that by Japan. So that gives you a sense of the role that all member economies and all departments and agencies of our respected governments play in making the work of the Economic Committee go forward.

I should also add that we regularly draw on non-governmental, or research institutes that relate to our work. This year, we have been very pleased to work with the Pacific Economic Cooperation Council (PECC), which of course pre-dates APEC, and in particular on its Pacific Food Outlook about which we will hear at the discussions tomorrow and which will be presented formally as a finished product at the PECC International General Meeting in Santiago, Chile at the end of this month. We have also worked with the APEC Study Center Consortium which met this year in Banff and, indeed, one of their workshops was on the FEEEP initiative which helped myself and my colleagues think through the approach that the Committee might take to advancing this particular initiative.

Fourth, in respect of the FEEEP initiative, I might just repeat what I set out in my letter to my colleagues in all the APEC fora that are represented here, namely that the Committee has agreed, as its interim report for Leaders for the Vancouver meetings in November of this year, to summarize in seven to ten pages APEC's progress on FEEEP, drawing on the work of the Task Force on Food, the Fisheries Working Group, the Energy Working Group, the Marine Resources Conservation Working Group, the Senior Environmental Officials, and indeed all the relevant work of all APEC fora, including of course the primary themes that arise from this Symposium.

Hopefully, this will lead to a good discussion of the issues by Senior Officials, Ministers and Leaders this year, to be followed with work to identify possible joint initiatives and policy ideas for cooperation to bring to Leaders next year.

Statement by Len Edwards, 1997 SOM Chair[2]

The foregoing presentations have outlined some of the detailed work of direct relevance to FEEEP that has been going on in APEC over the last year and before. Because FEEEP does not exist in a vacuum, I thought that it would be useful to set this work in the broader context of APEC's overall program of work.

As you know, I have the honor to be the Chair this year of the Senior Officials process – which includes, I might note, our Japanese colleague, Mr. Shibuya, who reported on the Task Force on Food. And I am pleased to report that, based on our recently concluded meeting in St. John's, we are all on track to deliver a very substantial product to our Ministers and Leaders in Vancouver in November. Let me just tell you a little bit about our other areas of emphasis this year and try and draw some linkages with your work.

First, as a number of speakers have noted, there are two major pillars of APEC activity: one is trade and investment liberalization and facilitation (TILF) and the other is economic and technical cooperation (ECOTECH).

As regards the first area, grappling with issues of supply and demand for energy and food against a background of rising population and economic growth naturally raises questions of efficient production and distributions systems and price structures. So one of the questions which then must be asked, and which I assume you will be asking yourselves, is how does the existence of various tariff and non-tariff barriers to trade and other trade-distorting measures affect the region's ability to cope with increasing demand? As you know, APEC economies are working to eliminate over time these trade barriers and you will be aware that the Bogor agenda calls for the achievement of free and open trade and investment in the region by 2010 for industrial economies within APEC and for 2020 for developing economies.

[2] Len Edwards was the Chair of APEC Senior Officials in 1997 and was also the Assistant Deputy Minister for Trade and Economic Policy in the Department of Foreign Affairs and International Trade in the Government of Canada.

As regards this TILF program, there are three major areas that we are pursuing this year in the Senior Officials process.

One is to improve the individual action plans (IAPs) which were tabled for the first time in Manila last year. The IAPs set out the unilateral steps that have been taken to liberalize trade and investment pursuant to the Bogor commitments and include a very substantial range of undertakings that member economies have made in the Uruguay Round and various bilateral, multilateral and regional agreements. Ministers and Leaders called for the IAPs to be improved during the course of this and subsequent years and we are now in the process of collating all of the new improvements as well as reviewing their implementation. Many of these measures are supportive of freer and open markets in areas that you are looking at.

A second area is sectoral liberalization, to which a couple of speakers have already referred, and which is quite relevant to what you are doing because it includes some of the sectors at which you are looking here.

While APEC has generally tended to stay away from the agriculture sector, awaiting the resumption of agricultural negotiations in the WTO in 1999 which was mentioned by Minister Goodale, there have been efforts to tackle some product areas under the sectoral liberalization initiative this year. A few economies for instance have proposed processed food products for sectoral liberalization. Another group of economies, as noted by Marshall Moffatt, is having some very interesting success in lining up support for sectoral liberalization in the fisheries sector. Similarly, in the energy sector, there is support for liberalization led by Australia and a couple of other economies. Finally, work is underway to identify what might be included in an initiative in the area of environmental technologies, and I am pleased to say that Canada is one of the key players in pulling this area together. As you can see, there is much work underway in TILF that impacts on your discussions here.

The final area of TILF that I would like to mention just briefly is trade facilitation. We think that we are going to have a significant package of trade facilitation measures available for Leaders to look at in November, which will be centered on improvements in customs. Here we are working towards a blue print for simplified customs procedures to set the stage for what will eventually be electronic customs across the region. This will, as you will appreciate, go a long distance to making it cheaper to move products across borders within the APEC region. And that too, will have an impact on your deliberations, particularly in the areas of environmental products and services, food products and of course, energy.

Now turning to ECOTECH, we are centering our work this year around infrastructure which is our main theme for 1997, with a key focus on ways in which we can attract greater private sector investment into infrastructure development in the region. The package is still taking shape, but it pulls together a number of strands, including the work of a number of ministerial meetings that have taken place this year. For example, you have already heard Minister Goodale talk about some of the progress that was made at the Energy Ministerial in this regard. Transportation Ministers meanwhile looked at

the issue of congestion points, amongst other things. And we have just heard from Larry Funnell on the result of this year's Environment Ministers which looked at the important issue of sustainable urbanization, perhaps the most significant of the major phenomena of modern times in the Asia Pacific region.

We are planning to pull together all these advances this year, build on a lot of good work that is already underway in APEC, and present it to Leaders as a conceptual whole, hopefully with some recommendations for future action. While most of this work is still in the finishing stages, and it is a little early to say exactly where it will be, I am quite optimistic that it will be a significant outcome for this year's work.

The interrelationship of this work with your broad complex of issues is quite clear. Infrastructure is directly related to the movement of goods and products in areas that you are talking about and its role in sustainable development is absolutely essential. In this latter regard, I am pleased to say that, at the last Senior Officials meeting, there was support for the notion that sustainable development forms an important and underlying feature of our work in infrastructure and, indeed, that the two are interlinked. We will be carrying that message into the November meetings.

The last area at which Senior Officials are looking extends beyond these two substantive areas to the consideration of ways to broaden APEC's engagement. Canada has, as Chair, sought to involve the business community as never before, building on the efforts of previous Chairs. For example, we have included business events at all our Ministerial meetings and we will plan an interface session in Vancouver between Leaders and the APEC Business Advisory Council. We have also sought to broaden APEC's engagement to include youth, women, the academic community and particularly the APEC Studies Centers, which held their recent meeting in Banff, and more broadly still civil society.
I am most pleased to see, among those attending this meeting, representatives from all these areas. This sends a strong signal that engagement of the world beyond governments is absolutely essential in dealing with the complex issues which you have before you. It is important for generating ideas, for generating support for finding solutions and most important of all, it is important for implementing results.

That is the outlook for 1997 in these three areas. The FEEEP result is going to be an essential component of this overall package. It represents the knitting together of the two main areas of APEC's work, TILF and ECOTECH. This is a theme that many of us have been emphasizing for some time and FEEEP represents perhaps the best example of it. It is relevant to, and underpins analytically and intellectually, the practical work that we are doing on liberalization and cooperation. And it shows APEC's capacity for leadership in tackling this important set of complex issues. In no region of the world do all of these elements come together with such force and importance for the future of our world.

FEEEP shows that APEC, in addition to being a forum for liberalization and for economic cooperation, also has a human face. It is relevant to the people and the public. And this is a big year as a number have pointed out for sustainable development

with “Rio plus five” review and the UN climate change meeting coming up in Kyoto in December.

Finally, speaking in the broadest sense, FEEEP helps situate APEC at the leading edge of the multilateral fora dealing with global issues today. As a new type of institution, it can advance issues in a way that many other institutions cannot and it breaks new ground and shapes the world even as it itself is being shaped.

I do not know what your report will look like at the end of the day and what the Economic Committee will pull together for Leaders. We do not anticipate an in-depth discussion of this issue in Vancouver. We are still working on what the Leaders' discussion will be. I think that it will be situated around the infrastructure theme so that the conclusions that you draw with regard to FEEEP will feed directly and productively right into that discussion.

Once again, it is a pleasure to meet you all and to have had the chance to talk to you over these last two days. I too would like to welcome you to my home province, to all the sunshine that you see outside, and of course to meet the fine people that live here and who will make you feel welcome. Thank you.

PANEL ON
EXPANDING POPULATION AND ECONOMIC GROWTH

Remarks by the Moderator of the Panel, Dr. Schive Chi, Vice Chair of the APEC Economic Committee

After the sweeping overview provided by our keynote speaker and the review of APEC's current activities related to this complex nexus of issues of FEEEP, we are now going to discuss in this panel the principal factors driving the concerns about sustainability of prosperity in the Asia Pacific region: namely, the continued expansion of population and economic activity.

The various interwoven issues that must be dealt with in thinking about sustainability have preoccupied me for some time and I have given much thought to the formulation of the problem as developed by APEC Leaders at Osaka: the impact of expanding population and economic growth on food, energy and the environment.

At first blush, there appears to be a distinction among the five variables with population and economic growth having an exogenous nature and food, energy and the environment having an endogenous nature. However, a deeper consideration of the issues reveals quickly that the influences flow in all directions.

I have concluded that, in thinking about sustainable development, we must take into account the various directions of influence.

- people are the most important element in our scheme, since sustainable development is the for benefit and the improvement of the welfare of the population;
- land, or more broadly speaking, natural resources (of which energy is clearly but one) is also a basic factor;
- people use natural resources to produce output, including the very fundamental product, food; and
- production impacts of environment, which it is crucial to protect.

Other channels of influence can be discerned and I will not attempt a full listing, leaving this work to the various panels this afternoon.

In addition to the flows of influence amongst these basic variables, we must also take into account key contextual parameters: the level and type of technology; prices; and the effectiveness of institutions.

Bringing these various considerations together, we have something that approaches a comprehensive framework for sustainable economic growth. To ensure sustainability, with particular reference to the situation in the APEC region, I would submit the following key questions for your consideration:

- How to transfer technology from developed economies to the underdeveloped? How should new technology be developed?
- Can the price mechanism, which exerts its influence through free market and trade, accommodate the smooth operation of the economic system?
- What are the essential institutional building blocks?

All these issues are important and challenging in their own right. But putting them together is an especially great challenge. Against this background, I now turn to our panelists to broach the issues surrounding population and economic growth respectively.

Plenary Presentation by Margaret Catley-Carlson[1]

The Population Paradox - What is going on?

The world's population as of August 1997 was 5.87 billion, and growth is far from finished. Depending on what we do in the next 10 years, it will continue to grow to some number between 8.5 billion and – in an almost unimaginable worst-case scenario – between 12-15 billion.

And yet new reports from the UN show that population growth, although not the population levels, is dropping sharply. World population is now growing at 1.48 percent per annum[2], below the 1975-1990 average of 1.72 percent. This is adding 81 million people to the world population total per year, much lower than the 87 million per year added during 1985-1990 which was the peak period in the history of population growth. Of the current growth rate of 1.48 percent, about 1.08 percent is accounted for by growth of population in developing economies and 0.4 percent is accounted for by growth of population in the industrialized economies.

This lower growth means that the 1995 population was 29 million or 11.2 percent lower than originally forecasted in 1994. The underestimation was accounted for by slower-than-expected growth in population in the developing economies, which turned out to be 34 million lower than projected; population in the industrialized economies by contrast turned out to be 5 million higher than projected.

The current world average of 2.96 children per family is down from the 1990-1995 average of 3.10 children per family.

So what does this mean for what is ahead? Under the current medium fertility assumptions, world population is now projected to reach 9.4 billion in 2050. Under the

---

[1] Margaret Catley-Carlson is President of the Population Council, which is located at One Dag Hammarskjold Plaza, New York, New York 10017. Telephone: (212) 339 0500; Facsimile (212) 755 6052; email: pubinfo@popcouncil.org; and website: http://www.popcouncil.org

[2] UN release dated November 13, 1996

high fertility assumptions it would be 11.1 billion, and under the low fertility scenario it would be 7.7 billion.

Asia has the biggest population mass with China's population level at 1.23 billion; India at 945 million, Indonesia at 200 million, Pakistan at 140 million, and Bangladesh at 120 million. These figures compare to the USA population of 269 million.

However, over the period 1980-1985, fertility rates were estimated to have declined in Bangladesh from 6.2 to 3.4 children; in India from 4.5 to 3.4 children; and in Pakistan from 6.5 to 5.5 children.

In fact, according to the UN, 20 developing economies are at or below replacement-level fertility rates in 1995-2000, including: China; Hong Kong, China; Macao; South Korea; Singapore; Thailand; Armenia; Georgia; Bahamas; Barbados; Cuba; Martinique; Reunion; DRP Korea; Sri Lanka; Guadeloupe; Netherlands Antilles; Puerto Rico; Trinidad and Tobago; and Brazil.

The Demographic Transition

Despite the decline in population growth rates, the fastest growth in terms of absolute numbers is now. It took until the 19th century to reach 1 billion, i.e., it took a million years to reach 1 billion people on earth. But this similar amount of growth now happens in a decade – and will indeed continue to happen over the next two decades, but in amounts less than forecasted.

This enormous growth is one of the characteristics of the *demographic transition* through which our global civilization is passing. It is unique. It never happened before. It will never happen again. It is a phenomenon of the past 200 years. And it will end in another 100 or 150 years. We are currently living in it.

What is it? It is a term used to describe the change from high birth and death rates – where a very high percentage of the population dies before the normal life span. Most die in the first year or before 5 years and thereafter probably of infectious disease. The population evolves into societies with low birth and death rates within which most of the death takes place in the last ten years of life expectancy. The cause of death tends to be chronic disease, genetic, and diseases of lifestyle.

This demographic transition is underway everywhere right now. The rate differs, the phenomenon is the same. If we hasten the year in which the planet will have its peak population, the number will be smaller.

The faster the transition proceeds, the faster will be the phenomenon of aging, a fact which is known but not yet reflected in policy in Asia. If the population profile is a pyramid, it will be succeeded by a ballooned column. After the period when the proportion of older people increases, there will be a period when the age profile goes back to being a vertical column.

Economic Effects

There is no consensus on the relationships and linkages of population growth and poverty – it would be an easier world if there were such a formula. In 19 economies of the developing world where population growth was slowest, average GDP in real per capita income terms grew by 2.04 percent over the period 1970-1990. In the 19 developing economies with the fastest population growth, per capita income fell by 1.16 percent per year over this period. But the links flow in both directions, and the factors impelling high population growth also lead to low economic and social progress: low education, low life expectancy, low status of women, etc.

Similarly, it is not clear if rapid population growth increases the number of people in poverty, the percentage of the population in poverty, or the severity of poverty. What is clear is that high fertility leading to a rapidly growing population will increase the number of people living in poverty in the short run, and, at least in some cases, make escape from poverty more difficult. UNICEF describes a PPE spiral: Poverty, Population and Environment. Let us look at these poverty and population linkages:

<u>Linkages: Influence of Poverty on Population</u>

- High child mortality rates lead parents to compensate to ensure survival of families by having many children.

- Lack of water supply, fuel and labour-saving devices increases the need for children to help in fields and homes.

- Lack of security in illness and old age increases the need for many children.

- Lack of education means less awareness of family planning methods and benefits, less use of clinics.

- Lack of confidence in the future and control over circumstances does not encourage planning, including family planning.

- Low status of women, often associated with poverty, means women often uneducated without power to control fertility.

<u>Linkages: Influence of Population on Poverty</u>

- Unemployment, low wages for those in work, dilution of economic gain.

- Increasing landlessness – increased division and subdivision of land among children.
- Overstretching of social services, schools, health centres, family planning, water and sanitation services.

Environmental Implications

The question here is the stress that will be added to the global ecosystem with the addition of at least 3.5 billion people over the next half-century. Since a good part of the close to 10 billion people minimum will be living at standards higher than most of the 5.87 billion alive today, the consumption of planetary goods will increase per person as well because there are more people.

There will certainly be more people affected by flood, disaster, volcanoes, famine and the like because there will be more people.

We cannot produce food for this high number without severe environmental implications. There are environmental and ethical issues involved as we crowd out other species and irreversibly change our soils, woods and the habitat of rivers. The future cost of our running down now the world's hydrocarbon reserves raises intergenerational transfer issues of very troubling dimensions.

The food situation is seen by some as worrying with cereal production per person on a downward trend – but others point out that there are no higher-price effects, implying that there is no underlying shortfall. Most experts believe the world can continue to feed itself in aggregate terms. However, this will continue to leave out those who live closest to the margin. Land degradation continues to be a major problem with developed economies having 0.53 hectares per person. Developing economy residents have an aggregate of only 0.18 hectares per person (down from 1.32 in 1961), and 95 percent of population growth in the next half-century will take place in the developing world.

Population growth will probably have its worst effects in terms of human impact on freshwater scarcity. Already 30 economies have scarcity or stress at some time of the year. This number will increase to 50 economies and 3 billion people in the next quarter century. Water wars will undoubtedly be a reality.

The worst environmental impacts will be in continuing deforestation and the related issue of stress and biodiversity. Here figures are always contested, and estimates range from a loss of between 2 and 25 percent of forest cover over the next quarter century. Habitat loss is highest where population density is highest. We are aware that overfishing need not be preceded by high population figures; however, that high population can exacerbate the situation is indisputable.

Each human being currently consumes water, soil, fossil fuel and accounts for stress on the environment. Already some people place a great deal more stress on the environment than others, and specifically we in the North:

1. Bangladesh has a population of about 120 million, with a 2.4 percent increase per year. That is about 25 times the increase in, for example, the United Kingdom. But each British resident consumes 35 barrels of oil per year (and Americans consume more than British); each Bangladeshi consumes 3.

2. There are 75 Africans per automobile versus only 2.5 North Americans.

3. North Americans produce 1,587 lbs. of waste per year – 100 times or more the equivalent produced by developing economy residents.

4. Energy implications: if the world population reached 10 billion and consumed energy at the rate of the United States in 1988, all of our oil reserves would be burned up in four and one-half years.

You can see that the mathematics of carbon dioxide emission, global warming, etc., can get fairly complicated when we factor in how much of everything we use, in comparison with how many we are, or how many "they" are.

Policy Issues

It is vital to remember that, while rapid population growth creates a climate in which it may be even more difficult to address issues such as poverty alleviation, environmental degradation, and improving communal relations, reducing population growth does not in and of itself generate improvement on these fronts. Economies still need good income policies, environmental laws, educational laws and establishments, etc.

Can we and should we do anything about hastening the demographic transition? We certainly can, in the following ways.

Family Planning

This is a very different world from 30 years ago. Family sizes have fallen from six children to below four in the developing world. Contraceptives now reach well over half of the world's women. And yet of the 750 million married women of reproductive age in developing economies, 350 million are not using contraceptives. One hundred million of those would prefer to space the next birth or have no more children.

According to reliable surveys, in economy after economy, one finds that women and their families would have postponed or averted their last fertility had methods been available to them. Thank goodness for our world that this does not mean 25 percent of children are unwanted or unloved! But it does mean that 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 percent of all the pregnancies that take place. About 100 million more women would use contraceptive services if they were available and of high quality.
If we met the needs of these women, child mortality would decline, so would infant and maternal mortality. We might raise contraceptive prevalence to between 60 and 65 percent. In demographic terms, 75 percent prevalence is enough to reach replacement levels. And the stability level of population in developing economies would be reached at a global population of 8 billion, rather than 10 billion.

There is a lot more consensus now about the desirability of establishing programs in this area. The world is in many ways catching up with Asia. The results of the Cairo

Conference were markedly different than all preceding conferences in which references to contraception had to be hedged, qualified and/or relegated to footnotes.

But there is a change. The essence of this change – and why it is so often discussed in the same breath as demographic futures – is that of a paradigm shift away from a focus on contraceptives in the service of any national or community goal (which has been the case in respect of many programs in the developing world) and toward the goal of providing a range of good quality services targeted on the specific needs of the individual.

The Second Imperative: Reducing Desired Family Size

Even with availability of contraception, fertility would still be well above the replacement level of two births per family because desired family size is still higher than two children per family in 145 economies of the developing world.

Surveys in Africa and Latin America in the late 1980s found not a single economy with a desired family size at or close to two. These surveys document a preference for large numbers of children. For example, in sub-Saharan Africa, the average desired family size was about six, while in most economies of Latin America, Asia and North Africa, the average desired number of surviving children was between three and four.

These preferences for high fertility and the social and economic insecurity that underlie them are fundamental causes of high birth rates and rapid population growth. We have to go deeper into why most of the world's families still want more than two children.

Large family size has a positive correlation with being poor. Although large families do not cause poverty, having a large family can decrease the probability that the wife will work in the cash economy and decrease the per-child investment in education and health (and this is not usually gender neutral – girls are overwhelmingly disfavoured). A large number of children can also decrease investment capability.

The Third Megaforce: Population Momentum

The third megaforce with which we must contend is this: even if, from 1995 on, every woman in the developing world had 2.1 children, we would still increase the global population to 7.3 billion. This is called population momentum and the above example shows how powerful a demographic force it is.

Since we are not going to move to 2.1 children right away, we will not get away with as few as 7.3 billion (unless women have fewer than 2 children). But it does show a third window of opportunity.

For the sake of the planet and the health of the women on it, as well as working on "too many" births, we have to get much more serious about stopping the "too early, too often" birth pattern that still persists in many places.

If the first birth in all developing economies could be delayed by 5 years, global population would stabilize at 6.1 billion, rather than 7.3 billion. Delayed marriage in many societies could have as significant a demographic effect as the introduction of new contraceptives. Teenage pregnancy has a demographic effect, as well as all too often a devastating human effect.

Getting on with it

We want girls and women in school. We want this because it will enhance their lives in immeasurable ways and because, if all young girls were in school, it would dramatically bring down population growth rates in terms of both the numbers of children wanted, and the age of first childbirth.

We want them to have babies later in life – in order to have healthier babies and lower infant mortality, to give girls a chance to be educated, to find values; we want this because it could cause a decline in the maximum population the world will reach.
We want infant mortality to decline – because it is wrong that babies and young children should die, that families should suffer, and because there is no economy on earth where fertility has declined before infant mortality has fallen. And we want maternal mortality to decline – because there is no reason so many young women should die.

We want better quality of care because people should be well treated and given choices. This promotes more contraceptive prevalence, and therefore a better demographic outcome.

We want, above all, to meet unmet demand for family planning because it is wrong that women should have fertility which they do not want, which impedes them and their families from living better lives, and because there would be as much as 1.9 billion fewer people in our future forecasts if we started to address these needs seriously.

Thank you.

Plenary Presentation by Minoru Shibuya

In my presentation this afternoon I will first address the relationship between economic growth and the population and then the problems confronted by East Asia with regard to population and economic growth.

While there is no data that substantiates any firm correlation between population and economic growth, it is generally believed that positive and negative correlations exist.

Positive correlations

1. Impact of population on economic growth: since the increase of a well-trained labour force supports economic growth, growing population is a supportive factor for economic growth, if adequate education and training is provided.

2. Many studies confirm that the accumulation of human capital is positively correlated with technological progress; accordingly, growth in human resources of good quality will tend to promote technological innovation.

3. Impact of economic growth on population: there is a widely-held view that economic growth, by improving standards of living, lowering infant mortality, and improving the status and educational standards of women, tends to slow birthrates and population growth.

Negative correlations

1. Population-induced growth in the labour force, if not matched with commensurate growth in employment opportunities, would not necessarily lead to the accumulation of human capital, but instead may lead to higher unemployment.

2. Similarly, population growth, if not matched with adequate growth of capital, may restrict the growth of per capita GDP.

3. Low savings rate stemming from high birth rates and the presence of greater numbers of children in households may also be a restraining factor for economic growth, in both developed as well as in some developing economies.

In this light, I would like to turn to the problems confronted by East Asia, where the issues posed by economic growth and expanding population are most prominent.

The Asia Pacific region achieved sustained strong economic growth for the last 30 years, supported by increasing trade and direct investment which in turn was promoted by the policy transition from protection-oriented import substitution regimes to export-oriented industrial growth. Key additional factors were the availability of an inexpensive and abundant labour supply in the region, coupled with the improvement in the quality of human capital owing to the spread of secondary and higher education. So

in the past, the positive dynamic identified above from population growth to economic growth came very much into play.

In the coming years, however, the prospects may not be so bright. There may be a negative factor starting to function. In the foreseeable future, although the rate of population growth will decrease, the population itself will continue to increase dramatically in this region. This trend, like in the past, may serve as a positive internal economic factor; however over-population may become a negative external factor on economic growth by generating excessive demand for food, energy and other key resources. In other words the size of the market economy may simply exceed the reproductive capacity of the planet earth and economic growth will be no longer be sustainable under such conditions. Let me elaborate on this problem from the perspective of the food supply.

A long time ago, Malthus predicted that population would grow much faster than food production and that food shortages would thus be inevitable. This prediction has so far been proven wrong because the growth of food production has in fact kept pace with population growth owing to such developments as the "green revolution". In the future however the Malthusian concern may become reality.

The Task Force of Food (TFF) was established to tackle this problem. While there are no definitive results from the analytical work as yet, some issues have been identified:

- There is a widely-held view that additional "green revolutions" can no longer be expected in the future;
- In East Asia in particular, significant expansion of arable land is no longer possible;
- Environmental pollution, farmland degradation, structural socioeconomic transformation due to rapid urbanization and industrialization are all impinging on food production;
- Investment in R&D and in infrastructure development in the agricultural sector has diminished;
- While free trade may help assure a stable food supply and food security, we may not be able to rely on free trade alone for food security; and
- Poverty alleviation is required to solve the food problem of the world, since many food needs are not transformed to food demand because of the lack of purchasing power.

Given the many uncertainties, both pessimistic and optimistic scenarios can be constructed. For the foreseeable future, many theories support cautious optimism; however, in the long run, particularly in the context of projected population levels reaching as high as ten billion by the middle of the 21st Century, some rather pessimistic, Malthusian scenarios are also conceivable. Accordingly, deliberate policy change is necessary in order that the optimistic scenarios are realized, and this is what the Task Force on Food will be addressing next year.

I have tried to outline some decisive factors for sustainable economic growth. Of course, there are other factors that affect economic growth, such as energy and environment, on which other speakers will elaborate.

Sustainable economic growth cannot be attained by market mechanisms alone. We must strengthen our efforts to promote technology, investment and international cooperation. I really hope that APEC will help us meet the big challenges addressed under the FEEEP project.

Thank you.

PANEL ON FOOD

Remarks by the Moderator, Ron Duncan[1]

The really important thing about APEC's FEEEP initiative is that it makes us think about the interdependencies between the topics included within that acronym. Just to illustrate the kinds of interdependencies that exist, consider the case of a largely rural-based population. The main force for growth in that economy will be agricultural productivity. In turn, growth in income, as we have just heard in the panel on population and economic growth, will lead to changes in the population growth rate. One of the main sources of the productivity growth will be the use of energy because the main fertilizer that brings about food production increases is nitrogen-based fertilizer. More intensive use of fertilizer has implications for the environment and so on. The linkages are readily evident.

However, they are not simple. They are non-linear linkages. As we know in the case of economic growth and environmental pollution, pollution per capita increases with incomes up to a certain point and beyond that point pollution per capita declines with incomes.

What stress points should we be concerned about, particularly as regards the food situation? I believe that we have heard many of them listed here so far in this Symposium:

- The higher cost and declining quality of water supplies;
- Land degradation and loss of crop land to increased urbanization and industrialization;
- Over-exploitation of seafood resources;
- The slowing rates of growth of responses to fertilizers;
- The loss of our germ plasm resources;
- Pessimism about further scientific breakthroughs;
- Concerns about dependability on trade for food security; and finally,
- the distributional impacts – how will the poor gain greater access to food?

---

[1] Ron Duncan, MAgEc (UNE), Ph.D. (ANU) is Professor of Economics and Executive Director of the National Centre for Development Studies (NCDS) at the Australian National University, Canberra. NCDS is a centre for post-graduate teaching and research providing an Australian focus for the study and evaluation of aid and development issues, reflecting Australia's substantial trade, strategic, and cultural links with the immediate region. Professor Duncan has worked at the World Bank (1980-1993) as Chief of the International Commodity Markets Division and Chief, International Trade Division. In this capacity he supervised studies on global commodity markets, trade reform and the impact of the Uruguay Round Agreements on developing economies and was responsible for liaison with international organizations concerned with trade – GATT, FAO and UNCTAD. Since returning to Australia in 1994, he has mainly published on agricultural and state-owned enterprise reform in China and economic policies in the Pacific island economies. Cambridge University Press has recently published The World Food Outlook written jointly with World Bank colleagues Don Mitchell and Merlinda Ingco.

We look forward to hearing these and other issues addressed by our speaker, Mr. Robert Thompson.

Plenary Address by Robert L. Thompson[2]

Food, Economic Growth, Energy, The Environment and Population: The Essential Links

In this presentation, I will address the combined effects of population and economic growth on demand for food in the APEC region and the rest of the world, noting the challenge to the world's food system to produce twice as much food in the next 30 years at no higher real prices and without environmental damage. I will then turn to a highly stylized region-by-region review of the food supply and demand potential, starting with the APEC region and then providing the rest-of-the-world context. Finally I will draw inferences for investments in agricultural research and infrastructure, public policy, and the global food and agricultural trading environment.

Hunger and Poverty

Of the world's 5.9 billion people, an estimated 800 million suffer hunger. At the individual level, food insecurity is mainly caused by poverty. The rich in no economy go hungry except in times of war, natural disaster, or politically imposed famine.

There are 1.3 billion people who subsist on an income of less that one U.S. dollar per day. The World Bank calculates that 80 percent of the world's poor live in rural areas, where the bulk of the people earn their living from farming. Half of these poor people live in less favored areas. To understand the roots of the problems of poverty and hunger in rural areas, it is important to recognize that no economy in the world has solved the problem of rural poverty by focusing exclusively in agriculture. Certainly by raising productivity in agriculture, it is possible to improve the lot of rural people, to increase the availability of food, and to reduce the real price of food. But availability is not enough. It takes purchasing power to gain access to food needs above a family's own production. And there is not enough land per person in most rural areas for everyone who is trying to make a living from agriculture to grow enough to feed their

[2] Robert L. Thompson works on strategy and policy for agriculture and rural development at the World Bank. At the time of the FEEEP Symposium, he was President, Winrock International Institute for Agricultural Development, Morrilton, Arkansas, USA, a not-for-profit international non-governmental organization whose mission is to help reduce hunger and poverty in low-income economies by increasing agricultural productivity and rural employment while protecting the quality of the environment. Winrock believes that, only be working at the intersections among these same themes, will it be possible to feed the future world population better than today without causing environmental damage. Mr. Thompson is also chair of the PECC Pacific Food Outlook project. The comments below were made in Mr. Thompson's personal capacity and should not be attributed to any other organization.

family adequately and to have enough left to sell to raise their family income above the poverty line.

The only economies that have substantially reduced rural poverty have created off-farm employment opportunities – either within the rural communities or in distant cities. In the highest-income economies today, the majority of farm families earn more than half of their family income from non-farm sources. One or more members of the family works full time or part time off the farm. Some of these jobs are in agricultural input supply or in adding value to the raw products of the land. Many, however, are in cottage industries and other businesses completely unrelated to agriculture.

In many developing economies today, the only option for rural people to escape poverty is to move to distant cities. In 1990, there were four cities of over 10 million people in the world, and it is projected that by 2010 there will be 21 cities of this size, 13 of which will be in Asia. The diseconomies of supplying safe drinking water and social services and of removing garbage and sewage from cities of this size are overwhelming. While urbanization is a trend that will not likely be reversed, it could be slowed down if there were more attractive opportunities in rural areas. To create these will require much larger investments in roads, communications, education, health care, and putting in place the necessary preconditions for employment and enterprise growth. These investments in infrastructure and human capital are also important for successful agricultural development.

Population and Economic Growth

The world's population continues to grow rapidly; however the growth rate is falling faster than many analysts expected. Each year the United Nations' median projection of the world population at zero population growth is revised downwards. Much that is written about the ability of the world's farmers to feed this population adequately and to do it without environmental damage focuses on the number of mouths to be fed. Certainly the growth in the world's population creates additional need for food, but whether that need is translated into effective demand depends on purchasing power.

While global population growth gets most of the media attention, what has been much less noted is the broad-based economic growth that has been empowering millions of poor people with the purchasing power to upgrade the quality of their diets. As poor people gain more income, the first thing they do is to modify their family's diet, usually by including more fruits, vegetables, animal protein, edible oils and sweets. This income effect accounts for more of the recent growth in global demand for food than does population growth. While there are hundreds of millions of people in the world who have been left behind by this economic growth, many millions more are participating – particularly those living in urban areas. Much of this economic growth is export-led and is in East and Southeast Asian members of APEC. Much also is associated with privatization and transition to a market economy.
The combined effects of population and income growth are expected to double global food consumption in the next 30 years and to triple it in the second half of the 21st Century. This brings us to the question of aggregate global food security.

At the individual-economy level, food security is a problem of availability. We ask whether an economy's farmers can satisfy its food demand at competitive prices. Each economy should use its arable land and agricultural production potential to the fullest extent that it can efficiently or without wasting resources. It is important to recognize that investments in infrastructure and agricultural research can create a comparative advantage in agriculture where it did not exist previously. If an economy cannot efficiently produce its own food supply, then can it export other products to earn the foreign exchange to purchase food imports? Or is a dependable supply of food imports available (on either commercial or concessional terms)?

At the global level, food security concerns whether the world's farmers and food system can provide twice or even three times as much food as today – at no higher real cost, and can do this in a manner that does not destroy the environment.

There are only three ways to increase global food availability: increase the area of land devoted to food production, increase the productivity per hectare of that land, and reduce post-harvest losses.

It is important to keep in mind the competition for land that occurs as economies grow. Crop production is not the only agricultural application of land, of course. Ruminant livestock, which makes a contribution to animal protein supply, depends on grazing. Such livestock uses much land which has limited productive potential in animal cropping, but not exclusively so. Economic growth also increases demand for products of the forests, including fuelwood, poles, building materials, paper, and furniture. Forestry generally competes directly with agriculture for land although at times it can be complementary, as in agroforestry-based farming systems. Confinement production of poultry, livestock, and fish (aquaculture) requires relatively little land directly, but substantial areas of lands are needed to produce the feed grain and protein meal inputs.

There is limited fertile, well-watered, unforested, non-erodable land available that is not already in production. If we try to double food production by doubling the number of hectares of land in food production, it would create massive environmental damage, including large-scale destruction of forests, and with them, of wildlife habitat and biodiversity. This would also reduce the carbon sink, contributing to faster global warming. It would also destroy the homes of indigenous peoples.

Next we will take a highly stylized tour of the world's food system to address the questions of how much more land is available for food production and how much potential there is to increase agricultural productivity on land already in production. We then can draw inferences for research, public policy and international trade developments needed to ensure an adequate global food supply without environmental damage. We will start with the APEC member economies and then examine the situation in the rest of the world to provide the global context in which the APEC region will function

APEC Member Economies[3]

The APEC region has for several decades witnessed the most dynamic growth in the world economy. Within this region, the strongest growth was realized by the APEC member economies in East and Southeast Asia.

While the APEC member economies in East and Southeast Asia have, in general, a much larger fraction of the world's population than of its arable land, most of these economies started the process of economic development in agriculture, where the bulk of their populations were employed. However, once generalized economic growth took off, their demand for food quickly outstripped their own production potential, and they became large net food importers.

The APEC region also includes several high-income economies with relatively low population density relative to their arable land area, in particular Canada, the United States, Australia, and New Zealand. These large net food and agricultural exporting economies have generally shifted their focus from the European market to the rich and growing Pacific Rim market in recent years.

In addition, the APEC region also includes several economies which have experienced significant food export successes in recent years, including Mexico in vegetables and Chile in fruits and wine.

As a consequence, the food and agricultural sectors of the APEC economies have become, in recent decades, highly integrated with one another through international trade flows.

East and Southeast Asia

Asia has a much larger fraction of the world's population than of its arable land. Many parts of Asia have made significant investments in agricultural research and in

[3] My discussion of the food system in the APEC member economies draws upon, among other sources, the *Pacific Food Outlook* (PFO). The PFO is a project of the PECC Food and Agriculture Forum (FAF), whose members come from government, business, and academia. The FAF is chaired by Carole Brookins of the United States. The PFO, which is modelled after PECC's widely used and respected Pacific Economic Outlook, was conceptualized at the FAF meeting in Singapore in 1994 and was formally advanced at the Hong Kong FAF meeting in 1996. The first edition of the Pacific Food Outlook, which was published with funding support from the APEC Economic Committee, was released at the PECC International General Meeting in Santiago, Chile in September 1997. The uniqueness of the PFO approach is its emphasis on the total food system, which includes the production of agricultural commodities and their storage, transformation and transportation as food products to consumers; accordingly, it includes the rural-urban infrastructure (e.g., the "cold chain" from farm to consumer). The FAF has recommended that APEC establish a Pacific Food System initiative, including infrastructure and new technology initiatives. The characterization presented here, and the conclusions reached, should not however be ascribed to any PECC member or to any institution.; they are purely mine.

education. A number of economies of East and Southeast Asia have been experiencing very rapid economic growth with rapid creation of non-agricultural employment, often widely dispersed through the countryside. As these economies raised per capita incomes from a low to a middle level, diets changed rapidly, including more fruits and vegetables, animal protein, edible oils, and sweets. Despite significant growth in agricultural productivity, these economies' food consumption quickly outgrew internal food production capacity, and agricultural imports grew rapidly, particularly for feed grains and protein meals to feed livestock and poultry. As incomes have risen, rice consumption has fallen and wheat consumption has risen.

The land-labor ratio in most of these economies is very low. Some of the highest-income economies of East Asia introduced quite high price supports and protectionist import policies for their most important traditional products. However, even with these policies, they could not provide parity of income to their farmers from their small land holdings. As a result, large off-farm migration has occurred, and part-time farming has become a common means of supplementing off-farm income.

Of central importance to the East Asian food situation is China, which with 1.2 billion people, has 22 percent of the world's population, but only 9 percent of the arable land. While its population is growing slowly, rapid income growth (reflecting average annual GDP of around 10 percent per year since the 1980s) is leading to rapid change in diets, with large increases in poultry and pork consumption in particular. China experienced very rapid growth in agricultural output during the 1980s following its economic reforms; however, its future ability to feed itself has become an issue of great media attention and numerous academic conferences. Until recently, there was significant doubt about how much productivity growth potential existed in China. However, the recent announcement by the State Statistical Bureau that the statistics on land area under cultivation had been significantly underestimated means that crop yields per hectare are lower than previously thought. With larger investments in agricultural research and in technology transfer, it should be possible to raise yields considerably.

Over the last 20 years, China's public policy has varied in how supportive it has been of agriculture. When public policy has been supportive, agriculture has progressed rapidly. The inadequate rural transportation infrastructure reduces the ability of the internal market to function efficiently. Some attention is being given to increasing the production of high value per hectare plant and animal products in place of cereals, with the objective of not only supplying domestic demand, but also generating export revenue that could pay for imports of even more grain than could be grown on the same land. Consistent with this, the Government of China has reduced its cereals self-sufficiency goal from 100 percent to 92 percent. China is likely to become the world's largest importer of maize and soybeans.

Australia and New Zealand

Australia and New Zealand have historically been strong agricultural exporters and are expected to continue to be in the future. In these mature, high-income markets, internal demand for agricultural products is growing slowly.

These economies have traditionally afforded their agriculture sectors low levels of government assistance. Several years ago, New Zealand completely eliminated agricultural assistance. These economies have historically invested strongly in agricultural research, often paid for by taxes that farmers impose upon themselves. With high productivity levels, their agricultural export potential is limited mainly by their size and climatic constraints, in particular, low rainfall in much of Australia.

Both economies have significantly repositioned their agricultural sectors in recent years to take advantage of the rich and growing markets to the north in Asia. Australia has experienced a large increase in dairy and cattle production, and New Zealand in dairy and fruits. Both have shifted the balance of their exports from bulk commodities to higher-valued agricultural exports for which demand is growing in the more affluent Asian markets. They will continue to be major agricultural exporters, but with limited expansion potential.

North America

North America has a mature, high-income, slowly growing market for agricultural output. As a result, this region, which has invested large sums in agricultural research and is blessed with large expanses of fertile, well-watered soils and a relatively low cost transportation system, has become the largest agricultural exporting region of the world. However, like the other regions described, agriculture in this region too is undergoing significant changes.

Canada has a large land area and sparse population. While Canadian agriculture might be expected to be constrained by its northerly climate, large investments in agricultural research and rural infrastructure made it possible for Canada to become a major agricultural exporter. Canadian agriculture has also benefited from substantial government assistance. Prairie grain producers benefited from large subsidies to rail transportation to ocean ports for almost a century, until two years ago when the subsidy was eliminated. As a result, Prairie agriculture is rapidly repositioning itself and has substantially increased the production of oilseeds, particularly canola, and fed livestock, particularly cattle and hogs, relative to wheat. The balance of Canada's agricultural exports has shifted towards higher-value products, particularly meats.

Canada has a highly protected segment of its agriculture which has been supported by production quotas, particularly dairy and poultry. The capitalized value of the quotas has raised their cost of production, and these sectors have stagnated technologically. As a result, they are not internationally competitive and not able to expand to take advantage of growing international market opportunities. There are large political constraints to change in these policies. However, Canada has significantly reduced the assistance it provides to its agricultural sector, and the parts of the sector not subject to supply controls have responded quickly to greater world market opportunities, particularly in higher-value products. We can expect Canada to be an even larger exporter of both bulk commodities and higher-valued agricultural products in the future.

About half of the U.S. agriculture received significant levels of government support for more than 60 years, in particular field crops and dairy, while the rest of American agriculture, including horticultural crops and the rest of animal agriculture was basically on the free market. In 1996, the U.S. Congress made the largest changes in agricultural policy since support began in 1933. Most subsidies linked to the volume of agricultural production were eliminated. This effectively got the U.S. government out of the business of stock holding. Set-asides associated with price supports were eliminated (however, a long-term set-aside of erodable or environmentally fragile land in the Conservation Reserve Program was retained). Target prices and deficiency payments were eliminated. Even price supports to the dairy sector, which previously had been one of the most politically-powerful lobbies, were cut.

The net effect of all of these changes was to move most of the previously protected parts of American agriculture to a free market. These changes have significantly increased U.S. farmers' planting flexibility and responsiveness to world market demand. While government programs formerly provided substantial protection against risk, American farmers are well served by market institutions that permit them to manage risk at reasonable cost, in particular, by means of well-developed futures markets.

While many parts of the U.S. are blessed with fertile soils and favorable climatic conditions, public and private investments in agricultural research and transportation infrastructure account to a significant extent for the international competitiveness of American agriculture. In the last 20 years, public investments in agricultural research have declined in real terms, but there has been a large increase in private sector investments in research. This reflects, in part, improvements in intellectual property rights protection which ensure that the private sector can reap the returns on its investments in research. These developments are focused particularly in biotechnology and in electronic sensors, information processing, and geopositioning systems.

Another major recent innovation has been low-till agriculture or conservation tillage, which reduces labor and energy costs, conserves moisture, and improves soil conservation. Applications of the electronic technologies in so-called precision farming are starting to expand, and we are poised at the beginning of the biotechnology revolution in production agriculture. These technological changes are expected to significantly increase productivity and to reduce unit costs of production, while having positive environmental effects as well. They should make it possible for the U.S. to further expand agricultural production and exports.

Several sectors of American agriculture are undergoing rapid structural change. The transformation that the poultry industry underwent over the last several decades has occurred almost overnight in the swine industry, and is occurring in parts of the dairy sector, particularly in the Southwest. By bringing together state-of-the-art genetics, improved nutrition, and disease control technologies with electronic sensors and information processing capacity, it has become possible to manage large-scale production units at high productivity and low unit cost. While animal waste disposal from large production units is a significant environmental challenge, there appears to be

a comparative advantage in locating such units in wide open spaces away from concentrations of population.

In 1981, 90 percent of U.S. agricultural exports were raw, bulk commodities. Today, over half are high-value products like meats, fruits, vegetables, nuts, and wine. I anticipate that, in the future, the U.S. will export a larger fraction of its maize and soybeans in the forms of meats and other animal products, including dairy products. It will also export large quantities of high-value products from the horticultural sector, but it will also continue to be a large exporter of food and feed grains and oilseeds.

Rest of the World

The preceding section suggests that the larger fraction of the APEC region's food production is likely to move through international trade among member economies. But what about the rest of the world? Is it likely to provide export competition to the APEC food exporters, or is it likely to add to the world's net food import demand?

- *South Asia*

While China has received most of the recent media attention, we should also pay attention to India. Some demographers now project that, by the middle of the next century, India will have 1.5 billion people compared to China with 1.4 billion. India has made large investments in agricultural research. The Green Revolution that started in the late 1960s satisfied the growth in food demand for at least one generation. It is important to remember that India has 250 million middle class consumers, but also half a billion more with very low incomes. While India has been slow to abandon the socialist model and to let market forces work, economic growth is starting to accelerate. If this growth becomes broad-based, diets are likely to change, and India too is likely to place greater demands on the world food system. India already consumes large quantities of dairy products. With higher incomes, Indian consumers are likely to eat a lot more poultry products and sheep and goat meat.

- *Africa*

Africa has experienced rapid population growth and slow economic growth. It is the one continent with declining per capita food production, and this has occurred for three decades. Africa has the oldest exposed land surface in the world. The heavy weathering of its soils has left them with weak structure and very low nutrient content. Many regions of Africa receive low annual rainfall with quite high variance. Some regions are prone to desertification. Africa is the continent with the greatest natural limitations to high productivity agriculture. While there is a modest amount of additional land that could be brought into agricultural production, especially in the southern cone, much of this land is subject to these same climatic and soil quality constraints.

There is a smaller cumulative stock of agricultural research results available in Africa than on other continents. This reflects an under-investment by African national governments and by the international system. Because the food staples in many African economies are crops not widely grown in other parts of the world (e.g., millet, sorghum, yams and sweet potatoes), there exists a smaller stock of international research results upon which to draw than in respect of other crops such as wheat, rice or maize. Nevertheless, the available research demonstrates that high yields are attainable in many regions of Africa with improved varieties, better soil management, and application of chemical fertilizers.

Many economies in Africa have had a pronounced anti-rural or anti-agricultural bias in their public infrastructure investments and agricultural price policies. Many economies have enforced price ceilings and accepted dumped-food aid to keep food cheap in the cities which, in turn, depresses farm prices. In addition, as a result of the terrible condition of most rural roads, the cost of transport is extremely high, further depressing the farm-level prices of commodities and increasing the price of fertilizer and other purchased inputs. These price-distorting effects have often been further accentuated by inefficient parastatal marketing monopolies. As a result, it is simply not profitable for farmers to adopt the improved technologies that are available in many parts of Africa.

Diffusion of improved technologies is also impeded by several other factors. The agricultural extension service is often weak and fails to recognize that working with the 70 percent of African farmers who are women may require a different approach than with male farmers. The private sector serving agriculture is often not well developed because of inadequacies in the legal code or because of unfair competition from inefficient but subsidized public companies. Moreover, credit is often unavailable.

Agricultural productivity could be much higher than it is now in Africa, and somewhat more land could be brought into production without causing environmental damage. Accordingly, Africa could produce much more of its food supply. And there are a few signs of progress in various parts of the continent, particularly in the southern cone.

The anti-rural bias of many African governments is also reflected in the low priority that they afford to agricultural and rural development projects in their dealings with foreign aid donors and the international development banks. There are often more resources available to Africa for agricultural and rural development than are taken up.

If and when faster economic growth occurs in Africa, this will cause food consumption to grow even faster. Therefore, even with some agricultural successes, I expect Africa to continue to be a net food importer from the rest of the world – on both commercial and food aid bases – well into the 21st Century.

- *Western Europe*

Western Europe is a mature, highly-protected, high-income market, with limited expected growth in food consumption. Western Europe's high-income consumers are

very quality conscious and are placing increasing demands upon their food system for organic foods and for labeling food products as to the processes used to produce the raw agricultural products from which they were made.

Large investments in agricultural research and relatively high price supports have led to very high agricultural productivity levels by international standards. The European Union's (EU) price policy substantially stabilized the internal prices of most products, insulating European farmers from international price shocks. Agricultural production has grown much faster than internal consumption over the past two decades, with substantial quantities exported with the assistance of subsidies to offset the high internal support prices.

Government stocks have accumulated at various times as a result of price support operations. At times, these inventories have been donated as food aid to poor economies. Land set-asides and marketing quotas have been used to constrain overproduction stimulated by the high price supports. In response to both financial and political pressures, the EU's price support levels have been reduced significantly in recent years. Furthermore, in the Uruguay Round GATT agreement, the EU agreed to reduce its subsidies to agricultural exports.

Western Europe has had some of the most intensive crop and livestock production in the world in terms of livestock feeding rates and heavy fertilizer and agricultural chemical application rates. This has led to adverse environmental consequences, especially in surface and ground water where nitrates and pesticide residues have accumulated. As a result, environmental activists in Western Europe have sought and achieved government regulations to reduce the intensity of agricultural production.

In addition to environmental regulations, a number of Western European economies also impose animal welfare regulations and other production process regulations which prevent their farmers from adopting lower unit-cost-of-production technologies available to farmers in other economies. Other regulations restrict the ability of European agricultural scientists to use certain powerful basic research tools to develop productivity-enhancing and cost-reducing technologies, or prevent European farmers from adopting such technologies, which have been developed in other economies. Biotechnology is a prime case in point. Such regulations tend to increase the unit cost of agricultural production and to reduce the competitive position of European farmers. Their competitiveness has been further reduced as the value of price supports and marketing quotas has been capitalized into farm asset values, thereby raising the capital cost of farming in Europe relative to other economies.

An unanticipated consequence of the EU’s price supports was a loss in the domestic market for cereals in livestock rations. Imports of several cereal substitutes (in particular, manioc), have been admitted to the EU free of tariffs. As a result, the relatively higher-priced cereals grown in Europe dropped out of least-cost ration formulations to be replaced by manioc imported from Southeast Asia and by other cereal substitutes. This further increased the fraction of the EU's cereal production to be

exported. As cereals price supports have fallen in the last few years, more EU-grown cereals are going back into least-cost rations, reducing the quantity available for export.

In summary, as price supports have fallen and environmental regulations have been imposed, the intensity of agricultural input use has been reduced in Western Europe, and the volume of agricultural products available for export has fallen. As EU-grown cereals once again replace cereal substitutes in rations and as export subsidies are further reduced, this will limit agricultural export prospects. Therefore, despite the likely growth in world agricultural import demand in the next century, I expect that Western Europe's agricultural exports will be no larger, and likely, smaller, than recently.

- *Central and Eastern Europe*

Agriculture in Central and Eastern Europe underperformed relative to its potential under central planning during the socialist period. To appreciate the productive potential of this region, one has only to recall that Ukraine, which has some of the world's most fertile soil, was the world's largest wheat-exporting economy as recently as 1930. The former Soviet Union, however, was a major cereals importer during the 1970s and 1980s.

During the socialist period food consumption levels were quite high relative to other economies because of food price controls and large consumer subsidies for food. Food processing was generally done by large-scale state monopolies, which paid little attention to consumer service or quality control. Agricultural productivity levels were low by international standards, reflecting inadequate economic incentives, weak applied research, limited technology transfer, and unreliable agricultural input supply systems. Production units were often extremely large, but with inadequate information-processing capacity and lacking the incentives required to effectively manage such large-scale units. Post-harvest losses were very large, with the losses between the farm field and the consumer estimated as high as 40 percent.

The agricultural sector of the former Soviet Union consistently underperformed relative to its potential. While some observers point to the climatic constraints imposed by its northern climate, Canada, with a similar climate, has consistently been a major agricultural exporter. Basic agricultural science in the former Soviet Union was well respected on an international standard; however, in contrast the applied research and technology transfer system was weak. For example, conversion rates of feed into meat were very low because rations were not balanced with enough protein. There needs to be a much stronger two-way flow of information between production agriculture and agricultural researchers with stronger incentives to study real world problems of importance to the agricultural sector. Since the economic reforms, public investment in agricultural research has fallen, and many formerly prestigious research institutes have fallen on hard times.

Since the beginning of economic reforms in the former Soviet Union, per capita income has fallen and the previously large food subsidies have been eliminated, with a resulting drop in food consumption. With a reduction in agricultural production subsidies, agricultural production dropped even more, especially in animal agriculture. The previously large periodic bulk commodity imports, particularly of feed, have ceased. However, liberalization has resulted in a number of high-value food products, including meats and processed foods, now being imported. These products could be produced in the region, but the consumers with purchasing power to buy such goods are unsatisfied with the domestically-produced products due to lack of attention to customer service and quality control.

As the economies of central and Eastern Europe have moved towards a market system, privatization of agriculture has begun, moving at different speeds in different economies. In many cases, property rights are still ill defined, and not easily registered, protected, transferred, or pledged as collateral against loans. Private input markets and sources of production credit have been slow to evolve. Rural roads and other marketing infrastructure, including bulk and refrigerated storage, have not been improved fast enough. Public monopolies have often replaced state monopolies, with no improvement in customer service or quality control. The old state-supported basic research system has collapsed for want of resources, and it has not been replaced with an effective applied research and technology transfer system. Public policy continues to reflect an anti-agricultural bias, with farm product prices depressed well below world-market levels, and farm input prices held well above world-market levels.

Once the transition to a market economy is completed and these problems are addressed, there is no reason why Central and Eastern Europe cannot supply more of its internal consumption and become a large exporter of a number of crop and animal products. The northern economies of Central Europe are well positioned to do this soon. Most economies of the former Soviet Union and the southern economies of Central Europe appear to be a number of years away from achieving their potential. Nevertheless, as we contemplate the capacity of the world's farmers to produce twice or three times as much food as today at no higher prices and without environmental damage, this region will have an important role to play.

- *Other South America*

South America is the region of the world with the largest area of arable land available to be brought into agricultural production without causing deforestation or other environmental damage. While the destruction of the Amazon rain forests receives a great deal of media coverage, there is abundant non-erodable unforested land than can be brought into agricultural production in regions south of the Amazon. South America is a region of abundant land area relative to its population, and it has some of the world's most fertile soil in its southern cone. While it is an historically important agricultural exporting region, its performance has fallen far short of its potential.

The agricultural sector of South America has underperformed relative to its potential for over 60 years. Many economies have had a strong anti-agricultural bias in their public policies, often under-investing in rural services and infrastructure and imposing heavy taxes on agricultural exports. Public policy so depressed returns in agriculture that it remained a very extensive industry with very low productivity per hectare relative to its potential. It was not profitable to adopt higher-yielding varieties and to apply much fertilizer.

Exports have often been further taxed implicitly by over-valuation of exchange rates, while bouts of hyperinflation have caused flight of capital into agricultural land. Many economies until recently followed import-substitution industrial development strategies which created inefficient, but highly protected, non-agricultural sectors, which further increased farmers' costs.

Recently this situation has been changing rapidly in many Latin American economies. Economic reforms have liberalized the economies of many economies, and an export-led growth strategy has been adopted. Agricultural export taxes have been cut, and several outstanding agricultural export success stories have occurred in the last 20 years, including soybeans and frozen concentrated orange juice in Brazil, cut flowers in Colombia, and, as previously mentioned, fruits and wines in Chile.

Brazil, in particular, has made a major commitment to public investments in agricultural research. As a result, the huge *campo cerrado* region in the central west part of Brazil has been converted from an unproductive region of scrub vegetation to a highly productive producer of soybeans. This is but one example of how investments in agricultural research in the region are breaking natural bottlenecks to expansion of agricultural production to meet the growing world market demand.

It is important to recognize that the distribution of income and wealth is more skewed in South America than in other regions of the world. If an economic development strategy is adopted which successfully increases the incomes of the millions of poor people, there will be a large increase in demand for agricultural products within South America, and a larger proportion of their production will be consumed internally, rather than be exported. Nevertheless, this region is expected to supply a much larger volume of agricultural exports to satisfy the growing import demand in Asia and other regions in the 21st Century.

General Observations

At the same time that demand for food is growing rapidly due to population and income growth, the structure of demand for food is changing all over the world. In low-income economies, demand for meat and other animal products, fruits, vegetables, edible oils, and sweets are growing rapidly. In a number of high-income economies, consumers are demanding much more processing and packaging of food, improved food safety, better nutrition, improved labeling of production processes, and specialty products such as organically-grown and vegetarian foods. This is requiring the marketing system to be able to preserve the identity of smaller lots of more differentiated products as they move

through national and international markets. In any case, it is important to think of agriculture as part of a total food system, which exists to satisfy consumers' demands.

A bifurcation of the size distribution of farms is occurring all over the world. We may soon reach the point where 20 percent of the world's farms produce 80 percent of the output, while the other 80 percent of the farms collectively grow only 20 percent of the output. The high-producing 20 percent have high land-labor ratios and high capital-labor ratios. In fact, agriculture may be more capital-intensive than the rest of the economy. These farms are generally in the more favorable agro-climatic zones. They use state-of-the-art production technologies and highly sophisticated management, including financial management, risk management, and marketing. Their unit cost of production is very low, and they earn a competitive rate of return on their investments. These farms have the potential to significantly increase their output at low unit cost of production. Many of these farms are in APEC member economies.

The situation is very different for the 80 percent of the world's farmers who collectively grow only 20 percent of the output. They tend to be concentrated in areas of high population density, often in the less favorable agro-climatic zones. Many are located in hilly or mountainous areas. In many of these areas there is little physical capital in agriculture and little credit available. In many areas, the governments have invested little in education, health or other rural social services. These areas are generally characterized by widespread poverty with few non-agricultural income sources. There is simply not enough land per person available for everyone to grow enough for their own families' consumption and still to have enough left to sell to provide a family income that exceeds the poverty level.

Many of these regions can, however, increase their food production. Increasing agricultural productivity can help, as can shifting their mix of products to high value per hectare crop and animal enterprises. However, without creating part- or full-time employment opportunities off the farm, there is little hope for solving the problem of rural poverty and hunger in such areas. Transportation and communications infrastructure that links rural agricultural and food markets to the national and international markets is also necessary for successful rural economic development.

Rapid changes are underway in national agricultural policies in many parts of the world. There is a widespread move to place greater reliance on market forces and to reduce the role of government. Many high-income economies are cutting the subsidies that they have provided to their farmers, especially those that have been linked to the volume of production. They are making direct payments to farmers instead of distorting market prices. These measures are reducing inefficient production in high-cost producing areas and dumping of the resulting surpluses onto the world market. The availability of food aid is also falling. A number of low-income economies have reduced their government intervention in agriculture and permitted domestic agricultural prices to rise closer to world market levels. However, much more progress is needed to eliminate the anti-agricultural bias in their public policies.

In many low-income economies and economies in transition to a market economy, property rights are inadequately defined and protected. Many also lack an adequate commercial code and contract dispute settlement procedure for a well functioning private sector to emerge, create employment, and contribute to agricultural and economic development.

Agricultural markets are becoming global in extent. The fraction of the world's agricultural output that moves through international markets is growing rapidly. This has been facilitated by a tendency towards a freer and more open international trading environment. It was further advanced by the recent agreement under the Uruguay Round of multilateral trade negotiations under the GATT. This agreement officially acknowledged for the first time that domestic agricultural subsidies linked to the volume of production can distort trade, and it reduced and bound domestic agricultural subsidies. The agreement mandated a reduction in the volume and value of agricultural export subsidies, and guaranteed a minimum access for imports to every market. The agreement also established that good scientific reasons must exist before sanitary and phytosanitary barriers can be imposed on imports.

With few exceptions, the agreement required that non-tariff barriers to imports be converted to tariffs, often referred to as "tariffication". This was important because quotas and other non-tariff barriers had effectively cut the link between internal and world market price in many economies. As a result, world market prices were much more volatile in response to supply shocks than they would have been if all economies shared in the adjustment to the shocks. Tariffication fell short of expectations in stabilizing world market prices, however, because the tariffs were set at prohibitively high levels under so-called "tariff rate quotas."

To achieve greater world market price stability, these tariff rates will have to be cut substantially and the quotas increased. The existence of undue international price instability makes economies less willing to rely on the world market for their food security. However, with modern global telecommunications and transportation infrastructure, there is no reason why the world market could not ensure national food security. For this to occur, however, economies have to be confident that they can be assured access to supply in any year, and that they can sell the goods in which they have a comparative advantage in the world market.[4]

Today there is great public concern about protecting the quality of the environment. This concern often manifests itself in regulations that restrict agricultural production practices, particularly in the application of agricultural chemicals. It is unfortunate that sweeping generalizations are made concerning the environmental effects of chemical fertilizers and pesticides. Some are harmful, with long-term persistence in the environment and high mammalian and avian toxicity; however, many others are quite safe. Many of the modem chemicals are applied in small doses and quickly degrade

[4] The U.S. National Center for APEC has recently released a report entitled, "Building an Open Efficient Food System on the Pacific Rim: A Call for APEC Action," which develops some of these points in more detail. I commend it to you for reading.

into harmless byproducts after serving their purpose. Biological controls and integrated pest management are also important tools in controlling pests, but are not likely to suffice. Biotechnology, which some environmental activists also criticize, has great potential not only to raise productivity, but also to "breed-in" resistance to diseases, insects and other pests, reducing the need for chemical controls. While agricultural chemicals get much of the media attention, probably a greater environmental problem for agriculture today is the disposal of animal wastes without causing nitrate accumulation in the groundwater.

A major environmental constraint to agricultural production in the early 21st Century is likely to be the adequacy of water availability. Water is priced to agriculture at zero in many economies and, as a result, agriculture wastes a lot of water and has no incentive to adopt water saving technologies. Greater incentives for agriculture to use water more efficiently will have to come in the 21st Century, or water will become a severe constraint to world food supply.

The greatest environmental danger, however, will occur if the best that science has to offer is not brought to bear on increasing the productivity of the food system substantially from present levels. If we should attempt to double or triple agricultural production by doubling or tripling the area of land in food production, this would require massive destruction of forests, and with them, wildlife habitat and biodiversity, and it would reduce the carbon sequestration capacity of the forests. The only acceptable alternative is to increase productivity on the unforested fertile non-erodable soils and in animal production systems, and to reduce post-harvest losses.

Conclusions

The above discussion leads to a number of general conclusions:

1. There exists a limited amount of additional fertile, well-watered, non-erodable, unforested land in the world that can be brought into agricultural production at low cost. This tends to be in North and South America and Southern Africa. There is somewhat more land that can be brought into production with significant investment in reclamation or irrigation.

2. There exists a great deal of much-higher-productivity technology available in the world than is presently in use. For example, there is widespread application of fertilizer with the wrong nitrogen-phosphorous-potash balance and widespread use of rations for poultry and livestock with the wrong energy-protein balance. As a result, in each case, the productivity from using these inputs is much lower than their potential. In some cases the technology transfer system is deficient, and farmers do not know better; in other cases the marketing system, especially when it is in the public sector, does not make the proper inputs available. In many economies, public policy depresses output prices and increases input prices, so that it is not profitable to adopt higher-yielding technologies. Investments in

transportation and marketing infrastructure are essential to reduce the costs of input supply and product marketing. These observations are particularly germane to the cases of Africa and Eastern Europe.

3. We are living in the "golden ages" of biological sciences and of information processing. There are numerous powerful research tools available to agricultural scientists to develop environmentally benign agricultural production technologies. However, just as these powerful research tools were becoming available, the public sector reduced its investments in agricultural research at both the national and international levels. The private sector has increased its investments at the same time, but not by as much as the public sector cuts. In several economies, government regulations have restricted the ability of the private sector to apply some of the powerful new research tools, like biotechnology. Many governments provide inadequate intellectual property protection or so increase the cost of getting approval to sell the products of their research that the cost becomes prohibitive. Moreover, the private sector will not invest in minor products or regional staples of poor economies where there is a limited commercial market for the products of the research. Overall there is substantial under-investment in agricultural research relative to what is needed to raise productivity on the fertile, non-erodable soils. Otherwise, it will be necessary to expand production onto fragile lands or presently forested lands, with great environmental drainage. Larger investments in agricultural research should increase agricultural production potential on all continents and protect the environment.

4. It is important that governments which discriminate against their agricultural sectors reduce the anti-agricultural bias in their public policies. I am not advocating a policy of subsidizing agriculture. The experience of a number of high-income economies demonstrated that such policies have rarely helped the intended beneficiaries and have often resulted in unanticipated adverse environmental consequences. Rather, governments should give their farmers a level playing field in which they are not asked to pay more than the world price for their inputs and receive the world price for their outputs. There is an important role for public investments in rural infrastructure, human capital and agricultural research and for government in registering and in protecting property rights and providing a legal code and fair judicial system to support the efficient functioning of a market economy,

5. It is important to remember that no economy in the world has solved the problem of rural poverty and food insecurity in agriculture. Increasing agricultural productivity can help, but it is not sufficient. It is necessary to augment farm income from non-farm sources either through part-time or full-time employment outside of agriculture. Part of this can be in industries that supply inputs to farmers or add value to the raw products of the land. However, part of it needs to be in sectors completely unrelated to agriculture.

6. A larger fraction of the world's food production is likely to move through international trade in the 21st Century. Research and technology transfer has the

potential to raise agricultural productivity in all regions of the world. However, because the world's population and arable land are distributed among the continents in very different proportions, we expect that particularly Asia and to some extent Africa will be larger importers of food and agricultural products in the 21st Century. Australia, New Zealand, North and South America, and Central and Eastern Europe have the productive potential, if appropriately developed, to supply this import demand at no higher real prices and without environmental damage. As long as the international trading system is reasonably free and openly transmits price signals to suppliers and demanders in all economies, there is no reason that the trading system cannot ensure food security to all.

Thank you.

PANEL ON ENERGY

Remarks by the Moderator of the Panel, Jong-Duck Kim[1]

This afternoon we will have a good opportunity to discuss the various energy aspects of FEEEP. As you know, energy is central to economic development and also to supporting our standard of living – indeed, standard of living is directly related to per capita energy consumption. However, rising energy demand creates many issues in the areas of security of supply, financing and environmental consequences.

In the energy field, we have been working hard to harmonize the three E's: energy, economic growth and the environment, including by promoting economic cooperation amongst APEC member economies in areas such as supply and demand, energy efficiency, energy technology and energy-environment links. We have become very familiar with the issues related to these three E's. Now we must become more familiar with the broader issue of FEEEP.

Today, we will address questions such as, "How can we improve energy security?", "How can we improve our energy efficiency?" and "How can we use energy in environmentally sounder ways?" Please join me in welcoming our distinguished speakers.

Plenary Address by Dr. Keiichi Yokobori[2]

Thank you very much, Dr. Kim. I am going to talk about how energy issues relate to other elements of FEEEP, and in particular with the environment. However, I do have to caution you that the link between energy and agriculture might be a bit weak, so I am not going to spend too much time on this linkage. But at the same time, there are some other links that we need to explore further.

First, however, just to clarify some comments that were made in the preceding session, the agriculture sector accounts for between two to five percent of total energy consumption, although in developing Asia, this percentage is higher. With further mechanization and replacement of manpower in agriculture, energy intensity in agriculture will tend to increase.

$C0_2$ Emissions and APEC

$C0_2$ emissions in the APEC region are growing, both in absolute terms and as a share of the world total. In 1985, APEC accounted for 49 percent of the world emissions. In 1994, this region accounted for nearly 57 percent of the global emissions. In part, this

[1] Dr. Jong-Duck Kim is Director, Energy Efficiency and Conservation, Policy Research Division, Korean Energy Economic Institute, Korea.

[2] Dr. Yokobori is President of the Asia Pacific Energy Research Center (APERC) in Tokyo, Japan.

expansion in relative terms could be attributed to the decline in emissions in the former Soviet Union and in Eastern Europe which resulted from the economic difficulties in that region. However, a closer look at the incremental volume and growth rate by economy gives a more alarming picture, showing that the volume of emissions from the APEC region increased between 1985 and 1994 and that this growth exceeded that of global emissions during this period.

Developing economies in the APEC region accounted for the bulk of the increase in emission and registered higher growth than the OECD members of this region. China alone accounted for one-third of the region's incremental emissions. This suggests that emissions from developing APEC economies could at some point exceed those from industrialized economies in absolute volume. The Asia Pacific Energy Research Centre (APERC) is at present developing an energy demand and supply outlook for the APEC region up to the year 2010. I hope that this outlook will contribute to the discussions of the future carbon dioxide emission path related to energy use.

Interlinkages

Population, Economic Growth, Energy Use and Environmental Impacts are related as shown in the following formula suggested by Professor Yoichi Kaya which relates CO_2 emissions to the level of population, per capita GDP, the energy intensity of GDP and the $C0_2$ intensity of energy used:

$C0_2$ Emissions = (Population)(GDP/Population)(Energy/GDP)($C0_2$ Emissions/Energy)

Please note that the environmental pollution parameter is represented by $C0_2$ emissions. The above formula will produce the following derivative:

$C0_2$ Emissions Growth = (Population Growth) + (Growth in GDP/Population) + (Growth in Energy/GDP) + (Growth in $C0_2$ Emissions /Energy)

From this formula, it is clear that, in order to reduce the pace of environmental degradation while maintaining growth in both population and per capita GDP, either the energy intensity of GDP or the environmental-impact intensity of energy or both must be reduced. In other words, without energy efficiency improvements and/or substitution to less polluting fuels such as non-fossil fuels, the deterioration of the environment from energy-related activities would not be stopped. Thus, the changing pattern of energy in both demand and supply affects the path of energy-related environmental impacts.

While similar formulas can also be developed to link food and population and GDP growth, the relationships between food and energy are less apparent. On the one hand, energy is an input into the production of food. On the other hand, biomass and agricultural waste can be used as fuel. At the same time, taking the case of biomass for example, food and energy production could compete directly with each other in terms of land utilization. While further study would be needed to clarify the mutual impacts of food and energy use, this relationship should not be overlooked.

Energy Efficiency and Fuel Substitution

The scope for reducing environmental degradation by increasing energy efficiency appears to be substantially larger than through substitution away from carbon-intensive fuels. First, both in the world as a whole and in each member APEC economy, the differences in energy efficiency are wider than in the carbon intensity of energy use. This reflects the heavy dependence on fossil fuels of most economies. As a result, the $C0_2$ intensity of GDP generally follows the pattern of energy intensity of GDP. Further, a pattern of low energy/GDP ratios but higher $C0_2$ emissions per capita is observed in industrialized economies while the reverse is observed in developing economies.

The wider range in energy intensity in itself implies greater energy-saving potential through alignment of energy intensity towards the lowest level in the region. This suggests that an emission reduction strategy should place the priority on energy conservation and efficiency improvement. For this reason, it is worthwhile to note that the second APEC Energy Ministers Meeting, which was held in Edmonton last week, welcomed the proposal to establish guidelines for energy efficiency and asked the Energy Working Group (EWG) to consider these ideas in developing an expanded work program.

At the same time, the barriers that prevent the wider adoption of available energy-efficient practices and technologies should be identified and should be removed through policy cooperation. The aforementioned Energy Ministers Meeting also encouraged the advancement of the on-going EWG work of reducing environmental and business costs through cooperation on energy standards. In my personal view, the emission trading currently practiced largely in North America would have potential to encourage freer flow of energy-efficient practices and technologies.

Further, a caution should be made that energy efficiency and fuel mix are not totally independent. The type of fuel chosen also affects energy efficiency. As shown in the power sector combustion efficiency in the OECD economies, power generation efficiency varies by fuel. It is also known that traditional burning of biomass fuel is less efficient and more polluting. Thus, if a change in fuel mix is not accompanied by more efficient utilization technologies, it could fail to contribute to the eventual lowering of C02 emissions.

Factors Affecting Energy Efficiency

Energy efficiency is also affected by factors other than prices and the technologies in use. Consumer perceptions and behavior, the availability of relevant infrastructure, education and institutional arrangements are also important.

While it is not possible to predict exactly future energy demand patterns, the initial results of the regional APEC outlook which APERC is developing suggest the continuation of rapid increase in the energy intensity of GDP in many developing and industrializing economies and a slower increase in this intensity in industrialized economies. This might reflect the continuous industrialisation and urbanization of the

former group, and the relative growth of the service sector in the latter group. At this stage, these conclusions remain highly speculative.

Caution must be exercised in drawing conclusions as to the implications of change in industrial structures for energy use. For example, while a shift towards services will certainly reduce an economy's overall energy intensity, total energy consumption can still grow in absolute terms, unless goods produced by the industrial sector are replaced by goods or services which require less energy as input. Thus, a shift toward a service-oriented society may not by itself ensure a more energy-efficient society.

Fuel Substitution

Although the scope for CO_2 emission reduction from fuel substitution appears to be smaller than from strategies that emphasize increasing energy efficiency, fuel substitution can also help reduce energy-related pollutant emissions. Indeed, after the oil shock in 1973, CO_2 emissions were reduced and remained comparatively low until the late 1980s due not only to increased energy conservation but also to fuel substitution, for example, to nuclear power. However, two major constraints must be taken into account when considering a strategy of fuel substitution towards fuels which have no greenhouse gas emission or that have lower CO_2 intensity than fossil fuels.

The choice of fuel type or its delivery patterns is constrained by the available infrastructure. In this sense, the lack of international pipeline networks in Asia constrains the use of natural gas in LNG form. Also the extent of connections to the electricity grid influences the scope of choice of generation sites and fuel mix. An Indian study suggested that the creation of a national electricity grid would eliminate the need for additional power plant construction for a certain period. APERC plans to consider these two gas and electricity infrastructure issues in its 1998 research themes.

Another consideration associated with fuel choice is the extent of externalities associated with various fuels. For example, nuclear options are often discarded for their radioactive radiation risks and weapon conversion potential despite their non-emission of S0x, N0x and CO_2. Moreover, as in the case of hydropower projects, almost all energy forms are associated with some forms of environmental and other external costs. The failure to assess these externalities in a comprehensive manner could raise other risks to sustainability. Therefore, all the alternative supply options should be objectively assessed for their capacity to contribute to sustainable development, without prejudice.

Conclusion

Energy efficiency and fuel substitution remain key options to reduce energy-related emissions of pollutants. However, priority should be given to energy efficiency improvement. Energy efficiency and fuel substitution are not mutually independent, as some interactions exist. All energy efficiency and fuel substitution options should be carefully considered in terms of their potential contribution to reducing emissions and to their other potential externalities.

Thank you.

Plenary Address by Angus Bruneau[3]

You have before you an engineer, not an economist. And I come from a part of Canada – in fact St. John's, Newfoundland – which those who understand our geography know is intimately more connected with the Atlantic than the Pacific. Indeed, APEC in our part of the world usually means the Atlantic Provinces Economic Council. However, it is a great pleasure to be with you here at this APEC FEEEP gathering.

This is a challenging meeting and the approach that you are taking here, of exploring how the elements of our economies captured in your acronym FEEEP interrelate with each other, I find a most interesting one. Keiichi Yokobori has given you the information about APEC and the activities in the energy field there. What I will try to do is to talk about energy as a global system.

Energy is a global system today and we depend on global flows, which are the principle sources of commercial energy employed in all developed economies today. But that is just one dimension of it.

Another global dimension of energy is, of course, that we use energy in almost everything that we do. We manipulate it to produce light and heat, to cool ourselves, to refrigerate, to transport and move, to lift, to shape things, to assemble things, to listen to sound and be entertained and so forth. Everywhere we look, we see energy in use. We depend on its availability and the expectation is that it is there on demand.

One of the challenges of this meeting is to somehow relate energy to economic growth, to population, to food production, and obviously to the environment. As I listen to some talk about the uncertainties of population growth and I listen to others describe some of the uncertainties between the linkages of population to the size and growth of economies, I think about the uncoupling that took place between energy growth and economic growth. About 20 years ago, if you knew your economic growth rate, you could very comfortably assume that you knew what your energy consumption growth would be. Looking at the uncoupling of that relationship, I would suggest that only a fool would stand here and say what the future requirements for energy will be. But one

[3] Angus A. Bruneau is past Chairman of Canada's Energy Council.

thing that I am certain of is that the energy requirements of Asia will be met in world markets. There is little doubt about that.

Now to understand what will impact on those markets on the demand side and on the supply side and to inform our policy thinking, it is very important that we back up a little bit and look at some very basic issues.

The first of these basic facts is that we do not really use energy. What we do in all those machines that we use is to convert it from one form to another, almost always with some material as a carrier. We have a chunk of wood, we burn that chunk of wood. We get heat out and we get material out, we get ash, we get gases, we get water vapor, all sorts of things. And in fact, if you examine almost all the processes that we use to provide ourselves with energy, you will find that they are similar types of processes.

Now, what we have been able to do until fairly recently with impunity is to let all the by-products simply dissipate into what was assumed to be the infinite sink of the atmosphere, the ocean or wherever the byproducts were dumped. And now we are coming to a time when we really are becoming concerned about the fact that the by-products of those processes are far more harmful than the product that we use.

A second basic fact concerns the amount of energy than mankind transforms. The numbers are, in fact, startling. Our planet annually intercepts some forty thousand units of energy from the sun. Now these units are big – for those with a physics background, each unit is one joule times ten to the twentieth power. Obviously, because the earth is in thermal balance, it also radiates about forty thousand units as well into space. All of mankind's activities in manipulating energy for own use amount to using about three such units.

Here is third important fact. If you make some fairly simple assumptions about how the earth gets rid of heat, and if you assume that the earth's albedo (i.e., its reflectiveness) does not change, for us to today to raise its temperature by 1 degree Celsius with the energy that we use would require approximately two hundred times as much energy as we actually do use. The conclusion then is that it is not the energy use itself that gets us into trouble, it is the uncontrolled dissipation of the by-products which as I mentioned we hitherto simply thought we could disperse with impunity.

Now, clearly, in the next couple of decades the real constraint on energy availability both in terms of supply and demand and how it is used will be the constraint imposed as a consequence of green house gas emissions. That was Keiichi Yokobori's conclusion and I come to that conclusion as well.

There are of course all sorts of side effects that impact locally that will have to deal with. For example, burning large amounts of coal that contains a lot of sulfur and letting the acid gases escape will acidify local soils and take land out of agricultural usefulness. But these kinds of effects generate very strong negative feedback. You start doing that and you know that you have to clean up the process.

It is the global effect that is going to impact on all of us. So where do we go from here? Looking back at the history of commercial energy, it is only about 200 years since it really got underway about the time that Stevenson opened the Stockton to Darlington railway line in Britain and ran his "rocket". That was the first commercial transport provided with steam. Since then, there has been an inexorable rise in the use of commercial energy.

Initially, we saw the rise in the use of coal, which reached its zenith as a percentage of total primary energy employed in 1925. At that time, it represented seventy percent of the primary energy supplied in this planet. It is interesting to note that it rose from percent of total energy used to 50 percent in about 80 years. Oil followed it, also rising from about 2 percent towards 50 percent in roughly 80 years as well. Gas is now on the same slope.

If we examine the long-term trends, there are two observations that emerge. First, if we consider the machines that we use to convert thermal energy to mechanical energy, or "prime movers", there has been a steady increase in their efficiency over time. In fact, if you plot the logistical curve of energy efficiency[4] over a period of about 200 years, you discover a dead straight line to where we are today at approximately 60 percent. Secondly, we have witnessed a steady increase in the ratio of hydrogen atoms to carbon atoms in the sum of the fuels that we use. Wood has about one hydrogen atom to ten carbon atoms. By comparison, coal is one to one, oil is two to one, and natural gas is four to one. And have in mind that this is pushing us in the direction in which we really want to go.

Accordingly, looking at the challenges that we face to provide energy for ourselves, I conclude that they are focussed on how we can get through the next few decades before we can really start weaning ourselves away from the fossil fuel base on which we are now dependent.

The objectives of policy in the long term, it seems to me, should be to ensure that we support the research and development of technologies that are designed to move us further along the curves that I have described, increasing the hydrogen ratio in the energy that we use, while reducing our dependence on carbon, and increasing our efficiency of energy use. This would move us towards grid-based systems, towards greater use of natural gas, and towards systems in which are able to enclose and control the by products at the point of conversion.

In all of this, it is absolutely vital that we recognize the extraordinary value in the solar flux, forty thousand units per annum compared to the three that we manipulate today. And that solar flux is also there as a consequence of a neat little equation that says: $E = MC^2$. And make no mistake about it, ultimately, the systems upon which we will really rely will depend on that equation. The fission reactors that we use today are pretty cumbersome. I suspect that, a hundred years from now, people will look back on them the way that we look at Stevenson's locomotive and say something like "It's a marvel

[4] The logistical curve is represented by log(efficiency)/(1 minus efficiency).

that they ever worked, but at least they got us started!" Do not dismiss it, for we are just beginning. Only in my lifetime was it proven that there was a nucleus in an atom.

Now that is the long term. What must the object of policy be in the short term?

Here we come to the issues that we talked about that are important as long as we are captive to a fossil-fuel-fired economy. Clearly, issues of efficiency are important and this goes beyond the engineering concept of thermodynamic efficiency or even the concept of economic efficiency. I would suggest that there is a still broader concept of eco-efficiency that is vital. We know that we can greatly enhance the eco-efficiency of the energy systems that we have today with the technologies that are available to us today. In theory, it is possible. It takes capital and investment, the preferred equipment and processes, and access to preferred fuel systems.

Now, if we have a problem today with greenhouse gases, then it is a global problem and must be approached on that basis. For example, meeting 1990 emission statistics in this economy by the year 2010 is possible. However, it will cost a lot of money to make a very marginal difference in a tiny portion of the total greenhouse gas emissions on the planet. In my opinion, this would be a huge waste of both intellectual and financial capital. With the same resources, I suspect that we could put a small iron stove in one hundred million African huts and enhance the efficiency of the wood being burned by a factor of ten - not by ten percent, but by a factor of ten. This would have a profoundly greater global effect. So the objective of policy in the short term, it seems to me, has to be find the ways in which we can apply the resources available to greatest effect. in dealing with what is clearly understood to be a global problem.

Finally, let me close with a brief comment on the issue of sustainability and about sustainability of energy systems in particular. As I look at it, given the history over the past two hundred years, the least likely future is a future without profound change. Moreover, never have we had an energy system that, per unit of energy used in our societies, is as clean and as environmentally compatible as we have today. Efficiency is higher. Processes are cleaner. At no time in our past, could we take the system that we used then and say that it was sustainable. Indeed, if we took just a slice of the technologies available to us in 1950 and tried to apply them today, we would not be here. We would be choking.

Change is inevitable. Sustainability is not related to some idealized final state, it is maintaining the capacity to respond to the issues and problems that arise as we understand more, on an on-going forward-looking basis.

So we must in our policy ensure that we maintain the capacity to create the intellectual capital and the financial capital that will allow us to both first develop and then apply widely those technologies that will make the difference.

Thank you.

PANEL ON THE ENVIRONMENT

Remarks by the Panel Moderator, Dr. Vivienne Wee[1]

This is perhaps a fitting session to close a very stimulating first full day of discussions, because, although "environment" is a word like food, energy, and economic growth, it is in fact the "mother of all issues" – without the environment there is nothing else!

There are some issues and questions that I hope will be answered in the course of this panel discussion; in particular, the connected issues of resource scarcity and the need for long-term vision.

We live on a finite planet with finite resources, and the question we face is: how do we sustain ourselves indefinitely given the situation of resource scarcity? This in turn brings us face-to-face with a very important issue, what mechanisms do we have to generate the long-term vision needed to deal with this issue?

In the discussions today, we have been talking a great deal about economic growth and trade liberalization and this actually has a particular context in relation to the environment. At the beginning of this decade, it became possible for a global consensus to emerge on some of the global priorities of common concern. The first of these global priorities was environmental crises, which were addressed at the World Summit in Rio. Our first speaker, Dr. Jag Maini, played a key role in that summit.

I would like to bring us back to the original meaning of the term "sustainable development". The original definition that was used in Rio came from the Brundtland Commission Report of 1987, entitled *Our Common Future*, namely:

"*development which meets the needs of the present without comprising the ability of future generations to met their own needs*".

Sustainable development requires meeting the basic needs of all people and extending to all the opportunities to satisfy their expectations for a better life. There are two issues here: one is inter-generational continuity, the second is equity.

So we need to ask the question, is the market a mechanism that can address long-term inter-generational issues? It has been said that, in politics, a week is a long time; in the stock market, a day is a long time. Can we rely on a mechanism driven by individual or at most corporate interests to look out for our common future? That is a question I hope that our speakers will be addressing.

---

[1] Dr. Wee is Executive Director of "Engender", The Centre for Environment, Gender and Development Pte. Ltd., 14c Trengganu Street, Singapore 058468, Telephone: (65) 227 1439; Facsimile: (65) 227 7897; and email engender@egc.org; or vwee@cyberway.com.sg

Another issue that has come up in the course of this discussion is the relation between state and market. The end of the Cold War also marked the emergence of market-led development as the dominant form of development rather than state-led development. So what is the role and responsibility of governments in relation to market-led development. We have in fact this day talked about governance in terms of facilitation and regulation of markets, and trade liberalization. Another aspect that perhaps our speakers will also address is the contentiousness of the market. Now in this respect, the environment lobby in particular has had significant success in terms of its ability to actually change consumer behaviour and to promote consumer preference for what might be called "green goods" over the not-so-green goods. And that is perhaps something that we need to look at.

And this actually brings us to the third component that we need to address, if we are going to look at who the players are in generating a long-term vision. This is not just a state, not just a market, it is a community, a civil society. Because environment is precisely the area where civil society has played a very major role in shaping consciousness and effecting behavioural change.

These are some of the key issues to be addressed in the course of our discussions; I hope that some other key issues will also arise in the presentations.

Plenary address by Dr. Jag Maini[2]

Thank you Madam Chair for the kind words, including about “eco-tourism”, a term which I coined in my earlier incarnation. The title of this Symposium, *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment,* denotes a nexus of complex, cross-connected issues. Action in one of these areas ripples through other parts of this nexus and today we have heard of various such links between agriculture, energy, land degradation, water and also deforestation.

Looking at the map of the Asia Pacific region from a biological or basic life support system perspective, it is evident that a very large part of region is in fact accounted for by APEC economies is covered by forests. Accordingly, my entry point to these five elements of this Symposium topic is going to be the forest connection.

[2] Dr. Jag Maini is the Head Coordinator of the Secretariat for the Environmental Panel on Forests. Prior to joining the UN, Dr. Maini has held many positions in the Government of Canada, including research scientist in forest ecology, Coordinator of Environment programs, Director of Forest Research, and Director of the General environmental Policy. He has also held a position of Assistant Deputy Minister in the Canadian Foreign Service and since 1990 has served as Canada's Chief Negotiator on Forests during the Rio post and post-Rio deliberations. He received his MSc degree from the Forests Institute in India and his Doctorate in Ecology from the University of Saskatchewan. He has published over a hundred papers including three books and coined the term "Eco-tourism". He prepared the first State of the Environment and the State of the Forests reports for Canada and laid the foundations for international consensus on forests through a Malaysia-Canada initiative that brought together developed and developing economies to agree on this very particular issue. He proposed the need for criteria indicators for sustainable forest management at Rio and he also chaired the Montreal process involving twelve developing and developed economies.

What then is the interface between forests and the main elements of this Symposium?

First, on a rough calculation, APEC economies account for almost thirty percent of the world's forests and some of what I call the super powers in forestry are located here: United States, Canada, Indonesia, Papua New Guinea, Malaysia and some other economies in South East Asia, each of which contains a very significant portion of the world's forests.

Second, many, many people in the developing economies of this region live in and around forests and are very much dependent for their subsistence on forests.

Third, forests are also very important as an instrument of economic development.

Fourth, there is the water issue, which was mentioned as one of the possible constraints in the future in a number of contexts. All the watersheds that we have are forested and the manipulation of forests on these watersheds has a very direct impact on the water supply, both in terms of quality and quantity. The Division of Sustainable Development, United Nations, recently prepared a paper for the Commission for Sustainable Development on the water situation in the world which suggested that, in the future, there are likely to be three dimensions of water about which we will have to be concerned:

- scarcity of water in terms of food security;
- scarcity of water in terms of economic development and
- scarcity of water in terms of health, given the fact that, in many parts of the world, as you all very well know, water is not drinkable due to contamination both in biological terms and from chemical pollutants.

Let me take the five elements we are discussing in this Symposium and explore the interfaces between those elements and forests.

Food

The clearing of forests that cover watershed hills causes tremendous amounts of erosion and loss of fertile soil. In the Philippines, China and Thailand we have seen a shift of cultivation taking place into the higher watershed hills. There is a very critical cross connection between watershed forests and food security through the role played by these forests in conserving soil and regulating water flows.

Energy

Many rural populations and forest dwellers depend on forests for their fuel wood. In fact, almost 80 percent of all the wood that is harvested in the developing economies globally is used as fuel wood and only 20 percent of it is used as industrial wood.

In the panel on energy, there was mention of the issue of joint implementation in respect of emission and tradable permits, which will be discussed in Kyoto at the Conference of Parties. Joint implementation holds out the possibility of generating a tremendous amount of financial cooperation to help us in better managing our forests and restoring degraded forest ecosystems.

Environment

From an environmental point of view, forests are very important for bio-diversity and wildlife habitat. Deforestation and forest degradation have resulted in loss of bio-diversity and wildlife habitat and these are the areas of concern. APEC member economies include very large areas of boreal, temperate and all kinds of tropical forests that are very rich in biodiversity and that play an important role in the global ecological cycles. These are an important heritage to mankind and can no longer be considered simply as nature's factory that produces wood. It is important to maintain these forests in a healthy state in order to ensure receiving numerous environmental benefits and services.

Population growth

Some studies show that, as per capita income increases, so does per capita consumption of forests products. For example, on a per capita basis, China uses about one-thirteenth of the forest products that an average Canadian uses. If the per capita income of India and China together over the next twenty five years were to, say, double or triple you can image the kind of demand that will create for forest products and environmental services.

Economic Growth

In terms of economic dimensions, APEC economies such as Canada, United States, Indonesia, Malaysia, New Zealand, Australia and Chile are some of the major consumers and producers of forest products. And a lot of the industrial wood that is used in developing economies comes from Chile, Indonesia, Malaysia and Papua New Guinea; accordingly, there are tremendous opportunities and interest in the Asia Pacific for economic development based on forests.

Certain economies in the APEC region are meeting their demand for forest products offshore. For example, Japan sources about 90 percent of its consumption offshore and so does Korea. I think that this raises opportunities for offshore investment in sustainable forest management that ensures a sustained supply as well as an opportunity to rehabilitate some of the degraded lands in the APEC region.

Against this background, I would like to suggest five policy issues for your further consideration in order to derive the full ecological and environmental economic benefits of forests.

First, as I mentioned, clearing of land for agricultural applications is a major threat to forests. Around the world, about 13.5 million hectares of forestland are cleared every year. Of this, 80 percent is for agriculture, making this the major cause of deforestation globally. If you look at the agricultural and food production literature, interestingly it is suggested that over the next twenty years some 80 million more hectares of agricultural land will be required to feed increasing populations -- but no mention is made of where this land is going to come from. So the policy issue that we have to consider is how to maintain the present agricultural land in a productive state and not allow it to be degraded to pasture land, subject to desertification and/or to become derelict. This approach will reduce the need to cut down forests to create new agricultural land.

The second policy issue that we have to consider is one that was mentioned by Mr. Shibuya in his discussion this morning; namely, that we need to rehabilitate degraded and marginal agricultural land. Around the world, almost 1.8 billion hectares of land is in a degraded state -- indeed, one third of the land in India is degraded. If the Kyoto meeting results in joint implementation and tradeable permits then, from a rehabilitation point of view, this could generate a very large amount of financial resources for international cooperation and rehabilitation of these lands. I think that there are opportunities there and we will be watching the Kyoto meeting with great interest.

The third policy issue is, as our Chairman pointed out, that certain long-term policy perspectives are needed in terms of supply and demand. Personally, I think that as the economies of this region expand, there will be a tremendous demand for forest products, for paper, for building materials and so on. There are accordingly tremendous opportunities in this region, particularly in the tropical parts of this region where trees can grow in a much shorter time frame than in the boreal and temperate regions. However, we must remember that, whereas we need only a very short lead-time to increase agricultural production, a much longer time frame is needed to increase the production of forests. For example, in order to produce wood you need in tropical economies say 12 to 15 years but in Canada up to 50 and 75 years in certain areas. So we need to look at forest issues with much longer perspectives and, given the linkages that I have noted above, this time dimension has implications for the discussions in this Symposium.

The fourth policy issue is about cross-sectoral policy harmonization. We have heard a lot about linkages, etc. and I too have been saying the same thing over the years. However, when you look around you seen very few concrete cases where policy from one sector is being harmonized with that in another sector. I would suggest that, as a test case, we should harmonize the policies of forest management and watershed management. First, because it is relatively simple. Second, because it is important to ensure the water supply for many urban areas. For example, all of Tokyo's water supply comes from the Yamanshi prefecture; Vancouver's comes from the forest in the neighbouring Rocky Mountains; and similarly, in the case of Seoul, the source is the

hinterland. In the urban centres, people are taking the water supply for granted but I think that we need to start thinking about how the watersheds and their forests are going to be maintained and this requires, as I have noted, cross-sectoral policy harmonization.

The fifth policy issue that I would like to raise is conservation; with the intense pressure of population growth, it is extremely crucial that we set aside representative and unique types of lands as ecological reserves.

To summarize, I have suggested that, from a policy perspective, we have to do the following: maintain agricultural land productivity; rehabilitate degraded lands; develop long-term policy perspectives, particularly on forest-related issues; and undertake cross-sectoral policy harmonization -- and we cannot just talk about it, if we are serious about linkages. Finally as a very crucial priority, I have suggested that we set aside natural ecological reserves in the face of expanding population.

Thank you.

Plenary Address by Somrudee Nicro, Ph.D.[3]

APEC and the Environment: Asking the Right Questions

As we approach the year 2000, our development and environment records urge us to rethink our effort toward achieving sustainable development. Needless to say, environment recognizes no administrative boundary; it is therefore only appropriate to discuss environment in regional and international fora. The fact that APEC member economies comprise one of the most dynamic regions in the world and that the thrust of APEC is economic cooperation makes it all the more essential to address the issue of environment and sustainable development in this forum.

In these comments, I take as my point of departure the APEC Economic Committee Chairman's Discussion Paper on *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment in APEC*. In particular, I reflect on the "indicative questions" outlined in that paper in the subsections on "population" and "environment". This is because population growth is deemed the primary independent variable and the basis of the discussion of economic growth, food, energy and the environment at this symposium; as the reference paper puts it:
(1) "*Population growth is a major source of economic growth, both through increasing labour supply and by increasing demand,. it is also a dominant factor in overall food and energy requirements and pollution creation*."[4]

---

[3] Dr. Somrudee Nicro is Director, Urbanization and Environment Program (UEP) Thailand Environment Institute (TEI), 210 Sukhumvit, 64 Bangchak Refinery, Bldg. 4, Prakanong, Bangkok 10260, Thailand. Tel: 662 331 0047 Ext. 4156; Fax: 662 332 4873; and email: somrudee@tei.or.th

[4] *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment in APEC,* APEC Economic Committee Chairman's Discussion Paper (October, 1996), p. 9

The following are a few of the "indicative questions" in the subsections on "*population*" and "*environment*". The emphasis is my own addition.

On Population:[5]

(2) *What are the implications of population distribution between rural and urban settings for labour force growth, land available for cultivation, and distribution of infrastructure requirements*?

(3) *What is the scope for gains in economic efficiency, improved efficiency of energy consumption, reduced environmental pollution, and ultimately improved quality of life through better urban planning and development?*

(4) *With the advent of the information age, steep reduction in the costs and time of travel, and growing importance of services in GDP, what is the scope for more decentralized patterns of production and thus of habitation?*

(5) What *is the scope for more efficient utilization of water through application of recycling techniques (e.g., use of strained dishwasher to flush toilets and so forth), expanding effective supply by stopping the use of rivers as sewers and desalinating seawater, and what are the implications in terms of infrastructure requirements, pricing etc.?*

(6) What *are the implications of rising relative price of water in terms of:*

- *distributional impacts on populations, particularly on those living at or near subsistence income levels;*
- *industrial locations,*
- *requirements for technological development and dissemination;*
- *viability of marginal farmlands;*
- *changes in habits;*
- *health impacts; and so on?*

On environment:[6]

(7) *To what extent is it possible to quantify and integrate into a long-run economic welfare calculation, environmental damage and costs?*
Sustainable development is a new thinking. It is possibly one of our best responses to our past failures and therefore demands an industrious "redoing" of our framework of knowledge and way of thinking. If our goal is to achieve sustainable development, we have to seriously rethink our past course of development, our development theories, our assumptions and also our questions. It is inadequate to ask questions which are embedded in the conventional mode of knowledge. Do we make the right assumptions?" and "Do we ask the right questions?" are the right questions to ask.

---

5 *idem* pp. 11-12
6 *idem* p. 18

(Economic) Indicators

An excellent example of obsolete thinking is our dependence on economic-based development indicators such as GNP. Henderson (1995) graphically puts it in the following metaphor:

"*GNP is a malfunctioning strand of our 'cultural DNA code' -- carrying erroneous information and signaling to the body-politic a form of growth analogous to that of cancer cells which consume the host's body."*

A concrete example of how these economic indicators have failed us is the current downturn of Thailand's economy. Having enjoyed impressive economic growth for a couple of decades and prided itself of becoming the next 'Asian Tiger', Thailand has seen its currency, the baht, devalue since it was allowed to float on July 2, 1997 and is now the latest economy to have to turn to the International Monetary Fund (IMF) for assistance. Setting aside questions of 'what' or 'who' is to blame (see in this regard the editions of *The Far Eastern Economic Review*, *The Economist*, and *Asiaweek* cited below), it is apparent that the economic growth indicator used to signify Thailand's prosperity failed to indicate the temporal dimension of the economy: i.e., its (un)sustainability.

Getting on the right track

A positive trend to internalize environmental costs into the equation can be seen in developments such as the attempt to develop Green GNP and the green tax pioneered by Norway and the ongoing effort by the WBCSD and Canada's NRTEE to develop 3 sets of alternative indicators to measure industrial environmental performance, namely the 'resource productivity index' the 'product and disposal cost to durability ratio', and the 'toxic release index' (NRTEE, 1997).

Population and Equity

Population is <u>not</u> merely 'labour supply' or 'demand' as cited above. To put it differently, population does not have only *quantitative* but also *qualitative* value. One can never assume without committing a fallacy that a population is homogenous, let alone populations of different economies.

The vast income gap between the rich and the poor in the less developed economies (LDCs) is widely known. Less recognized, however, is the fact that there also is such a gap within developed economies (DCs). According to the United Nations Development Program, it is estimated that in 1992 as many as 30 million people were unemployed in OECD (Organization for Economic Cooperation and Development) economies. Moreover, the wealthiest 20 percent received on average seven times the income of the poorest 20 percent. Population and its growth indeed beg equity question.

Additionally, it is too often assumed that populations of the DCs are more educated, possess more advanced technology and therefore are more economically efficient, and use resources more wisely than their counterparts in the LDCs. In contrast, Thorbjorn Berntsen (1995), Minister of Environment of Norway, admits that "Each Norwegian uses roughly twice as much energy as each Japanese, four times that of the average Spaniard and 250 times that of each Tanzanian."

Two Worlds Apart

A case of an attempt to transfer clean technology from Europe to Thailand exemplifies the gap between DCs and LDCs. A project financed by the Deutsche Gessellschaft fuer Technische Zusammenarbeit (GTZ) has the following to report:

"*... it is surprisingly difficult to identify actual clean technologies which could be transferred to Thailand in present circumstances. There are two reasons for this. Firstly, in Europe the 'base case' against which a clean technology is compared also assumes either clean-up using end-of-pipe technology or elevated charges for discharges to water or for waste collection and disposal, whereas these are not yet brought into the equation in Thailand since effluent and waste treatment costs have not yet been internalized into the production costs. And secondly, the relative costs of capital and labour in Thailand, and the fact that many factories use old and therefore low-cost capital equipment militates against investment in new European technology.* "

An implication of the differences between DCs and LDCs to the APEC forum is that we cannot expect the same strategies to be equally successful for both member groups. Rather, we have to be honest, courageous and creative enough to address this gap straightforwardly. We have to go beyond rhetoric of 'social harmony within a nation and between nations' by actually tabling a realistic agenda for actions.

People-Centered Development

Population also means people, humankind and citizens. The concept of 'people-centered development' that is widely accepted nowadays precisely addresses these qualitative aspects of population – cultural, biological and political. To reach sustainable development, it is important to recognize and 'internalize' human values (social and spiritual development) and human rights into the 'equation'.

Human values and human rights are difficult to internalize not least because they are difficult to measure for they are qualitative in nature. But weakness of measurement should not deter us from the subject of measurement itself. Human values and human rights are qualitative and essential to us, people, as Henderson (1995) nicely puts: "*Quantitative growth is dominant as children grow to adulthood, but once their mature size and weight are reached this gives way to qualitative growth: education, social skills, broader awareness and even greater ethical understanding and wisdom*."

And as Berntsen (1995) declares: "*..striving towards the fulfillment of basic human rights is an integral part of environmental protection*."

Quantification and Measurement

In fact, environmental economists have attempted to quantify the qualitative nature of people by using techniques such as valuation that is based on 'willingness to pay' and 'willingness to be compensated'.[7] But economic tools such as these and pricing have yet to address the crucial question of 'who gets what' (including the ability to pay), which must be addressed before they can be fully embraced.[8] Valuation technique still cannot quantify 'quality'. Indeed, quality of life demands more complex indicators than prices and markets as it also encompasses ethical and aesthetic values. [9]

It has been argued that a good sustainable development equation should incorporate ecological sustainability, social sustainability, ethical or spiritual sustainability and temporal dimension (Dahl, 1996: 29). Apparently, effort has been made to internalize only environmental costs. Yet, it is worth questioning whether we should limit our thinking only to the Newtonian paradigm (Dahl demonstrates his Newtonian thinking most vividly). That is whether it is suffice to reach sustainable development with the conventional paradigm which we have 'internalized' comfortably into our mode of thinking and 'calculating' the equation.

We are in dire need to measure. This need can be traced back to the beginning of natural science. But as Schumacher (1995/1977) has candidly warned us two decades ago that we can only see what we put down on our map, we can only measure what we already know. Indeed, we assume that what we want to know are measurable.

This paper has addressed the issues of environment in the context of sustainable development and population growth. It discusses crucial elements from the most obvious issues and moves on to the least obvious issues and from the measurable to the unmeasurable.

Thank you.

References

APEC Economic Committee Chairman's Discussion Paper, *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment in APEC* (October 1997).

Bartelmus, Peter, *Environment, Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, New York and London, 1994.

Berntsen, Thorbjorn, "Challenging Traditional Growth", *Our Planet*, Vol. 7, No. 1, 1995, pp. 11-12.

[7] See for example Panayotou (1993).

[8] For an example of arguments along this line see Bartelmus (1994).

[9] See Papaneck (1995), Porteous (1996), Roseland (ed. 1997), and Van der Ryn and Cowan (1996).

Dahl, Arthur Lyon, "Measuring the Unmeasurable." *Our Planet*, Vol. 8, No. 1, 1996, pp. 29-33.

Emerson, Tony, "After the Rescue," *Newsweek*, Vol. 130, No. 8, August 25, 1997, p. 49.

Geddes, Robert, ed, *Cities in Our Future: Growth and Form, Environmental Health and Social Equity,* Island Press, Washington, D.C., 1997.

Goldblatt, David, ed, *Social Theory and the Environment,* Westview Press, Colorado, 1966.

Henderson, Hazel, "Redefining Wealth", *Our Planet,* Vol. 7, No. 1, 1995, pp. 13-15.

National Round Table on the Environment and the Economy, *"Backgrounder - Measuring Eco-Efficiency in Business: Developing a Core Set of Eco-Efficiency Indicators*", Eco-Efficiency Measurement Workshop, Washington D. C., April 2, 1997.

No author, "The Fall of Thailand", *The Economist,* Vol. 343, No. 8018, May 24, 1997, p. 11.

No author, "Hanging on in Thailand", *The Economist,* Vol. 344, No. 8030, August 16, 1997, p. 22.

Panayotou, Theodore, *Green Markets: The Economics of Sustainable Development,* ICS Press, San Francisco, 1993.

Papaneck, Victor, *The Green Imperative: Ecology and Ethics in Design and Architecture*, Thames and Hudson, 1995.

Porteous, J. Douglas, *Environmental Aesthetics: Ideas, Politics and Planning,* Routledge, London and New York, 1996.

Roseland, Mark, ed, *Eco-City Dimensions: Healthy Communities, Healthy Planet*, New Society Publishers, Gabroiola Island, B. C., 1997.

Shaineen, Assif, “Worse than You Think", *Asiaweek,* Vol. 23, No. 32, August 15, 1997, pp. 42-49.

Schumacher, E.F., *A Guide for the Perplexed*, Vintage, London, 1995 (first published in 1977).

Tasker, Rodney, “Hard Times Roll”, *Far Eastern Economic Review,* Vol. 160, no. 32, August 7, 1997, p. 27.

_____ “The First Step”, *Far Eastern Economic Review*, Vol. 160, no. 33, August 14, 1997, p. 52.

_____ "The Bright Sight”, *Far Eastern Economic Review,* Vol. 160, No. 34, August, 21,1997, p. 85.

Van der Ryn, Sim, and Cowan, Stuart, *Ecological Design,* Island Press, Washington D.C., 1996.

Plenary Address of Dr. Xia Guang[10]

It is my great pleasure to have this opportunity to share some of my ideas with respect to the FEEEP issue, and also to say a few words concerning the issue of environmental pollution in China.

First, I would like to stress that it is very important for progress on environmental issues that they not be discussed in isolation but rather within the framework of economic issues, such as the framework set out by the APEC Economic Committee for FEEEP. So, it is my pleasure to express my support for this program.

Second, I would like to draw attention to the "indicative question" in the section on environment in the Chairman's Discussion Paper on FEEEP, namely *"To what extent is it possible to quantify, and integrate into a long-run economic welfare calculation, environmental damage and costs?"* This question identifies a very essential problem to address, because without an accurate assessment of environmental losses, we can not formulate policy correctly.

The calculation of environmental pollution has two key functions at least. First, it furnishes information for government policymakers, and second it can be helpful in developing the economic accounts. Given the importance of calculating environmental losses from pollution, I would like to provide a very brief introduction to my project concerning the environmental losses from pollution in China.

China's Environmental Economic Policy for Sustainable Development

Sustainable development is of special significance to China given its situation as a developing economy with a huge population that is experiencing unprecedented development and great change. In turn, China's ability to achieve sustainable development not only has important implications for the long-term future prospects of China itself, but for the prospects for regional and global sustainable development as well. China has approached this problem by a adopting an environmental economic policy.

Environmental economic policy is the aggregation of laws, regulations and administrative measures used by legislative institutions and governmental organizations which apply economic incentives to affect economic behaviour with the aim of

[10] Dr. Xia Guang graduated from the Chinese Academy of Social Sciences with a Masters degree in Environmental Economics and is now a Ph.D. candidate in the same field in the China Runming University. He is the Deputy Director and Associate professor of the Policy Research Centre for Environment and Economy of the National Environment Protection Agency of China. He is also Senior Consultant in the China Association of Environmental Protection Industries. For a long time he has been working in the field of theoretical policy issues related to environment and economy especially environment policy in China. He has written one monograph and more than 60 academic papers. His main research projects have been on China's environmental-economic policies for controlling pollution, estimating the economic losses due to environmental pollution in China, and environmental issues of joint ventures and other such topics.

environmental protection. Therefore, environmental economic policy is characterized by an indirect approach and flexibility. Insofar as it resolves conflicts between environmental protection and economic development, this policy is in line with the principles of sustainable development.

Following Ma (1996), China's environmental economic policies could be classified as follows:

1. Policies that are implemented by environmental protection departments:
   a) pollution charges;
   b) emission permits;
   c) the system of "three-simultaneities"; and
   d) ecological compensation.

2. Policies that are implemented by industrial sectors:
   a) compensation for mineral resources;
   b) compensation for land loss;
   c) environmental protection investment in urban construction;
   d) preferential treatment for the recycling and utilization of wastes;
   e) payment for caring for the forests;
   f) forestry fund;
   g) special fund for afforestation by sectors; and
   h) favourable loans for afforestation, and caring for the forests.

3. Policies that are implemented by comprehensive management departments:
   a) taxes on urban land use;
   b) taxes on taking up arable land;
   c) taxes on urban maintenance and construction;
   d) resource tax;
   e) tax exemption by comprehensive utilization of resources;
   f) retaining a portion of profits by comprehensive utilization;
   g) environmental investment in projects of enterprise renovation;
   h) cleaner production;
   i) industrial enterprises for environmental protection;
   j) financial and taxation policies conducive to environmental protection; and
   k) environmental protection loans.

It could be seen from the classification that policies implemented by environmental departments are for the control of environmental pollution, and policies implemented by comprehensive management departments and industrial sectors focus rather on the rational utilization of natural resources and the conservation and restoration of the ecology.

China's earliest environmental economic policy started from encouraging the recycling and reutilization of waste materials, which formed a set of management methods in the early 1950s. But environmental economic policies directly aimed at protecting the environment with real significance started from levies on pollution discharges in 1978.

China's market reform, which started in the early 1980s, created suitable conditions for the development of environmental economic policies, which were mostly formulated and took effect in this period of time. In accordance with the essence of environmental economic policy, a healthy market system in good operation is the basic condition for pricing signals to take effect. Since the initiation of these reforms, China has been formulating and perfecting all types of environmental economic polices. This has now developed into a complete policy system that includes pollution prevention and control, ecological conservation and rational utilization of resources.

Environmental economic policies have played important roles in China's environmental management. First of all, the implementation of these policies has gradually enhanced the environmental awareness of the society, especially the industrial enterprises. Allowing the price of environmental resources to be directly reflected in the business activity of producers militates against the excessive utilization of environmental resources, which results from the idea of regarding them as something free of charge. Secondly, environmental economic policies manifest the position of the overall society as the rightful owner of environmental resources and thus serve to reconcile the various interests in society and to promote an optimal distribution of environmental resources. Thirdly, environmental economic policies have created important sources for fund raising for pollution control and ecological restoration. This is of specia1 importance for an economy like China, which is at the preliminary stage of industrialisation and greatly in need of financial resources. Every year in China funding for environmental pollution prevention and control and urban environmental infrastructure building amounts to RMB 25 to 30 billion (about US$ 3 to 3.6 billion), most of which comes from fees collected through environmental economic policy. Fourthly, environmental economic policies also contribute to environmental management capacity building in China. Environmental management institutions at the grass-roots level in China, by implementing environmental economic policies, obtain the funding needed for self-construction and development, and the further carrying out of environmental economic policies.

Pollution Charges: A Typical Example of China's Environmental Economic Policy

Among environmental economic policies, pollution charges have been in use for the longest time in China, and are relatively more mature. Accordingly, it is worth giving this set of policies particular attention here. Based on the internationally accepted principle of “Polluter Pays”, China started to collect pollution charges at the end of 1970s. According to this policy, all enterprises and organizations that discharge pollution into the environment pay stipulated fees according to government regulations and standards, as a means of internalizing the external environmental costs of their activities. Now, a rather complete regulatory and policy system has been built up on pollution charge. It is confirmed by 4 national laws, and involves 2 special regulations by the State Council, and 12 complementary regulations.

The policy of pollution charges has the following characteristics:

- This policy is implemented in all regions in China and has wide applicability. The items on which pollution charges are levied include wastewater, waste gas, solid wastes, noise and radioactive substances. In all, the policy applies to 113 pollutants classified into five major categories, making it probably one of the most complete of such policies in the world.

- For most items, fees are collected only when the discharge amount exceeds the emission standard; for some items like wastewater and sodium dioxide, fees are collected on immediate discharges.

- Fees collected flow into budgetary revenues, and therefore have the nature of a “paratax".

Principles for pollution charges are as follows:

- Polluters are not exempted from responsibility after paying the pollution charge.

- Payment is compulsory. Failure to pay the charge within the designated period of time results in a 1% increase in the charge every day.

- The principle of accumulation is applied: from the third year following the initiation of collections, the pollution charge is to be raised 5% every year.

- New pollution sources incur more stringent pollution charges. Charges in respect of new pollution sources created after 1989 will be doubled.

- As for wastewater, both pollution discharge fees and fines for exceeding standards will be collected.

- Pollution share could be put into production cost.

- Pollution charges collected shall be used only for environmental protection on the following basis: 80% for pollution control at source and 20% for capacity building of environmental protection departments.

- Payment for the utilization of these funds is required. A proportion of the funds obtained through pollution charges is set aside for establishing a special fund for pollution source control. This fund is entrusted to a designated bank to finance loans.

In order to carry out the system of pollution charge, 1,600 environmental supervising institutions have been established by environmental departments at all levels, involving 20,000 staff.

Since its implementation, the number of payers from whom charges are collected is increasing all the time, and so is the amount of fees collected. Table 1 provides a statistical review of pollution charges collected each year:

Table 1
Pollution Charges Collected in China, 1979-1994

Year	Pollution charges collected Unit: 100 million RMB
1979-1983	17.48
1984	7.56
1985	9.30
1986	11.90
1987	14.28
1988	16.09
1989	16.74
1990	17.52
1991	20.06
1992	23.81
1993	26.80
1994	30.97
1995	34.00

The Pollution Charge System has enhanced enterprise management, promoted pollution control, and achieved environmental, economic and social benefits with relatively limited funds. From 1979 to 1994, RMB 11.8 billion was collected through pollution charges, making up I5 percent of the overall fund used in industrial pollution control during this period. In some large cities, this proportion is as high as 30-40 percent. At the same time, this system has promoted environmental management capacity building. Funds raised through pollution charges that were used in developing environmental protection accumulated to RMB 4.5 billion in the period to 1994. Of this, RMB 3.1 billion was used to purchase environmental monitoring equipment and for related activities, and RMB 1.4 billion was used for environmental education and staff training.

Reform and Development of China's Environmental Economic Policy

1. Reform of the Economic System and Environmental Economic Policy

China is now going through significant economic system reform, and environmental economic policies shall be adjusted and developed accordingly to adapt to this great change. Actually, market-oriented reforms have prepared the ground for environmental economic policies to play a more effective role. If environmental economic policies could be integrated into the modem enterprise system and macroeconomic management, the costs of implementing these policies could be notably reduced. Therefore, in designing and formulating environmental economic policies, an effort should be made to develop them in line with overall economic system reform. For example,

- environmental taxes should be established in accordance with tax and financial policy reform;
- mechanisms encouraging investment in environmental protection should be established in accordance with reforms to the overall macroeconomic investment system; and
- measures to promote clean production and green industrial practices should be developed in accordance with industrial structural adjustment.

In general, the economic system reforms establish the basic premises for the study and design of environmental protection policies.

It could also be seen from this perspective that the study and formulation of environmental economic policies is no longer the only concern of the environmental protection departments, but the common concern of all departments from which coordinated and concerted efforts are needed. At a time when environmental issues are receiving more and more attention, the integration of environmental information and requirements into economic reform and policy formulation is indeed necessary and inevitable.

2. Sustainable Development and Environmental Economic Policy

According to the principles of sustainable development, the ultimate purpose of environmental economic policy is to ensure that the real value of environment is reflected in economic activities so that environment as a kind of natural resource will meet the long-term and sustained development needs of human beings. Therefore, the major role of environmental economic policy is to encourage policy audiences to adopt behaviour that is friendly to the environment.

However, the point of time at which individual economies are able to reach such a goal differs according to their level of development. In the case of developing economies, the first priority is to obtain enough funds for environmental protection and management. For a rather long time, this need will be met primarily through the implementation of environmental economic policies. Therefore, these policies will play a key role as a means for collecting and distributing environmental funds.

This applies obviously to the case of China. According to China's social and economic development plan, investment in environmental protection from 1996 to 2000 will amount to RMB 450 billion. Some of this will come from general government revenues and some from international financial aid. Most of it, however, will be collected by implementing, environmental economic policies.

In China, environmental economic policies form an integral part of the strategy for sustainable economic development. China’s Agenda 21 (State Council, 1994) calls for research and experimentation with the objective of integrating consideration of natural resource utilization and environmental impacts into the national economic accounting system so that statistical indexes and market prices could reflect more accurately the

changes to resources and the environment brought about by economic activities. The reform and development of environmental economic policies should not be directed at increasing the number of policies, but rather at mastering the essence of the issues. Environmental economic policy will become an integral part of sustainable development policy when environmental information is fully and accurately reflected in the national economic accounting system.

Reference:

Ma Zhong, *The Environmental Economic Policies in China* (Beijing, China Remin University, 1996).

State Council, *China Agenda 21* (Beijing, China Environmental Science Press, 1994).

Xia Guang, *Economic Instruments and their Policies for Environmental Protection* (Beijing, Management World, No.3, 1993).

SUMMARY OF THE DISCUSSIONS AT THE OPENING PLENARY: REMARKS BY DAN CIURIAK

The following points draw out some of the central themes that emerged in the panel discussions with a particular view to establishing a link to the workshop discussions that followed. Accordingly, the points are organized according to the workshop themes.

Markets

A clear link can be seen between rising prosperity and globalization. This reflects the importance of trade in stimulating the specialization of production that in turn supports the development of markets that meet qualitative demands and generate rising incomes. The possibility was noted, however, that short-term market-clearing behaviour might not deliver long-run sustainability.

The inability to "price in" externalities is the key area of market failure – although it might equally well be characterized as "governments failing markets" by not providing a proper regulatory framework.

The damage that subsidies can create was also repeatedly mentioned – to the environment, especially in excess use of water and energy, but also in terms of undermining technological modernization and leading to excessive $C0_2$ emissions

The importance of adequate infrastructure in supporting the development of markets, especially in rural areas, came up several times. It was argued that linking rural areas to national and global markets through improved infrastructure was a key to efficiency of food and energy systems. This was an important point because infrastructure is essentially a tractable area for public policy.

Technology

The region bears a high cost by not being at the known technological frontier. This manifests itself in terms of the big gap between actual and potential productivity of resources, not least in energy efficiency. Knowledge gaps and market gaps are key explanations for these circumstances.

Technology is a way to reconcile a) rising demands and stresses and b) the capacity to meet these demands and deal with the stresses. There is accordingly in some sense a "race against time", particularly on energy and possibly on food as well, to get the right technology developed and in place.

Governance

The ability to deal with issues is in many ways a question of governance. The importance of maintaining social cohesion, of involving all stakeholders and gender issues came up repeatedly in this context.

In considering access to basic necessities such as food, energy and a healthy environment in demand and supply terms, the issue of effective demand is raised. This is tied up with distributional issues and broaches a set of issues which might be summarized as "equitable development"

An interesting and difficult question related to governance is that of global responsibility for global "commons", which was raised in particular in the discussion of fisheries and the depletion of migratory fish stocks.

Closely related to governance is the issue of property rights. It was noted in several connections what lack of such rights meant in terms of removing incentives for investment and development.

The importance of cross-sectoral management of inter-linked FEEEP issues was highlighted and many cross-links amongst the issue areas were drawn out. However it was noted that, in practice, cross-sectoral integration of policies may not have been achieved.

Socio-Economic Context

Issues of sustainability must be considered in the context of prevailing conditions. FEEEP must thus be addressed in the context of a global era, an urban era, a unique era of the demographic transition.

For example, global markets and global issues imply global solutions. Meanwhile, the transitions that economies are undergoing are changing the age structure of societies, the rural/urban distribution of population, and the forms of economic organization (including features such as the family farm).

Specific implications that flow from these considerations include, for example, the importance of:

- bringing a broader range of economic activity, not just agriculture, to rural areas,
- ensuring the adequacy of social support policies such as pensions, retirement ages etc. to facilitate the various transitions;
- developing the appropriate regulatory and legal frameworks to support the transfer of technology from developed to developing economies, which in many cases is currently impractical due to the lack of supporting conditions.

Over-arching themes

From the perspective of economic theory, the recurring observation about the non-linearity in the socioeconomic system dynamics is particularly noteworthy. Such non-linearity calls into question many of the tools that have developed for economic analysis, from CGE models to dynamic macroeconomic structures which might incorporate non-linear trends but which are not equipped to deal with the non-linear aspects of inter-relationships among issue areas.

Qualitative issues and their intimate relationships with quantities came up – how structure of income affects population growth for example, to note but one such inter-linkage.

In a similar vein, the adequacy of economic indicators was called into question. It was noted that a narrow focus on indicators that do not necessarily reflect quality of life may be misleading policy makers and contributing to continuation of obsolete thinking in many areas.

The difficulties associated with making assumptions about the future of any factor were noted. The availability of water and energy were particular cases in point. However, even in the case of population, which many observers think is the easiest quantum to project, the surprises that have invalidated past extrapolations of trends were noted.

These considerations served as a note of caution in making projections, whether the projections are of Malthusian futures or rosy scenarios where technology fixes all. Ultimately, there is the issue of just how "knowable" the future is. In this regard, it was noted that the least likely future is something that resembles that which prevails today. In this sense, sustainability may not be a fixed state towards which economies can aim but rather the capacity to respond to issues as they arise.

THE PROCEEDINGS OF THE CLOSING PLENARY SESSION

The closing plenary session took place on the afternoon of September 4, 1997 under the chairmanship of Dr. John M. Curtis.

Opening Remarks of the Chairman, Dr. John M. Curtis

Good afternoon ladies and gentlemen and welcome to the closing plenary session. This session will consist of reports from the Chairs of yesterday's workshop discussions, followed by an open discussion. Mr. Brian Hunter, Chief Economist of the Asia Branch of the Canada International Development Agency (CIDA), will moderate the discussion which will be launched by commentaries from our two discussants, Dr. Vishvanath Desai of the Asian Development Bank and John Dixon of the World Bank.

I trust that this discussion will be as open and free flowing as we have had for the last three days. It is hoped that this discussion will help finalize the shape of the work that is in front of you today and help the Workshop Chairs in finalizing their reports which, combined with the reports of various APEC fora and the panelist presentations from the opening plenary of this Symposium, will constitute the proceedings of this Symposium.

Introductory Comments by the Moderator, Brian Hunter

As John Curtis said in the opening session two days ago, this is a very innovative process. The individual items in FEEEP are very familiar to us all but the approach that we have been taking over the last couple of days is very different from the approaches we would have taken four or five years ago. And, although this is a very complex and difficult approach, there is growing awareness around the world that we have to change the way that we have normally looked at these issues.

Consider again the cross linkages among the individual elements of FEEEP. These linkages embody information that we vitally need to make decisions, even within our individual disciplines. In my own work, I have tended to think of this nexus of issues in terms of a sphere, within which are all the cross linkages between the individual factors and into which we peer through various prisms or lenses, including governance, social issues, environment, economic development, and so forth. In the past of course, we have seen the linkages revealed by the specific prism or lens through which we looked. What we have been doing at this Symposium over the past few days is to gradually rotate the sphere and to look at these linkages through different prisms and lenses to wee what this reveals. First we looked at the linkages from the perspective of the individual issue areas themselves; then through the prism of four themes of our own choosing. The questions for us then are as follows: Does this add to our sources of information? Does it allow us to make decisions better than if we were looking through

only one lens? Does it improve our insight into the nature of these often-complex issues and help us to find solutions to the problems that we are facing?

I would also like to offer a second opening observation. I was very encouraged over the past couple of days that there were no attempts to make predications. Predications can be very useful in terms of bringing together our thinking in an organized and disciplined manner. At the same time, they can contribute to problems by inducing panic or lulling us into complacency. More fundamentally, they can create the impression that the future is in some sense predetermined whereas it is of course always a question of circumstance and choice. The questions for us are the following: How do we make those choices? What factors do we need to bring together to deal with the issues effectively? What information do we have to gather and to whom do we then have to disseminate this information to stimulate change? Do we have the incentive structures to effect change itself?

I would like now to ask each of the Workshop Chairs to bring the results of the considerations in their breakout sessions yesterday where the issues were looked at through those four lenses of markets, technology, governance and social economic processes. I would also like to welcome which will be launched by commentaries from our two discussants, Dr. Vishvanath Desai, who is the Director and Chief Economist of the Asian Development Resource Centre of the Asian Development Bank, and John Dixon, who is responsible for chief indicators in the Evaluation Unit of the Environment Department of The World Bank.

Report by John Merson, Chairman of the Workshop On The Role Of Technology

It is somewhat of a tall order to distill the wide-ranging discussion of these very complex issues that took place in the Workshop on Technology where we tried to work from the very baseline of ideas to something more refined that would be relevant to policy.

It was recognized at the outset that in looking at the technology implications of the FEEEP agenda, the environmentally sustainable future which the APEC countries are working towards, is not a fixed or static end, but a dynamic equilibrium as Angus Bruneau argued in his presentations on Tuesday.

Characteristic of such an equilibrium would be a high level of feedback allowing economies the flexibility to respond quickly and effectively to ever changing global market and environmental conditions.

In looking at the technological implications of this FEEEP perspective, we were well aware of the work that is already going on in the other APEC working groups, on Energy, Food and Industrial S&T. It was also observed that there was a need to view the Trade Liberalization and ECOTECH agenda in an integrated perspective. So given that the task of FEEEP is to look at the long-term impacts of economic and population

growth on food production, energy needs and the environment, we arrived at the following list of observations and policy options.[1]

Incentive Structures

A central issue that came from our deliberations was how the markets could be made to operate more effectively by sending the right price signals that would allow full cost accounting. One of the major obstacles to this has been the existence of hidden subsidies in areas such as water, energy, timber, and atmospheric resources – subsidies that have led to the devaluing of these crucial environmental resources.

In this respect, an important role of government in structuring markets and building incentives that encourage the efficient use of scarce resources would be firstly to shift subsidies from blocking change to more environmentally benign technology, to facilitating it. This reduction of subsidies would free up resources that could be channeled into making the move to more efficient technologies affordable for farmers and small and medium sized firms in many of the less affluent economies in the APEC community.

Infrastructure & Technology Frontier

While recognizing that these were essentially issues for national economies, one of the roles of APEC in supporting the process in which technological choices are made would be in establishing an information-technology-based Technology Network. Such a network would provide information and demonstrations of best practices in managing industrial technology and in the design of urban and rural infrastructure.

This is particularly important given the critical choices over infrastructure that are now being made throughout the rapidly developing economies of Asia and Latin America, where there is massive infrastructure investment being put in place (estimates run as high as US$ 3 trillion) but which have fewer R&D resources and less access to this knowledge. It is obviously imperative that the best scientific and technological information and options inform these decisions.

This facility, using the Internet system and multi-media capability which now exists in most economies or is available to key groups, would also help support rural and industrial extension workers develop pilot projects and demonstrations that would improve basic education, and help overcome the issues of risk.

[1] Note that this is of course only a brief summary or distillation of a wide range of ideas that were developed by the participants in the two sessions of the workshop. These are available via the flip chart records.

Technology Transfer

In terms of the critical issue of technology transfer, it was felt that there was a greater need for a more effective partnership between government, markets and other stakeholders throughout the region. This could take the form of regional collaboration in demonstration projects, and in developing effective strategies for Technology Impact Assessment.[2]

As we heard in the opening plenary session, the problems associated with transfer of technology are often problems of uptake and training capability. Accordingly, one of the critical issues to address in supporting technology transfer is human resource development, in particular through lifting of education and technology training to support the uptake of new opportunities and to encourage indigenous innovation.

Trade & Investment

One of the important recommendations was that trade and investment agreements recognize the need to achieve common environmental and industrial standards. As implied by the concept of sustainable development as a dynamic equilibrium, this will require government to gradually lift standards to support changing international best practice and which can help the region's continued strong economic growth but without the collateral damage of degraded urban and rural environments and ever diminished natural resources.

[2] There are options of urban development examples from Germany, USA and Australia that use up to 80 percent less energy through passive solar and other design innovations.

Report by Federico Macaranas, Chairman of the Workshop On The Role Of Markets[3]

Before reporting on the Workshop on the Role of Markets, I would first like to make a few observations.

First, we have been working in APEC over the past years to encourage groups like the Economic Committee to be able to integrate more fully the voluminous agenda of APEC. Thanks to people like John Curtis we were able to push through crosscutting issues in APEC despite years of resistance. We are at this happy junction where I think that we can see the fruits of those years bearing fruit.

Secondly, yesterday, during the excursion to the First Nations, I was reminded of how free competitive markets can be likened to the Shaman in a Canadian story about how Saskatchewan berries originated. If you do not know the story you should read an APEC booklet that we in the Philippines put out last year on theories about creation. While this was meant for children, we are all children and so let me tell you how the Canadians thought about the creation of berries, because this is very much like the free market.

A Canadian folk story tells of a medicine woman whom people suspected to be a witch in disguise of a human being. Many people suspect markets of being witches in some form.

Because her fame spread as a great healer of various maladies – as markets do heal – some jealous village spread rumours and ruined her reputation – as ecologists have done in the past to markets. They soon ran after her into the woods where she was tied up

---

[3] Acknowledgments: The Workshop on Markets was chaired by Federico Macaranas (Philippines), assisted by Workshop Coordinator Frank Des Rosiers, Canada. Carole Brookins (United States), Jane Lee (Hong Kong, China), Kenneth Jackson (New Zealand) and Chai Yu (China) acted as facilitators. The note-takers were Xavier Furtado, John Davies, Denis Landreville and Bryant Fairley, all from Canada. Workshop Approach: participants were divided into tables (three in the morning session, two in the afternoon session) with a mix of representatives from academia, business, government and non-governmental organizations in each. Each group was presented with four key questions concerning the impact of markets on FEEEP issues and what APEC might do in these areas:. These questions were:

1. To what extent do market prices reflect short-run market-clearing considerations versus longer term supply-demand considerations?
2. Do prices give sufficiently early warning of supply-side constraints, given the response lags, particularly for the development and adoption of new technologies?
3. To what extent do market prices imperfectly reflect information that is critical to decision-making (e.g., market prices reflect and affect "effective" demand for food - i.e., purchasing power - not the need for food). Thus rising prices can restore the demand/supply balance by reducing effective demand with a resultant increase in malnutrition).
4. What can be done to improve the quality of price signals (e.g., by reducing subsidies for environmentally damaging activities or by capturing more of what are now externalities")?

A facilitator rendered a brief report on the key points towards the end of each of the sessions. These reports, together with the notes compiled by the note taker for each group became the basis for the Chairman's report.

and hung from a tree. Through time, blood dripped from her nose onto the bush below, forming clumps from which of course the Saskatchewan berries come from.

Now one day an old man went into the woods and chanced upon the berries and he heard something saying "Eat me, eat me", and he was afraid because there was no one around him. Then, lo and behold, he looked up into the tree and there was the old Shaman hanging down, still alive after all these years – like a market which despite being pillaged, survives through the years.

When he ran to the village he announced the news that the old medicine women was still alive and so people rushed to the forest where they chanced to eat the berries and mysteriously were healed.

Now the market is like these berries and the medicine woman because we too have been healed in so many ways over the past years, especially in the Post World War era, of the many maladies that bother ideologists. However, there are still people who believe that witches exist in the world. That is why I had an interesting time chairing the workshop on markets. With the assistance of the facilitators and notetakers, the views we summarized are set out in a paper for your perusal. I will simply highlight the key issues.

Key Issues Raised

There are five key issues that were raised in our discussion.

1. Delineation of Roles

There is a nagging question as to whether governments matter any longer or is it only the market that matters now. We concluded that there are valuable roles that each play: markets provide a valuable mechanism through which information can be clearly transmitted to producers and consumers while governments play an important role in insuring the efficient functioning of markets and nurturing their development, especially in new areas where they may not yet exist such as in dealing with environmental concerns. These points can be summarized as follows:

a) Role of markets: through the interaction of supply and demand, efficient markets send important signals to producers and consumers for both the short and long terms. In doing so, resources can be more efficiently utilized.

b) Role of Government: in order to help markets function more effectively, governments have a role in the following areas:
   - provision of infrastructure (including the improvement of transport systems in rural areas);
   - providing mechanisms to internalize externalities (full-cost pricing), especially in the water sector;

- investing in R&D, especially in those areas that are of unique interest to FEEEP (e.g., agricultural and bio-technology research, as in Innovation Place at the University of Saskatchewan);
- educating both producers and consumers regarding product/input substitutes, new technologies, and how markets work;
- ensuring macroeconomic stability (e.g., low inflation rates, competitive interest rates and competitive exchange rates); and,
- promoting greater competition in the marketplace through trade liberalization and other market reforms.

2. Extension of Markets

Recognizing the critical role that markets play in allocating resources, workshop participants suggested that greater attention be dedicated to the broader use of market-based instruments in sectors where they have not traditionally been utilized. For example, risk management instruments (e.g., use of futures or options markets and insurance markets, etc.) which are of course quite new to some of the developing member economies of APEC, were considered particularly useful in this regard.

3. Addressing Externalities and the "Commons Problem"

In light of the centrality of sustainability concerns to FEEEP, it is necessary to find ways to capture externalities, including both negative externalities such as pollution and positive externalities such as the contribution that farmers make in traditional agriculture, and to address issues related to common resources. With respect to the latter, a prerequisite is the extension of clear, secured and transferable property rights. It is appropriate for APEC members to further reflect on other trans-boundary issues, in particular cost-sharing issues between national and global structures. An example that was suggested is how one economy such as Canada might be able to help in CO_2 reduction by giving grants to other economies where the effectiveness per dollar might be of greater global significance. Another example provided was the production of palm oil in Malaysia. There was recognition that the private sector has a tendency to have a shorter planning horizon given that it utilizes a discount rate higher than the social discount rate.

4. Importance of Technology

New technologies can impact a variety of areas relevant to the FEEEP agenda. Emerging technologies can improve the response time of markets and prices especially through information technology. They can also promote increased market participation by disseminating information such as prices to producers in remote local areas. As well, APEC's efforts to help its members develop basic research capacities would be useful.

5. Promotion of a More Competitive Economy

Workshop participants emphasized the need to infuse greater competition in their respective economies. Two major areas were highlighted:

a) Trade and Investment Liberalization and Facilitation (TILF): greater attention is needed to the negative impacts of government subsidies (for capital and labour), and all other direct and indirect barriers to trade. These barriers lead to market distortions and prevent sustainable development – especially in the case of agriculture (for example, the agricultural marketing boards were singled out in this regard). Specific issues highlighted include the need to:

- Establish rules with respect to non-discriminatory market access for the resource/commodity sectors (e.g., as called for in the PECC and U.S. National Centre for APEC study, "A Call for Action on an Open APEC Food System");
- Highlight the impact of trade liberalization on consumers – in particular domestic food security issues need to be further examined; and,
- Further investigate the potential for international stockpiles which was highly debated because of the nature of stock piles created by government versus free market measures.

b) Other Measures: beyond TILF initiatives, other measures that can foster greater competition in the marketplace include deregulation, regulatory reform, privatization, tax reform, and competition policy. It would be useful for member economies to share their experiences in this regard, particularly in the telecommunications, water, energy, transport, agriculture and sewage sectors.

Next Steps - Key Elements of a FEEEP Agenda for APEC

Having been involved in APEC for six and half years, I note that what Senior Officials and Ministers want is to move from vision to action. And typically it is identifying next steps that we find most useful. The workshop on markets identified five areas for next steps. Basically these can be addressed through the APEC Study Centres network, many of which are represented here, and the Economic Committee and the APEC Working Groups.

1. Fostering Competition

Undertake research and share experiences on best practices to ensure well-functioning markets especially in areas of specific interest to FEEEP. For example: research on deregulation, regulatory reform, privatization, tax reform, and competition policy. A lot of these issues have been already discussed in other APEC committees and working groups in APEC. What is important I think is for the Economic Committee to move from vision to action, to develop crosscutting research synthesizing these shared experiences.

2. Trade liberalization

Efforts should be made to assess the costs and benefits of market distorting measures, such as subsidies, quotas, price controls, supply management, and various government transfer payment schemes. As well, particular attention ought to be given to minimizing transition costs as a result of market liberalization (e.g., impact on small farms and rural economies).

3. Market instruments

Consideration should be given to establish a work agenda or a Symposium in the area of risk management. This would involve participation from the government, other international organizations, business and academia, especially those experienced in managing derivative markets in non-traditional sectors. I have been privileged to be in the Leaders' meetings at Bogor, Osaka and Subic and I note that risk management is an item in the thinking of Leaders.

4. Research and Development

APEC should ensure that basic research capacity exists, especially in areas like biotechnology, agriculture, energy. APEC Study Centres could have a role in researching the effective application of information technologies in rural settings.

5. Externalities

Undertake research and further discussion on the best ways for governments to internalize costs of externalities (e.g., examination of best practices). I think it will be important for the Economic Committee to look at these economic instruments because they have been well studied for application in APEC.

Supplemental Ideas

A predominance of supply side concerns emerged from the discussions in the five groups except for one where food security was addressed as a major concern at the national rather than the individual consumer or regional market levels. Other presentations in the symposium however directly referred to demand side issues.

- Demand side management in energy markets;
- Influencing consumer tastes for green goods through provision of information;
- Population pressures on food which translates to greater demand for available land at the expense of forest and watersheds;
- Increased demand for meat as incomes per capita increase (which consumers more resources than grains production;

- Lower demand for fishery fleets as over fishing becomes serious and increase demand for cooperative arrangements for sharing stocks.

An elegant formulation of FEEEP interlinkages was presented in a formula for $C0_2$ emissions which expresses these emissions as a product of the population, economic growth (measured as GDP per capita) energy intensity and carbon intensity factors.[4] Reduction in the first two variables will reduce carbon dioxides concentrations in the earth's atmosphere which contribute to global warming just as will the improvement in energy efficiency (lower energy consumption per GDP) and the shift away from fossil fuel ($C0_2$ emission per energy consumption). How the price system works out the relationships between $C0_2$ emission and the four variables can be further studied by the APEC Economic Committee since it received less attention in the Workshops.

Other issues to consider are the following:

- With the addition of at least 3.5 billion people over the next half-century, stresses on global resources will increase as will the per capita consumption of food and energy. Are the relationships linear?

- A United Nations survey (Potential and Policy Implications of Energy and Material Efficiency Improvement, April 1997) points to the fact that material consumption (cement, steel, chemicals, plastics, aluminum, etc.) is still increasing even though trends in industrialized countries show saturation on a per capita basis, i.e., material intensity (as function of unit GDP) declines after reaching a maximum due to increases in material efficiency and recycling. The initial increase is caused by large investments required in building an industrial infrastructure as well as increased mechanization in agriculture, which leads to increased energy demand and the use of commercial fuel in developing countries. However, material intensity does decline as a function of unit GDP, be it in the production of food, fertilizers and pesticides. What best practices are available for information in exchange in APEC?

- Service-oriented economies reduce energy intensity because of decreases in the material intensity of society as the East Asian growth experience suggests. They can also leapfrog by adopting clean production technologies. But why are investments not being made if, as the UN survey shows, there are so many effective energy efficiency opportunities with so many desirable effects?

- The UN lists a number of implementation barriers which the APEC Economic Committee may wish to explore further:
  - Willingness to invest (favourable market expectation, rising energy costs not recoverable in produce prices or which can be passed on to users); information and transaction costs;

[4] Plenary Presentation by Keiichi Yokobori, APEC FEEEP Symposium, September 2, 1997

- Profitability barriers (e.g., consumers requiring returns on investment as high as 40% or more for more efficient refrigerators, furnaces, electric water heaters, freezers);
- Management or organizational barriers (internal "hurdle rates" for energy efficiency investments higher than the cost of capital to one firm), lack of skilled personnel, and other market barriers (difficulty of quantifying and demonstrating impacts of energy efficiency and slow diffusion of innovative technology into markets).

The APEC Economic Committee may wish to survey member economies' current policies in the organization for management of full material chains from the extraction of resources to the manufacturing, consumption and waste processing stages. They have tended to be sector-specific rather than cover the full-cycle of materials. This survey may be implemented through the Working Group on Industrial Science and Technology.

Conclusions

The crosscutting issues in FEEEP that emerged in this Symposium, especially from the Workshop on the Role of Markets, should be prioritized for inclusion in the statements which will come out of the Vancouver meetings of APEC this coming November. This will ensure that this Leaders' initiative is given top-level attention by Ministers of various sectoral concerns within member economies as well as across APEC itself. How the vision of a community of prosperous stable and secure economies can be translated into actionable programs remain to be seen in the work of the Economic Committee as it progresses in its agenda. Its laudable convocation of various APEC fora and delegations from various ministries, academic, business and civil society groups deserves full support. This Saskatoon Symposium should be continued.

Markets and governments have their complementary roles to play as APEC aims at the 2010 and 2020 deadlines for free and open trade and investment in the region. One sharp observer on globalization notes that the "symmetry between markets in both geographic scope and mode of organization ... is characteristic only of a very brief window of time: perhaps the 100 years spanning the late 19th to late 20th centuries".[5] Perhaps this gives APEC a limited time frame within which to translate vision into action especially as we live in the Age of Demographic Transition of our global civilization, in the unprecedented economic growth of many nations especially in the Asia-Pacific which is challenged with the dawn of the ending petroleum era, continued massive increases in food requirements and global climatic change.

[5] Stephen J. Kobrin, "Globalization and Multinationals", in *Financial Times, Mastering Management* (London, Pitman Publishing, 1997).

Report by Michael Harcourt on the Workshop on the Challenge to Governance

The Workshop on the Challenge to Governance organized its discussions against the background of the following schema:

- Concepts: two broad concepts are salient – that of "sustainable development" (which involves challenges of definition, as well as of measurement and management), and FEEEP (which involves the question of the whole vs. the sum of the parts).
- Institutions: the setting includes the web of public/private linkages as well as the existence of an APEC "commons" which raises the issue of joint action.
- Tractability: this involves the relationship between policy frameworks and private conviction.

Some of the issues and objectives that we felt we had to address were as follows:

- Sustainable cities: as the Urban Century approaches, problems and solutions are concentrated in cities and involve inter-linked issues of air pollution, energy, environment, transportation, and land use.
- Governance: how do we carry out sustainable development?
- Advice to Leaders: identify common problems and solutions for consideration by APEC Leaders' meeting in November 1997 Vancouver, and for subsequent development into an action plan to present to Leaders' Meeting at Kuala Lumpur in November 1998.

We also felt that we had to agree on what we meant by governance. There are various definitions. The UNDP explains governance as follows:

"*The exercise of political, economic and administrative authority in the management of a country's affairs at all levels. Governance comprises the complex mechanisms, processes and institutions through which citizens and groups articulate their interests, mediate their differences and exercise their legal rights and obligations... Governance includes the state, but transcends it by taking in the private sector and civil society. All three are critical for sustainable human development*."

Governance thus deals with the following types of issues:

- Interaction between the state, civil society, and the business sector
- Economic and social policies
- Allocation of resources
- Public administration and institutions
- The legal framework
- Human security, peace, dispute resolution

Some of the characteristics of sound governance are:

- Participatory nature,
- Efficiency/effectiveness
- Integrity, Equity, Transparency, Accountability and Predictability

I would to thank very much the participants that we had, over sixty participants at the two sessions, organized into five tables, all of which were quite lively. I would also particularly like to thank the facilitators and notetakers and to acknowledge the tremendous assistance from Julie Gould and André Paul Normand in putting together what I hope is a distilled and accurate summary of the issues and recommendations from the Workshop discussions.

What are the key areas and questions for discussion?

There are four basic areas that we addressed in the workshop on Governance and one follow up item. The four areas that we focussed on were:

1. The role of governments,
2. Information,
3. Constructive dialogue and co-operation between various groups in society, and
4. The question of rural/urban dynamics that came up time and time again in all of our sessions.

And lastly, the Workshop considered follow up for the APEC FEEEP fora.

1. <u>The role of government</u>[6]

There was a strong feeling that governments should exercise leadership on FEEEP issues. We noted the frequency of reference to sustainable development and FEEEP issues in APEC, which I take as a sign of the commitment of Leaders as well as a sign of growing impatience for some practical actions.

In addition, the Workshop felt that governments must combine and reconcile short-term "political" imperatives with long-term "statesmanlike" vision. Many of you will appreciate the difficulty of trying to deal with short-term crises while keeping your eye on the horizon, but both must be done. In this regard, the integrative, forward-looking quality that it brings to discussion constitutes, I think, the value of FEEEP.

As well, the Workshop noted that the capacity and resources of local authorities to deal with FEEEP issues must be enhanced. The reality is that a lot of issues such as urbanization, for example, are crashing in on local authorities, which lack resources to cope, and we felt that this had to be addressed.

---

[6] Other associated questions include: Who are the actors (e.g., government, private sector, civil society, individuals, etc.?), and what are their respective role, interests and participation? What institutions, processes and mechanisms come into play to facilitate the role and interface between the various actors in sound policy-making and implementation?

While, as was mentioned previously, it is important for governments to nurture markets, the Workshop also agreed that governments must deal with areas that markets cannot or will not address, whether it be externalities or subsidies being used more creatively to help in addressing the environmental and some of the other issues that have been mentioned.

So those are some of the explicit recommendations on the role of government that also emerged implicitly from the discussions in the group on the role of markets.

2. Information

Information is critical for sound decision- and policy-making and particularly so on complex issues such as the five elements of FEEEP. The Workshop participants agreed that various information sources should be tapped and we should not restrict ourselves. There is a lot of valuable information not just in governments and business but also possessed by experts, media, community groups and citizens.

As well, we agreed that information on FEEEP issues must circulate in many directions with transparency and accessibility being key features. For example the tremendous information and material and insights that we received at the opening plenary on Tuesday should be made widely available. This is one area where the APEC fora can be very helpful.

3. Constructive dialogue and co-operation between various groups in society

Over and over again, it was emphasized that there are many actors with the potential to impact positively or negatively on FEEEP outcomes and, whether they be national governments, local authorities business experts, farmers, urban dwellers or community groups, there is a need to engage these various actors in a constructive way so that they could all help impact positively on FEEEP.

These considerations led the workshop to stress the role of education in raising awareness, and access to good and factual information, as factors that are likely to facilitate processes that lead to cooperation. Good information, good processes, well defined are the best way to involve people.

But, I know very well from the aggressive political culture in British Columbia that conflicts are bound to arise. There is a need to mediate the various legitimate interests and to resolve conflicts peacefully and equitably. We recommended accordingly that that this is something on which we should work on some more to explore ways to accomplish this.

And lastly, under the area of constructive dialogue, we recognized that the mechanisms to put in place may vary according to local institutions and cultural contexts. As one of our participants said very clearly, “No one model will work in APEC. There are many paths to the top of the mountain.”

4. Rural/Urban Dynamics

The last issue or area that we looked at was the interaction between rural and urban matters. In particular, we acknowledged the massive urbanization that is underway and UN population figures that in the next 30 years there will be a 100 percent increase in the world's urban population from 2.5 to 5.07 billion.[7] By contrast the rural population will grow only marginally from 3.10 to 3.42 billion. Most of the urban growth will happen in an accelerated way in the APEC economies and will raise the average degree of urbanization throughout APEC from 44.5 percent in 1995 to 64 percent in 2015 – an immense shift in a very short period of time and indeed, to use the Japanese word, an urban "tsunami".

There is a real need for corrective actions to mitigate the rural drain into the larger urban areas, whether this be through diversifying the local rural economies and services, or by providing education, medical care and other services in the rural areas.

And lastly, there is a need to further work on how to resolve conflicts between rural and urban demands particularly as regards over water and land; this was one of the major points made in the presentations that we received on Tuesday and we all agreed that this was a huge challenge.

Next steps/Work Program

How can APEC address these concerns, both as an institution and as a catalyst for action at the national level? We felt that there was a very important role for the FEEEP fora in follow-up without building up a large bureaucracy.

One way would be to gather information on FEEEP issues and governance through compilation of best practices. I understand, for example, that the Ministry of Environment in Canada has substantially completed a "best practices" compendium on sustainable cities. This and other similar information can be made available through various means, including websites, seminars, etc.

Secondly, we considered participatory mechanisms to involve a range of actors. One of the ideas that we explored was the possibility of an advisory body on FEEEP issues.

And lastly, in keeping with the spirit of Federico Macaranas' suggestion, our workshop agreed that there should be a further FEEEP meeting to develop these ideas in terms of more specific actions to be able to present them to our leaders.

[7] This trend is well described in a very good paper by Dr. Richard Gilbert that was developed for a workshop held May 5-6, 1997 under the APEC Environment Ministers process that was reviewed by Workshop participants.

Report by Ippei Yamazawa on the Workshop on the Socio-Economic Context[8]

Chairman's Introductory Remarks

The FEEEP initiative is characterized in the following three ways:

First, FEEEP has global implications. Each of the five variables addresses not only APEC members but also nonmembers as well. APEC has become a huge regional cooperation group only comparable in size to the European Union, which means APEC now has a global responsibility. But so far we have been talking only among us, on trade and investment liberalization and facilitation (TILF), and economic and technical cooperation (ECOTECH). With the FEEEP initiative, APEC is now addressing the rest of the world as well.

Second, FEEEP has an important functional role to play in the APEC agenda. APEC has already launched two main tracks, TILF and ECOTECH, the latter including more than 300 projects that are going on independently of each other. FEEEP can be a supplementary mechanism to support ECOTECH, and TILF to some extent. In particular, by helping to integrate these activities, FEEEP can help make a break through in achieving tangible results.

Third, the five variables of FEEEP are often rearranged as the impact of the two variables, population increase and economic growth on the other three: food, energy, and environment. This cause and effect relationship can flow, however, in the reverse direction as well, with food, energy, and environment serving as major bottlenecks to population increase and economic growth. Here we should note that FEEEP has a "spatial element": since no economy can resolve these bottlenecks within its own boundary, international cooperation is required in order to sustain economic growth and development. Indeed, cooperation on a global scale is essential for some FEEEP-related issues such as global warming and the population explosion. Global cooperation will be a very slow process and it is important to explore whatever can be do within APEC to generate quicker practical solutions.

Leaders last year emphasized the crosscutting approach to the FEEEP initiative. In the opening plenary session, each of the five FEEEP variables was discussed separately. In the workshops, these five variables are to be discussed in the context of four themes cutting across the five variables. The first three - technology, markets and governance - each have a clear focus. The theme of the workshop on the socioeconomic context, however, is not so narrowly defined and indeed is somewhat like a "soup" in which virtually everything can be thrown. At the suggestion of the Chair, the workshop approached the issue as follows. It is understood that the other three workshops will assume customs, habits, practices, institutions, and organizations as given, and address their issue area within this given socioeconomic context. The workshop on the

[8] Acknowledgments: The Workshop on the Socio-Economic Context was chaired by Ippei Yamazawa (Japan), assisted by Roohi Ahmed (Canada) as coordinator. Note takers were Peggy Thorpe and Wayne Gosselin, both of Canada.

socioeconomic context, however, will consider whether we may have to change or at least modify these socioeconomic conditions in order to tackle the FEEEP issues effectively.

Against this background, the following is a synopsis of discussion that took place on some of the issues related to the socioeconomic context in which FEEEP issues will play themselves out in the coming years.

Introduction: the Nature of the FEEEP Initiative

The well-being of the APEC region is inextricably linked to global sustainability. No economy, on its own, can solve the complex food, energy, and environment issues and problems resulting from expanding populations and economic growth. The integrative aspects of the FEEEP initiative fosters dialogue across disciplines, encourages discussions on the broader issues and draws on the cross-cutting nature of FEEEP in the mutual reinforcement of the TILF and ECOTECH agendas in APEC.

Economic growth, increasing populations, and globalization has resulted in profound changes in the APEC region including widespread urbanization, intra and international migration (both legal and illegal), increased poverty, changes in lifestyles, customs and habits, and stresses to the environment.

Sustainable Development

There was agreement on the need to define sustainable development, Many participants suggested that the definition offered in the opening plenary was more reflective of reality than conventional definitions. Sustainable development means: maintaining the capacity to respond to issues and problems in a dynamic and fluid system on a forward going basis.

There was recognition that conventional indicators such as GDP are not satisfactory to measure the overall progress of development in nations. These have to be supplemented by other indicators. In this regard, there is innovative work being done by the UN, the Commonwealth Secretariat, and the World Bank, amongst others to develop indicators that are broader in scope, including not only economic and ecological factors but also social indicators. It was agreed that APEC should contribute to the ongoing work on the refinement and dissemination of sustainable development indicators.

Environment

There are examples in the world where issues of socioeconomic development and technology transfer are written into international environmental agreements.

The Montreal Protocol on Ozone Depletion is an example of how an international agreement can be improved by the inclusion of civil society, the scientific community and North-South governments as equal partners in decision-making.

With the commercialization of many products, there is a tendency to apply patents and intellectual property rights. The outcome of this has had a devastating impact on forest/agricultural biodiversity. Local communities and farmers are further deprived of the economic benefits that could be derived from their traditional products and knowledge.

In applying and following the rules and regulations set out by the WTO, governments tend to ignore other conventions (*The Plant Breeders Rights* is one example amongst several others).

Poverty and Urbanization

With expanding populations and economic growth, the world has seen a doubling of poverty with women and rural populations disproportionately affected.

There is unsuitable distribution of wealth, resources and income as the transition from rural to urban centres occurs.

Economic growth depends on social sustainability. Breakdown in social cohesion leads to economic decline.

Urbanization, without balanced development in the rural regions, is also a contributing factor to the poverty gap, as it leads to the disappearance of agricultural communities as land, water and labour resources move to the cities and results in dislocated farmers

Human Resources Development:

Human resource development and training are critical to the economic development of an economy. The development of human resources goes beyond capacity building. It includes the provision of opportunities for people to become self-sufficient and productive members of society.

There are problems faced by small rural farmers in developing countries to access credit and appropriate technology. These and related issues need to be addressed in APEC.

Free trade has resulted in dislocating several members of the labour force without providing them with alternative meaningful employment. Consequently, there is a need to support dislocated people with mechanisms that do not distort markets. The importance of investing in human resource development to adapt the dislocated labour force to a changing job market is critical. APEC is invited to look at these experiences in both developed and developing countries to resolve some of these issues.

Impact of Trade Liberalization

There is a need to study the impact of sectoral liberalization on certain groups within society. Liberalization also generates the need for human capacity building and

institutional strengthening particularly in respect of those segments of society that are most affected by the liberalization (thereby enabling them to cope and adapt to change).

Infrastructure and Transfer of Technology

There is a need for transfer of technology and appropriate infrastructure development (both physical and services) in the rural areas. It was further elaborated that the technology and infrastructure that is developed for one particular socioeconomic context may not be suitable for another. These differences should be taken into consideration by both private sector and government when investing in infrastructure development and technology transfer.

Changing Lifestyles

As incomes increase, diets become more diverse, including the increased consumption of meat products with the consequent increased grain production to feed livestock. This has economic implications for the consumption patterns of developed and developing economies and an associated impact on traditional lifestyles, customs and habits.

Serious attention has to be given to the preservation of traditional cultural dietary practices that are environmentally friendly, healthier, and more economically viable.

Each economy should seek lifestyle practices that take into consideration the environment, including energy consumption.

Chairman's Concluding Remarks

It is hoped that the above report on the socioeconomic context of FEEEP makes clear that the socioeconomic context is not simply a "catch-all" (or a "soup" in which everything can be thrown), but rather contains a rich menu of clues to developing the FEEEP initiative. Each of these can be related to at least a few of the over 300 ECOTECH projects going on within APEC and has the potential to provide them with a fresh enthusiasm, a global perspective and to additional momentum to move them forward toward tangible achievements. The FEEEP initiative will make an effective supplementary mechanism to ECOTECH, not as a separate work agenda under a separate APEC Working Group, but in a catalytic role in combining and revitalizing the ECOTECH agenda.

Lastly, it is also important to disseminate widely the ideas that have evolved from this symposium and, in particular, to share them with all participants in ECOTECH projects. The FEEEP report that will come out of the Economic Committee will provide a basis for a crosscutting approach to APEC's ECOTECH and TILF work. It would also be desirable that this kind of Symposium be held every year or every other year to provide academics and NGO people with access to the APEC process.

Remarks by the Moderator, Brian Hunter

On behalf of the Symposium participants, I would like to thank all four of the Workshop Chairs for having done a remarkable job in bringing together the very diverse discussions that took place in the Workshops. I know that, going into this exercise, all involved were wondering how in fact we would bring these issues together and how much coherence there would be at the end of the process. As I said before, this is an incredibly innovative approach. What we are going to have to do is to expand our way of thinking so that we can handle complex issues and then to narrow in terms of deciding on what specific actions to take. And we have gone a long way in both senses today.

The question now is how we can bring these components together and the kinds of things we would propose for next steps for the APEC process, I would like to ask our distinguished guest panelists/discussants, Dr. Desai and Dr. Dixon to give us their thoughts on what they have heard.

Comments by Dr. Vishnavaneth Desai, Asian Development Bank

As a late comer to this meeting let me first say, how happy I am to join you all here. The Asian Development Bank (ADB) has worked with APEC before and APEC's different committees and group. The Bank is complementing APEC's work in areas such as infrastructure and development of capital markets and so on. I also want to congratulate the organizers, especially the APEC Economic Committee and its Chairman John Curtis, for conceptualizing this very innovative way of looking at the issues. The subject of this Symposium, *The Impact of Expanding Population and Economic Growth on Food, Energy, and the Environment*, and the interrelationships between these factors, are of great importance for the Bank's member economies.

There has been a consensus that the five components described here – food, population, energy, environment and growth – pose different problems for the future, not only of the APEC region but globally. The normal way of looking at these issues is to take one particular aspect, say economic growth, and see what its implications are for the different components. However, it is only when we understand the interconnections and interlinkages, and frame the issues in terms of their integrated impact, that we gain the capacity to respond and to resolve the issues.

I say this in part because of what I have heard today but also based on our recent work at the Asian Development Bank in developing the study entitled *Emerging Asia*, which looks at the growth prospects of Asia over the next thirty years. In doing this study, we realized that looking only at the growth prospects was very partial and probably painted a misleading picture. Accordingly, we began to broaden the scope of the inquiry and finally came to the conclusion that we had to consider what would be the "quality of life" in Asia at the end of thirty years, which meant looking at not only economic growth but also a whole host of other elements such as environment, socioeconomic conditions, and so on.

Obviously, as has been brought out in the discussions here, there are numerous interconnections amongst the individual variables. For example, population affects economic growth through changes in the structure and rate of growth of the labour force while, at the same time, economic growth impacts eventually on the growth and structure of population. Developments in both of these areas impact on the environment. In turn, the condition of the environment feeds back into economic performance. Numerous examples have also been cited of links between agriculture and the environment as well as between poverty and environment. In the latter case we see that poverty can at times aggravate environmental degradation but at the same time environmental degradation in many instances aggravates poverty.

So it is clear that these interlinkages exist and, to us at the ADB at least, it is also very clear that these interlinkages hold the key to successful management of the future. Take, for example, measures to improve environment such as pricing policies or "end-of-the-pipe" solutions. If we address the issues in partial terms and do not take into account how these measures affect certain communities, how they affect the people, how they impact on related prices and affect certain other markets, then solutions that appear optimal or that are effective from the point of view of the environmental agenda will not necessarily result in the desired outcomes. Accordingly, we at the ADB have come to appreciate the significance and real importance of these interconnections. I was very pleased accordingly to see that this particular Symposium is framing the issues in terms of interrelationships and I would like to touch on one or two aspects of our work on *Emerging Asia* that are of relevance to the issues under discussion today.

This particular Symposium has also emphasized the role of policies. As a starting position, one might say that markets should take care of a lot of things. But there are numerous situations where markets would not resolve issues and that is where governments have to take much more proactive positions. In fact, we find that how governments organize themselves is one of the three critical issues on which the future improvement of quality of life in Asia will depend. The other two areas are how well Asia responds to the forces of globalization; and how well Asia addresses its environmental issues. Globalization, which is being driven by changes in technology and integration of markets, is creating such rapid changes in economic conditions in Asia that governments are hard pressed to respond appropriately. How quickly and how well economies will be able to effect necessary structural and policy adjustments will be important. As regards the third element, Asia will need to take care of its environment, very pro-actively and on an urgent basis. As is well known, the Asian environment has become extremely degraded in the last thirty years and the situation is such that there are real prospects of environment becoming a constraint on economic growth in the future.

But coming back to the role of the government, there are questions as to whether governments, in particular governments in East Asia, can continue doing in the future what they did in the past.

First, as I have just noted, globalization is directly circumscribing the scope of certain government policies: for example, the WTO imposes disciplines on trade policies while integrated financial markets do not let governments have complete sway over their own fiscal and monetary policies. So governments will find that room for maneuver and policy autonomy is limited by external factors.

Meanwhile, additional constraints are emerging internally from within the economies. A tremendous change has taken place within societies in Asia in the last thirty years. As we know, in a number of economies incomes have gone up several times over. People have become much more educated, there has been much greater participation of women in the labor forces, as well as urbanization and the rise of the middle classes. And in the last ten years especially, there has been a greater degree of democratization, or perhaps one might say a greater demand for pluralism in societies. Better educated people, economically more empowered people, urbanized people, are asking and will continue to ask for greater transparency, will ask for greater accountability and will ask for better services from their governments.

So it is in this situation of a "double squeeze" that governments will have to perform their roles and some of these issues were touched upon by my friend Ippei Yamazawa in his presentation earlier on the Socio-economic Context.

In our view, there will continue to be an important role of government in maintaining social cohesion and in setting out a vision of economic development for the future. The latter is not, however, to be confused or directly compared with earlier regional plans and multi-year plans and the like, which were prepared by technicians sitting in planning ministries.

When we talk of an "economic vision", it is quite necessary in our view, and especially in the developing economies, that there be a certain amount of understanding, if not consensus, within society about the direction that economic policy is taking and the kind of economic future that the government is trying to achieve. The provides the private sector and civil society (including NGOs and so on) with a better understanding of the implications in terms of what industries are going to go down, what activities are going to change, and how society as a whole has to respond to cope with the changes.

In this process, as was mentioned several times in the workshop reports, there are a number of trade offs to be made and associated with this is a potential for conflicts, such as urban/rural conflicts, new public/private conflicts (e.g., with regard to the environment), regional conflicts, and so forth. Moreover, with the private sector now increasingly entering into the provision of public goods such as utilities, education, health and others, the role of balancing the public interest with private incentives falls very heavily on the government.

To summarize, governments will play a key role in terms of providing governance, managing various trade offs and bringing about a certain cohesion to assist their economies in coping with the challenges that are ahead.

Background Notes on Emerging Asia

Earlier this year, the Asian Development Bank completed a major study looking forward to the future of Asia and the Pacific. I would like today to discuss some of the results of that study. Some of the more interesting findings of the study were those that address the connection between expanding population, economic growth, and other factors affecting the quality of life. Asia still faces many challenges ahead: energy and food consumption growth are outpacing growth in production, and Asia's environment is among the most polluted in the world, especially in the region's megacities where a growing share of the population live, Asia's natural resources have declining fast during the last three decades.

Asia has lost 50 percent of its forest cover and 50 percent of its fish stocks. But Asia's experience is also proving that good policies and technologies can make a critical difference.

In the end, as in the beginning, we are concerned with people, so let us start by looking at population. The demographic transition from higher to lower mortality and fertility rates, which took one or two centuries in Europe, is being compressed into a couple of generations in Asia. Demographic trends, especially changes in the population's age structure and life expectancy, account for a large part of the differences in growth rates among Asian economies and sub-regions in those economies. Where an increasing share of the population is of working age, economic growth per person tends to be higher and national saving rates tend to rise, if other policies are adequate.

The structure of Asia's population will undergo profound change in the next few decades. It will age in East Asia, and the economically dependent population will increase at the rate of 1.1 percent per year, in the next 30 years, compared to 0.3 percent growth in the past, 1965-1990. A rising proportion of retirees in the total population will likely dampen East Asia's future economic growth and saving rates. In the People's Republic of China and Korea it will peak around 2005 and then fall by 3 percentage points before 2025 in the latter. In Southeast Asia, on the other hand, the economically dependent population will grow at only about 0.8 percent annually during 1995-2025 compared to the past annual growth rate of 1.7 percent which will help Southeast Asia to maintain its growth momentum. South Asia will experience far more favourable demographic changes: its economically dependent population will increase at an annual rate of 1.2 percent against 2.0 percent in the past.

Asia's population is likely to increase overall by 50 percent during the next 30 years, to reach almost 5 billion people by the year 2025. The rate of population growth will continue to decelerate, but the pace of urbanization will accelerate.

Asia's cities present a particularly acute problem. The share of Asia's population living in urban areas will increase from 35 percent in 1995 to 55 percent in 2025. Unlike in other regions, Asia's urban population is highly concentrated in megacities rather than mid-sized cities, with higher economic and environmental costs. This trend results from overly- centralized national politics and under-investment in inter-city transport and

communications. Developments in land use policies, public transportation networks, water supply and sanitation systems, and public administration will have a critical impact on the quality of life for these urban residents.

In the newly industrialized economies of East Asia, GDP per person at purchasing power parity rose from about US$1,100 to US$7,900 over the period 1965-1990. During the same period, per-capita income in Southeast Asia also increased, from US$800 to US$2,400 while the increase in incomes in South Asia has been modest.

The study Emerging Asia concludes that living standards in many Asian economies will continue to rise. Increased affluence means a rapid increase in Asia's consumption, especially of food and energy. Agricultural production is increasing more slowly than in the past, and the region will increasingly rely on imported food. By 2010, Asia's share of world cereal imports will rise to about 42 percent from its current level of 33 percent. Renewed commitment to agricultural research is essential to avoid the prospects of unacceptable price increases on this account, Without continued public and private support for agricultural research and development, future productivity growth will not match past accomplishments. It is worrying to note that, in Asia, interest in and expenditure on agricultural research has weakened in recent years. In addition, policy reform would also make an important contribution to increasing agricultural production. In developing countries, agricultural production faces an average effective tax rate of 30 percent. Removal of such an imposition on agriculture should bring about improved supply response.

Comments by Dr. John Dixon, World Bank

It was fascinating to hear the reports of the four workshops and I would like to thank John Curtis and Brian Hunter for inviting me to participate in this discussion. Also it is a pleasure to see so many friends from Asia, a region in which I have been living since 1954, and to see how well the region has done. It is very impressive.

I would like to start my comments with a quote across which I recently came about the island of Java. It goes as follows:

"*This cannot go on. The level of population density, the pressure on resources, the ability to feed the population cannot be maintained nor expanded in the future. Java has 7 million people. What are we going to do when we have 15 million*?"

This was written in 1907. Of course, Java now has close to 100 million people, the income has doubled or tripled in the last two decades alone. There are serious problems, but there is also the question of why such forecasts have proven wrong.

In a similar vein, one might ask what happened to the "Club of Rome"? As those of you who remember the Meadows report will recall, the Club of Rome developed

mathematical projections showing that world was going to run out of land, water, mineral resources and food. At one level, Asia, with its rapid economic and population growth, has in many ways proved the Club of Rome wrong. But there are still major issues.

The four sessions presented a very long and interesting list of such issues. I would like briefly to highlight a few things that came up over and over again.

First, as regards the title, *The Impact of Expanding Population and Economic Growth on Food, Energy and the Environment,* causality flows from population and economic growth to food, energy and the environment. However, as was pointed out in the workshop reports, the sustainability of production of food and energy and of the environment will have an impact on economic growth in the short run and, if things get very bad (as for example is the case in North Korea right now), on population growth as well. The issues are linked and the causality does indeed become circular.

A faith in markets was evident in the reports. As an economist, I was of course glad to hear about a faith in markets, which I do share, tempered though by the considerations pointed out by Dr. Desai concerning the limits of markets, and particularly in the area with which I deal personally which is the environment, where markets often fail. Indeed, the results from people pursuing their own best interests are often ones with which society is not happy – fragile environments destroyed, the air polluted from private vehicle exhausts, water contaminated by effluent wastes pumped out by firms into public streams or bodies of water without taking appropriate precautions.

There was also great faith expressed in technology as a solution. I think technology does offer much today. At Innovation Place at the University of Saskatchewan, we saw some of the very innovative work being done here in Saskatchewan to apply technology to producing better quality foods, in a way that is more sustainable, less environmentally damaging and hopefully at a moderate cost.

A third component that I believe is fundamental – and frankly believe is the most important dimension of all and the reason why Asia has done so well – is human resources development. Investing in people, education, literacy and equity between the sexes has, I believe, laid the foundation upon which this remarkable growth one that sees in the Asia Pacific region has taken place.

Information, including both the ownership of information and the transparency with which it is communicated, has also been mentioned frequently and is also fundamental. An informed society and an educated population are essential to managing these issues, if only to put pressure on governments – because it must be borne in mind when dealing with externalities, that governments very rarely lead, they follow. This is particularly true in the case of environmental externalities, which as I noted earlier is my own area of interest.

And whom do governments follow? They follow the public. This is because the benefits from <u>not</u> cleaning up wastewater, or from venting pollution into the atmosphere

are individual or private economic benefits. To take these away, even though the social benefits from doing so are much larger than the private costs, means coming up against what are frequently very powerful interests.

The same is true in the case of management of forestry or management of fisheries. Precisely because sustainable use of these resources is a major issue, we all know what is desirable to do as a society. But implementing many of these policies means taking away some rights, some benefits or some economic rents – basically taking away some money – from people who are benefiting from unsustainable practices.

Urbanization was mentioned. Urbanization is a very powerful force for good but also creates many problems. The rapid urbanization of Asia is creating difficulties, particularly in terms of transportation bottlenecks and the associated increase in air pollution, congestion and noise. This is a real and growing problem. When I was a young man I lived in Malaysia for five years and I used to ride a little motor scooter around Kuala Lumpur. Now I would be crazy to do the same thing, because of the traffic, let alone what I would be breathing into my lungs.

The issue of sustainable development indicators was also mentioned and that is one topic that I would like to come back to briefly. How do we, as a society, as planners, as members of governments, as members of international organizations, track whether or not the economy is on the path for a sustainable future. In the first instance, this is a measurement issue – measuring what we are doing, measuring understanding, looking for indicators that give some insight into what is happening and that provide the basis for developing policies that allow us to take steps to address the problems that we have identified.

We spent a fair amount of time recently at the World Bank looking at the issue of measurement. We tried to develop indicators to track the resources that economies have at their disposition and what they are doing with these resources. We then observed how these indicators change over time. I will take advantage of being up here to describe our work on this issue, some of which is set out in the World Bank publication *"Expanding the Measure of Wealth*".

In looking at national wealth, we identify four types of capital:

- produced assets (i.e., a table, a building, an airplane);
- natural capital (i.e., the natural resource base, land and water, forest, fisheries etc.);
- human capital, which measures the investment of a society in the education and training and health of its population; and
- social capital, which goes beyond measuring what a society has or what its people know, to see how this is all put together – whether societies pull together to achieve a common vision and purpose or pull apart and take a zero-sum approach

The latter two types of capital we are forced to combine because of measurement problems. However, we know that social capital is fundamental in explaining the

success of many, many economies, in particular in East Asia, which has a strong tradition of social capital. When social capital disintegrates, even in places such as Yugoslavia where there is an educated population, or Russia where there are resources, things do not work

In measuring national wealth, we found to our surprise that the smallest component was natural capital. Moreover, the ratio of natural resources per capita from rich to poor countries was on the order of 3 to 1 whereas in terms of total wealth, produced assets or the contribution from human capital and social capital together, the differences were on the order of twenty to thirty to one between the richest and the poorest. Most of the differences are in fact explained by the return on human capital – what people do with what they have.

Now societies manage their natural capital base. The question is: do you invest the proceeds from mineral deposits, from agricultural production, from the forest and fisheries, in education and infrastructure and health? Or do you buy Mercedes Benz automobiles? There is a difference; there are tradeoffs and they result in different trajectories for economies.

A related measure is what we call genuine savings, which is a flow concept. Here we basically take savings rates and make a number of adjustments. In particular we add in spending on education, which we do not treat as a cost but rather an investment in the future, and make deductions for net foreign borrowings, capital depreciation, degradation of the environment, and mismanagement of potentially renewable resources. The numbers that come out of this are quite interesting. Looking at genuine savings rates by regions:

- East Asia and the Pacific is notable by being positive and trending upward;
- Latin America and the Caribbean was positive but went negative in the "lost decade" of the 1980s;
- the troubling one is Sub-Saharan Africa which went negative in the late 1970s and has been negative ever since.

The genuine savings rate is more revealing than straight GDP growth or investment rates which, even in Sub-Saharan Africa, are positive. With these adjustments one can go to the planning Minister and demonstrate that because of the mismanagement of resources, whether of forestry or fisheries or soils, the economy is on a trajectory which guarantees that the population is going to be worse off in the future than today. The useful feature of the genuine savings is that the index moves much more quickly than the wealth of nations numbers, which only move very slowly.

What makes the difference between those economies that do well and succeed and those that do not? We do believe in the role of markets. And the national wealth of a country, its natural heritage, its resource endowment certainly helps. The Middle East economies are fortunate in having a lot of oil. But most economies are not as fortunate and have to be more careful. And, as Dr. Desai pointed out, governments have a fundamental role.

Indeed, what makes the difference frequently is their policies: the investments that they make, in their population, whether they invest the proceeds of their resource endowment in consumption or in investing in their future.

I would like to end with three points of a good news/bad news story.

The first piece of bad news is that, with the rapid population growth and economic growth, the environment and resource problems will get worse. The good news is that, by identifying the areas in which these problems are going to occur and through judicious policies and good planning, we can avoid the mistakes of the past.

The second piece of bad news is that integrated programs, whether you are managing a city or a watershed, are really neither possible nor desirable. Integrated resource management, just like integrated rural development, has largely been unsuccessful because it does not follow existing governmental structures, line-reporting systems, budgets, etc. However, the good news is that integrated analysis is very powerful. Indeed, the fact that this Symposium is being held reflects the recognition that it is not sufficient any more just to look at energy policy or population policy alone, but rather one has to look across energy, food, environment population growth and economic growth and take into account the links among them. Once you have identified solutions, you still have to go back to the different Ministries involved to give them their marching orders. They are not necessarily going to understand the big picture entirely but at least they will be working towards a common goal, even if they do not always recognize it as such.

The third piece of bad news is that there will be no new money for all of this. In the environmental area those that were waiting for the money to fall from the heavens after the Rio meeting are still waiting five years after Rio, and will continue to wait. The money is not coming. The good news is that the economic growth in this region will result in huge volumes of investment over the next few years. If you have a vision of how the pieces should be put together, which investments are cost effective, and which problems are likely to be most important, you can do a better job investing that money. Being in a growing dynamic region like Asia, even with all of its problems, gives real possibility and optimism for making much better investments and decisions and growing your way out of some of these perplexing longer-term problems that are facing us right now. There is a publication that we have just prepared reviewing policies in the five years since Rio which shows a wide range of technology that are being used, market-based, non-market based, involving the public and participatory approaches. They are being used now to address this whole set of issues.

In conclusion, I think that the topic that you have identified is probably the central one for ensuring a more sustainable and more desirable future for our children. There is real reason for optimism because of both the recognition of the problem and because we have learned a lot about what can be done and what is cost effective. Our resources are always going to be scarce but it is much better attacking these problems in the context of growth than in the context of stagnation. Thank you.

Closing Remarks by the Symposium Chair, Dr. John M. Curtis

These last three days have been productive indeed as the depth and breadth of the first day's keynote addresses and panel discussions and today's reports of the Workshop Chairs and the ensuing reviews and discussions have shown. We each take away our own personal impressions and draw our own conclusions as to the meaning and import of what transpired here. For the Economic Committee and other APEC fora engaged on FEEEP, the task is now to reflect upon these discussions and draw from them insights and inspiration in further developing APEC's response to FEEEP issues.

Without pre-judging what those formal conclusions might be, I would like to offer a few very personal observations on what struck me as particularly important issues brought out in the discussions.

First, sustainable prosperity, as called for APEC Leaders, is a dynamic process that includes economic growth, improving environment and building social cohesion by broadening participation in prosperity.

Second, trade and investment is an integral part of sustainable prosperity. Increasing efficiency is essential to sustainability and the markets, including international markets, play a key role in promoting efficiency.

Third, the essence of sustainable development is the capacity to adjust to changing conditions and to cope with emerging constraints; this involves education and developing the institutional capacity (which includes both efficient markets and good governance) to accommodate changing technological and supply side conditions.

Fourth, we have to acknowledge that the combined effects of technological innovation, of rural-urban transitions, of changing demographic structures, and the non-linear nature of the interactions, a point that repeatedly came up, all make projections unreliable. The emphasis must accordingly be placed on building capacity and the ability to adapt to change, rather than trying to predict or plan the future. At the same time, longer-term perspectives are essential and longer-term investments, such as in infrastructure, clearly shape future conditions. This raises questions of how one copes with the uncertainties.

Fifth, I draw the message from the discussions that the FEEEP exercise is indeed a valid way to integrate a broad range of APEC's work, including both on the ECOTECH and TILF sides and to constructively engage all sectors of society. Moreover, through FEEEP, APEC can be a global leader in this complex and sensitive nexus of issues.

In short, there is a rich menu of ideas and suggestions for practical action in the short and medium term to be developed over the course of the next months to put before Leaders.

Dr. Curtis concluded the Symposium by thanking delegates, expert speakers, the workshop chairs for their participation, and the individuals and organizations who had contributed to the success of the event.

ANNEX 1

SYMPOSIUM DOCUMENTS

- List of Participants
- Background Notes for Workshop Sessions
- Thematic Notes for Workshop Sessions
- Economic Committee Chair's Discussion Paper

LIST OF PARTICIPANTS

Name	Economy	Organisation
AHMED Roohi	Canada	CIDA
ALBALADEJO Marissa D.	Philippines	Bureau of Fisheries and Aquatic Resources (BFAR)
ANDERSON Bill	Canada	CIDA
ANWAR BEY Estelia	Indonesia	Indonesian Consulate General, Toronto
ARNOLD Flavia Urerava	Papua New Guinea	BEST, Coady International Institute
ASAZUMA Shinichi	Japan	Ministry of Foreign Affairs
AU Andrew	Hong Kong, China	Financial Services Bureau
BAKER Philip	Canada	Environment Canada
BALLINGER Marcus	Canada	Environment Canada
BOEHM Marie	Canada	University of Saskatchewan
BROOKINS Carole	United States	World Perspectives, Inc.
BROWN Christopher	Canada	University of British Columbia
BRUNEAU Angus	Canada	FORTIS, Inc.
BUCHAN John	Canada	Saskatchewan Agriculture and Food
CARLSON Maryellen	Canada	Saskatchewan Agriculture and Food
CATLEY-CARLSON Margaret	United States	Population Council
CHAI Yu	China	APEC Study Centre, Nankai University
CHAN Mary	Canada	Asia Pacific Foundation of Canada
CHAPPLE, Rosalie	Australia	University of New South Wales
CHOI Sei-Kyun Korea	Korea	Rural Economic Institute
CHOU Chang Erh	Chinese Taipei	Taiwan Institute of Economic Research
CHOW Cyril	Hong Kong, China	Hong Kong Policy Research Institute Ltd.
CHRISTOPHERSON David	Canada	Government of Saskatchewan
CHYN Reqina Yeu-Shyang	Chinese Taipei	Council for Economic Planning and Development
CIURIAK Dan	Canada	Department of Foreign Affairs and International Trade
CROSS John	Canada	Philom Bios Inc.
CURTIS George F.	Canada	University of British Columbia
CURTIS John M.	Canada	Department of Foreign Affairs and International Trade
DAVIES John	Canada	CIDA
DEMYEN Mitchell	Canada	Saskatchewan Wheat Pool
DES ROSIERS Frank	Canada	Department of Foreign Affairs and

		International Trade
DESAI Vishvanath	International	Asian Development Bank
DIXON John A.	International	The World Bank
DOUGLAS Zach	Canada	Saskatchewan Opportunities Corporation
DOWNING Donald 0.	Canada	The Coal Association of Canada
DUA André	United States	Yale University
DUNCAN Ronald	Australia	Australian National University
DURAN Susana	Mexico	Secretariat of Finance and Public Credit
EDWARDS Len	Canada	Department of Foreign Affairs and International Trade
EGAITSU Fumio	Japan	Chiba-Keizai University
FAIRLEY Bryant	Canada	B.C. Ministry of Agriculture, Fisheries and Food
FENG Haifa	China	Chinese Academy of Agricultural Sciences
FERNANDO Dilhari	Canada	Agriculture and Agri-Food Canada
FUJIKURA Ryo	Japan	Kyushu University
FUNNELL Larry	Canada	Environment Canada
FURTADO Xavier	Canada	Asia Pacific Foundation of Canada
GHOSE Tushar Kumar	Hong Kong, China	City University of Hong Kong
GOODALE Hon. Ralph	Canada	Department of Natural Resources
GOSSELIN Wayne	Canada	Saskatchewan Agriculture and Food
GOULD Julie	International	APEC Secretariat
GRAHAM lkumi	Japan	Interpreter
GRANTHAM John N.	Canada	International Trade Centre, Industry Canada
GREENBERG Louise	Canada	Saskatchewan Agriculture and Food
HADAD lsmid	Indonesia	KEHATI (Indonesian Biodiversity Foundation)
HANSEN Brian	Canada	Saskatchewan Economic & Co-operative Development
HARASYN Terry	Canada	Saskatchewan Wheat Pool
HARCOURT Michael	Canada	University of British Columbia
HEDLEY Douglas	Canada	Agriculture and Agri-Food Canada
HENG Terry	United States	Motorola
HINTHER Royal	Canada	Saskatchewan Economic & Co-operative Development
HLADIK Taylor	Canada	Department of Foreign Affairs and International Trade

HOPKINS Mark	Canada	Environment Canada
HU Hong-Tao	China	State Family Planning Commission of China (SFPC)
HUNG Wing-Tat	Hong Kong, China	The Hong Kong Polytechnic University
HUNTER Brian	Canada	CIDA
HUNTER Jason	United States	Nautilus Institute
HYDEN Neil	Australia	The Treasury
ITO Shoichi	Japan	Tottori University
IZUMI Mari	Japan	MAFF
JACKSON Kenneth Edward	New Zealand	Auckland University
JOHNSON Robbin S.	United States	Cargill Inc.
JOHNSTON Donald	International	Organisation for Economic Co-operation and Development
JORY Alvin	Canada	Ontario Ministry of Agriculture, Food and Rural Affairs
JAMIL lr. ldris Maxdoni	Indonesia	Ministry of Environment
KAO Henry	Chinese Taipei	1-Mei Foods Co. Ltd. and Fu Mei Co. Ltd.
KARTHA Kutty	Canada	NRC - Plant Biotechnology Institute
KATSUMATA Hiromi	Japan	Central Union of Agricultural Co-ops.
KELLY, Daniel	Australia	World Vision Australia
KIM Jonq-Duck	Korea	Korea Energy Economic Institute
KIRKLAND Clare	Canada	Saskatchewan Economic & Co-operative Development
KOHNO Hiroshi	Japan	Central Union of Agricultural Co-ops.
KOKUSHO Fumiko	Japan	MAFF
KONDO Mieko	Japan	Interpreter
KOSSICK Donald	Canada	CUSO
LA Yifan	China	Ministry of Foreign Affairs
LANDREVILLE Denis	Canada	Agriculture and Agri-Food Canada
LATAPI Andr6s	Mexico	Universidad Nacional Autonoma de Mexico
LEE Jane	Hong Kong, China	Hong Kong Policy Research Institute Ltd.
LEE Janq-Ro	Korea	Ministry of Agriculture and Forestry
LEVISTE Victoriano	Philippines	Department of Agriculture
LIU Chung-Ming	Chinese Taipei	National Taiwan University
LOH Douglas K.	Chinese Taipei	Texas A&M University
LUCIUK Gerry	Canada	Prairie Farm Rehabilitation Administration
ACARANUS Federico	Philippines	Clemente Holdings (Asia) Ltd.
McGREGOR Robert	Canada	Agriculture and Agri-Food Canada

MAEKAWA Taiichiro	Japan	MAFF
MAIAUA losefa	International	South Pacific Forum
MAINI Jag	International	Inter-governmental Forum on Forestry, UN
MASUMOTO Kiyoshi	Japan	Environment Agency
McCANN Peter	Canada	Ag-West Biotech Inc.
McGEE Terry	Canada	University of British Columbia
McNEIL Mary	Canada	APEC'97 Canada Co-ordinating Office
MELNYK Michelle	Canada	National Farmers Union
MERSON John	Australia	University of New South Wales
MITURA Verna	Canada	Mitura Economic Research Inc.
MIYAMOTO Shoji	Japan	MAFF
MOFFAT Marshall	Canada	Department of Fisheries and Oceans
MOHAMAD Ali Maricar Hairuni	Brunei	University of Brunei Darussalam
MOHAMED Zunika	Malaysia	Economic Planning Unit, Prime Minister's Department
MOORE Judith	Canada	Western Economic Diversification
MORALES lsidro	Mexico	El Colegio de Mexico, UDLA-P
MORALES Maria Soledad	Chile	APEC Senior Environment/Economic Off.
MORGAN David	Canada	National Round Table on the Environment and the Economy
MULJANA Bernardu	Indonesia	Faculty of Economics, University of Indonesia
NAWAZ Rasheda	Canada	City of Ottawa
NICRO Somrudee	Thailand	Thailand Environment Institute
NORMANDIN Henri-Paul	Canada	CIDA
O'CONNELL Christine	Canada	Department of Foreign Affairs and International Trade
OMURA Keiji	Japan	Institute of Developing Economies
OOI Say Chuan	Malaysia	MITI
PANG Sen	China	Ministry of Foreign Affairs
PEARSE Peter	Canada	University of British Columbia
PENA DE PAZ Francisco Javier	Mexico	University of Chaping
PERRAULT Michele	United States	The Sierra Club
PHILLIPS Peter	Canada	University of Saskatchewan
PINTUKANOK Ampan	Thailand	Office of Environmental Policy and Planning
PRABOWO Dibyo	Indonesia	Gadjah Mada University
PUSPOKUSOMO R.M. Talib	Indonesia	Department of Foreign Affairs

QUALMAN Darren	Canada	National Farmers Union
RAMLI Kamariah	Malaysia	Economic Planning Unit
ROBERTS Ivan	Australia	Department of Foreign Affairs
ROSARIO Joseph A.	Canada	Alberta Agriculture Food & Rural Development
ROSS Paul	Australia	Department of Primary Industries & Energy
ROWLAND Gordon	Canada	University of Saskatchewan
RUNNALLS David	Canada	International Institute for Sustainable Development
RYAN Mike	Canada	SaskTel Public Affairs
SADLER Paul	Canada	Department of Foreign Affairs and International Trade
SAITO Masao	Japan	Science and Technology Agency
SAMSON Roger	Canada	Resource Efficient Agriculture Production
SANTOS Eduardo	Chile	Embassy of Chile, Washington, D.C.
SARKAR Asit	Canada	University of Saskatchewan
SAWIT Mohamad Husein	Indonesia	National Food Logistics (Buioq
SCHICK Libby	Australia	Department of Foreign Affairs & Trade
SCHIVE Chi	Chinese Taipei	Council of Economic Planning and Development
SCHNEIDER Aaron	Canada	Centre for International Studies
SCHULBERG Richard	United States	Sustainable Development Training and Information Network
SCO'TT Terrence	Canada	Saskatchewan Agriculture and Food
SEKI, Shig2taka	Japan	MITI
SHAUF Marvin	Canada	Saskatchewan Wheat Pool
SHIBUYA, Minoru	Japan	Ministry of Foreign Affairs
SOETRISNO Noer	Indonesia	Ministry of Food
SONGCO Margarita R.	Philippines	National Economic and Development Authority
SPARKES Phil	Australia	Department of Foreign Affairs and Trade
STALZER John	United States	Department of State
STRANKS Rob	Canada	Department of Foreign Affairs and International Trade
SUYONO Titiek S.A.	Indonesia	Indonesian Consulate General, Toronto
TAKUMA Hideo	Japan	MITI
TAMANG Jesus T.	Japan	Asia Pacific Energy Research Centre
TANNER Susan	Canada	Learning for a Sustainable Future

THOMPSON Robert L.	United States	Winrock International
THORPE Peggy	Canada	CIDA
TOFANI Rick	Canada	Saskatchewan Research Council
TUNKU YAHYA T. M.	Malaysia	MARDI
TURK Lynn J.	United States	US National Center for APEC
TYRCHNIEWICZ Ed	Canada	International Institute for Sustainable Development
VALDES Constanza	International	Pacific Economic Co-operation Council
WEE Vivienne	Singapore	Centre for Environment, Gender and Development Pte Ltd.
WEN Lih-Chyi	Chinese Taipei	Chung-Hua Economics Institution
WHITTLETON Jack	International	APEC Secretariat
WILLIS Darcy	Canada	Alberta Agriculture Food & Rural Development
WILSON Don	Canada	Department of Foreign Affairs and International Trade
WONGSAENGCHAN, Atchara	Thailand	Ministry of Agriculture & Co-operatives
WRUBLESKI Martin	Canada	Saskatchewan Agriculture and Food
WYETH Peter	United States	Washington State University
XIA Guang	China	China Association of Environmental Protection Agency
YAMAZAWA lppei	Japan	Hitotsubashi University
YANG Hee-Sun	Korea	Ministry of Environment
YOKOBORI Keiichi	Japan	Asia Pacific Energy Research Centre

BACKGROUND NOTES FOR WORKSHOP SESSIONS

Introduction

At Osaka in 1995, APEC Economic Leaders agreed to put the impact of fast-expanding population and rapid economic growth on food, energy and the environment on APEC's long-term agenda and to consult further on ways to initiate joint action so as to ensure that the region's economic prosperity is sustainable.

The FEEEP Symposium in Saskatoon, Saskatchewan, Canada, between September 1-4, 1997 is a key event in shaping the APEC Economic Committee's approach to providing its contribution to APEC's work on this nexus of issues, complementing and building on the work being done in other APEC fora. This latter work includes:

- The Economic Committee's Task Force on Food which has a broad-ranging work program under way, addressing FEEEP from the perspective of food and its linkages to areas such as population, growth and the environment;
- The Energy Working Group which is addressing energy issues and the interlinkages of energy and other FEEEP areas such as growth, environment and population;
- APEC Environment Ministers who addressed many of the environment concerns under the FEEEP rubric at their meeting on Sustainable Development in Toronto, June 1997, and mandated a broad action program focusing on Cleaner Technologies, Clean Oceans and Sustainable Cities that addresses many of the issues touched on under the FEEEP initiative;
- The Fisheries Working Group, which deals with the fisheries-related aspects of food as part of its work program;
- The Marine Resources Conservation Working Group, which is taking the lead on the Clean Oceans initiative,
- The Industrial Science and Technology Working Group, which is taking the lead on the Cleaner Technologies initiative, and
- The Economic Committee's Infrastructure Workshop/Round table process, which is, amongst other things, developing infrastructure-related inputs to the work on Sustainable Cities.

The Symposium in general, and the workshop sessions on the second full day of the Symposium in particular, will provide a venue for input from academia, business, and non-governmental experts into this broad APEC process. This process will result in a report to APEC Leaders in Vancouver on FEEEP by the Economic Committee, which will draw on the Symposium results as well as on the output of all the above-mentioned APEC fora. In addition, the presentations during the first day's plenary sessions and the reports of the Workshop Chairs will be published later in 1997 by the Economic Committee as the Proceedings of the Symposium.

Process

Having had an opportunity on the first full day of the Symposium to discuss FEEEP issues in plenary session, delegates on the second full day (September 3rd) will participate in four concurrent workshops that will explore the FEEEP issues from the perspective of four cross-cutting themes - the role of technology, the role of markets, the challenge to governance, and the socioeconomic context. Each workshop will have three sessions over the course of the day, providing delegates with the opportunity to participate in discussions of various aspects of three of the four themes.

In the workshops, delegates will be organized into tables of some eight to ten persons each. The Chairs of the four workshops (technology, markets, governance and socioeconomic context), working with the moderators appointed for each of the round tables, will report the findings of each workshop to the closing plenary of the Symposium on the afternoon of September 4th.

Workshop Discussions – Challenges, Approach and Desired Outputs

(a) Challenges

Complexity

Food is essential to life, energy to economic activity, and a clean environment to quality of life. In the long run, all these elements – demand for food and energy, quality of the environment, population size and economic output – are determined simultaneously and influence each other, in often complex ways.

- Relationships are not always linear: For example, rising economic activity creates unwanted by-products that can damage the environment. At the same time, the increased wealth from economic growth creates effective demand for a cleaner environment and provides the resources to achieve it.

- Outcomes can be the reverse of what is anticipated: For example, improvements in technology to allow greater capture of fish stocks can inadvertently precipitate the closure of entire fisheries.

- Efforts to increase supply can indirectly reduce demand: For example, changes in land-based food production methods, agricultural technology and market frameworks that allow a shift of labour from food production to other activities also leads to urbanization which in turn changes population dynamics – including slowing the pace of growth.

- There may be discontinuities in relationships: For example, scarcity – which is at the heart of FEEEP concerns – is both a constraint and an incentive. As relative scarcity drives up prices, past thresholds at which new technologies become feasible, relationships amongst variables are suddenly altered.

The complexities and discontinuities that characterize this nexus of issues have bedeviled model builders and forecasters and continue to do so. As well, simple analytical frameworks can lead to dramatically wrong answers (to which those who, after the oil price shocks of the 1970s, forecast $60/barrel oil prices for the 1990s can attest). Discussions in the workshops might lead delegates to some conclusions about what the real problems are and practical, concrete ways in which these problems can be approached.

Uncertainty

Time frames are important. FEEEP issues are intrinsically of a longer-run nature – the impact of population growth, for example, is put in sharp relief only over the course of decades. Long time frames provide both opportunity and risk – opportunity in that early action can sharply mitigate or even avoid looming problems; risk in that early action may be misguided, resulting in costly and needless initiatives.

Linking to Practical Actions

For APEC economies, which account for about two-fifths of the world's population and over half its GDP, emission of pollutants, use of energy, and production and consumption of food, FEEEP captures a crucial nexus of issues. In this regard, the important outputs of APEC's consideration of FEEEP will be answers to the following questions:

- What policy-relevant implications can be drawn from possible long-run developments?

- Amongst these, what will be most relevant for APEC as an institution engaged in promoting trade and investment liberalization and facilitation as well as economic and technical cooperation?

Workshop participants, in the end, must try to bring the FEEEP discussion from the theoretical stratosphere down to ground level. Given the complexities and uncertainties that characterize and are attached to FEEEP, this is undoubtedly the toughest challenge.

(b) Approach

To complement the first full day's consideration of FEEEP issues, which will have approached the issues "holistically" through the keynote addresses and "vertically" during the ensuing panel sessions that will have focused on the individual issue areas as well as the linkages amongst them, the workshop sessions will approach the FEEEP issues ‘horizontally’ or by way of cross-cutting themes that affect all the issue areas in different ways.

As noted, four themes have been identified:

1) ***The Role of Technology***, including questions about the pace of technological development vs. the growth in FEEEP-related supply-side pressures; the possibility of transforming technologies emerging to fundamentally reshape FEEEP inter-relationships; questions about speed of adaptation in response to emerging supply-side pressures; the role of social structures in facilitating adaptation; etc.

2) ***The Role of Markets***, including the fundamental role of markets in eliciting supply and demand side efficiency gains; questions relating to possible distortions of price signals given externalizes, subsidies, and exchange rate fluctuations; the acceptability of distribution impacts from price changes; etc.

3) ***The Challenge to Governance***, including questions relating to the operational meaning of "sustainability"; the web of public and private actors and institutions involved; the respective roles of policy and private choice in achieving sustainable outcomes; etc.

4) ***The Socio-Economic Context***, including the significance of the imminent dawning of the first "urban century"; the impact of the information age on FEEEP inter-relationships; and the significance of the growing share of services in output for resource requirements; etc.

Short thematic notes elaborating these themes as ways to draw out aspects of the inter-relationships among the FEEEP areas, and providing some suggested questions to help launch and guide the discussions in the workshops, will be circulated to participants two weeks prior to the Symposium. At individual tables in the workshops, participants with backgrounds in each of the five FEEEP issue areas will draw out points of commonality or points of contrast with respect to each crosscutting theme.

The workshop discussions will help identify how and to what extent FEEEP is more than the sum of its parts and how addressing FEEEP in a holistic sense will complement and build on sectoral approaches (i.e., as food, energy and environment individually and/or including obvious pair-wise links such as energy-environment).

Further, it is hoped that these discussions in the workshops will provide insights as to integrative and practical ways to approach FEEEP. For example, in pre-Symposium consultations on these themes (in this case on the socio-economic context), the central role of infrastructure in achieving economic, environmental and social goals was highlighted as an integrative concept that has very obvious scope for practical action and yet whose importance, while clearly highlighted in some of the sectoral analyses, may be overshadowed in others. Similarly, the importance of looking at FEEEP from the perspective of particular cities or local regions where people, economic activity, energy use, food consumption are concentrated and exist in – and contribute to – one particular micro-environment was highlighted as a useful complement to the focus on global/regional impacts of local activities. The importance of effective public administration in all issue areas was also brought out.

(c) Desired Outputs

The Symposium is an opportunity not only to look at the FEEEP issues in an integrated way, but also to bring all sectors of APEC member economies – experts from governments, business, academia and non-governmental spheres – together in this discussion. Since societies are complex, dynamic and reactive entities, just as are economies and environments, the integration of perspectives that is at the heart of the Symposium may also provide insights into how and to what extent the FEEEP nexus of issues is more than the sum of its parts.

Workshop participants will hopefully draw on their own experience and background to find points of commonality and contrast across areas and among the groups from member societies that are represented. The challenge facing the Chairs of the workshops and the moderators for all the individual sessions will be to identify and highlight these areas of consensus that may emerge from the discussions.

THEMATIC NOTES FOR THE WORKSHOP SESSIONS

WORKSHOP 1: THE ROLE OF TECHNOLOGY

Technological change has a pervasive influence on the nexus of FEEEP issues.

- It is a fundamental driving force underpinning economic growth;
- It influences the longevity of individuals and thus the age structure and size of populations;
- It influences the capacity to produce food and energy, as well as the consumption of energy; and
- It contributes to the stresses on the environment through its impact on growth, and contributes to the mitigation of those impacts by improving environmental goods and services and facilitating the development of clean production.

In addition, technological change results in continuous change in the social and economic circumstances in which FEEEP issues play themselves out.

The Pace of Technological Change: Technological change plays a role in increasing as well as abating pressures on the supply of food and energy and the carrying capacity of the environment. Is the pace of technological change in the APEC region, taking into account both innovation and application, enabling the region to keep pace with, or outstrip, such pressures? Is there a difference in this balance between the various FEEEP areas? Is there a difference in this balance between developed and developing economies?

Transforming Technologies: Some technologies, such as information technology, are often described as "transforming technologies" in the sense that they engender far-reaching structural changes. Are there other transforming technologies already known that, given the right conditions, could change fundamentally some or all of the FEEEP inter-relationships?

Adaptation to Technological Change: Technological adaptation takes time, reflecting:

- The lead-lag relationships between invention, innovation and application,
- The investment required (since technology is often "embedded" in physical goods),
- The human capital required to use new technologies,
- The social/regulatory changes required to support adaptation to new technologies,
- The economic structural changes set in motion by fundamental changes in technical conditions.

Since the time horizon over which supply side shocks or constraints can be foreseen may be very short, "speed bumps" en route to sustainable prosperity may be inevitable

if FEEEP-related supply side shocks/constraints are encountered, raising the question of how to prepare. Is there a difference in ability to cope between societies at different stages of industrialization or post-industrialization?

WORKSHOP 2: THE ROLE OF MARKETS

At the heart of the FEEEP issue is the question of scarcity – concerns about adequacy of food and energy supply and environmental carrying capacity. Prices play a key role in redressing supply demand imbalances. Relative scarcity of a key commodity induces price increases – whether it be market prices or shadow prices in the context of rationing – inducing demand and supply responses in the form of more efficient utilization of the scarce resource, increased supply through more efficient production, transformation of other commodities (a simple illustration is transformation of coal into oil through liquefaction or energy into fresh water through desalination), and/or substitution away from the scarce commodity (e.g., increased use of bicycles for short trips instead of cars if the relative price of gasoline increases and/or engineering new materials to replace scarce natural ones).

Quality of Price Signals: Product substitution and transformation depend on prices accurately reflecting the supply and demand pressures to consumers and producers:

- To what extent do market prices of food and energy reflect short-run market-clearing considerations vs. the longer-run supply-demand conditions that are key to FEEEP considerations?
- Given the well-known externalities, can the "carrying capacity" of the environment be "priced" thus allowing price mechanisms to be a fully "cross-cutting" aspect of FEEEP – i.e., Can we "price" sustainability?
- Given the complex impacts of government policies (including explicit price subsidies and implicit subsidies through the free provision of particular kinds of infrastructure such as city roads), is it possible to formulate policies aimed at "sustainability" through influencing relative prices?
- Given the often-extended periods when exchange rates are acknowledged to be far from purchasing power parity values, how reliable are short-run price signals in international markets such as those for food and energy for the longer-term investment decisions required to sustain food and energy production?

Distributional Impacts: Price changes affect incomes and unanticipated price changes affect asset values, with resulting distributional impacts. How does this influence the capacity to rely on market forces to redress supply-demand pressures, particularly in the case of food and energy, which are necessities?

Responsiveness: In the longer-run, supply/demand conditions are influenced heavily by technology. As technology is “embodied” in the capital stock, fundamental adjustments require turnover of this stock, including the write-down of existing capital equipment.

- Does the impact on asset values lead to delay in allowing prices to have their effect?
- Given the response lags, do prices give sufficiently early warning of impending supply-side constraints?
- What role does regulation have in influencing market response in the FEEEP areas?

WORKSHOP 3: THE CHALLENGE TO GOVERNANCE

The essential role of good governance in creating the conditions in which economic, social and environmental goals can be achieved is broadly recognized. In a more particular sense, in market-oriented economies, market failures or unacceptable distribution impacts in such basic necessities as food, energy or the environment can necessitate policy intervention. Governance is thus one of the key "cross-cutting" aspects to the FEEEP issues.

Concepts: In business, it is understood that "you don't manage what you don't measure". Sustainable development as articulated by the Brundtland Commission "meets the needs of the present generation without compromising the ability of future generations to meet their needs". However, in a world in which poverty and joblessness are still major policy issues, economic policy is predominantly geared towards sustaining growth in GDP, a construct that does not include the environmental or social/distributional components that are part of the sustainable development equation.

- Is the concept of sustainable development articulated in a way that allows effective measurement and management?
- If we measure and manage the components of FEEEP, do we measure and manage FEEEP?

Institutions: Reflecting the impact of globalization, business today is exhorted to "Think globally, act locally". Communities, cognizant of the local impacts of global trends, must "Think locally, act globally". Policies and instruments, meanwhile, are often seated with national governments. Moreover, through privatization, the relative role and influence of the public and private sectors is continually changing. A further complication is that the various elements of FEEEP impact on, and are influenced at, local, national and global levels to a differing extent.

- Is the web of "horizontal", "vertical" and public/private linkages that currently exist in principle adequate to the task of addressing complex, inter-dependent issues such as FEEEP?
- Is there an APEC "commons" the use of which can only be dealt with adequately through joint action?

Tractability: The current dynamism in economic development has been generated by the industrialization of innovation and the unleashing of largely private initiative in a context of globally stable conditions. The focus of governments has increasingly

shifted to ensuring that stability while private choice determines consumption and production patterns. In this context, in what measure is "sustainability", as a goal, to be achieved through establishment of policy frameworks, as opposed to depending on private conviction? How can policy and good governance influence choice and conviction?

WORKSHOP 4: THE SOCIO-ECONOMIC CONTEXT

The 21st Century will in all certainty be the first urban century (i.e., the first century in which most people will live in cities rather than in rural settings). It will also see the full flowering of the information age and witness the entrenchment of services as the main aspect of economic activity.

Urban Aspects: A city brings together people, economic activity, the bulk of food consumption (and potentially even food production, given the scope for cities feeding themselves), a large portion of energy use, and the major part of atmospheric, solid and effluent pollutants. The rural-urban transition in the APEC developing economies is thus one of the most significant "mega trends" underlying the FEEEP issues as it is re-shaping the region with major implications for patterns of land use, the organization of food production and types of infrastructure required (including for power and basic environmental services).

- What is the scope for gains in economic efficiency, improved efficiency of energy consumption, reduced environmental pollution, and ultimately improved quality of life through better urban planning and development?
- Does the geography-based concept of a city provide a useful integrative concept with which to approach FEEEP issues (e.g., via the "sustainable city" route)?

Information Age: The promise of the information age is that the movement of information will displace to some extent the more costly and resource-intensive movement of people and goods.

- What will be the impact of the information age on patterns of urban development, particularly in the rapidly urbanizing economies in East Asia where the major part of urban growth in the next few decades will take place?
- Will the developing economies bypass the mega-city stage and move directly to the emerging pattern of counter-urbanization presently taking place in North America and, if so, with what implications for FEEEP dynamics?

The Age of Services: In the age of industrialization, the main contribution to wealth came from increased resource-intensive industrial output. Services have now come to exceed industrial output as a share of GDP in most APEC economies. The emergence of the services-oriented economy may have far-reaching implications for FEEEP issues:

- Does the progressive shift to services suggest to some extent a de-coupling of economic growth from increased resource inputs?
- Are the distributional concerns raised by FEEEP issues heightened or diminished in a services-oriented economy vs. an industrial economy?

THE IMPACT OF EXPANDING POPULATION AND ECONOMIC GROWTH ON FOOD, ENERGY AND THE ENVIRONMENT IN APEC

APEC Economic Committee Chairman's Discussion Paper
October 17, 1996

1. INTRODUCTION

At Osaka in 1995, Leaders agreed on the need to put the impact of fast-expanding population and rapid economic growth on demand for food and energy and pressures on the environment on APEC's long-term agenda and to consult further on ways to initiate joint action so as to ensure the region's economic prosperity is sustainable.

APEC Senior Officials asked the Economic Committee to undertake this work given the Committee's mandate to analyze cross-cutting issues. This discussion suggests a framework for analysis, provides an indicative set of questions to stimulate discussion in, and feedback from, the relevant APEC fora and lays out a general process to advance this work in order to provide an in-depth report in time for the Leaders' meeting in Vancouver in 1997. It received a preliminary discussion at the Economic Committee's meeting in Manila, October 16-17 1996.

The Economic Committee's work will focus on the interlinkages among the various issues and, to the fullest extent possible, will draw on the expertise in, and integrate inputs from, each component from the appropriate APEC forum or international body: for economic growth, the Economic Committee's annual economic outlooks, as well as other international sources; for population, on the World Bank and the United Nations; for food, on the Task Force on Food established under the aegis of the Economic Committee, and on the Fisheries Working Group; for energy, on the Energy Working Group and the Energy Ministerial process; and for environment, on the Environment/Sustainable Development officials and the Environment/Sustainable Development Ministerial process.

Policy planning horizons tend to be much shorter than the time spans over which the cumulative impact of population growth is noticeably felt. In the case of economic growth, the cumulative impact of growth can of course be felt within policy planning horizons since a doubling of GDP in half a decade is realizable and, in fact, has been achieved by economies in the region. The Leaders' initiative however clearly reflects a desire to have a longer-run review of issues to provide a better perspective for short- and medium-term policy considerations. In this regard, the important outputs of this exercise will thus be answers to the following questions:

- What policy-relevant implications can be drawn from possible long-run developments?

- Amongst these, what is most relevant for APEC, as an institution engaged in promoting trade and investment liberalization and facilitation and economic and technical cooperation?

2. TOWARDS A FRAMEWORK FOR ANALYSIS

As the century draws to a close, world population has never been as large and global economic output never so high. At the same time, the planet has never been as polluted, the reliance on and consumption of fossil fuels has never been as high and, paradoxically in a time of relative plenty and despite measurable successes in reducing the incidence of absolute poverty on a global scale, the number of people subject to quantitative or qualitative malnutrition has also never been as large – 1/3 of the global population.[1]

Taken together, these observations raise legitimate questions about the ability to sustain growth over the longer term, about the quality of life that future generations will be able to enjoy, and about the impact on economic systems from pressures on the relative prices of fresh water, food and energy.

APEC member economies feature prominently in this calculus: they account for 2/5 of the world's population and over half its GDP, emission of pollutants, use of energy, and production and consumption of food. While APEC member economies have successfully reduced the proportion of the population facing chronic under-nutrition since the 1960s, the prospects for continuation of progress are subject to the ability to continue expanding food production in line with population growth. How well APEC member economies prepare to meet the challenges presaged by this nexus of issues will significantly influence the shape of events; by the same token, the benefits of finding appropriate responses to these issues will flow disproportionately to its members.

The Absolute Impact of Sustained Growth

The absolute impact of growth increases rapidly as the time frame over which growth continues is extended.[2] Even modest rates of growth, sustained for a sufficiently long time, have massive impacts on levels. For example, the 1 percent average annual growth in world population projected by the United Nations in its medium-case scenario over the period to the middle of the next century will cumulate to a 72 percent increase, or about 4.2 billion additional people.[3] This is a substantially larger increase than the doubling of the world population between 1950 and 1990 which added only about 2 1/2 billion people to the total. In terms of economic growth, an average annual growth rate of 2 percent per year over the same period would triple the level of world GDP – a growth rate of 3 percent

[1] Including about 800 million who are suffering from hunger.

[2] Sustained growth in any quantum – whether it be population, economic output or energy or food consumption – results in a doubling of that quantum in a period that can be conveniently expressed as 70 divided by the growth rate – in other words, doubling time is 70 years at 1 percent annual growth, 35 years at 2 percent annual growth, 10 years at 7 percent and so forth.

[3] United Nations, Population Projections to 2050 (citation required).

would quintuple it. Again, the absolute increase in economic activity from even such modest sustained growth rates would far surpass the absolute increase achieved in the post-WWII era.

By contrast, the annual natural supply of fresh water is, on average over the longer run, more or less constant (and some of the key reserves, in the form of ground water, are declining as evidenced by falling water tables around the globe). Similarly, the stock of fossil fuels is fixed and at some point additional exploration will fail to add to reserves as it has over the 2 decades since the first oil crisis in the early 1970s. The same is true of the land surface suitable for habitation and cultivation. These considerations give rise to natural questions regarding the implications for the relative prices of these basic commodities.

Policy Responses to Long Run Problems

The consequences of unsustainable growth patterns or relationships are typically only felt over the longer run. This poses a problem for public policy since its leverage in terms of effect is greatest early in the growth process when its leverage in political terms is minimal. Unfortunately, the dynamics of sustained growth result in the maximum absolute impact being felt in the later stages of the process by which time public policy options are much more limited.

Compounding this is the fact that uncertainty rises sharply the further out in time a problem lies which tends to undermine decisive early action. Furthermore, the status quo is replete with vested interests, which creates a built-in reluctance to proceed with reforms that impact on the value of existing assets (e.g., polluting production equipment).

In this context, an informed policy debate to help build consensus on short and medium-term strategies to anticipate and avoid long-run problems can pay enormous dividends.

A Framework for Long-run Growth

To reach a meaningful set of conclusions about the inter-relationships between growth in population and economic output, demand for food and energy and pressures on the environment in a way that lays the basis for a policy discussion oriented to sustaining prosperity – which is the objective that Leaders have established – requires a framework.

The concept of sustainable development as articulated by the Brundtland Commission offers such a framework. According to this definition, sustainable development is that which "meets the needs of the present generation without compromising the ability of future generations to meet their needs."[4]

[4] Gro Harlem Brundtland, *Our Common Fortune*, *Report of the World Commission on Environment and Development* (United Nations, 1987).

An essential contribution to sustainable development is economic growth as it provides fundamental material contributions to well-being and also the means to address particular problems. Considerations about long-run growth are usually framed in the context of economic growth models where growth is determined by growth in labour, capital and productivity.[5] Specific issues raised in using such a framework for the Asia Pacific region and over the time frame under consideration are discussed below.

Sustainable development cannot be directly equated with sustained increases in GDP or GDP per capita for several reasons:[6]

- GDP, as currently measured, does not account for reduction in welfare resulting from pollution caused by productive activity – in other words, in a context of growing pollution, growth in GDP per capita consistently overstates growth in welfare;

- GDP does not account for the draw-down of non-renewable natural resources used in productive activity – i.e., if mineral resources in the ground are accorded a capital value, then treating the full value of the extracted resource as current production, which is the case in GDP accounting, is to overstate the change in net worth; and

- GDP does not take into account distributional issues which are key to the impact of growth on welfare (which is of particular importance since relative scarcity of food, energy and/or fresh water would have significant distributional impacts) – as one simple illustration, under the usual assumption of declining marginal utility of consumption, a rise in GDP per capita in the context of a widening of income inequality would tend to overstate the rise in welfare.

To pull together these considerations, it may be helpful to consider an economy's environment, its stock of non-renewable resources and its social harmony (which is in part a function of all groups in society sharing in the benefits of growth) as "assets" that underpin long-run welfare. Looked at this way, economic growth that involves running down those assets cannot be considered sustainable, any more than a corporation which records revenue from asset sales as current income can be considered to be recording profits at a sustainable pace. Conversely, economic growth in a context of cleaning up the environment, extending the life span of non-renewable resources through efficiency gains, and broadening the basis for prosperity, creates welfare gains beyond those measured by GDP. This boost to an economy's "net worth" makes clear their contribution to higher welfare in the long run and thus to sustainable development.

Sustainable growth also involves quite a different sense of the term "sustainability", in this case, in terms of the limits to growth debate [7]. Of particular relevance here is the idea that

---

[5] This same approach is used in historical analysis of the sources of growth and is the basis of the approach adopted in the Economic Committee's paper, *The State of Economic and Technical Cooperation in APEC* (Singapore, APEC Secretariat, 1996).

[6] In addition, the identification of growth in GDP per capita with improvements in long-run welfare can only be made under the conditions of optimizing inter-temporal consumption/investment decisions, competitive pricing, rational consumption choices etc. Moreover, GDP ignores non-commercial household production, which nonetheless increases welfare.

the food supply could be a constraining factor on the size of population and similarly that the supply of non-renewable energy could be a constraining factor on economic expansion.

Interlinkages

In the long run, all these elements – demand for food and energy, quality of the environment, population size and economic output – are determined simultaneously and influence each other. In other words, they are all endogenously determined. In that sense, "gaps" do not emerge. Rather, the variables evolve in a way that is mutually consistent.

Prices play a key role. Relative scarcity of a key commodity induces price increases – whether it be market prices or shadow prices in the context of rationing. This induces demand and supply responses in the form of more efficient utilization of the scarce resource, increased supply through more efficient production, transformation of other commodities (e.g., a simple illustration is transformation of coal into oil through liquification or energy into fresh water through desalination), and/or substitution away from the scarce commodity. The latter can reflect anything from change in habits (e.g., increased use of bicycles for short trips instead of cars if the relative price of gasoline increases) to the modern technological response of engineering new materials to replace scarce natural ones.

Establishing the scope for such substitution and transformation possibilities, the role of prices in accurately reflecting the supply and demand pressures to consumers and producers stimulating more efficient consumption and production, the distributional effects within societies and the respective roles of market frameworks and governments, will be a key element of this work. By creating the information base to allow sound long-run planning for infrastructure, particularly for the new mega cities predicted to emerge in coming decades, this information may well be one of the key contribution of APEC's work on this set of issues.

3. BASIC QUESTIONS TO BE ADDRESSED

Before attempting to integrate considerations of food, energy, environment, economic growth and population, a task for the Economic Committee over the next year, it will be necessary to establish a common information base in each area with initial working assumptions on relevant aspects of some of the main variables, in particular population and economic growth.

While population growth, as noted above, is in the long run endogenously determined, initial working assumptions for overall growth in population will be drawn from existing

[7] The question of limits to growth has been debated off and on in the economics profession since seminal works by Thomas Malthus and David Ricardo and achieved considerable prominence in the 1970s as a result of the work of the report to the Club of Rome by Donella H. Meadows et al, *The Limits to Growth*, Potomac Associates, Universe Books, New York, 1972).

sources, adjusted as necessary in line with member economies' views. It would appear, on this basis, that APEC member economies will experience population growth somewhat below the world average.

The prospects for sustained growth in the APEC region would appear to be very good, particularly given the very large scope for growth in the developing economies of the region.[8] As APEC includes both developed and developing economies, the issue of convergence will have to be explicitly addressed. Rapid rates of growth, such as those achieved in East Asian developing economies over most of the past decade, tend to reflect in large measure the mobilization of existing resources (e.g., increases in labour force participation rates) and rapid accumulation of capital, coupled with adoption of modern technology already in use elsewhere in the world. As the scope for such gains is progressively exhausted, growth slows to rates observed in the developed economies. The scope for growth in the APEC region thus reflects a combination of the ability of the developed economies to sustain "intensive growth", and the scope of the developing economies to narrow the gap through convergence of per capita GDP. Establishing reasonable parameters for possible economic growth in the region over the longer term will be an important early aspect of the work in this study as this will in turn serve as a key input to detailed considerations in other areas.

Bearing in mind the increased uncertainty of projections the further out in time one goes, it will be necessary to consider trends both in the medium-term (e.g., out to 2005-2007), the "Bogor" dates of 2010/2020, and even further to 2050 to get a sense of the long-run impacts of cumulative population and economic growth.

Following are brief discussions of key elements contributing to sustainable growth and equitable development. Each section sets out several preliminary observations of background information relevant to this study and then identifies particular questions that will have to be addressed to advance this work.

3.1 Population

Salient Observations

The UN projects world population to increase from about 5.8 billion in 1996 to between 7.8 and 12.5 billion in 2050.[9] In the middle case scenario, which assumes that fertility rates eventually stabilize at replacement levels (i.e., slightly more than 2 children per family on average), population grows to about 10 billion by the middle of the next century, an increase of 72 percent. The 4.2 billion increment under this latter scenario is substantially larger than that added to the world total in the population "explosion" that more than doubled population from 2.5 billion in 1950 to 5.3 billion in 1990,

[8] See Economic Committee, 1995 APEC Economic Outlook (Singapore, APEC Secretariat, 1995), pp. 56-58 for a discussion of growth potential in the region over the medium term. This work will be extended in the context of the FEEEP project. In considering the likely parameters for growth in the APEC region over the coming decades, the divergence between current market exchange rates and purchasing power parity exchange rates will also have to te taken explicitly into account

[9] United Nations, Population Projections to 205

notwithstanding the fact that the growth rate over this period of 1 percent per annum is substantially slower than the 1.9 percent rate of increase over the period 1950-1990.

Using the UN's medium-case scenario as a starting point, the population in APEC member economies would reach just under 3 billion in 2050, an increase of 36 percent from the level in 1996.

Small differences in underlying assumptions have large impacts over extended time frames. By comparison, the high scenario assumes that fertility rates stabilize at 2.5 children per family while the low scenario assumes 1.7. While these are not huge differences as regards family structures, they result in a global population 60 percent greater in the high case.

Population growth is a major source of economic growth both through increasing labour supply and by increasing demand; it is also a dominant factor in overall food and energy requirements and pollution creation.

An adequate supply of fresh water is an absolute prerequisite to sustain life. Within the APEC region, annual per capita internal renewable water resources substantially exceed withdrawals (withdrawals account for between 1 percent of renewable resources in Indonesia and 2 percent in Canada to a high of 42 percent in Korea). However, distribution is uneven: over 1 billion persons globally were without safe drinking water in 1994, including in some APEC member economies. Thus Singapore, which withdrew only 32 percent of its renewable water resources (1975 data), has been exploring desalination of seawater to meet its needs.

Withdrawal of significant proportions of renewable sources has environmental and ecological impacts that must be factored into long-run accounting. The pumping of water from subsoil aquifers at rates far greater than they are recharged has particular implications for food production in regions requiring extensive irrigation[10]

Table 1
APEC Member Economies Population, 1995 and 2050[11]

Economy	Population 1995 (millions)	Population 2050 (millions)
Australia	18.05	26.06
Brunei Darussalam	0.29	0.49

[10] *ibid*. The massive Ogalala Aquifer which supports grain production in the North American prairies is one such source that is being tapped faster than it is being refilled.

[11] A possibly surprising element in this projection is that, in the case of Japan and Hong Kong, the population is actually projected to be smaller in 2050 than at present, reflecting the interaction between aging of the population and replacement level fertility. For Hong Kong, in particular, given the scope for immigration from the People's Republic of China, this is undoubtedly an anomalous result. From a regional perspective, alterations to the distribution through migration have would have comparatively little impact on the overall total. The first question to address is the reasonableness of these projections as a starting point for the analysis.

Canada	29.46	39.87
Chile	14.26	22.45
China	1,208.00	1,606.00
Hong Kong, China	6.30	4.94
Indonesia	194.95	318.80
Japan	125.33	110.02
Korea	44.85	56.45
Malaysia	20.14	38.09
Mexico	94.81	161.45
New Zealand	3.53	4.67
Papua New Guinea	4.07	9.61
Philippines	68.62	129.53
Singapore	2.99	3.30
Chinese Taipei[12]	21.20	26.70
Thailand	60.28	81.91
USA	263.40	348.97
Total APEC	2,193.99	2,989.31

Source: United Nations, Population Projections to 2050; and Economic Committee.

Cities function not only as habitat for a large portion of the population, they also are the main production units of industrial societies. Urban growth, including the "urban fringes" which are growing much faster than urban cores[13], will outpace population growth by a considerable factor over the coming decades. Within the APEC region, most of the urban growth will be in the developing Asian economies, where the share of the urban population will grow from roughly 1/3 currently to about 1/2 by the early part of the next century.[14] Urbanization is already quite high in the Americas and Oceania.[15] The UN projects 30 "mega" cities on the globe by 2015, 12 of them in the APEC region.[16]

Indicative Questions

The overall size and rural/urban distribution of the population will have profound implications for all other variables under consideration here. Given that population growth will occur primarily in cities means questions and issues raised by the interlinkages among these variables will be answered or resolved to a large extent according to how cities are developed. The following are some of the key questions to be addressed in the context of this study:

[12] The figures for Chinese Taipei are provided by the Economic Committee.

[13] See, for example, World Resources Institute et al., World Resources 1996-97 (New York/Oxford, Oxford University Press 1996) p. 9

[14] This reflects the expansion of cities to accommodate growth in existing urban population plus, in the large agrarian developing economies, the influx from rural areas.

[15] UN, "How much do we know about urban growth in the late Twentieth Century?" in *World Economic and Social Survey 1996*, pp. 217-243.

[16] Note: the survey did not include APEC member economies Brunei Darussalam; Hong Kong, China; Papua New Guinea; Singapore; and. Chinese Taipei.

- To what extent is the growth in population "pre-programmed" due to the fact that a large proportion of the population (particularly in the developing economies that account for the largest share of global population) is currently in the reproductive age bracket?

- Given the relationships among fertility rates, women's participation in the labour force and rising family incomes and population growth, in what measure is there scope for public policy (e.g., education of women, facilitating access to the labour force etc.) to influence outcomes?[17]

- What are the implications of population distribution between rural and urban settings for labour force growth, land available for cultivation, and distribution of infrastructure requirements?

- What are the prospects for stabilization of the population, given historical fluctuations in fertility rates (even after the demographic transition from a high fertility/high child mortality environment to the low fertility/low child mortality environment which is characteristic of modern industrial societies); and given the fact that age structures do not reflect underlying mortality rates due to the impact of various historical shocks?[18]

- What is the scope for gains in economic efficiency, improved efficiency of energy consumption, reduced environmental pollution, and ultimately improved quality of life through better urban planning and development?

- With the advent of the information age, steep reduction in the costs and time of travel, and growing importance of services in GDP, what is the scope for more decentralized patterns of production and thus of habitation?[19]

- What is the scope for more efficient utilization of water through application of recycling techniques (e.g., use of strained dishwater to flush toilets and so forth), expanding effective supply by stopping the use of rivers as sewers and desalinating seawater, and what are the implications in terms of infrastructure requirements, pricing etc.?

---

[17] Regarding these inter-relationships in the case of Canada, see D. Ciuriak and H. Sims, Women's Participation Rates and Labour Force Growth (Department of Finance, Ottawa, 1980).

[18] Shocks have included changes in fertility and mortality associated with medical advances, changes in socio-economic conditions, rural-urban migration, wars etc. As a result of such shocks, there are various bulges and indentations in the typical economy's age structure which, over time, move through the age structure and produce ripple-like "echoes" in succeeding generations.

[19] The urban growth pattern in the developed economies of North America as well as Europe involves movement away from concentrated urban centres to sprawling metropolitan areas and/or small and intermediate-sized cities, which afford more living space per family at affordable prices (this latter phenomenon is also referred to as "counter-urbanization" see B.J L. Berry, "The counter-urbanization process: urban America since 1970", in Urbanization and Counter-urbanization, B.J.L. Berry, ed. (Beverly Hills, California, Sage, 1976)). This intra-urban shift does not affect overall urban-rural ratios but does have very significant implications for land-use, transportation requirements (roads vs. public transit) etc. See World Resources, op. cit.

- What are the implications of rising relative price of water in terms of:
  - Distributional impacts on populations, particularly on those living at or near subsistence income levels; industrial locations,
  - Requirements for technological development and dissemination;
  - Viability of marginal farmlands;
  - Changes in habits,
  - Health impacts,
  - Etc.?

3.2 Economic Growth

Salient Observations

Human Capital: the growth of population, a problem from some of the perspectives examined here, provides nevertheless a solid underpinning to growth both in terms of contributing to sustained growth in potential labour force, creating demand for sustained infrastructure development and creating demand for goods and services. In the industrialized APEC member economies, estimates suggest that human capital accounts for up to 1/2 of growth.

Capital: the APEC region today has a very solid savings/investment performance. In the developed economies in the region, capital intensity accounts for between 1/3 and 1/2 of growth. New capital stock often embodies the latest technology, including environmental technology. As a result, the pace of capital formation and thus the average age of the capital stock plays an important role in terms of energy consumption and environmental impacts (including consumer durables such as cars). This is one of the key channels for influence from economic growth to environment and energy and an area which is particularly subject to public policy influence including through: influence over the relative price of energy and, through that, on the nature of the future capital stock; support for savings and investment; and policies facilitating the international spread of technology (including protection for intellectual property rights and economic and technical cooperation).[20]

Productivity: Sustaining productivity growth over the longer term is a function of innovation (the scope for exploiting existing knowledge through developing applications) and invention (the development of new ideas). The scope for new ideas appears to be for all practical purposes unbounded which in turn suggests that the effective limitation on

[20] This nexus of issues draws together work of APEC Science and Technology Ministers, Environment/Sustainable Development Ministers, Finance Ministers and Trade Ministers. The work in these areas can both shed light on the evolution of the APEC region over the longer term and also serve to initiate joint action to shape that evolution along desirable paths, to achieve sustainable growth and equitable development over the medium to longer term

productivity growth is set by amount of effort expended on research and development and factors that influence the spread of technology.[21]

Growth in services and improvements in quality are not in principle subject to material input constraints, only to the limits of the imagination.

Indicative Questions

Against this very general background, a number of questions will have to be addressed in order to shed light on the possible broad parameters for overall growth in the APEC region over the coming decades.

- What will be the growth in the working age population (as opposed to total population), the evolution of labour force participation rates and growth in human capital through improvements in education and training?

- Will diminishing returns to capital become a significant constraint on scope for growth in the developed economies over the time frame under consideration?

- What is the scope for the APEC member developing economies to expand capital intensity to catch-up to the developed economy levels or otherwise move out to production possibility frontiers already charted in the developed world?

- Given the scope for substitution of labour and capital, what are the implications of long-run trends for employment, productivity and income distribution?

- Given the scope for developing new materials tailored to specific industrial applications, are specific material resource constraints less problematic than was once assumed or asserted?

3.3 Energy

Salient Observations

Energy plays a central role in supporting economic growth as well as the quality of life in modern households and industrial/service establishments.

As a major input to production, changes in its price flow through both directly and indirectly to final prices and thus influence overall macroeconomic performance.

Energy infrastructure constitutes a major component of overall economic infrastructure and the energy industry itself is a major contributor to jobs and output.

[21] See Martin L. Weitzmann, "Hybridizing Growth Theory", American Economic Review, Vol. 86, No. 2 (May 1996), pp. 207-212, for a recent update on thinking about the scope for sustained growth through productivity gains.

Energy is required in many forms for different purposes. In the short run, the structure of demand is highly dependent on the nature of the capital stock (including in this instance cars and household appliances as well as the nature of fuel sources for power plants). Patterns of investment and the design of cities thus influence energy use significantly over the medium and longer term.

Non-renewable forms of energy are subject to eventual supply constraints but energy is highly mutable (i.e., coal can transformed into oil, oil into electricity, electricity can be stored in chemical batteries etc.) providing scope for technological development and evolution of the capital stock to adapt the patterns of use towards relatively abundant forms.

Emissions from energy use constitute the most important contributing factor to atmospheric pollution, generating heavy costs in terms of health in cities, damaging forests through associated acid rain, and contributing to climatic change which could potentially impact on patterns of food production as well as patterns of habitation.

The experience gained in the two decades since the first oil price shock shows that price increases do indeed generate significant demand and supply responses.

Indicative Questions

The interlinkages between energy demand and supply and the other main variables in this study raise many questions and issues that will be addressed as part of the work of APEC's Energy Working Group. Key questions from the perspective of the work on FEEEP will include:

- What are the implications for the energy-intensity of GDP from changes in the relative scarcity of some forms of energy, the patterns of urbanization, the relative growth of the services sector relative to goods production, and the impact of global environmental regulations related to energy use?

- What is the scope for efficiency gains at the various stages of energy production from extraction (e.g., through application of tertiary recovery techniques in the case of oil and gas), conversion to electricity (more efficient burning); transmission (reduction of losses in moving energy around energy grids); to end use; and what is needed to achieve such efficiencies in terms of new investment, technology development and dissemination, modernization of end-use equipment and all which the latter entails in terms of changing habits of consumers and industry alike?

- What is the scope for substitution among alternative fuels both over the medium and longer-term, what is the scope for environmental benefits from such substitution (e.g., between coal and natural gas) and what are the related implications for infrastructure (e.g., in this example, gas pipelines, converted power generating equipment, retail gas distribution systems and a switch to gas-burning domestic appliances)?

- What is the scope to expand sustainable sources such as hydro and solar power, what are the environmental implications (i.e., hydro, while "clean" compared to fossil fuels, has associated requirements for dams that in turn have attendant ecological impacts and, in the case of shared river systems, pose international co-operation challenges), and what are the relative price points at which new fuel sources become economically feasible?

3.4 Food

Salient Observations

Food, as a basic necessity of life, has three broad dimensions – quantitative (i.e., daily caloric intake requirements), qualitative (i.e., quality, safety, variety and nutritional balance), and distributional (i.e., affordability of food required for adequate diets). With rising prosperity, the qualitative dimension becomes increasingly important as is evidenced by high-income elasticities of demand for higher quality foodstuffs.

Food production, as an industry, provides an important contribution to GDP and employment, particularly in rural areas and coastal areas dependent on fisheries.

The doubling of world population since the middle of this century was accommodated through a "green revolution" achieved through a combination of new technologies, massive application of irrigation, fertilizers and pesticides, and to some extent through an unsustainable rise in the global fish catch. The latter issue is particularly important in APEC member economies in Asia where fish protein comprises over 1/4 of animal proteins consumed.[22]

APEC member economies feature a wide range in dietary patterns, have agricultural, fisheries and food sectors with divergent characteristics, and include both net exporters and net importers of food.

Indicative Questions

The interlinkages between food demand and supply and the other main variables in this study, raise many questions and issues that will be addressed as part of the work of the Task Force on Food under the auspices of the Economic Committee as well as by the Agricultural Cooperation Technical Experts Group, the Fisheries Working Group and work in the Sustainable Development Ministerial process. Some of the questions to be addressed in considering the evolution of food demand over the coming decades include:

[22] The global fish catch for the latest year on record (1993) reached a new high; this very fact is part of the problem as the world's major fisheries are all under considerable stress from over-fishing, and the risk of severe declines grows. For example, the bounty of the cod harvest on the Grand Banks off the eastern coast of Canada in the 1980s was followed shortly thereafter by a complete collapse and shutdown of the fishery in 1992, with serious international tension related to migratory fish that constituted an integral part of that fishery.

- What are the implications of the prospective increase in the population in the APEC region by over 1/3 over the time frame under consideration and a several-fold increase in for demand for food, both in quantity terms to eliminate the remaining basic deficiencies (assuming of course that the income growth of the poorest is in fact sufficient) and also in terms of quality and variety demanded?

- In what measure can these growing food requirements (quantitative and qualitative) be met through improvement in agricultural efficiency through improved strains of grain, better animal husbandry techniques, improved fertilizers, reduction of loss ratios in transportation and storage, and shifting the international pattern of food production in line with comparative advantage; and what are the implications in terms of requirements for infrastructure, R&D, human resource development, enhanced market frameworks, and trade patterns?

- What are the inter-relationships between the efficiency of agricultural production, population size and associated urban development, requirements for land under cultivation and implications of these inter-relationships for the relative price of food?

- What are the long-term implications of falling water tables that feed irrigation systems and what is the scope for expanding the life span of existing aquifers through more efficient irrigation and/or other means of maintaining irrigation-dependent regions as viable farmlands?

- What are the long-term implications of intensive use of fertilizer and pesticides on soil quality, pollution of rivers and coastal zones through run-off, and associated health risks?

- What is the scope for addressing requirements for marine foods through aquaculture, relieving pressure on marine fisheries and what are the implications for infrastructure requirements, coastal zone pollution control, and marine ecology?

- What are the risks to the climate of the world's current "bread baskets" and "rice bowls" from global warming and what, if any are the implications for the quantity of food produced globally and the patterns of production?

An understanding of these various interlinkages will be important as a basis of an informed policy dialogue on appropriate responses, particularly given the sensitivity of agriculture and food trade issues.

3.5 Environment

As a crosscutting issue in its own right, the various links between population, economic growth, food and energy and the environment have already been touched on at various points above. However, a number of additional observations and specific questions can be raised here.

Salient Observations

The pressures that exist today on habitat for other species, on forests, on oceans and on the atmosphere cannot be expected to diminish or even stay the same in the context of an expansion of the human population by some 4.2 billion worldwide and close to 1 billion in the APEC region, as well as a several-fold expansion of economic activity. Accordingly, there is some urgency to an early engagement of the issues.

Environment is the quintessential cross-cutting issue: it is at once an outcome (determined by industrial production, energy production and consumption, agricultural practices, urban infrastructure – or lack thereof) and a factor that contributes to or detracts from the quality of life of societies, an industry that contributes to jobs and growth, and even a potential determinant of agricultural patterns through impacts on climate.

New, clean technology is not a dead-weight cost but an investment that yields returns in competitiveness as well as a cleaner environment. Environmental protection is closely linked with investment, technology transfer and associated issues (trade-related intellectual property rights, foreign investment regimes etc.).

There is a generally recognized broad positive correlation between growth in incomes and improved environmental stewardship; a clean environment can be thought of as having a high-income elasticity of demand.

The economic costs from pollution are considerable and pervasive. They range from productivity loss due to poorer health to forest damage from acid rain. Added to this is the human cost of increased infant mortality, stunted intelligence, reduced life spans and generally a reduced quality of life. Moreover, polluting production processes use energy and raw materials inefficiently, generating more waste and burdening disposal systems.

However, the costs of environmental degradation and the depletion of natural resources are inadequately reflected in national accounts, hindering objective policy consideration.

Indicative Question

- To what extent is it possible to quantify, and integrate into a long-run economic welfare calculation, environmental damage and costs?

4. TOWARDS A BASIS FOR CONSULTATIONS WITHIN APEC

The issues discussed in this paper touch upon many sensitive policy areas. It is hoped that the consultative, consensus-based approach in APEC will facilitate an in-depth discussion to provide a sound basis for dialogue on possible policy requirements. This Section considers how the FEEEP initiative might be developed over the coming months to provide the basis for that in-depth discussion.

The earlier Sections have set out a framework in which to address the issues that APEC member economies will have to manage in order to sustain prosperity over the longer term. Moreover, a number of specific questions have been identified as a basis for a preliminary round of research to pull together relevant information. This Section provides a brief overview of the process that is envisioned to carry out this work and develop a full report by the Economic Committee to Senior Officials in time for the meeting of Ministers and Leaders in Vancouver in 1997.

Collation and Analysis of Information on Population and Economic Growth

In the first instance, as noted earlier, the Economic Committee, building on this preliminary report and the framework for analysis outlined above, will over the next several months develop a set of basic assumptions about population and economic growth over the period to 2050 to serve as a common framework for other APEC fora providing inputs to this work.

The Committee will rely to the extent possible on existing surveys and research results of international organizations, academic work and inputs from member economies, making such adjustments as necessary for the specific purposes of this research.

Analysis of the Interlinkages

By integrating and synthesizing the inputs from the sources noted above, the Economic Committee will develop an overall assessment of the implications of the various trends for the prospects for sustaining prosperity in the APEC region over the longer term. As this work progresses, additional questions may be raised for discussion within the Economic Committee and contributing APEC fora.

Broadening the Base of Inputs

As the considerations being addressed here are of broad and close interest to the general public, it will be important to provide for broad public input into the work. For this purpose, a Symposium on the Impact of Expanding Population and Economic Growth on Food, Energy and the Environment will be held, most likely in September 1997. This Symposium will bring together experts in the various fields from APEC member economies, academic experts, international institutions and non-governmental organizations working on these issues. The Economic Committee will prepare, in time for the Symposium, a draft report to serve as a basis of discussion. This report will reflect and incorporate the results of the 1996 and scheduled or tentative 1997 APEC Ministerials on Sustainable Development and Energy. Consideration may be given to additional Symposia on specific elements of the work.

Reporting

The Economic Committee, at the request of Senior Officials, has undertaken to discuss the FEEEP issues as a regular part of its agenda, in line with the agreement by Leaders that these issues be put on APEC's long-term agenda. This discussion will serve as the

basis for an annual report to Senior Officials, and as an attachment to the Senior Officials Ministerial report, for consideration by Ministers and Leaders.

It is hoped that the 1997 report will establish the basis for an initial discussion of possible options for initiating joint actions to be taken by APEC member economies.

ANNEX 2

INTERIM REPORT TO APEC ECONOMIC LEADERS ON THE IMPACT OF EXPANDING POPULATION AND ECONOMIC GROWTH ON FOOD, ENERGY AND THE ENVIRONMENT IN APEC

INTERIM REPORT TO APEC ECONOMIC LEADERS ON THE IMPACT OF EXPANDING POPULATION AND ECONOMIC GROWTH ON FOOD, ENERGY AND THE ENVIRONMENT IN APEC

BACKGROUND AND PROCESS

APEC Economic Leaders at Osaka in 1995 agreed on the need to put the impact of fast-expanding population and rapid economic growth on food, energy and the environment on APEC's long-term agenda, and to consult further on ways to initiate joint action to ensure that the region's future economic development is sustainable. Responsibility for this work was assigned to the APEC Economic Committee which was to advance it collaboratively with the other working groups and Ministerial processes dealing with the many aspects of this complex and cross-cutting issue. These fora include, in particular, the Economic Committee's Task Force on Food, the APEC Energy Ministers and the Energy Working Group, and APEC Environment Ministers and Senior Environment Officials. The Fisheries Working Group with respect to the fisheries aspects of food and the Marine Resource Conservation Working Group with respect to the marine-related environmental issues are also closely involved with the FEEEP initiative. Other APEC fora, particularly the Industrial Science and Technology Working Group, are also dealing with aspects of the FEEEP issue.

Last year the Economic Committee made a brief preliminary report on FEEEP-related work, setting out the process that had been established within APEC to address this issue. This 1997 interim report sets out the progress made during the past year in identifying and analyzing FEEEP-related issues as a basis for the policy-oriented work to be undertaken by the Economic Committee, in cooperation with other APEC fora, next year.

PROGRESS IN 1997

During 1997:

- The Task Force on Food, drawing on a network of experts in capitals, produced an in-depth report for Ministers outlining a range of issues in the food sector under three of four categories of analytical study – supply and demand, food and the environment, and future trends in food supply and demand;

- The Energy Working Group developed a report on the energy aspects of FEEEP that was drawn on by Energy Ministers at their August 1997 meeting in Edmonton;

- Senior Environment Officials reviewed and discussed FEEEP-related issues with the result that APEC Environment Ministers, at their meeting on Sustainable

Development in Toronto in June 1997, agreed that the three major environmental initiatives, Sustainability of the Marine Environment Cleaner Production, and Sustainable Cities, were all central to the FEEEP initiative; and

- The Economic Committee held a Symposium in Saskatoon in September 1997, which drew together over 175 delegates from all 18 APEC member economies, including representatives of the APEC fora working on FEEEP-related issues, academics, government officials, non-government experts and business persons, for a wide-ranging discussion of the issue areas, the links amongst them, and cross-cutting themes.

Interest in FEEEP grew substantially over the past year around the region. A number of seminars were organized in member economies to develop ideas on how to advance thinking in this area. The APEC Study Centres Consortium meeting held in Banff, May 1997, served as an APEC-wide forum for academic and non-government experts from around the region to engage in the discussion while a conference hosted by the Institute for Developing Economies (IDE) and the Japan Economic Foundation (JEF), in Japan in June 1997, also helped advance ideas on FEEEP-related matters.

Food

As part of APEC's response to the Osaka Declaration, the Task Force on Food (TFF) was created to examine the impact of population and rapid economic growth on the demand for, and supply of, food (in terms of production, trade flows and stocks) in the region; processing and distribution; and agriculture-related environmental issues. The TFF is chaired jointly by Australia and Japan. The Fisheries Working Group, also chaired by Australia, began focussing some of its work on FEEEP issues in 1997, including by undertaking demand and supply projections.

The TFF in particular faces a challenging task. APEC member economies represent a wide range of economic and demographic characteristics. There are also wide variations in rates of economic growth, income levels, and distribution within and among the member economies. Dietary patterns vary greatly. Many economies are experiencing profound changes in food consumption patterns as incomes rise. Agricultural and food sectors also have divergent characteristics. Some economies are net food exporters and some are net food importers. Furthermore, issues of food production and consumption in APEC cannot be considered independently of global trends. Accordingly, a wide-ranging and comprehensive approach is required.

In assessing future trends in food supply and demand in the APEC region in the medium and longer term, both quantitative and qualitative procedures have been used to develop a more comprehensive and complete view of the future opportunities and challenges facing APEC. The picture is complex.

Over the past decades, rapid economic growth, rising per capita real incomes, and population change have had a big impact on APEC's food sector, both agriculture and

fisheries. These changes have increased the overall demand for food, with marked differences in growth in demand for various food commodities and among members within the region. Economic growth, mainly in the form of rapid industrialisation, has also affected the region's capacity to meet changes in demand. Significantly, however, the region has not experienced a peacetime famine or critical food shortage in the past thirty years. It has, therefore, been able to meet the food challenges of one of the most extraordinary periods of rapid economic growth in world history.

Trade has played an increasingly important role in helping the region to meet its food requirements and will continue to do so. Increased trade flows will further change the geographical distribution of agricultural production and of fish harvesting. This can lead to more efficient patterns of resource allocation within the region in food production in the agricultural sector and under appropriate fisheries resource management schemes. Expanded trade in food can also generate efficiencies more broadly by reducing the need to carry costly food inventories and expanding opportunities for substitution amongst food products. In turn, this can help to sustain high rates of economic growth and generate the income needed to raise nutritional levels.

Looking to the future, the optimism that may be engendered by past experience in the region is tempered for many by consideration of a number of factors, including: concerns that some have about the future stability of world food markets with increasing trade in agricultural products and a shift away from supply management policies in key exporting economies; the trend over time for food stocks to decline as well as for exports to come from fewer economies; increasing environmental pressures; the pivotal challenge of raising yields when the benefits of earlier massive investment in rural R&D seems to be levelling off, the impact of aquaculture on the quality of the marine environment from the concentration wastes in limited areas; and the need to keep incomes rising for the region's poor so that their nutritional needs can be turned into effective demand. The inevitable pressures of structural adjustment on the rural sectors of the region, especially those that are associated with more traditional patterns of rural life, raise particular policy challenges for individual member economies to manage.

On the other hand, the long-term trend in world grain prices in real terms has been downward. More smoothly operating markets may be better able to adjust to unexpected short-term fluctuations in supply, and product mix is also likely to be more diversified, thereby spreading the risks of supply variability. The world community is also at the threshold of building on basic biotechnology research to achieve practical results. Meanwhile, population growth rates globally and in the APEC region are declining, reflecting higher incomes and lower fertility from changing age structure.

Whether the past successes in meeting the region's food challenges can be confidently projected into the future remains uncertain. The world has not reached biological or physical limits to food production. However, the rate of growth of production has been in decline. In particular, the growth of grain yields, which has been a major factor in production growth, is declining, reflecting factors relating to technology, investment, Environment and production incentives. Projections show a slow improvement in

future food balances, but not all food needs will be met. Accordingly, if the state of hunger is to be improved from a humanitarian standpoint, attention will have to be focused on how to fill the gap between food consumption and food need levels. Filling this gap will involve reducing poverty, improving food distribution systems, and increasing food production.

The capacity to expand food production varies greatly within APEC and globally. While scope exists to expand arable area in North America, Oceania, and elsewhere in the world, there is little or no scope to expand arable area in many APEC economies, especially in the Asian APEC members. At the same time, agriculture will be facing stiff competition for land and water resources from industrial and residential uses. Accordingly, tapping the full potential of existing technologies and creating new production technologies, as well as exploiting the scope that exists in different parts of the region to use available land and water resources more efficiently, will be critical factors to sustaining food output growth, especially in the Asian APEC member economies.

There can be a long time lag before investments in technological innovations and in development of land, water and irrigation resources begin to show results. If investment in agricultural research, health, nutrition, education, and extension continues to be reduced, it could adversely affect the future world food situation. The needed investment must either come through the public sector, or the public sector must ensure an environment conducive to private investment.

Environmental problems will also affect the future food situation. Problems such as soil degradation and desertification, if unchecked, will constrain growth in agricultural production. Similarly, in the case of fisheries, efforts are required to halt the depletion of fish stocks through overfishing and habitat degradation to sustain future fish harvests. There is also a possibility that, over the very long term, global environmental problems, such as greenhouse effects, will have some impact on food production. These effects could be positive or negative, or more likely some combination of both depending on circumstances in various areas. Individuals, member governments, and domestic and international organizations need to find ways to reduce negative environmental impacts without unduly reducing food output or increasing food insecurity, and to enhance positive impacts on the environment – for example, through strengthened infrastructure.

For many APEC economies, the structural adjustments in rural or single industry communities that accompany economic growth and trade liberalisation involve resource movements out of the various food sectors. These movements have the potential to disrupt traditional societal norms and, given the particular external economies and diseconomies of agriculture, to create welfare gains and losses for different sectors of the economy. In this regard, it is noteworthy that the only economies that have substantially reduced rural poverty have created off-farm employment opportunities, either within the rural communities or in distant cities. Social and economic opportunity costs must be dealt with through the political process as economic growth continues and as APEC economies become more closely linked. An assessment of the

overall impact should include the ameliorating benefits that can accrue from strengthened economic cooperation among APEC economies.

Energy

Collectively, APEC member economies currently account for approximately half of global energy consumption. This share will increase if APEC member economies realize their economic growth potential. Over the period to 2010, growth in the APEC region is forecast to average 3.3 percent per annum, compared to 2.5 percent in the OECD. On this basis, growth in energy consumption in APEC is forecast to grow by 2.2 percent per annum, compared to only 1 percent in the OECD. In the newly industrializing APEC member economies, energy demand is projected to grow even faster at over 4 percent per annum, raising their share of the region's energy demand from less than 30 percent currently to 40 percent by the year 2010.

Currently, primary energy demand within APEC member economies is met by a combination of oil (38.7 percent), coal (31.7 percent), natural gas (17.4 percent), nuclear (7 percent) and renewable sources (3 percent). While the relative energy mix will change over the period to 2010, fossil fuels will continue to dominate the primary energy mix into the foreseeable future. Moreover, as member economies seek to limit dependency on imported oil, the share of coal in the primary energy mix is expected to stay the same or to increase.

Natural gas is critical to improving regional energy security and environmental quality. The APEC region is already a significant producer of natural gas and increased exploration and application of new technologies is likely to increase the resource base. A large number of APEC members are also significant users of natural gas, but the potential to increase use in the region is large.

Asia Pacific Energy Research Centre

Although some APEC member economies (Australia, Brunei, Canada, Indonesia and Malaysia) are net energy exporters, the Asia Pacific region as a whole is a net energy importer. Against this background, APEC Energy Ministers, at their first meeting in Sydney, August 1996, agreed that ensuring secure supplies of affordable energy was a key objective. Ministers further agreed that this goal would be best served by providing business and government policy makers with improved market information on regional energy supply and demand trends and endorsed the establishment of the Asia Pacific Energy Research Centre (APERC) in Tokyo.

The work of APERC is central to the FEEEP initiative. Its first priority is to develop a Regional Energy Outlook to the year 2010. This outlook is due for publication in early 1998, and will include:

- Analysis of the current situation and future prospects of supply and demand for oil, coal, natural gas, nuclear power, electricity and new and renewable energy sources;

- Energy demand analysis by sectors (industry, transportation, residential and commercial);

- Development of individual energy models (e.g., oil refining and oil trade flow models, coal flow models, electricity system models, and macroeconomic and input-output models); and

- Development of consistent, comparable energy data to support the studies described above.

Second Meeting of Energy Ministers

At their second meeting in Edmonton in August 1997, APEC Energy Ministers emphasized the importance of sustainable energy development to the long-term welfare and prosperity of the Asia Pacific region. Ministers further agreed that concerted efforts of the region's governments, in partnership with business and the broader public, are needed to facilitate the development of efficient and environmentally sound energy infrastructure, to promote energy efficiency and conservation, and to develop the region's indigenous energy resources, included renewable sources.

Ministers agreed that the Energy Working Group (EWG) was well advanced in responding to Economic Leaders' concerns in respect of the energy aspects of the FEEEP issue. Ministers highlighted the EWG's work in facilitating power infrastructure development; mitigating the environmental impacts of energy production and use; and improving energy security, particularly through the comprehensive energy outlook being produced by the APERC. Ministers also endorsed a number of initiatives which are integral to APEC's approach to addressing FEEEP issues:

- Ministers endorsed non-binding principles promoting transparency in institutional and regulatory structures. The principles, as set out in a *Manual of Best Practice Principles for Independent Power Producers*, cover institutional and regulatory structures; tender/bid processes and evaluation criteria; power purchase agreements and associated tariff structure; and financing and its implications. The implementation of the manual will facilitate the private sector investment needed to meet the burgeoning energy demand in the region.

- Ministers endorsed a set of non-binding principles promoting good environmental practices in the development of power projects, and agreement to consider incorporating them flexibly within domestic policy deliberations. Ministers also exchanged views on what constitutes good policy practice, including the principles identified in the report *Environmentally Sound Infrastructure in APEC* electricity Sectors, and referred the report to the EWG for further consultation, including with

the business community, with the aim of developing a work program to advance the recommendations.

- Ministers requested the EWG to prepare recommendations for their next meeting in Okinawa concerning the acceleration of investment in natural gas supplies, infrastructure and trading networks in the APEC region.

- Ministers approved an expanded work program on energy efficiency, including work to establish the basis for greater cooperation in energy standards in the APEC region aimed at improving efficiency in energy appliances, and to establish guidelines for energy efficiency.

Ministers further recognized the importance of accelerating action to deal with global emissions of greenhouse gasses. They noted that this important issue would be addressed in the Third Conference of the Parties (COP3) under the United Nations Framework Convention on Climate Change in Kyoto. Ministers agreed on the importance of the efficient use of energy and confirmed that enhancing energy efficiency is a key element in addressing climate change. They also noted the importance of developing market opportunities related to reduction of greenhouse gas emissions. Ministers also agreed to discuss at their next meeting the possibilities of a voluntary "pledge and review" system aimed at improving energy efficiency in APEC.

Environment

Environment Ministers at their meeting in Toronto in June, 1997, concluded that the entire APEC environmental agenda represents a response to FEEEP issues.

Ministers in particular noted that the health of the marine environment is crucial to economic and social well being in the region. They noted further that oceans and seas link APEC economies to one another and to the world. In this context, Ministers agreed to the Action Plan for Sustainability of the Marine Environment in the APEC region which has the following three objectives: (i) integrated approaches to coastal management; (ii) prevention, reduction and control of marine pollution; and (iii) sustainable management of marine resources. The APEC Marine Resource Conservation Working Group is principally responsible for carrying out this Action Plan through research; exchange of information, technology and expertise; capacity-building, training and education; and public-private partnerships.

The adoption of cleaner technology and process in industry is critical to environmental outcomes in the coming decades. New investment in industrial capacity in the Asia-Pacific region offers an opportunity to incorporate flexible and cost-effective environmental management techniques to achieve more sustainable industrial development. Environment Ministers therefore agreed to promote cleaner production in industry by identifying and expanding use of best practices, and establishing a cooperative agenda for technology diffusion with particular attention to the needs of

small and medium-sized enterprises. In particular, they identified the agricultural sector as an important area for implementation. In these regards, Ministers agreed to encourage the development and use of tools to facilitate cleaner production;

- Involvement and enhancement of science, technology and research networks;
- Development of capacity and mechanisms for sharing technical/policy information in areas such as application of environmentally sound management systems, including ISO 14000;
- Development of industrial environmental performance indicators;
- Wider dissemination of information electronically, including through the APEC Virtual Centre for Environmental Technology Exchange, and through the APEC Centre for Technology Exchange and Training for Small and Medium Enterprises;
- Accelerated flow of technology within the APEC region; and
- Promotion of demonstration projects in specific sectors.

The Industrial Science and Technology Working Group is primarily responsible for following through on the Cleaner Production Strategy over the next two years.

In view of the impact of the rapid growth of urban areas that is expected over the coming decades on the environment and on economic and social well-being, Ministers agreed that all aspects of urban planning and development must be people-centred and take into account environmental protection and economic and social considerations. Ministers placed special emphasis on pollution prevention and control, environmentally sustainable infrastructure development, addressing the needs of urban poor settlements and promoting their economic well being. Ministers agreed on a Program of Action on Sustainable Cities which identifies specific measures to:

- Bridge the knowledge gap;
- Encourage investment;
- Integrate the agendas of the public and private sectors;
- Draw on the creativity and knowledge of stakeholders, especially at the community level; and
- Enhance human well-being and quality of life.

Ministers specifically committed to working with others to double, by the year 2003, the current number of 170 APEC communities with Local Agenda 21 plans.

In view of all the environmentally-related work under way within APEC, Environment Ministers called for improved coordination to link and integrate the many sustainable development initiatives within APEC and, in particular, urged that environmental considerations continue to be addressed as an important cross-cutting element of the FEEEP initiative.

As did Energy Ministers, APEC Environment Ministers stressed the importance of the Third Conference of the Parties (COP3) at Kyoto for the Framework Convention on Climate Change. All APEC economies agreed to take steps to meaningfully address the

adverse impact of climate change. APEC Environment Ministers recommended further that Leaders send a strong message of support to ensure the success of the COP3 and achievement of the objectives of the Framework Convention.

Cross-cutting and integrative issues

To complement the work of the various APEC fora referred to above, which has focused principally on various aspects of food, energy and the environment, the Economic Committee has approached its task of undertaking overall responsibility for the FEEEP initiative by identifying and analyzing cross-cutting issues and themes that are common to all of the FEEEP areas. The Committee advanced its responsibilities by bringing together representatives of the APEC fora working on FEEEP-related issues, academics, government officials, non-government experts and business persons at a FEEEP Symposium that was held in Saskatoon, Canada, September 1-4, 1997.

The Symposium discussed each of the five FEEEP areas, then focused on possible ways and means that APEC member economies might have available to both manage complex systems and to respond to emerging FEEEP-related challenges. The discussion was organized in terms of four cross-cutting aspects of the FEEEP issues: technology, markets, governance and socioeconomic processes. The main themes highlighted at the Symposium were as follows:

- There was broad agreement that taking a systematic approach to the cross-linkages among the FEEEP elements added value to the more in-depth and specialized work currently ongoing within APEC on the individual issue areas.

- It was recognized that FEEEP outcomes will be influenced positively or negatively by the decisions and behaviour as consumers or producers of many groups within our societies, including member governments, local authorities, business leaders, the scientific community, but also individuals and communities in both urban and rural areas. Accordingly, there was broad agreement that managing the complex FEEEP challenges requires complementary engagement of markets, governments and the broader community. Further discussion is needed with respect to the appropriate roles of each and to their interaction. Given the diversity of APEC member economies, approaches, modalities and structures will vary.

- Information and knowledge relevant to FEEEP is critical for the development of incentive structures and sound policies. Relevant information can be tapped from various sources (markets, governments, and communities) and should be accessible to various actors. The scope of relevant information extends beyond traditional indicators to include ecological, social and management factors.

- Efficient markets play a critical role in allocating resources, establishing incentives for producers and consumers, and encouraging technological innovation. APEC's trade and investment and economic and technical cooperation agendas illustrate

critical areas where distortions can be reduced and the flexibility and responsiveness of markets improved.

- Market prices can best provide effective incentives for sustainable development if they fully reflect all costs and benefits, including costs and benefits that affect third parties ("externalities"). Where externalities are not reflected in market prices, governments must be alert to manage public goods and external factors that are beyond the scope of markets, and to nurture the development of markets by putting in place appropriate policies and incentive structures.

- A particular challenge for governments, markets and communities is to maintain social cohesion, particularly in light of the differentiated impact of economic development and growth on various social groups (e.g., women, segments of the labour force, dislocation of some rural communities) and the marginalisation of some of these groups in transition periods.

- FEEEP challenges must and can be addressed through initiatives and action at the individual economy level as well as at local levels. However, in some cases, international collaboration including through organizations such as APEC, will be necessary to complement member economies' own efforts to address FEEEP challenges.

Summary

As work has progressed over the past eighteen months, it has come to be widely recognized that the FEEEP initiative, by examining and highlighting the key potential constraints to, and opportunities for, sustained growth and equitable development in the region, is in effect providing a focused, forward-looking approach to sustainable development issues more generally.

While various aspects of the FEEEP nexus of issues are sensitive, the voluntary, consensus-oriented nature of APEC has allowed these issues to be developed constructively and creatively. The APEC approach has demonstrated the value of this type of dialogue as part of the array of mechanisms to advance cooperation within the region. While firm conclusions about the issues and policy implications have yet to be reached, the cautiously optimistic tone emerging from the first round of substantive work during 1997 is encouraging. At the same time, this work has focused attention on the importance of addressing issues with a broad, horizontal vision relating to the challenge of Sustainability, including developing food systems, putting in place the capacity to meet rising needs for energy in ways that protect the environment, and moving forward resolutely on key environmental issues of common concern.

The emphasis placed by participants at the FEEEP Symposium on the importance of economies being adaptable in order to cope with changing circumstances and emerging constraints and opportunities is an important conclusion that deserves further

exploration over the coming year, particularly the longer-term significance of education, accessibility to technology and accommodation to technological change, and institutional flexibility as keys to sustaining growth and development. APEC over the next year could, as part of the response to our Leaders, assist member economies by facilitating the collection and dissemination of information relevant to FEEEP, in particular lessons learned, case studies, and best practices with respect to addressing FEEEP issues while, at the same time, undertaking further analyses of emerging issues and setting out possible joint actions for Economic. Leaders to consider at their meeting in November 1998.

ANNEX 3

Notes and Statements submitted by participants

1) *Rice vs. Wheat: which is winning?,* Shoichi Ito, Associate Professor, Tottori University, Japan

2) Statement by JA Zenchu, Central Union of Agricultural Cooperatives, Japan

3) *APEC's Bridge to Food Markets*, Carole L. Brookins, World Perspectives Inc., USA

4) *The Gap between Food Production and Demand in China in 2000 & 2010*, Haifa Feng, China

5) *Environmental Crisis: Pressure, Rogue Waves & Responses*, Brian Hunter, CIDA, Canada

6) *FEEEP: An Evolving Integrated Assessment*, Rob Stranks, DFAIT, Canada

Rice vs. Wheat: Which Is Winning?[1]

Shoichi Ito, Ph.D.

Abstract: Rice is the major crop and food in Asia. During the last few decades, however, rice consumption in Asian economies has been on a declining trend, while wheat consumption has been increasing steadily. In terms of total consumption of rice and wheat in Asia, wheat used to account for less than 30 percent in the early 1960s but it increased dramatically to 40 percent in the early 1990s. Even in China, per capita rice consumption is already declining. If this trend continues, total rice consumption in Asia, which currently accounts for about 90 percent of the world rice consumption, may start declining soon forcing market prices to plunge. This may eventually force Asian farmers to reduce their rice production substantially and change the entire picture of agriculture in Asia. Can Asia afford it?

Introduction

Rice has been regarded as a sacrosanct food in most Asian economies. Total production and consumption of rice in Asia accounts for approximately 90 percent of the total amount produced and consumed in the world. However, per capita rice consumption in Asia has been on a declining trend and, in some Asian economies, total rice consumption has also been declining. On the other hand, per capita wheat consumption in Asia has been steadily increasing in both total and per capita terms. If these trends continue, they may cause serious agricultural problems in Asian economies.

Consumption of rice and wheat in Asia

Ito *et. al. (*1989) pointed out almost 10 years ago that, in an increasing number of Asian economies, per capita rice consumption was declining.[2] They found, using data from 1960 through 1983, that in Japan, Chinese Taipei, Malaysia, Thailand, Singapore, and even Nepal, per capita rice consumption was already declining and that other Asian economies were following the trend. In these economies, the income elasticities of rice were found to be negative, indicating that rice consumption declines as per capita income increases.

There are many factors along with economic development such as urbanization, modernization, prices of rice as well as increases in incomes, all of which are changing Asian people's palate. Egaitsu (1994) emphasizes, "Plant DES (dietary energy supply:

[1] Shoichi Ito is Associate Professor, Tottori University, Japan. This note was prepared for the FEEEP Symposium. The author is grateful for the assistance of Satoshi Watanabe and Keiji Takeuchi in preparing this note.

[2] Ito et. al. employed the following model: $Q= EXP(\alpha - \beta Y^{-1})Y^{-\chi} P^{-\delta}$
where Q is per capita rice consumption; Y is per capita real income; P is the real market price, and α,β,χ and δ are estimated coefficients. They used pooled data from Asian economies during 1961 and 1985.

food that is usable per capita per day converted to energy) reaches a peak at around the medium income level, although the animal DES increases in proportion to the level of income."[3]

Because of this phenomenon, total rice consumption in some Asian economies is declining. Around 1980, the only Asian economies with declining total rice consumption were Japan and Chinese Taipei; nowadays, South Korea and Cambodia have joined this category and China, Brunei, Indonesia, Singapore, Thailand, and Bangladesh are in close pursuit. Once per capita consumption starts to decline, total consumption can be increased only by a growth in population. In Asian economies during recent years, however, population growth has generally been quite well controlled even in the large-population economies such as China and India. Accordingly, it may not be so far into the future when China and India fall into this category, if this tendency does not change.

Meanwhile, wheat consumption in Asian economies has increased dramatically. Table I shows the difference in rice and wheat per capital consumption in Asian economies in 1985 and 1993. During this 8-year period, only a few Asian economies increased per capita rice consumption, while almost all showed an increase in per capita wheat consumption. Obviously, the relative shares of total rice and wheat consumption in Asia have changed over the years: where wheat accounted for less than 30 percent of the total in the early 1960s, by the first half the 1990s, it had increased to 40 percent. If this trend continues, wheat consumption may soon surpass the amount of rice consumption in Asia; then rice would no longer be the sacrosanct or staple food in Asia, but rather wheat.

Declining rice production in Asian economies

Up to the early 1980s, declining rice production was observed only in Japan and Chinese Taipei. In the 1990s, rice production has been declining in South Korea, where per capita rice consumption started declining in the mid-1980s.[4] In China, Indonesia, Bangladesh, and India, the rate of production increase is flattening indicating that rice production may start decreasing soon. According to our recent research in China, it was evident that declining rice production is not due to technical problems such as decrease in suitable land or a flattening in the increase of yields, but rather due to weak incentives to grow rice stemming from cheap market prices of rice.

Further weakening in demand would put additional downward pressure on market prices and lead not only to lower production but also to lower incomes for producers, less agricultural assets, harder life in rural areas, and migration to urban areas in Asia.

---

[3] Egaitsu, Norio: "Starvation" and "Gluttony" ("Kiga" to 'Houshoku"), Kodansha, Tokyo, 1994

[4] There are two more economies where rice production and consumption declined during the 1990s. In these economies, however, the decline may be due to domestic political conflicts and/or unfavorable weather. United States Department of Agriculture, Economic Research Service (USDA/ERS): PS&D View, April 1997.

World market prices of rice vs. wheat

Weakening market prices in individual economies will influence world market prices. It is well observed that world market prices of grain have generally declined substantially during the last three and a half decades due to improved technology. In fact, the real world market price of rice declined to a third of its former value during the last three and a half decades, while the real world price of wheat fell only to slightly less than half its former value. Thus, even though world production of wheat is increasing much faster than rice, wheat is still maintaining relatively higher prices than rice. Rice and wheat are substitutes for each other over time. Wheat is gaining an advantage over the weakening rice market in Asia.

Conclusion

Declining rice consumption may be a serious matter for most Asian economies. This may eventually lead to lower incomes and less value of agricultural assets in Asia reducing the attractiveness of agriculture as an industry. To avoid such a chaotic situation, it is important for Asian economies first to reorganize rice production to cut production costs to make rice more competitive with wheat. Second, it is important to develop processed food that uses rice as an input. In Asia, rice has been mainly consumed as table food, which limits the volume of rice consumed by individuals. To increase demand for rice, development of various types of processed food may be a key for the future. Third, more international marketing activities are needed. While U.S. rice growers are quite involved with these types of activities, Asian rice growers are lacking the same initiative. In the long run, rice market promotion should be conducted in non-rice eating regions such as Europe and the former Soviet Union in particular. The declining trend of rice consumption in Asia is very steady. Unless Asian economies take serious measures, this trend will only get stronger.

References

1. Egaitsu, Norio: “Starvation” and “Gluttony” ("Kiga" to 'Houshoku"), Kodansha, Tokyo, 1994.
2. United States Department of Agriculture, Economic Research Service (USDA/ERS): PS&D View, April 1997.
3. Ito, Shoichi, E. Wesley F. Peterson and Warren R. Grant: "Rice in Asia: Is It Becoming an Inferior Good?," *American Journal of Agricultural Economics*, Vol. 71, 1989, pp.32-42.

Table 1
Per Capita Consumption of rice and Wheat in Asian Economies, 1985 and 1993

Economies	Rice Consumption per capita			Wheat Consumption per capita		
	1985	1993	Change	1985	1993	Change
East Asia						
China	110	106	-12	71	73	2
Hong Kong, China	66	68	2	36	57	21
Japan	81	75	-6	41	42	1
Macao	64	n.a.	n.a.	n.a	n.a	n.a.
North Korea	157	50	-107	36	6	-30
South Korea	136	119	-17	61	77	16
Chinese Taipei	100	70	-30	31	34	3
Southeast Asia						
Brunei	109	112	3	n.a.	n.a.	n.a.
Myanmar	238	184	-54	5	4	-1
Indonesia	152	170	18	6	15	9
Cambodia	150	167	17	5	n.a.	n.a.
Laos	228	163	-65	n.a.	n.a.	n.a.
Malaysia	105	84	-21	31	42	11
Philippines	102	101	-1	12	25	13
Singapore	75	82	7	46	51	5
Vietnam	170	188	18	8	5	-3
Thailand	157	149	-8	3	9	6
South Asia						
Afghanistan	23	16	-7	191	70	-121
Bangladesh	153	150	-3	17	17	0
India	79	85	6	46	51	5
Nepal	104	100	-4	28	32	4
Pakistan	22	18	-4	103	113	10
Sri Lanka	119	107	-12	33	40	7

Source: For consumption data, USDA/ERS PS&D View; for population data, IMF International Financial Statistics, and FAO Production Yearbook .

Statement by JA Zenchu,
The Central Union of Agricultural Cooperatives
Tokyo, Japan[1]

We are grateful to the organizers of the FEEEP Symposium for providing us with this opportunity to discuss and analyze some of the most important trends and forces that will be shaping our collective future, and how we may most effectively meet the challenges that lie ahead. We believe that it is vital that the views and experiences of family farmers, who feed the vast majority of the world's population, be taken into consideration in this Symposium.

1. Food security will be humanity's greatest challenge in the 21st century

As has been well documented, the twin forces of economic and population growth will have a profound impact on the world's demand for food. According to United Nations forecasts, the earth's population in 2050 will reach 10 billion, an increase of 4.2 billion people. This is far greater than the increase experienced over the past 40 years, when we added approximately 2.8 billion people to our earth's population.

The Food and Agriculture Organization of the United Nations estimates that 840 million people, nearly 15 percent of the world's population, are currently suffering from chronic food insecurity. Given that we do not have the ability to adequately feed our planet's current population, it will be a profound challenge to find the resources to feed these far greater numbers of people in the years ahead.

The burden on our planet's resources will be increased by the influence of economic growth, particularly in the APEC countries. It is a well documented trend that people's tendency to eat meat increases with their income. In Japan, for example, per capita meat consumption increased from 9 kg to 30 kg in the past three decades. Given that it takes 840 pounds of grain to produce one pound of beef and 6 pounds of grain for one pound of pork, rising meat consumption will lead to sharply increased demand for feed grains.

We are also beginning to reach the limits of our ability to expand farmland. Urbanization and population growth are destroying hundreds of thousands of hectares of prime farmland worldwide every year. Even if new resources can be developed, the addition of 90 million people per year to the earth's population will steadily reduce the amount of farmland per capita.

Some more optimistic observers believe that increased use of fertilizers and agricultural chemicals in developing economies will increase crop yields, and avert potential catastrophes. However, it must be pointed out that most developing-economy farmers

[1] JA Zenchu is the Central Union of Agricultural Cooperatives. It represents the five million family farmers of Japan. It is located at 8-3, Otemachi 1-chome, Chiyoda-ku, Tokyo 100, Japan. Phone: (81-3) 3245-7550; and facsimile: (81-3) 5255-7357

lack the resources, purchasing power, or infrastructure to make use of this technology. Furthermore, declining availability of water resources is calling into doubt the water-intensive crop production strategies that have been chosen by many countries.

Biotechnology is also frequently hailed as a potential source of dramatic increases in crop yield growth. However, we would caution against excessive optimism. Although biotechnology holds great promise, its ability to greatly increase crop yields remains to be seen. Thus far, biotechnology has been applied mainly to high-value crops in developed economies, but not for the staple crops that are consumed by much of the world's population.

Given that there is no easy method of increasing food production, solving the dilemma of food insecurity will become one of the primary challenges that lies ahead of us as we approach the 21st century. In light of this fact, we strongly recommend that the APEC governments work to maintain production on existing farmland, to preserve the long-term viability of this essential asset.

2. The market is not a panacea

One of the main objectives of APEC is to promote trade liberalization between economies of the Asia-Pacific region. As citizens of an economy that imports a large proportion of its food needs, we understand and appreciate the importance of agricultural trade. However, we also firmly believe that wholesale liberalization of agricultural trade will not solve the problem of food insecurity. There is widespread support for maintaining domestic production of the basic crops that form the staples of our peoples' diet.

We believe that every economy must maintain a diverse range of sources for its food supply, including imports that are purchased from a wide number of economies, and domestic production.

Surplus food production is highly concentrated. Virtually all of the world's food exports come from a small number of economies. A poor harvest in only one or two of these economies could lead to severe price shocks and shortages – as was clearly demonstrated last year. The probability that a major crop failure can occur, and that it can have widespread international repercussions, has increased in recent years, for several reasons:

- Most farmers in large exporting economies purchase their seeds from a small number of large seed companies. As a result, their crops are genetically identical, and are susceptible to the same diseases and pests. Crop blight can thus devastate huge expanses of cropland in only a few weeks.

- The dispute over the so-called greenhouse effect continues. However, all observers agree that weather patterns have clearly become more volatile over the past decade. This, too, makes harvests and grain supplies more volatile.

- Governments have sharply reduced their grain stock holdings over the past five years. Global grain stocks have hovered at historically low levels for the past three or four years, greatly magnifying the impact of any supply shocks.

We firmly believe that wholesale liberalization of agricultural trade will not only fail to increase food security, but that it is actually more likely to harm it. International commodities markets were not designed to serve as a means of providing food to regions that are most in need of supplies. Instead, they are a mechanism for balancing between the productive capacities of food-exporting economies, and the purchasing power of food-importing economies. Markets will not take into consideration the hunger and suffering experienced by the people of a famine plagued economy, but only their ability to pay.

3. Respect the multifunctional role of agriculture and family farms

Another reason why markets will not solve the world's food security problems is the fact that agricultural production is far more than a simple economic activity. Agriculture is a central part of any country's social and cultural fabric. In economic terms farming creates many "positive externalities" – public benefits for which farmers do not receive any payment.

Central among these is the environmental contribution of farmers. When carried out in a sustainable manner, farming preserves and maintains the long-term productive value of the farmland and the ecosystem in which it exists. The family farm system of agriculture has been the basis of sustainable agricultural production for thousands of years.

In Japan, for example, rice is grown by family farmers on hundreds of thousands of small paddy fields. These rice paddies play a vital role in preserving the land and environment, and in managing our economy's water supply. The paddy fields act as dams, preventing flooding during the rainy season, and storing water for future use.

Wholesale trade liberalization would force millions of family farmers around the world out of business. It is an almost universal rule that, once agricultural production on a plot of land ceases, it will never resume. Nobody has ever torn down a house, or torn up a highway to plant a field of rice.

4. Establish a new agricultural trading order

Given that international trade, by itself, cannot solve the problems of food insecurity, and because unrestricted liberalization would destroy the many functions of agriculture that are not valued by the marketplace, we believe that a new agricultural trading order needs to be established.

In essence, the goal of the FEEEP Symposium is to discuss how we can preserve the earth's productive capacity for future generations. The most basic resource that we have

is our planet's increasingly scarce farmland. In light of the tremendous demands that will be made upon this resource in the years ahead, we firmly believe that it is vital that a new system of rules for agricultural trade be established that would take into consideration the full value of the farmland and of the services that are provided by the farmers, rather than simply the price of the food that they produce.

The FEEEP Symposium has provided us with an opportunity to talk about these important topics. We strongly urge the governments of the APEC member countries to consider our proposals, and to put them into action.

APEC's Bridge to Food Markets:
Building an APEC Food System and Reducing Rural Poverty

Carole L. Brookins[1]

Introduction

Globalization and global interdependence are the themes most dominant in our economic system as we approach the 21st Century. Agriculture is essential to supporting life and is thus the most critical component of economic life. As such, the sustainable development of a modem, viable global food system presents the most important challenge to improving life for all people on the earth.

Traditional policy has tended to utilize agricultural production and price support mechanisms as the primary means of improving living standards in rural regions around the world. The terms "rural" and "agriculture" are often used interchangeably when referring to economic benefits for the non-urban population.

Moreover, the traditional policy framework typically isolates the consideration of "agriculture" in the national and global economy, despite the fact that it is one of the most highly integrated and inter-dependent economic sectors when considered in the full context of the food system.

The food system includes the factors of agricultural production that generate food supplies, the industries that provide farm inputs, food processing, and the wholesale and retail food distribution chain. But the food system also includes the social and economic factors that impact "food producers" in rural areas and their families.

The modem information age's technological revolution is changing the content of the entire global food system – from biotechnology in production to global sourcing of inputs and marketing of consumer food products, to expanding the potential for diversified employment and investment creation in rural regions around the world.

The goal of APEC should be to bring the health and food security benefits of the modem global food system to every man, woman and child living in the 18 member economies, and from there to the entire world. This goal obviously has many policy dimensions, and the development of an integrated food system requires a cross-disciplinary integrated set of responses.

As the 21st Century draws near, we must ask questions today that are relevant to achieving our goal. We must challenge long-standing theories that have been at the basis of policy development, but have not brought the desired effects to our rural

[1] Carole Brookins is Chairman and CEO, World Perspectives, Inc., 1150 18th Street, NW, Suite 275, Washington, D.C. 20036 USA. Ms. Brookins also chairs the PECC Food and Agriculture Forum.

residents. One of those "false" beliefs is that per-unit price supports and high walls of agricultural trade protectionism at borders would enrich rural residents.

This legacy of 20th Century agricultural trade policies was grounded in misguided market economics that will not achieve our goal of feeding more than 6 billion people at the birth of the millennium and 10 billion by 2050; nor will it reduce the poverty and inequality that is characteristic of rural areas.

The following points present a new way to approach this nexus of issues:

- Rural populations – both on and off farms – will receive the benefits from globalized markets only if they are able to participate competitively in those markets.

- Infrastructure – not agricultural price policy – is the most critical priority to giving rural residents a stake in the global economy and to giving farm producers a position in the global food system.

- Rural infrastructure should not be viewed in isolation. Modern technology provides the innovations that can more equitably create seamless links of rural areas to national and global markets.

- Public and private investment and public policy need to work hand in hand to support the infrastructure development that builds the required human and physical capital to allow the simultaneous flow of market benefits to and from rural to global.

The World Bank recently published a study focusing on the development of East Asia, "Everyone's Miracle?: Revisiting Poverty and inequality in East Asia". This study highlights specifically the growing inequality in poverty reduction between rural and urban populations. The authors' findings included the following:

> "East Asian poverty remains principally a rural phenomenon, and it continues to affect farmers and the uneducated disproportionately."
>
> "That disparity in the spatial distribution of economic prosperity, which can be measured across regions or between urban and rural areas in many economies, is rising."
>
> "Growth in rural non-farm employment opportunities has been a major feature of rural income growth, helping to absorb workers from lower-productivity farming."
>
> "Rural infrastructure both provides employment... and reduces the cost of rural commerce."

The purpose of this discussion paper, therefore, is to build a conceptual framework for linking national food system infrastructure development in the APEC region to the APEC 2010/2020 commitment of creating an APEC food market, or an APEC of "Food without Borders".

Food without Borders

The APEC region occupies the dominant position in the world economy, regardless of what measurement that is adopted – population, purchasing power, share of total GDP, trade flows.

However, the food sector is still relatively closed in many cases and the benefits of an open and integrated APEC food system are yet to be realized. Without an open APEC food system, both regional and global economic performance will be restrained and distorted.

What would it take to unleash the full benefit to mankind of a totally open and integrated global food system?

Just as there is the valuable French medical aid unit called 'Medicins sans frontieres" ("Doctors without Borders"), APEC should set a goal of "food without borders".

Every agricultural producer would like to capture a competitive position in the global food system moving into the 21st Century. Growth in consumption of farm/food products will be rising with populations and incomes.

However, decisions we make today in trade policy will determine:

- whether agricultural trade will account for a larger share of total food consumption;
- whether agricultural resources will be used more or less efficiently; and, as a result,
- whether agriculture will contribute to the positive growth of global GNP.

In order to achieve "food without borders", no trade policy is more important than the commitment to food security on a non-discriminatory basis by the world's agricultural exporting economies. APEC's agricultural exporters should take a lead even before the WTO resumes agricultural negotiations in 1999 by committing to give importing economies equal access to supply and by pledging non-discrimination in their treatment of foreign and domestic buyers in times of short supply.

The Uruguay Round Agricultural Agreement's Article 12 which covers trade restrictions and prohibitions does not go far enough to provide importers with confidence in their access to necessary products. The world needs to be know that all exporters will be "reliable suppliers" and APEC should put this commitment as a priority for an "early harvest" achievement.

Ending Agricultural Apartheid

In achieving the goal of a global food system we face strong opposition from those who profess to be staunch supporters of agricultural producers. These defenders against trade argue that agricultural markets cannot be opened without hurting farmers. Agriculture, they say, is too difficult and too sensitive politically. They argue that farming is not like the rest of the economy and that only by maintaining high internal commodity prices through high border protection can economies support the social structure of rural areas.

The history of the past fifty years tells a very different story. We have, in fact, imposed a great burden and great cost on the rural citizens of our nations by maintaining agricultural policies to support the price per unit of commodity production. We have applied rules to agriculture that were totally contrary to market fundamentals.

We took these actions for the alleged purpose of bringing prospect to rural and farm populations. The result has in many cases been just the contrary. The world has, in fact, practiced what I would call "agricultural apartheid" – enforcing policies that have attempted to keep the agricultural sector separate and outside of the dynamic market economy's opportunities and full benefits.

While not deliberately malevolent, the effects have been to harm rather than to improve the lives of rural residents. Rather than enriching rural residents, we have created in many economies a permanent under-class. Industrial economies have enacted policies to support prices of commodities with strict government controls that restricted flexibility in production and markets; developing economies have often sought to maintain low food prices, which have had an equally devastating effect.

By supporting prices, rather than supporting infrastructure development, we have not allowed rural residents to competitively participate in national and global markets. The result has been a negative impact on environment and social instability through accelerated urbanization.

By denying a basic modem infrastructure to rural societies, we have driven young people to cities in record numbers. That outward migration is growing geometrically as people all through the developing world seek to participate in the wealth creation brought about by the globalization of the industrial economy and made possible by the technological revolution – particularly information technologies.

Why are they fleeing their families and communities? Because they cannot better themselves by staying at home.

The 20th Century myth is that trade liberalization is the biggest threat to farmers' incomes. In fact, many farm producers today are unable to compete effectively and receive a reasonable price for their output in their own domestic markets, because they have no efficient means to transport their production to market, to retain product quality. Or, in many cases, they don't even know what price their goods would bring.

The truth is that the lack of modern infrastructure development building bridges between rural and urban areas has prevented rural residents from participating fully in their national economy and the global economy. This has led to a widening poverty gap that is the real threat to agricultural producers and their families and communities as we approach the 21st Century.

Food System Infrastructure's Economic Benefits

The traditional approach to agricultural infrastructure has been focused primarily on farm production inputs, irrigation and rural roads.

A modem food system infrastructure, in contrast, gives agricultural producers the ability to competitively market their products in national and international markets. Conversely, a modem food system infrastructure gives distributors of processed foods the ability to sell their products throughout the national marketplace. A modem technological infrastructure is critical to farm producers and consumers, by allowing the processing and delivery of the same safe, quality, diversified food products to consumers in both urban and rural areas.

Moreover, the benefits of building infrastructure linkages that bind rural agricultural societies to the mainstream economy extend beyond marketing opportunities for the food industry sector.

A modem food system infrastructure permits expanded job creation in rural communities, by providing the technological "backbone" or capacities that permit businesses to operate outside of major urban centers. This gives members of farm families the opportunity to earn wages from off-farm employment in a diversified industrial and service sector expansion which benefits the rural region, and reduces its income dependence on basic agricultural commodity prices and productions.

Trade agreements are only one variable in market building. Infrastructure expansion is an even more critical force that must be addressed.

What is that infrastructure? Viable modem roads and transportation modalities, telecommunications, power generation, sanitation of water and sewage treatment, education, health care and access to finance – all are critical to expanding the benefits of the modem food system to every citizen on this planet – and to bringing the benefits of competing in the global economy to every farm producer.

FEEEP's Role in the APEC Food System Infrastructure

APEC's FEEEP initiative has a critical role to play in providing the impetus to bring rural and agricultural residents into the mainstream of economic life through infrastructure development. Integrating rural regions into an APEC food system would:

- Improve production efficiencies and resource utilization to improve the level of sustainable farm and food production.

- Improve per capita economic growth rates through diversified business activity.

- Expand the creation of competitive investment in business outside of urban mega-cities.

- Reduce the growing living standards gap between rural and urban populations.

- Reduce the environmental and social crises straining the infrastructures of over-populated urban "mega-cities".

U.S. Trade Ambassador Charlene Barshefsky recently quoted a study that estimated that consumers around the world would save US$ 1 trillion by the year 2010 from lower trade barriers under the Telecommunications Agreement.

By comparison, consumers in OECD economies alone are paying an estimated $190 billion annually more of their income for food due to agricultural protection than they could be spending. Accordingly, if we were to totally open food markets, we would save $1 trillion over 5 years in developed OECD economies alone. And when the cost of agricultural protection throughout the world is taken into account, the numbers dwarf the telecommunications savings.

Trade negotiators are focused on opening markets at borders. But, simultaneously, we need to open markets to rural residents within economies by developing the food system infrastructure.

We could be building a bigger and wealthier food system if we were to direct a percentage of the money we save from reduced protection to building the infrastructure bridges that connect rural economies to national and global markets.

We should be enabling rural and farm families to diversify their sources of income, including policies and development assistance that expand investments in agricultural processing and food production, in non-agricultural industrial and service businesses and in education and training.

APEC, in its FEEEP initiative, should consider directing resources to examining the factors, costs and benefits of more fully integrating agricultural producers and rural residents into the global economic mainstream This analysis should engage not only

agricultural and rural policy officials, but should be a cross-disciplinary exercise engaging both private and public sector officials involved in areas of economic activity that comprise the necessary macro- infrastructure base.

Concluding Summary

In conclusion, without adequate modem infrastructure linking rural areas to urban and international markets, we will slow down demand growth, income growth and support for trade liberalization.

We have the opportunity to enter the 21st Century with a commitment to build a global food system. The greatest threat we face is that we will not learn from our past experience.

If we want a world of "food without borders", we must end agricultural apartheid and bring the benefit of globalized markets to all the people who produce the food that sustains human life on this planet.

The Gap between Food Production and Demand in China in 2000 & 2010

Haifa Feng, Ph.D.[1]

Introduction

Since the publication of Lester R. Brown's book, *Who Will Feed China,* by World Watch in September/October 1994, the issue of whether China could feed its people in the next century has caused worldwide concern. More and more people in China and outside China are interested in China's future food situation. Some of them, especially economists, have put and are putting a part of their time into research on this issue, and many opinions, some of them being similar and some of them being very different, have been produced. There have been arguments among economists, particularly between Chinese economists and foreign economists, with the key point of these arguments being how large the gap between food production and demand will be in China in the next century.

It is easy to understand why the issue of China's future food situation has become a worldwide one. China is a big economy with more than 1.2 billion people which is about one-fifth of the current world population. With an annual increase of 13 to 14 million people, which is approximately equivalent to the total population of the Netherlands, China is expected to reach 1.3 billion people by 2000, 1.4 billion by 2010, and 1.6 billion by 2030, which is projected as China's peak population. Meanwhile, China's economic reforms have brought about accelerating economic growth, with GDP increasing at an annual rate of more than 10 percent since 1980, which has raised disposable income per inhabitant considerably. As income increases, people adjust their food consumption structure, eating more meat and other animal products, and allocating their marginal income for these products. This has become a fact in China now. So it is obvious indeed that China will need more food not only to feed its increased population but also to raise its people's living standard in the future.

Another main reason is that China is becoming an important player on the world market. Owing to the open-door policy since 1979, China has become more and more active on the international trade arena and increased its integration into the global economy. The world market has now become a major tool for China to balance its supply and demand of food. In this policy environment, if China has a gap between food production and demand, it will make up the gap by importing food rather than by imposing food consumption quotas as it did before; and if the gap is large, China's food imports could impact on the price of food commodities on world markets.

[1] The author is Professor and Assistant Director General in the Agricultural Economics Research Institute in China. Mr. Jaap Post, Head of the General Economics and Statistics Division of LEI, is gratefully thanked for his constructive revision and comment.

If China's food gap were to grow as projected by Lester Brown, it could indeed have disastrous consequences for world food markets. So in my opinion a smaller gap between food production and demand in China would be better than a bigger one for the world economic development and stability. However, I do not agree with Brown's conclusion. According to the past trends in China's economic development, it is sure that there will be a gap between food production and requirements in the future; however, the gap is not likely to be as large as Brown projects.

In this paper, I will review briefly the results of some research commissioned by China's Agricultural Ministry, which I coordinated from January to October 1996. Future food demand is discussed first, followed by perspectives on food production. We then consider how large the gap between food production and requirements will be and estimate China's likely share of world cereal imports. Some measures for China's food and agriculture development are proposed in the last part.

Future Food Demand In China

Food includes grain food (e.g., bread and rice) and non-grain food (e.g., meats, edible plant oil and fruits). These are considered separately.

Grains

Grain, as the term is used in China, consists mainly of cereals and pulses. However, yams (potato, sweet potato and cassava) are also included, being counted into this category in the proportion of 5:1.

Grain is still the most important foodstuff in Chinese diets, especially in rural areas. The national annual average direct grain consumption per capita is 102 kg in urban areas and 257 kg in rural areas, for an overall average of 215 kg. Grain is also an important input for production of non-grain foods such as meat, egg, milk and fishes. If consumer demand for meat rises, much more grain will be needed. So grain is the key food in China, and most concerns about China's future food situation are focused on grains.

Generally speaking, grain demand can be divided into two parts: direct demand and indirect demand. The former is the direct consumption of grain in the way of grain food such as bread; the latter is derived from demand for the meat and other animal products for which grain serves as input. Seed grain demand (which is nearly constant from year to year) and industrial demand not for food processing, which is negligible, may also be included in indirect grain demand.

Population growth and income increase are the two most important factors determining China's grain demand in the future.

Population growth has thrown, and will continue to throw, many obstacles in the way of China's economic development. One hundred million people will be added to China's population by the year 2000 compared to 1995 and another one hundred million will be

added in 2010 compared to 2000. Based on the level of direct grain consumption per capita at the beginning of 1990s, this population increase alone would increase direct grain demand by about 23 million tons in 2000 and 46 million tons in 2010, compared to 1995. Feeding so many people will not be an easy job for China.

Another challenge is coming from the increase in incomes. As income rises, one of the first things that low-income people do is to alter their diets, shifting from direct consumption of grain food to more meat and other animal products. During the ten years from 1981 to 1991, meat (pork, beef, mutton and poultry) consumption per person year increased 4.1 kg in rural areas and 6.1 kg in urban areas. Given an average of 4.5 kg of additional grain as input for each kg of meat produced in China, this rise in meat consumption increased indirect grain demand per capita by 21 kg in 1991 against 1981. As incomes in China rise further, these trends will continue and, in fact, indirect grain demand is likely to be the leading factor in determining total grain demand in China.

Taking the above factors into full account, using the Urban–Rural Structure model, we have projected the Chinese grain demand future as follows:

Table 1
Projected Grain Demand in China, 2000 and 2010

Projected Grain Demand in China	Year 2000		Year 2010	
	millions of tons	% of total	millions of tons	% of total
Total	512.96	100.0	580.23	100.0
By End Use				
- Direct	299.15	58.3	313.46	53.7
- Indirect	213.81	41.7	266.77	46.3
- of which: feed	156.48	(30.5)	201.52	(34.7)
- of which: other	57.33	(11.2)	65.25	(11.6)
By Category of Grain				
- Rice	189.20	36.9	197.13	34.0
- Wheat	125.80	24.5	142.94	24.6
- Corn	122.43	23.9	154.44	26.6
- Other	75.53	14.7	85.72	14.8

It can be seen clearly from the above results that there will be two notable trends as total grain demand expands:

- The share of feed grain demand is projected to rise by more than four percentage points over the period to 2010 while the share of food grain demand falls commensurately.
- The share of corn demand is projected to rise to nearly 27 percent of the total in 2010.

Other food

The same method as the above is used to project demand for other non-grain foods in China with the following results:

Table 2
Projected Demand for Other Foods in China, 2000 and 2010

Projected Demand for Other Foods	Year 2000	Year 2010
	millions of tons	millions of tons
Total Meat	57.12	79.56
- Pork	(41.51)	(57.47)
- Beef and Mutton	(7.22)	(12.01)
- Poultry	(8.39)	(10.08)
Edible Plant Oil	10.38	13.09
Sugar	9.92	14.30
Eggs	18.96	25.43
Milk	7.59	10.95
Fish and other Aquatic Products	27.42	39.21

Food Production Perspectives In China

Grains

There are many factors which influence China's food production, with the availability of arable land area, the price of grain purchased by the government on a compulsory basis from farmers, and the investment level in agriculture being in my opinion the three most important factors.

Arable land is with no doubt the most vital resource for grain production. China has a vast territory, including currently more than 95 million hectares of arable land. This is large in absolute terms but very small in per capita terms. In fact, arable land area per person is less than 0.08 hectares below the world average level. By comparison, the territory of the United States is only a little smaller than that of China, but it has twice as much arable land and its per capita average is nine times that of China. So it is difficult for China to produce sufficient grain to feed its people.

An even more challenging factor is that many farmlands are becoming occupied by non-agricultural industries. Arable land was reduced by more than 17 million hectares over the period of 1957-1994, or an average loss of 470 thousand hectares a year. As the development of non-agricultural industries accelerates, the transformation of arable land to industrial land will continue. It is projected that 150 thousand hectares of farmland will be lost per year in the next fifteen years. The downward tendency of arable land will be the most serious threat to the future domestic food supply in China.

The price of grain is another problem. The government is a key purchaser, buying grains to provide grain food for urban people and some other social uses as well as to store. These purchases are made, however, not from the market, but directly from the farmers at a rather low price. Table 3 shows the margins between the government price and the market price in the period of 1991-1994. One can see that the government price is lower than the market price almost all the time and in some cases less than half of the market price. Because of the low price, farmers are disinclined to sell their grain product to the government; the compulsory nature of these purchases is therefore inevitable. Moreover, the low prices do not stimulate farmers to raise yields and improve productivity.

Table 3
The Margin between Government Purchase Prices & Market Prices, Chinese Yuan per Kilo

	Rice	Wheat	Corn	Soybean	Rice	Wheat	Corn	Soybean
	Government Purchase Prices				Market prices			
1991	0.51	0.51	0.69	0.88	0.83	0.72	0.60	1.46
1992	0.55	0.59	0.46	0.91	0.99	0.90	0.63	1.81
1993	0.62	0.66	0.42	1.04	1.23	1.11	0.73	2.44
1994	0.89	0.89	0.38	1.54	2.10	1.82	1.01	2.80

Source: China Agricultural Development Report '95.

A third issue is inadequate investment in agriculture. As described above, farmers do not have enough incentives to invest more money on grain production; nor do they have the resources. Although the government, especially the central government, is trying to increase agricultural investment and has increased the volume of government agricultural investment in absolute terms, the proportion of agricultural investment in the total government investment has gone down in recent years. Local governments meanwhile apply most of their money to the non-agricultural industries where the profits are greater. As it will be impossible to raise grain production capacity and to modernize agriculture without significant investment, the lack of investment will be the major bottleneck to grain production in China.

Taking the above factors into account, China's grain production prospects can be projected as follows with the Simulation Model:

Table 4
Projected Grain Production in China, 2000 and 2010

Projected Grain Production in China	Year 2000		Year 2010	
	millions of tons	% of total	millions of tons	% of total
Total of which:	490.48	100.0	551.56	100.0
- Rice	190.61	38.9	199.48	36.2
- Wheat	111.12	22.7	126.56	22.9
- Corn	115.63	23.6	141.80	25.7
- Other	83/12	14.8	83.72	15.2

Other food

The same method as above is used to project production levels for the other food commodities. This yields the following picture.

Table 5
Projected Production of Other Foods in China, 2000 and 2010

Projected Production of Other Foods	Year 2000	Year 2010
	millions of tons	millions of tons
Total Meat	58.56	69.59
Edible Plant Oil	7.80	9.50
Sugar	9.92	12.00
Eggs	18.05	20.09
Milk	8.35	11.81
Fish and other Aquatic Products	28.33	39.39

Future Food Gaps In China

Based on the above supply and demand projections, China's food gaps by commodity can be derived. It can be seen that the grain gap will widen between 2000 and 2010 but will remain less than 5% of demand, much less than the gap projected by Lester Brown.

Table 6
Projected Gaps in Grain Supply and Demand in China, 2000 and 2010

Projected Gaps in Grain Supply and Demand	Year 2000		Year 2010	
	millions of tons	percent of total demand	millions of tons	percent of total demand
Total of which:	-22.48	4.38	-28.67	4.94
- Rice	+1.41		+2.35	
- Wheat	-14.68		-16.38	
- Corn	-6.80		-12.64	
- Other	-2.41		- 2.00	

The shares of each grain imports in the total imported grain amount to.

Table 7
Projected Share of Grain Imports in China, 2000 and 2010

Projected Share of Grain Imports in China	Year 2000		Year 2010	
	millions of tons	percent of total grain imports	millions of tons	percent of total grain imports
Total of which:	22.48	100.0	28.67	100.0
- Wheat	14.68	61.5	16.38	52.8
- Corn	6.80	28.5	12.64	40.7
- Other	2.41	10.0	2.00	6.5

We can see from the above shares that the largest grain gap in the future in China will be the wheat gap, but the corn gap will widen the most, reflecting its role as feed for raising animals to meet the growing demand for meat and other animal products as described above.

Other Food

Apart from edible plant oils, there are small surpluses in non-grain food projected in China over the next decade or so.

Table 8
Projected Gaps in Supply and Demand of Other Foods in China, 2000 and 2010

Projected Gaps of Other Foods	Year 2000	Year 2010
	millions of tons	millions of tons
Total Meat	+1.44	+0.03
Edible Plant Oil	-2.58	-3.59
Eggs	+1.09	-1.51
Milk	+0.76	+0.86
Fish and other Aquatic Products	+0.91	+0.18

The proportion of Chinese Grain Import in the World Market

China needs to import grain especially wheat and corn to balance its grain supply and demand in the future. This has raised concerns as to the possible impact that China's grain imports will have on the world markets.

According to my projections, world grain production will increase at an average annual rate of 1.8 percent over the 15-year period 1996-2010, including by 2.0 per year in the first five years of this period, 1.8 percent per year in the second five years and 1.6 percent per year in the third five years. Under this scenario, world total grain production will reach 1,958 million tons in 2000 and 2,342 million tons in 2010. Assuming that about 14 percent of production is traded, world total net trade volume of grain could reach 274 million tons in 2000 and 328 million tons in 2010.

Under this scenario, China's grain gap would represent less than 10 percent of world total net grain trade volume; in fact, only about 8.2 percent in 2000 and 8.74 percent in 2010. These figures do not suggest that China's grain imports will have major impacts on world grain markets – China will not starve the world!

Further Observations on Future Food Gaps

The gaps projected above are reasonable if we look back over the history of China's grain production and imports. Reviewing the past is helpful to understand the future.

China was a net exporter of grain during the 1950s. However, since the 1960s, China has become a net importer of grain. Nonetheless, the dependence of China on the world market has been small because the grain deficits have been relatively small. The ratio of net grain imports to total grain production in China has trended downward since the end of the 1970s. In fact, this ratio fell from an average of 3.2 percent during the period 1978-1984, to 1.2 percent during 1985-1990, and further to 0.4 percent during the period 1991-1995. As a proportion of total grain consumption, imports of grain have been only about 0.5 percent on average since 1984.

However, taking all food production into account, China is a net food exporter: total food exports were US$75.6 billion and total food imports were only US$ 34.0 billion during the eleven year period 1985-1995.

According to the historic trend, it is unlikely that China will become a much bigger buyer of grain in the world market in the next fifteen to thirty years, and the gap of about 5 percent shown above is credible.

Some Measures for Agricultural Development in China

Although I have shown an encouraging picture of the future food situation in China, there is much work to do to realize this outcome and the road to this goal is uphill, not flat. Indeed, if China's government does not do its best to promote agricultural development, it would be not impossible for a bad situation is to emerge.

Generally speaking, China's agricultural production remains in traditional modes with most of the farm work in most rural areas done by hand and not by machines. It is undoubted that China's agriculture needs to be modernized or that the future economic development of China needs a modernized agricultural sector as a solid foundation. The experience of world economic development has shown that it is not possible for a powerful economy to be based on a weak agricultural sector. So if China intends to develop its economy rapidly, more attention must be paid to agriculture to modernize agricultural production in the next decades. There are many things that need to be done by China's government; the following are several aspects that in my view should be at the top of the list.

First, the government has to adopt effective measures to protect arable land. Although the reduction of farmland is inevitable in the course of modernization because of the demand for land for new highways, railways, airports, houses, recreational areas, and so on, there are some possibilities to do the work better. For example, a great deal of farmland can be saved by controlling urban sprawl, concentrating the location of townships and of rural industries, designing houses reasonably in the rural areas and reclaiming discarded land.

Secondly, it is absolutely necessary to promote agricultural technical progress more rapidly to raise yields per unit of land to offset the shrinkage of land area available for farming. Only through adapting new techniques and methods cam land productivity can increase quickly enough. In China, two thirds of all farmland is considered medium and low-yielding land, with a grain yield per hectare that 2,250-3,000 kg lower than that of the high-yielding land. Although many achievements have been made in raising yields in China, average yields are not high compared with other economies. For example, the rice yield per hectare has reached 7,657 kg in Egypt, 6,400 kg in the United States, 6,270 kg in Japan, compared with 5,850 kg in China. Similarly, the wheat yield per hectare has reached 6,860 kg in the United Kingdom, 6,487 kg in France, 5,250 kg in Egypt, compared with 3,525 kg in China. So there is significant potential to raise yields in China and the government needs to promote technical progress in a faster way to realize this potential.

Thirdly, the present grain price system must be reformed. As demonstrated in this paper, low-price policy does not motivate farmers to increase yields and thus harms agricultural development. The key to reforming the price policy is to let market forces determine the price, including that of government purchases.

Lastly, the government has to increase agricultural investment. The main field of government investment is in public goods, such as agricultural education, research, extension and infrastructure construction. The government must be clearly aware that it is its responsibility to provide high quality public goods for farmers and puts this rule into practice.

Environmental Crisis: Pressure, Rogue Waves & Responses

Brian Hunter
Chief Economist, Asia Branch,
Canadian International Development Agency

Introduction

The world alternates between periods of optimism and pessimism with respect to the earth's capacity to improve the quality of life for an expanding population. Since 1950, the world's population has doubled, economic activity increased five fold, commercial energy consumption tripled[1] and carbon dioxide emissions from fossil fuels increased 3.6 times.[2] Global population may double again in the next century, but growth rates for food production and crop yields are falling. While the future depends on how societies manage scarce resources, urbanization and globalization are rapidly altering economic structures, consumption patterns, the pressures on the environment and the capacity of societies to respond to change. Finally, even when global conditions appear stable, they often mask potential crisis facing countries and individuals. It is the latter that will determine human security and social stability.

This paper will not try to predict environmental crisis. Predictions focus attention, but are highly unreliable, and are part of the problem if they mislead decision-makers and the public. Instead, the paper will examine emerging pressures in four areas that can give rise to environmental crisis and which are critical to human security: population growth, economic development, energy use, and food security. Particular emphasis is placed on the very close cross-linkages among these factors that can transmit feedback and potentially convergent pressures. The last section looks at some emerging new ideas to help us to think in terms of complex systems, yet focus sufficiently to build the consensus required for action. While there has been considerable academic work on theory and models, there is a growing body of work on conceptual frameworks for policy makers and on practical tools.

The thesis of this paper is that the ecology and societies can meet future demands – but only if decision-makers recognize the effort required to respond to changing pressures. Timely response requires the capacity to anticipate risks, incentive structures to stimulate change, and the capacity of policy makers and institutions to set the economic, social, and political frameworks to facilitate adaptation. Any system also has to be resilient enough to absorb sudden, unpredicted crisis (rogue waves[3]).

---

[1] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources", 1996-97, pp.277-278.

[2] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources", 1992-93 p.5.

[3] A rogue wave is an enormous ocean wave that can emerge suddenly, even under calm conditions, and cause serious damage to ships and shorelines. Rogue waves appear to be the result of complex

Convergent Pressure & Rogue Waves

Population growth, poverty, economic growth, urbanization and technology create specific pressures that are powerful enough in themselves to exert tremendous stress on the ecology and challenge our capacity to manage. Some, like economic growth, urbanization and technology, offer both pressure and possible solutions. While we often treat these as distinct, they are simply sub-systems of a larger complex development process – and any complex system carries the potential for multiple and unanticipated feedback. Mutually reinforcing or convergent pressures can create either downward (vicious) spirals or upward (virtuous) cycles. Some are relatively stable – slow to develop and difficult to change (such as the population/poverty/environment trap discussed below). Others can create sudden crisis – rogue waves. Rogue waves may be caused by a single large disturbance or by the convergence of changes in a number of small factors. The change in any one factor may be too small to cause concern, but convergence amplifies the impact. The past thirty years was a period of easing global pressures on both oil and food security (marked by increasing reserves and falling real prices) – yet it also produced five rogue waves (oil in 1973-74, 1979 and 1990; and food in 1972-74 and 1994-95).

Population Trends

For much of recorded human history, people had relatively little impact on the environment. Until the eighteenth century, global population growth was negligible[4] – largely due to poverty, famine, disease and war. Around 1750, population growth rates began to accelerate. By 1800, the world's population was doubling every 125 years. By the 1960s, it was doubling every 35 years[5] – but then the acceleration stopped. The population growth rate peaked in the late 1960s at about 2.2 percent annually, and has since dropped to about 1.6 percent – and is expected to continue to decline. Nevertheless, the globe is still adding more than 80 million people a year and could reach 8.1 billion by 2025.[6] Nearly all of the population growth will occur in the developing world, over half in Asia and some 90 percent in urban areas.

Economic Development

Since 1950, the world has seen unprecedented economic growth – yet more than one billion people live below the poverty line. The links with the environment are examined below from four perspectives: (1) population growth with poverty; (2) population growth with rising incomes, (3) urbanization, and (4) macroeconomic instability.

<u>Population growth with poverty</u>

---

interplay of currents and waves – unpredictable, but like earthquakes, scientists are tying to understand the underlying conditions so that they can monitor high-risk areas.

[4] International Food Policy Research Institute, "Population and Food in the Early Twenty-First Century: Meeting Future Demand of an Increasing Population", 1995.

[5] World Bank, "World Population Projections, 1994-95", page 4.

[6] World Bank, "World Population Projections, 1994-95".

Population growth combined with poverty attacks the productive capacity of the ecology. The population-poverty-environmental degradation trap, in which increasing numbers of people exist on diminishing resources, is an example of a mutually reinforcing downward spiral.[7] Lacking necessary assets (such as skills required for employment, credit to expand self-employment and legal access to the more productive land), the poor often have little choice but to settle on marginal land.[8] One study estimates that 60 percent of the poor in developing economies live in ecologically vulnerable areas.[9]

Without the resources to reduce the pressure they place on the environment or to protect themselves from the lost productivity and health risks, the poor are both victims and causes of environmental degradation: soil erosion, reduced soil fertility, deforestation, depleted game and fish stocks, and pollution of water sources. The result is a further degrading of the only assets available to the poor – the productive capacity of the land and the health of their labour. Fertility tends to be highest among the poor in large part due to high infant mortality, the need for labour (at least in rural areas), and to provide security in old age. The immediate survival needs of the family make it difficult to invest in environmental protection and provide a strong incentive to keep children working (and not in school) – thus reinforcing the poverty cycle for another generation. Economic growth that breaks the downward cycle by engaging the poor and expanding their assets (opportunities) is critical to easing environmental pressures.

Population growth with rising incomes

Population growth combined with rising incomes places different stresses on the environment because of both increased consumption and changing patterns of consumption shifting to more energy-intensive products and more diversified diets. With expected population growth, food production will have to increase some 40 percent by 2025 just to maintain current consumption levels. Rising incomes also shift consumption from grain to meat which accounts for 60 percent of grain consumption in OECD economies and which places two stresses on systems:

1) it requires considerably more grain to provide a given amount of nutrients indirectly though meat than if used directly as food;[10] and
2) it may mean a diversion of grain from the poor to those who can afford meat.

Meat consumption in developing countries increased 4.8 percent annually between 1970 and 1990. Grains used as feed has increased 5.6 percent per annum since 1970, nearly

---

[7] FAO, "World Agriculture: Towards 2010", Nikos Alexandratos (ed.) 1995, pp.xv-xvi.

[8] Mink, Stephen, "Poverty, Population and the Environment", World Bank Discussion Paper, No. 189, 1993.

[9] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1992-93", p.30.

[10] Lester Brown states that, in feedlots, it takes 7 kilograms of grain to produce one kilo of beef, four for pork and two for poultry - as cited in "Who Will Feed China?", W.W.Norton & Company, 1995. p. 47.

double the growth rate of grain for direct food consumption.[11] In the fast-growing Asian economies, the use of grain for livestock is growing even faster. China accounts for 40 percent of developing economy meat consumption and its use of grain for feed has already increased from 9 percent of total grain consumption to 23 percent between 1974 and 1994. Even more dramatic shifts have taken place in Korea, Thailand, Malaysia, the Philippines and Indonesia.[12]

Urbanization

Urban areas are likely to account for 80 percent of future economic growth in developing economies.[13] By 2025, almost two-thirds of the world's people may live in urban areas (compared to just over one-third in 1975[14] and about 5 percent at the turn of the century[15]). This would imply some five billion urban dwellers – roughly equivalent to the current global population.

Urbanization is a mixed blessing for the environment and human development. It concentrates growth and resources and makes it more efficient to provide education, health services, clean water and sanitation. Compared to rural areas, infant mortality and fertility levels tend to be far lower; and access to education, water and sanitation higher. However, the magnitude and speed of urbanization often swamps the willingness and capacity of urban administrations to respond. There are already 22 cities with over 9 million people (12 in Asia). In the developing world, 90 percent of urban domestic waste is dumped in water systems untreated.[16] Those with resources can protect themselves from water-borne disease by buying water from vendors (but at a cost estimated to range from 4 to 100 times greater than from a piped city supply)[17] - the poor cannot.

Urban societies are considerably more dependent on transport (and therefore, energy) than rural, agrarian societies. The increased concentration of people and urban expansion ensures that food, other goods, people and waste have to be transported over increasing distances. The results are congested streets, increased accidents, air and noise pollution, and social inequity as transport costs rise. While the food sector accounts for some 70 percent of global energy consumption, one estimate suggests that

[11] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, pp. 95 and 98.

[12] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.243.

[13] Carl Bartone at al., "Towards Environmental Strategies for Cities: Policy Considerations for Urban Environmental Management in Developing Countries", Urban Management Programme Policy Paper No. 18 (The World Bank, Washington, D.C. 1994), pp.9-10.

[14] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p. 1.

[15] Martin, W.f., Ryukich Imai, H. Steeg, "Maintaining Energy Security in a Global Context". A Report to the Trilateral Commission. 1996, pp. 93.

[16] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.21.

[17] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.20.

only about 3 percent is actually used in production and another one percent is required for fertilizers.[18] The rest of the energy is consumed in processes related to urbanization, rising incomes and trade - packaging, transport, bottling, canning, refrigeration and preparation. Some of these are essential to meet the needs of urban areas and to reduce post-harvest losses. Others entail unnecessary energy consumption, such as the shipment of European bottled water to North America. Rising energy costs, reduced efficiency of transportation systems and reduced labour productivity due to health problems all undermine economic growth.

Macroeconomic instability

Macroeconomic instability is normally accompanied by inflation, low growth, unemployment and large fiscal deficits which bias decision-making in favour of short-term priorities (high discount rates and short-term calculations which are anathema to long term sustainability[19]). Under such conditions, preserving environmental resources or investing in environmental protection are likely to receive less emphasis. While adjustment programs are necessarily crisis management tools, they can be designed to minimize negative impacts on the environment or even help by reducing subsidies or increasing taxes on activities that affect energy consumption, forests, other natural resources, or environmentally sensitive areas. According to the World Bank, in the mid-1990s, developing and transition economies alone were providing subsidies for environmentally damaging activities worth some US$ 242 billion.[20]

Commercial Energy

The combination of rising incomes, urbanization, industrialization and the resultant increase in motorized transportation will ensure that commercial energy consumption continues to rise significantly for the foreseeable future. Most of the growth in demand will likely be met by fossil fuels which means significant increases in emissions of greenhouse gases, the risk of climate change, increased health risks, and increased acidity of both land and water systems.

North America and Europe still account for two thirds of commercial energy consumption, but consumption in Asia has tripled since 1973[21] due to the rise of energy-intensive manufacturing and energy-intensive consumer products. Led by China and the fast-growing Asian economies, developing economies' share of energy consumption increased from 15 percent in 1973 to over 25 percent in 1993, and is expected to reach 40 percent by 2010.[22] Global energy consumption may well increase by another 50

[18] International Institute for Applied Systems Analysis, 'The Future Population of the World", Wolfgang Lutz (ed.), 1995, p.235.

[19] Steer, Andrew, "Macroeconomics and the Environment", IMF, 1995, p.67. Ved Gandhi (ed.)

[20] Gandi, V., D. Gray and R. McMorran. 1997. As cited by in "Five Years After Rio: Innovations in Environmental Policy", The World Bank. 1997. p.8.

[21] Joint publication of World Resourc!es Institute, UNEP, UNDP and World Bank, "World Resources, 1992-93", p.287.

[22] Martin, W.f., Ryukich Imai, H. Steeg, "Maintaining Energy Security in a Global Context". A Report to the Trilateral Commission. 1996, p. 50.

percent by 2020 – led by a doubling of consumption in Asia and a 50 to 77 percent increase in Latin America.[23] Three-quarters of the increase in energy demand is expected to be met by fossil fuels which have the advantage of well established production and distribution systems. While oil is likely to continue to dominate commercial energy markets, supplying some 40 percent, coal accounts for 27 percent of global energy production[24] and is particularly important for China and India where it is abundant, relatively inexpensive and already accounts for 75 percent of energy production. Unfortunately, coal is the worst of the fossil fuels in terms of atmospheric emissions and much of the Chinese coal is high in sulphur content. Natural gas is by far the cleanest fossil fuel and will become more widely used, but requires very large infrastructure investments.

Fossil fuel combustion creates negative feedback loops to the ecology, economy and human security through three processes. First, combustion is a major source of all three of the most significant gases that affect climate change: carbon dioxide, nitrous oxide and methane. Second, emissions of sulphur dioxide and nitrogen oxides during fossil fuel (particularly coal) processing and combustion combine with water to create sulphuric and nitric acids. Unless these acids are neutralised by naturally occurring or added lime, they can seriously degrade both water and soil quality, in turn degrading forests, agricultural productivity and fisheries.[25] Any degrading of the forests reduces their capacity to absorb carbon dioxide thus exacerbating the impact of emissions on climate change. Third, the concentration of people and vehicles in urban areas has dramatically increased the health risk of air pollution, which increases the cost of health care and reduces labour productivity and the attractiveness of locations for foreign investment.

Reducing fossil fuel-intensive energy development requires advances in three areas: (1) more efficient use of energy, (2) development of less environmentally damaging alternative energy, or (3) more cost-effective approaches to pollution control. There is considerable scope for increasing all three, but it requires a strong structure of incentives.

[23] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.278.

[24] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.276.

[25] Martin, W.f., Ryukich Imai, H. Steeg, "Maintaining Energy Security in a Global Context". A Report to the Trilateral Commission. 1996, pp. 85-96.

Environment

Land resources.

The FAO estimates that cropland expansion will contribute 30 percent of the growth of food production mainly in Sub-Saharan Africa, with a relatively low person/land ratio, followed by Latin America. There is little potential for expansion of agricultural land in South Asia. While only about 30 percent of the 6.5 billion hectares with rain-fed crop potential is currently used for crop production,[26] there is increasing competition for productive land.

Competing demands for land arising from population growth, industrial uses, urban expansion and infrastructure are estimated to account for a further 3 percent of potential agricultural land (rising to 4 percent over 15 years[27]). While this is small in percentage terms, the reality is again more worrisome, particularly for land-scarce regions, such as South Asia. The projection assumes that Asian urban centres will continue to be densely settled compared to North American cities. The FAO cites a study of India that suggests that urban areas expand by some 3.5 hectares for every additional 1,000 people (compared to, for example, 64 hectares per 1,000 people in Canada). While culture and rational urban development might argue in favour of high density, it would seem likely that rising incomes will mean that urbanization will result in considerably more land diversion than suggested by the FAO. In addition, human settlements generally develop in the most fertile regions, and in vulnerable coastal areas. Accordingly, human settlements often remove some of the best agricultural land from production, either directly through use conversion or indirectly through pollution. The new lands to be brought under cultivation tend to be more marginal and require considerable investment for infrastructure, fertilizer and water to become productive. At least 45 percent of the remaining land is under forest cover, conversion of which would entail extremely high environmental costs in terms of net C02 emissions and loss of biodiversity.

Pressure on the productivity of land comes from poorly planned or ill-maintained irrigation systems and poor farming practices through waterlogging, salinisation, soil erosion and nutrient mining (loss of nutrients that plants remove from the soil). The soil is also at risk of increasing acid level due to fossil fuel combustion (in some cases, up to 1,000 kilometres from the source[28]). One recent study suggests that given current trends, acid deposits in parts of China and India could eventually exceed critical load limits for major agricultural crops by a factor of 10.[29]

---

[26] FAO, "World Agriculture: Towards 20 1 0, Nikos Alexandratos (ed.) 1995, p. 151.

[27] FAO, "World Agriculture: Towards 20 1 0, Nikos Alexandratos (ed.) 1995, p. 152.

[28] Martin, W.f., Ryukich Imai, H. Steeg, "Maintaining Energy Security in a Global Context". A Report to the Trilateral Commission. 1996, p. 90.

[29] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.279.

Water resources

Water resources are renewable, but abuse of water sources could seriously threaten development in many economies and in significant regions within economies. Although water withdrawals are still a small percentage of water available for most economies, problems arise from the distribution of water and the issue of water quality. From 1940 to 1990, withdrawal of freshwater has increased four-fold[30] – primarily for irrigation, but also for industrial and domestic use. Pressure on water quality stems from rising salt concentrations in irrigated areas, and contamination from fertilizer and pesticide and organic effluents from intensive livestock production and fish farms. Destruction of wetlands and overloading of other water systems decreases their natural capacity to renew water quality. In addition, deforestation and climate change alters rainfall patterns. Excessive withdrawal in China, Vietnam and the Gulf of California are causing intrusions of sea water into deltas and coastal aquifers.[31]

Much of the success of irrigation has been due to the rapid expansion of tubewells which are cheap, easy to build and do not entail the loss of fertile land associated with large-scale reservoirs and gravity-fed irrigation systems. The number of tubewells in India alone increased from some 90,000 in 1950 to over 12 million in 1990. However, the use of tubewells is unsustainable when the rate of extraction exceeds the rate of replenishment. This is particularly true for "fossil" aquifers, which are essentially not replenished.[32] The problem is amplified when combined with deforestation in upland watersheds, land degradation that accelerates runoff and reduces infiltration, or saline intrusion, particularly in coastal areas. In response, farmers are drilling deeper wells that exacerbate the basic problem. These wells are more expensive to drill and to run (higher electricity usage for pumping), thus forcing poorer farmers to abandon the fields.

Climate Change

Carbon dioxide is the primary greenhouse gas which human activity adds to the atmosphere – some 26 million tons of carbon monoxide in 1992 (in addition to releases from natural sources, such as volcanic eruptions). However, the actual accumulation of carbon dioxide in the atmosphere was only half that amount. The other half of the emissions were absorbed by the globe's natural carbon sinks (which include expanding forests, peat bogs, and under certain conditions, oceans). Any actions that negatively affect the carbon sinks, such as deforestation, have a direct effect on net carbon accumulation in the atmosphere. Currently, burning fossil fuels account for some 80 percent of net carbon accumulation. Deforestation and other land use change accounts

[30] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p. 300.

[31] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p. 301.

[32] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p.355.

for most of the remaining 20 percent.[33] Thus, increased emissions combined with deforestation would amplify the impact on climate change.

There is considerable debate over the possible impact of climate change on agriculture. There is mounting evidence that global warming is taking place and that human activity is a major contributor, but considerable uncertainty exists over the timing and magnitude of the impact and, in particular, the implications for different regions. Carbon dioxide aids plant growth and water utilization and may have accounted for 10 percent to 25 percent of the increase in yields of some crops in recent decades.[34] Under some assumptions, global agricultural production may well increase in the near future and the negative effects may not be felt until some time after 2060. However, there is considerable risk inherent in such projections. They assume relatively smooth change in response to increased variability of precipitation and evaporation and increases in land and air temperature. Gradual change would provide time for farmers to adapt by adjusting the variety of crops grown, switching to new crops, adjusting the timing of planting and irrigation patterns, and adjusting the level and combinations of fertilizers. While the globe may have time to adjust, individual regions may not, or may not have the resources to anticipate change and react.

The impact of climate change may well be amplified by changes in related areas, such as increasing acidity that affects both forests (thus increasing net carbon dioxide emissions) and agricultural productivity. Some of the other uncertainties concern the impact of climate change on water tables, the spatial range of pests that attack crops, and the frequency of natural disasters (floods, droughts, cyclones, or tornadoes). The FAO concludes "any climate change that would cause the production potential of agricultural resources to deteriorate in the countries with food security problems and high dependence on agriculture can prove disastrous for their welfare."[35] While studies suggest that the overall impact of climate change may be small in terms of global agricultural production and prices, the benefits would mainly accrue to agricultural exporters (who would benefit from rising prices even if production fell). For food importers and areas which are less able to adapt, studies estimate that an additional 40 million to 300 million people would be at risk of chronic malnutrition.[36]

Food Security

Food security entails carryover stocks from previous harvests, current production and net imports. In the 200 years since Malthus, the question of whether the world can feed its growing population has defied consensus. For the period 1970 to 1991 as a whole, food production has been an unprecedented success. Globally, per capita food supplies are now some 18 percent higher than in 1965.[37] Nutrition rates increased in many

[33] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p.355.
[34] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 363.
[35] FAO, "World Agriculture: Towards 20 1 0, Nikos Alexandratos (ed.) 1995, p. 193.
[36] International Food Policy Research Institute, "Population and Food in the Early Twenty-First Century: Meeting Future Demand of an Increasing Population", Nurul Islam (ed.), 1995, p.231.
[37] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 1.

developing countries, while global prices dropped and reserves increased. The majority of developing countries participated in this success, particularly in Asia, but many did not. In Sub-Saharan Africa, nutritional security has actually fallen. There is also concern whether the past success will continue and whether it will extend to those who have yet to benefit. Per capita food production has declined since the mid-1980s. While this is mainly due to the collapse of production in formerly centrally planned economies and reductions in traditionally major exporters, there are increased risks to the global system.

A critical concern is the steady fall in the growth in crop yields. Increasing crop yields are expected to account for some 66 percent of growth in food production.[38] Part of the past increase in yields came from improved plant varieties that were more resistant to drought, diseases and pests. A greater contribution came from more intensive use of inputs such as fertilizers and pesticides. However, there is disturbing evidence that yields are beginning to stagnate even for the best crop varieties and that there is a declining response to inputs. These results are showing up both in long-term research trials at the International Rice Research Institute and in the field in the highly productive areas of the Indo-Gangetic Basin.[39]

A second concern for Asian and African economies which rely on fish as an important source of animal protein is the fact that global fish production peaked in 1989. Fish stocks are threatened by overfishing and deterioration of the coastal environment.

The FAO expects that for developing economies, domestic food production will not match the increase in effective demand – with the shortfall made up through imports (increasing from some 90 million tons in 1990 to 160 million tons in 2010).[40] This depends on exportable surpluses in the major producers and access to foreign exchange by import-dependent developing economies which is expected to be very difficult for Sub-Saharan Africa, and to a lesser extent South Asia. Rising incomes and increased food availability could reduce the number of chronically malnourished in developing countries from 800 million currently to some 650 million in 2010,[41] thereby reducing the incidence of chronic malnutrition from 20 percent (1988/90) to 11 percent despite population growth. This will only happen with a combination of increased domestic food production, increased capacity to import (foreign exchange) and sufficient equity to allow the poor to access the food. With continued good management, the FAO expects these conditions can be met in East and Southeast Asia and Latin America.[42] South Asia has the potential to reduce chronic malnutrition, but remains at risk. Sub-Saharan Africa is at greatest risk with food production well below potential and imports

[38] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.229.

[39] World Bank, "Main streaming the Environment", 1995, p. 141.

[40] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.235.

[41] for the 93 developing countries it studied, FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 7.

[42] FAO, "World Agriculture: Towards 2010", Nikos Alexandratos (ed.) 1995, pp. 86 and 87

constrained by foreign exchange and family income levels 'possibly doubling chronically malnourished to some 300 million by 2010.[43]

The FAO studies provide considerable hope for the future, but complacency would be dangerous. The projections are very sensitive to the assumptions. Either a 10 percent drop in expected yields or a 20 percent increase in population growth rates would increase wheat prices almost 30 percent.[44] The FAO projections are premised on stronger environmental standards and a concerted effort to create a regulatory and incentive structure to encourage research and adoption of sustainable technologies (both new technologies and the revival of indigenous technologies), reduced population growth, and participatory approaches to natural resource planning and management. Some of the changes are low cost, such as intercropping that can support rather than mine the soil, or integrated pest management that controls pests cheaply and with minimum chemicals. Yet even seemingly obvious changes are often not adopted.

In addition, the FAO may have underestimated the impact of increasing meat consumption on grain demand. Global experience suggests that with rising incomes, grain consumption increases 16 percent for every 10 percent increase in calories (an elasticity of 1.6)[45], but for its projections the FAO uses a much lower elasticity of 0.6 (an increase in grain consumption of 6 percent for every 10 percent increase in calories) - based on the experience of economies like Spain, Portugal and Greece.[46] For these economies, the weaker link between meat, calories and grain consumption may be due to their higher per capita fish consumption compared to the rest of the world.[47] If economies like China with rapidly rising incomes follow the global experience rather than that of the Mediterranean economies (either by choice or because of declining fish stocks), the FAO will have significantly underestimated the impact on grain demand, and on grain prices.

In 1972-74, a global food crisis sparked a sudden and substantial rise in food prices and "starvation and famine in several low income countries".[48] By 1974, food stocks had fallen to 15 percent of consumption (the lowest reserves recorded to that time). Again in 1994-95, global food stocks fell below the lowest levels reached in 1974 and food prices rose dramatically.[49] The impact was moderated by the drawdown of historically large grain reserves and by the fact that for many economies grain now accounts for a relatively small component of total food costs. The impact was more severe for those more dependent on grain imports and on grain as a direct source of nutrients. While the 1996 crop has eased food prices and immediate concerns, grain stocks will take years to

[43] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 7
[44] International Food Policy Research Institute, "Population and Food in the Early Twenty-First Century: Meeting Future Demand of an Increasing Population", Nurul Islam (ed.), 1995, p. 2.
[45] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 128.
[46] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 129.
[47] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", pp. 310-311.
[48] International Food Policy Research Institute, "Population and Food in the Early Twenty-First Century"
[49] World Bank, "Global Food Prospects", 1996, p.3.

recover to levels that provide a comfortable buffer against future shocks. The recent food shock is not cause for panic - nor should the recovery be cause for complacency.

Adaptation: response mechanisms

"Natural systems can have more than one stable mode of behaviour."[50] Whether the particular stable mode that emerges is "desirable" depends on the values we bring to bear. Land can be environmentally stable, but at a low level of agricultural productivity. Markets (which rely on "effective" demand – the capacity to purchase goods or services – to set prices) may find a stable balance between food supply and demand, but at a high level of malnutrition. If societies recognize the need for broader objectives embracing human security, social cohesion and social stability, then broader frameworks linking multiple objectives are also needed.

Similarly, it is often difficult or impossible to understand change in one objective without understanding complex linkages. One example is population growth. A global population of 8.1 billion by 2025 and 9.6 billion by 2050 are projections, not predictions. Fertility rates are determined by the decisions of some one billion independent families[51] – decisions influenced by complex feedback among:

1) economic development (largely due to rising incomes and the shift from agrarian to urban industrial/service economies);
2) access to assets (particularly, education, skills upgrading, credit, and land tenure) that allow the poor to take advantage of emerging opportunities;
3) social change (particularly in the role, status and education of women); and
4) access to health services in the broadest sense (particularly, public health, family planning, but also clean water and sanitation).

If positive socioeconomic feedback loops are strengthened, the global population in 2050 might be as low as 8.6 billion. Negative feedback loops could increase the number to 10.1 billion – a difference of some 1.5 billion people[52] depending on decisions societies make today.

East and Southeast Asia produced very strong positive feedback loops ("virtuous circles") among these factors. Economic growth created employment that valued skills acquired through broad-based education. Support for agriculture was critical to food security, employment, real incomes and poverty reduction. Rising family incomes allowed more children to attend schools. Early returns to education (including for women), hard work and savings created self-reinforcing cycles, which delayed the age of marriage and increased demand for family planning. The result has been a drop in the region's total fertility rate from 5.7 in 1970 to 2.2 in 1994.[53]

---

[50] International Series on Applied Systems Analysis, "Adaptive Environmental Assessment and Management", C.S. Holling (ed.),1978, p. 9.
[51] World Bank, "World Population Projections, 1994-95", page 5.
[52] World Bank, "World Population Projections, 1994-95", page 13.
[53] World Bank, "World Development Report", 1996 & 1993.

Market forces provide powerful incentives for adaptation, but currently are limited by the traditional sources of market failure, by the extent to which they fail to capture the full environmental costs of production and consumption, and by the extent to which markets under-value certain types of assets, such as biodiversity. Economic growth can reduce environmental degradation through easing the pressures caused by poverty or macroeconomic instability, and by providing the resources to finance clean technology and environmental improvement. A number of empirical studies[54] support the hypothesis that economic growth initially degrades the environment, but that societies will shift some of their resources to improving the environment once they have reached a certain level of economic security. The studies show improvements in some environmental indicators (such as, access to clean water, urban sanitation, and urban air quality) – but not in others (carbon dioxide emissions).

Relying on markets requires a significant degree of confidence that market-based incentives will produce "desirable" results. Past spikes in oil prices tended to spur exploration as well as conservation. At current consumption rates, proven reserves would meet petroleum needs for 40 years, natural gas needs for 60 years, and coal demands for some 200 years.[55] Declining real oil prices have undercut efforts to increase conservation. Barring political disruptions, current market conditions are not likely to raise fossil fuel prices sufficiently to spur the development of alternative energy sources. Nevertheless, there is scope to improve the links between markets and the environment (discussed below under *Improving Existing Tools*).

Technology, like markets, offers both potent opportunities and the risk of complacency. No one at the turn of the last century (when the global population was a quarter of current level) could have predicted the coming technological advances. Similarly, there are advances in technology that could radically alter the linkages among economies, natural resources and the environment – but for better or worse? Two factors offer hope for the future: (1) improvements in communications facilitated the increasing role of services which are less energy-intensive than manufacturing, and (2) the adoption of more energy efficient manufacturing and transport equipment – probably spurred by the convergence of two spikes in energy prices, the shift of the USA from net oil exporter to net importer, and environmental concerns. Market incentives can also produce perverse effects. Falling fish stocks and rising prices tend to stimulate greater international competition and investment in technology to increase catches rather than efforts to produce sustainable yields.[56]

Some innovative responses are emerging. Often they are a combination of new technology and traditional approaches. British Petroleum and Shell recently announced

[54] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p. 163.

[55] Joint publication of World Resources Institute, UNEP, UNDP and World Bank, "World Resources, 1996-97", p.275.

[56] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 250.

efforts to promote alternative energy sources such as solar power.[57] BP announced plans to boost solar power sales to US$1 billion a year over the next decade. Alterative energy sources still account for only small percentage of total energy, but are growing far faster than other energy sources and faster than oil at a similar stage of its introduction to world markets. In response to scarce surface waters and declining aquifers, Chinese researchers have developed a different approach (called "four waters") which views groundwater, surface water, rainfall, and soil moisture as an integrated system.[58] Similarly, in response to the need to control pests less expensively and with less chemical usage, there is considerable interest in integrated pest management, supported by the FAO. The program integrates five mutually reinforcing systems:

1) pest control using crop rotation;
2) increasing the resistance of host plants;
3) biological methods using, natural methods or introducing new enemies of pests;
4) selective use of pesticides; and
5) plant health programs.

From field training involving some 600,000 rice farmers in Asia, the initial results appear promising with a drop in pesticide use by two thirds, while increasing yields and cutting production costs.[59]

Stimulating Adaptation

Part of the pessimism of Malthus and Lester Brown stems from questioning whether the challenges we now face will overwhelm us – either because of the magnitude of the challenge or the timeframe for adaptation. Complexity and uncertainty pose three challenges: (1) the need for frameworks to allow us to think in complex terms and set priorities, (2) an understanding of what dulls or enhances a system's responsiveness to change, and (3) tools to move from concepts to practical action. Moving from concept to action inevitably entails narrowing and thus distortion. The challenge is to simplify without omitting critical factors.

Frameworks

To understand complex systems, researchers and policy analysts isolated important sub-systems, which evolved into specific disciplines focusing on such areas as economic, social, environment, and political dynamics. This approach was useful given the importance of each sub-system and the fact that each is a complex system, with its own internal dynamics and implications for policy makers – but it now hinders us. It obscures the feedback among the sub-systems and encourages debilitating arguments over which should take precedence when decisions entail trade-offs. Issues, such as poverty and gender equity, are still too often viewed as separate rather than as integral components that affect and are affected by economic and environmental systems. The

[57] Clover, Charles, The Daily Telegraph, May, 1997.
[58] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p 373.
[59] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p 377.

isolation of sub-systems makes it difficult for decision-makers to assess the full costs and benefits of trade-offs and obscures potential opportunities in which gains can be achieved in two or more sub-systems ("win-win").

Sustainable development provides a conceptual framework to understand how economic, social, environmental, technological and governance systems interact, to assess trade-offs between the sub-systems, and to recognize where feedback is likely. The Brundtland Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs".[60] Sustainable development does not imply rigidity, "but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are made consistent with future as well as present needs." The Brundtland concept has yet to be turned into a framework for analysis and decision-making. That framework cannot imply status quo. Meeting future needs has to include improving living standards, particularly for the billion still below the poverty line. It should not try to define a particular path for development, but focus on what would enhance the "quality of life" of individuals. It requires the capacity to adapt to constantly changing conditions and the flexibility to work with uncertainty, with differences in local conditions and with differences in public expectations shaped by culture, values and experience. It has to allow for decision-makers to assess impact across a broad range of factors that influence the quality of life. Finally, it has to improve on current methods (the use of present value) to reconcile intergenerational costs and benefits.

Recent work at the World Bank makes a valuable contribution by focusing on preserving and expanding the opportunities of people.[61] The emphasis shifts from flows (such as GDP, or the extraction of oil, fish or trees) to the stock of assets available to people, defined by produced assets, natural capital, human resources and social capital. Shifting from flows would correct a major flaw in economics – the fact that some activities that add to economic growth as currently perceived are actually costs (such as increasing health care costs caused by pollution; or the unsustainable extraction from fish stocks and forests). There is considerable work left to be done on what is included in the sets of assets and on the cross-linkages. Nevertheless, the concept of opportunities offers a valuable framework for assessing how decisions in one area might enhance or curtail opportunities in other areas, or for future generations. The addition of social capital (which might be defined as the willingness to voluntarily cooperate with others and with institutions) can help explain why some societies function more efficiently than others and with greater social stability. Broadening access to assets and participation in decision-making regarding their use determines equity, and quite likely, social cohesion.

[60] The World Commission on Environment and Development, 1987
[61] The World Bank, "Expanding the Measure of Wealth", 1996, p.5.

Enhancing or dulling responsiveness

Responsiveness requires efficient mechanisms that transmit information on emerging pressures and trigger responses – whether technological innovation, or changes in production/consumption patterns. These mechanisms of information feedback and adaptation include markets, governance systems (governments and civil society) and institutional capacity – all essential to ensure that those who benefit from and bear the costs of development are engaged, both as sources of information and as agents of change. But efficient mechanisms are not sufficient.

Adaptation requires change on the part of a sufficiently large number of actors to make a difference. Each decision-maker is using a set of values, experience, knowledge and perception of self-interest to assess trade-offs. Understanding why societies and individuals respond to some issues and not to others is important to both setting priorities and designing effective incentive structures. The initial success in controlling ozone-depleting substances such as CFCs was helped by a number of factors that made both governments and societies responsive to the threat:

1) the vivid image of a hole in the ozone layer;
2) a convergence of scientific evidence of the relationship between CFCs and ozone depletion and ultraviolet radiation;
3) experience with cancer;
4) acceptance that no one could exempt themselves from the effects; and
5) the existence of reasonable alternatives to CFCs.

Thus there existed a fairly closed circle of decision-making in which those that benefited from the production of CFCs also bore the costs. Any breakdown in that closed circle will make it more difficult sustain the progress already made on CFCs. Similarly, if decision-makers can exempt themselves from the consequences of their actions (e.g. by buying bottled water rather than upgrading public water services or moving from congested, polluted areas), balanced decisions are likely to be more difficult to achieve.

Improving existing tools

The same approach (i.e., expand the decision-making circle to encompass all those who benefit and pay the cost wherever possible) can be used to look at the efficiency of existing systems that we rely on for adaptation. Market mechanisms can be improved by removing distortions and reducing externalities (e.g., by reducing environmentally damaging subsidies, ensuring that incentive structures take into account environmental impact, and by broadening the market power of currently marginalized groups). Women account for most of the agricultural production in developing economies, but are they are often excluded in terms of land ownership, credit and training required to allow them to fully participate. The National Accounts would provide a fuller, sounder basis for both economic and environmental planning if both value and physical measures of natural resources were integrated with the economic systems now captured. Governance mechanisms can be improved by enhancing the linkages between

governments and civil society, reducing corruption, increasing education levels and encouraging openness and communication. For an increasing number of issues, the appropriate decision-making circle is cross-border, but the same principles can apply.

Innovations in economic incentives to change environmental behaviour show considerable promise. They fall into three broad categories:

1) using markets to reflect environmental costs (environmental taxes, user fees, deposit-refund, and shifting subsidies from environmentally harmful to benign activities),
2) combining regulations and economic incentives, and
3) creating markets (property rights, tradable permits, international offset systems).[62]

There is considerable scope to raise the effective price of environmentally damaging activities; for example, by reducing subsidies for use of fossil fuel. In 1995-96, fossil fuel subsidies cost some US$ 58 billion of which developing and transition economies paid some US$ 48 billion.[63] Chinese experience illustrates the effectiveness of prices on energy efficiency. Since the early 1980s, China has gradually reduced energy subsidy rates from 42 percent to 20 percent. Since 1985, China's energy intensity (energy per unit of output), while still very high, has dropped 30 percent[64] reducing energy demand by some 300 million metric tons (of oil equivalency) and $C0_2$ emissions by some 1.1 billion tons. Rather than hurt economic growth, the efficiency of government owned mines increased and government payments to cover operating losses fell dramatically.[65]

The USA and China are the largest sources of greenhouse gases (although China is very low in per capita emissions). China's commitment to increasing energy efficiency may have been strengthened by the fact that it became a net oil importer in 1984.[66] The USA became a net oil importer in the mid-1970s. In both cases, rising energy import costs have shifted the incentive from exploitation to promoting economically efficient use of energy.

In 1978, Malaysia decided that effluent from palm oil mills was destroying water quality and aquatic life in the rivers. It used a combination of regulations (progressively stringent standards for discharges) and rising effluent charges to internalize the costs borne by the environment and the fishing industry. Over the following 11 years, the number of mills doubled and palm oil production tripled, yet wastewater discharges fell by over 99 percent.[67]

---

[62] The World Bank, "Five Years After Rio: Innovations in Environmental Policy", 1997, p.5.
[63] The World Bank, "Expanding the Measure of Wealth", 1996, p. 47.
[64] The World Bank, "Expanding the Measure of Wealth", 1996, p. 49.
[65] The World Bank, "Five Years After Rio: Innovations in Environmental Policy", 1997, p. 20.
[66] Martin, W.L, Ryukich Imai, H. Steeg, "Maintaining Energy Security in a Global Context", A Report to the Trilateral Commission. 1996, p. 58.
[67] The World Bank, "Five Years After Rio: Innovations in Environmental Policy", 1997, p.39.

In conclusion, successful adaptation depends on the interaction among technical understanding of the trade-offs involved, the willingness and capacity of policy makers to act, and the degree of public awareness and sense of influence. Past approaches that treated economies, the environment and social systems as separate components is inadequate. It does not capture feedback that can lead to systemic failure or sudden crisis (rogue waves). There is a strong basis for confidence in the future, but not unless societies and systems are willing to adapt existing tools and to develop and adopt new approaches and new tools. Past success at adaptation provides reassurance, but can be a trap if it creates complacency. "The feedback loops between the economy, agricultural development and the environment are too complex and too dynamic to mimic with any certainty".[68]

[68] FAO, "World Agriculture: Towards 2010, Nikos Alexandratos (ed.) 1995, p. 401.

APEC and FEEEP:
An Evolving Integrated Assessment

Robert T. Stranks and Ravish Mitra

"Mankind's material power has now increased to a degree at which it could make the biosphere uninhabitable and will, in fact, produce this suicidal result within a foreseeable period of time if the human population of the globe does not take prompt and vigorous concerted action to check the pollution and the spoliation that are being inflicted on the biosphere by shortsighted human greed". Arnold Toynbee

Introduction

A key issue agreed upon by APEC Economic Leaders has been to ensure sustainable economic prosperity in the APEC region.[1] This is a tall order. Sustainable economic prosperity is not a well-defined policy objective; rather it is a synthesis of a number of policy issues and objectives. A fundamental set of issues within the synthesis is the impact of expanding population and economic growth on the demand/supply of food, energy, and the environment (FEEEP). To increase understanding of the whole – sustainable economic prosperity – each of these FEEEP issues must be considered independently and interdependently. Moreover, each of the issues and their interdependency must be considered in national and international contexts.

Given the diversity of policy issues (including social equity, economic goals, resource usage and demographics) and the dynamic linkages amongst them, a meaningful understanding can only be achieved through a holistic approach. In one sense, this might be considered to be an attempt to understand the dynamic process of globalization[2] or perhaps more broadly how the international and domestic aspects of the FEEEP issues come together.

This paper sets out a conceptual framework for addressing FEEEP through such a holistic approach. It identifies the interlinkages among the individual FEEEP elements of FEEEP and also highlights the role of technology, which is not separately included in

[1] Sustainable economic prosperity has been a major theme in the APEC Leaders' Declarations. In 1993, the "APEC Leaders Economic Vision Statement" envisioned a community of Asia-Pacific economies which *inter alia* would ensure "sustainable growth and provide a more secure future for our people". In 1994, the "APEC Economic Leaders Declaration of Common Resolve" sought to "attain sustainable growth and equitable development of APEC economies, while reducing economic disparities among them, and improving the economic and social well-being of our people". These goals were reaffirmed in the 1996, "APEC Economic Leaders Declaration: From Vision to Action".

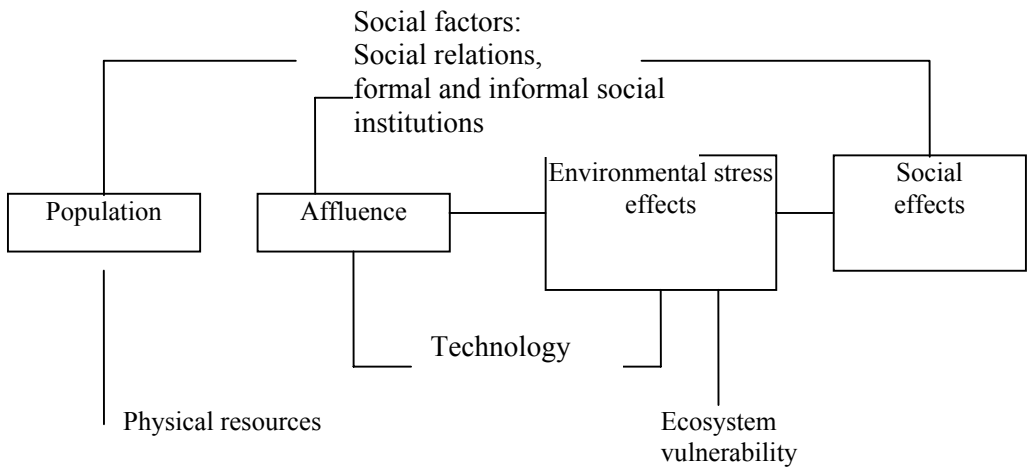
[2] In this paper globalization is understood to describe the phenomenon of a growing economic interdependence of economies globally through: an increasing volume and diversity of merchandise trade and international service transactions, less restricted flows of capital, and the widespread and rapid diffusion of technology that contributes to the development of knowledge-based economies.

the FEEEP acronym. The paper concludes by drawing some policy implications from the analysis of FEEEP through the integrated assessment methodology. [3]

An Integrated Assessment

To facilitate the understanding of FEEEP, the following paragraphs set out a conceptual framework for an integrated assessment. Figure 1 is a diagrammatic presentation of the interaction.

Figure 1. Conceptual Framework: FEEEP (Integrated Assesment)



The diagram has sequential components that can be viewed from left to right. These components are connected through causal, but far from completely deterministic links. Population and resource usage for example contribute to environmental stress effects. Environmental stress, which is a physical stress on the environment, in turn produces social effects. Moreover, there are many feedback loops that are not shown. For example, environmental factors, such as climate change, could influence human health. Of particular significance is the manner in which social institutions and technology influence the components. Changes in technology will alter relationships in the framework; for example, new technology will influence the degree of environmental stress resulting from population or economic growth. In the FEEEP framework, technology can be embodied in its component parts, such as how new energy efficient appliances reduce per unit energy demands. Similarly, formal and informal institutions, such as the cohesion of families or the strength of local communities, or the willingness of society to accept environmental degradation will influence how environmental stress is dealt with.

[3] For a individual economy case study using an integrated assessment methodology see Robert T. Stranks with Nicolino Strizzi, "China: Environmental Stress and National Security", Policy Staff Paper No.96/01, Department of Foreign Affairs and International Trade, Ottawa, February 1996.

Environmental stress effects are physical in nature and manifest themselves as environmental degradation, which can include both depletion of scarce resources and degradation of renewable resources, at the global, national, and local levels. The environmental effect is the product of total population and per capita environmental stress. Per capita environmental stress in turn depends upon affluence, a per capita variable that implicitly takes into account the use of physical resources, the technology used in the production process, and social factors such as preferences for types of food (i.e., meat vs. cereals). The "affluence" variables captures the fact that the average citizen of a developed economy and the average citizen of a developing economy do not have the same level of resource consumption, and thus do not inflict the same level of environmental stress. A third variable influencing the environmental effect is the vulnerability of the ecosystem to human activity.

The box labeled Social Effects refers to the social effects that arise from, or are exacerbated by, environmental stress. Two key potential social effects of environmental stress are population displacement – both internal migrants and emigrants to other economies – and economic decline. For example, land degradation from inappropriate irrigation (the environmental stress) could contribute to population migration (the social effect). Economic decline, exacerbated by inappropriate or unsustainable development strategies, in turn may be accompanied by social ills such as unemployment and large numbers of people living in relative poverty. An important factor influencing the extent and severity of social effects is proactive or reactive social response, such as the provision of educational opportunities or social safety nets to address problems arising from environmental, population, technological or economic change.

The conceptual challenge posed by FEEEP is that nearly all the variables influence each other, often in complex and uncertain ways. Annex 2 provides a list of illustrative FEEEP indicators.

APEC and FEEEP

While there are major uncertainties, there are also some stylized facts. With the global population and economic output reaching new levels, there has been a greater use, sometimes exploitative in nature, of energy, food, and the physical environment. Pollution, environmental degradation and resource usage rates and levels bring into question the likelihood of achieving sustainable growth in the long run. Globally this has generated a public and political concern, as witnessed by the 1992 United Nations Conference on Environment and Development (UNCED) and more recently its 5-year review in 1997. It is widely recognized that concerted action is required if sustainability is to be achieved. Yet political commitment to action, and a consensual understanding of what specific actions are required remain elusive. In fulfilling its vision of promoting a cooperative approach to sustainable economic prosperity, APEC has established a process to explore the challenges of FEEEP in respect to the APEC members.

Population

Population levels, geographic and age distribution, and growth rates fundamentally influence food, energy, economic considerations and the environment. It is also true, that the environment, food, energy and economic considerations influence demographics and the current or future health of populations. [4]

Yet while there is a general relationship between population and other FEEEP components, precisely how a given population or changes in a population influence the environment, for example, is case-specific and dependent upon many variables.[5] Technology will play a key role, both in the creation of environmental concerns, such as the increasing use of motor vehicles and emissions from their use, and in the technologies developed and deployed to reduce environmental stress, such as waste management or emission controls. In light of this, the further in the future population and demographic projections are made, such as forecasts of global figures for the years 2100 and 2150, the more difficult it becomes to understand FEEEP interactions and linkages, and the crystal ball progressively fades. The potential impact of a future population becomes more uncertain as more assumptions on possible new technologies are made. This is a critical point, as differences in view of neo-Malthusian "catastrophists" and prophets preaching of a coming gaia are often derived from differences in technological innovation assumptions.

In addition to total population or growth of population, the distribution of population is an important factor in FEEEP analysis. A prominent feature of future projected population growth is increased levels of urbanization and the continuing growth of "megacities". Population growth rates, and the rise in relative percentages of urban dwellers, will place increasing pressure on the economic infrastructure. In the APEC economies much of the urban growth will be in the developing Asian economies where urban populations are projected to increase significantly in the early part of the next century. Rapid urban population growth could exacerbate urban pollution problems, as well as contributing to social tensions. In economies with less-well developed safety nets and a large degree of polarization in incomes, political and social stability could

[4] For example, in terms of economic growth, population provides supply as labour and demand as consumers. Access to health services, such as family planning, and adequate sanitation, also influence population growth rates and health. Broader environmental conditions, such as climatic conditions, climate change and ozone depletion, are examples of other influencing factors. These socio-economic and environmental feedback loops will substantially affect demographic trends.

[5] Specifying a future population involves many problems. Depending on assumptions made, such as contraceptive use and the average age of marriage, a wide range of potential populations may be generated for any future date. The mid-1997 world population is estimated to be 5.9 billion. Whether the current global population will triple or quadruple, before it levels out, is a matter of speculation. The 1994 U.N. population projections for the year 2025 range from a low of 7.6 billion to a high of 9.0 billion. Source: The United Nations, The Sex and Age Distribution of the World Populations, The 1994 Revision, New York, 1994. An earlier publication, The United Nations, World Population Prospects, The 1992 Revision, New York, 1993, had global population estimates for 2025 ranging from 7.8 billion to 9.1 billion

erode. All of this makes the nature of urban growth and the public policy responses to growth pressures core elements of FEEEP.[6]

Economic Growth

Over the last few decades, the APEC region has experienced impressive levels of economic growth. The East Asian developing economies in particular grew at exceptionally high rates by mobilizing human resources, physical capital and modern technology. Yet economic growth may be "extensive" or "intensive" in nature. Extensive growth uses more of the factors of production to generate overall growth, but with little improvement in productivity. If growth is to be sustainable, it requires that economies be structured to promote intensive growth that enhances productivity and the efficient use of resources. Thus, sustainable growth in APEC depends upon economies' ability to sustain intensive growth.[7]

In order to generate intensive growth, innovation and invention are required. Innovation includes improvements in human capital, through education and training, as well as physical capital. Invention and the replacement of existing capital stock are significant to FEEEP as the rate of capital formation and the average age of capital stock affects energy efficiency and environmental degradation. Intricately related to productivity improvements is trade and trade liberalization, which influences specialization, economies of scale, and technological change.

The role of trade within FEEEP, particularly with respect to the environment, needs to be clarified. The fact that trade has the potential to have a negative environmental impact does not in itself imply that trade or trade liberalization should be avoided.[8] Rather, it implies that the appropriate environmental policy, designed to internalize environmental costs, is required to avoid negative environmental impacts. This is also true for investment, which will determine where production takes place. With respect to reducing environmental degradation, the maintenance of an open international trading system and investment climate is beneficial. Some general conclusions:

---

[6] With increasing percentages of people in urban areas, most economic growth is likely to take place in such areas.

[7] Differences in economies' per capita GDP are a crude indicator of relative levels of resource consumption. Other indicators could be per capita energy consumption or daily calorie supply per capita. The relationship between per capita consumption of resources and environmental degradation are not simple. The level of technology used in the production and consumption processes, for example, influence the level of environmental degradation.

[8] "Trade is rarely the cause of environmental degradation, although there are circumstances where it may draw attention to an existing environmental problem. Rather, the root cause of environmental degradation lies in the failure of markets fully to reflect environmental costs, often due to inadequate or inappropriate government policies or consumer information. Consequently, the most effective solution lies in implementing measures that will allow markets to reflect these costs more accurately and thus influence the behaviour of producers and consumers away from environmentally hostile decisions". Michael Hart and Sushma Gera, "Trade and the Environment: Dialogue of the Deaf or Scope for Cooperation?" Policy Staff Paper No. 92/11, Department of Foreign Affairs and International Trade, Ottawa, p. 15.

- economic prosperity is one of the most important determinants leading to a more sustainable environment;

- promoting economic development in developing economies through trade and investment is one of the most efficient ways to raise environmental conditions on a global basis;

- trade-restricting measures are often the least efficient way of ensuring that prices reflect environmental costs and thus rarely achieve environmental goals and may even retard them;

- pursuit of environmental objectives by means of trade measures lends itself to protectionist abuse; and

- there is no fundamental conflict between environmental objectives and the goals and provisions of the GATT-based trade relations system, although there is room for clarification to remove any ambiguities and to strengthen the basis upon which the trade and environment issues can be made more overtly complementary.[9]

Food

Food has the supremely important characteristic that it is required to sustain life. It is a basic determinant of human welfare and well being. Food production and distribution is, of course, an important economic activity. The more than doubling of the world's population in the second half of the twentieth century has been accommodated through what has been termed a "green revolution". This has been made possible through the use of new technologies, widespread irrigation, greater use of fertilizers and pesticides, and an unsustainable rise in global fish catch.

Populations must be fed and growing populations translate into increased food consumption. Significant population growth implies a substantial increase in food consumption, this is a quantitative factor stemming from an absolute increase in population. There is also a qualitative factor associated with food. This factor adjusts food consumption on the basis of income. As income increases food tastes change; for example, at higher incomes many people consume larger amounts of meats. This in turn has implications for the entire food chain. Taken together, increased population and increased income have significant implications for food demand. Moreover, distributional and social questions arise, as large differences in incomes translate into large differences in purchasing power for food.

Aside from population and economic growth factors, environmental and technological factors must be taken into account. How can growing food requirements (quantitative and qualitative) be met through improvement in agricultural efficiency? Similarly, what

[9] Michael Hart and Sushma Gera, "Trade and the Environment: Dialogue of the Deaf or Scope for Cooperation?" Policy Staff Paper No. 92/11, Department of Foreign Affairs and International Trade, Ottawa, p. 9.

are the long-term environmental implications of agricultural practices? The long-term implications refer not only to direct environmental concerns such as intensive use of fertilizers and pesticide use on soil, but also global commons issues such as climate change. These are all questions to which there are no uncontested answers, but to which some hypothesis must be attached to develop links within the integrated FEEEP framework.

Trade and trade liberalization contributes to food security. With trade, food security and food self-sufficiency are not synonymous. Declines in food self-sufficiency may be met by imports from foreign producers. International trading rules, including multilateral and regional trading arrangements, that enshrine rights and obligations upon parties to the arrangement add predictability to an economy's commercial transactions. Liberalized trade rules, whether in a bilateral, regional or multilateral context, which establish a secure and predictable trading system should reduce economies' desire to interpret "food security" as essentially the domestic ability to meet some degree of food self-sufficiency. Seeking such self-sufficiency may well have high economic and environmental costs. With liberalized trade rules, economies have access to global markets as well as sources of supply, and this should reduce any need to bring resources physically under national control.

Energy

An economy's energy infrastructure is an integral part of its overall economic infrastructure, energy is also vital input for sustaining an economy as well as contributing to economic growth. Without major structural changes to an economy, economic growth implies that more energy is required or that energy is used with increased efficiency. This means that, in the short run, the demand for energy is to a large extent dependent upon the energy efficiency of the stock of capital. Consequently, economies seeking rapid economic growth will have a significant impact on their energy demands. In the long run, technological development and changes in the capital stock may lead to increases in energy efficiency. So there are key linkages between economic growth, energy and technology.[10]

Energy is also linked with the environment. The production and consumption of energy has negative spillovers, including over national borders, in the form of pollution and placing stress on ecological systems. Most importantly, energy emissions, by increasing the concentration of gases, principally carbon dioxide, in the atmosphere, contribute to climate change.[11] The warming of the earth's surface is expected to give

[10] Variables influencing the linkages between energy and the elements of FEEEP include: evolution of economic structures (for example, from manufacturing to service industries); the rate of efficiency gains (for example, in the conversion to electricity and the reduction of transmission losses in moving energy through energy grids); the degree of substitution among alternative fuels, including implications for changes in economic infrastructure, and the trade-off this has for environmental conditions (for example, coal and natural gas); and the scope to expand sustainable sources such solar power.

[11] An example of an international initiative to address global commons problems is the United Nations Framework Convention on Climate Change. Article 2, sets out the Conventions objective to

rise to changes in climatic conditions, and this could have negative consequences, such as altering food production patterns and raising the sea level.

Environmental quality is therefore directly related to energy production and consumption patterns. A number of factors specific to each APEC economy, such as population growth, rapid industrialization, urbanization and higher per capita incomes will ensure domestic energy demand will grow. The composition of existing and expected supply of energy has significant implications for the environment. Economic growth based on hydrocarbons implies continued emission of carbon dioxide. At present, a number of APEC economies do not have a great deal of scope for fuel diversification. Substitution of coal with less polluting fuels, such as natural gas, is not an economically viable option on a large scale. Hydroelectric and nuclear power have potential promise, but their development requires large amounts of capital and long construction periods, and they are not without their own environmental considerations.

Environment

Comprehension of FEEEP is complicated by the various kinds of issues associated with the word "environment", including environmental stress, environmental degradation, and and depletion of non-renewable resources. In terms of the link between environment and economic growth, the environment is both an input (physical restraints on growth or the type of growth) and an output (economic growth's effect on the environment). For each linkage within FEEEP, there is a need to clarify how the "environment" is being interpreted in a specific analysis.

Major concerns have been expressed in respect to the environmental degradation resulting from economic activities and increasing populations. As noted above, energy production and consumption have major environmental implications. While interrelated, environmental degradation pressures may be categorized into pollution oriented or ecologically oriented. Pollution is a significant and widespread environmental threat. In a number of APEC economies, advancing urbanization, rapid industrialization, use of outdated technologies and inadequate sanitation have resulted in serious air, land and water pollution. Industrial and domestic solid waste disposal and hazardous and toxic wastes pose constant challenges. In rural areas, fertilizer use contributes to low water quality through the leaching of nitrates into groundwater and runoff into streams.

Aside from pollution problems, economies face ecological problems. Demand for food and agricultural practices have created a number of environmental problems. Excessive irrigation, misuse of fertilizers, overly intensive use of marginal lands and inappropriate use of pesticides have all played a contributing role. Degradation and deterioration of forests has been widely documented, although there is still debate over the precise extent of the abuse (such as new growth forests having lower phytomass or supporting less biodiversity). Overgrazing and improper use of grasslands for grain production

---

"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". It is proving difficult in practice to meet this objective.

have contributed significantly to desertification and soil erosion. Annex 1 summarizes the major causes and consequences of environmental stress on natural ecosystems.

Technology and the Knowledge-based Economy/Society

A key variable for FEEEP is innovation and invention. The rate of technological progress and the dissemination of innovation profoundly influence such FEEEP components as economic growth and the environmental context within which such growth occurs. Innovation and invention are influenced by both domestic and international factors. For example, international technology transfer, trade-related intellectual property rights, and foreign investment regimes all influence the rate of technological change.

The knowledge-based economy/society is characterized by three interrelated phenomena: the global reach of information and computer communications systems; knowledge-based economic growth where comparative advantage is derived from the capability to create, acquire, accumulate and exploit knowledge; and, the social changes associated with technology and knowledge-based growth and economies. A major component and agent of change in the global economy including the APEC region is Information Technology.

Information technologies have significant benefits, notably through effects on economic growth and stimulation of competition. The so-called "Asian Miracle" and the current dynamic role the Asian economies play in the global economy is firmly rooted in private and public sector promotion and use of information technology. Globally, governments are also well aware that their own efficiency and delivery of services may be enhanced through use of new information technologies.

Outside of a national or a regional context, the APEC members have been supportive of a predictable and open trading environment, which promotes competition and innovation. In this regard APEC initiatives toward trade liberalization and reducing protectionism contribute to fully realizing the benefits of new technologies and the global movement toward increasingly knowledge-based economies.[12]

Policy Implications

The two fundamental parameters of FEEEP are that the world is organized politically into states; and that these same states are becoming increasingly interdependent. Interdependence is most readily seen in terms of increasing economic integration and management challenges of the global commons. The concepts of national security and

[12] A major development was the WTO agreement to eliminate tariffs on information products, which was finalized on March 26. The value of this sector, which includes computers, software, and semiconductors equipment, is estimated at over US$500 billion. Together, the Information Technology Agreement and the Agreement on Basic Telecommunications Services liberalize approximately US$1 trillion in trade in goods and services.

human security are no longer confined to national political sovereignty. Nationally and internationally, there is a need for governments to take a more systematic approach to addressing FEEEP linkages.

The FEEEP linkages suggest that all governments will need to reassess domestic and international policy approaches that address FEEEP issues. To date, efforts to generate global cooperation on environmental issues have had mixed success. UNCED cannot claim much success in terms of concrete results, although it was a start and raised awareness of pressing issues.[13] The comprehensive program for action – *Agenda 21* – agreed to by governments at UNCED, lacks the force of law and the implementation of *Agenda 21* is dependent upon best endeavours and not contractual obligations. As the world has seen since 1992, the political rhetoric has not become translated into effective programs. There remains ample scope for countries unilaterally or collectively to make firm commitments for pursuing sustainable development.

Financial assistance remains a powerful instrument for promoting environmental stewardship or improving social conditions. Such assistance could consist of aid, but might also involve debt forgiveness. For the greatest impact, aid would need to provide new and additional resources. This was agreed to in principle at UNCED, but has proven to be politically difficult for the developed countries. Yet, there are good reasons for seriously considering further aid reorientation. Developed economy reductions in emissions of greenhouse gases could be more than offset by increases in emissions by developing economies. This would not bode well for the objective of reducing climate change. Awareness of FEEEP linkages may, and should, also give a shot of adrenalin to economies experiencing "donor fatigue". Taxpayers in the developed economies are more likely to support development assistance if they can draw an intellectual linkage between the assistance and their own private interest and well being.

But international action is more than "carrots" and "sticks" applied by the developed economies. The developed economies, with their high rate of per capita consumption, contribute to environmental degradation. In the long term, the developed economies are also not immune to population pressures and more general resource scarcity. The developed economies will, accordingly, need to encourage their citizens to change their lifestyles. Environmental effects of activity in the developed economies, such as their contribution to climate change, have a spillover impact on the developing economies.

[13] "The sad fact is that governments did not commit themselves, individually or collectively, to implement any concrete measures to reduce catastrophic rates of population growth, or to alter certain consumption patterns, say in fossil fuels. Nor did governments agree on any measures to roll back mass poverty, reduce the debt of poor countries - some voluntary announcements were made, but no collective agreement to increase poor-country access to rich country markets. There is nothing in the conventions on climate change and biodiversity that binds governments to concrete measures, with targets and timetables, to reduce emissions of carbon dioxide and other greenhouse gases or to reduce high rates of deforestation or species loss ... So, the sad bottom line is that governments did not agree to implement any measures that would alter the dismal trends that brought them to Rio ... Our leaders left almost nothing unsaid and almost everything undone". Jim MacNeil, the former Secretary General of the Brundtland Commission, statement before the Canadian Parliament's Standing Committee on the Environment. Quoted in Thomas Homer-Dixon, "Environmental and Demographic Threats to Canadian Security", Canadian Foreign Policy, Vol. 2, No.2, Fall 1994, pp. 27-8.

Thus, in part, the environmental stress in the developing economies is a result of activities in the developed economies.

International cooperation on FEEEP linkages will likely be hindered by uncertainties and divergent views surrounding the nature of the problems and their potential solutions.[14] As noted in the first paragraph of the paper, sustainable economic prosperity, while favoured by all, is not a well-defined policy objective. Until there is a convergence of views on the various aspects of FEEEP, it is not likely that adequate collaborative measures and responses will be undertaken.

A practical first step to increasing our understanding of FEEEP and developing a common understanding of the dynamic process at work, might be economy-specific case studies of the APEC members. Such an approach would essentially attempt to take each of the APEC economies through the conceptual framework presented in the paper. This would, for example, involve identifying population and "affluence" pressures, and the level and type of environmental degradation being placed upon the economy. This horizontal economy approach would complement the sectoral approach of the APEC Economic Committee's various groups and the work being conducted in other APEC fora. It would also require explicitly accounting for technological and social factors. With such case studies in hand, a symposium bringing together the economy-specific findings with an eye to identifying APEC regional trends could serve as a catalyst for developing a consensual understanding of the process.

Secondly, and linked to this first initiative, APEC could work toward building an inventory of "best practices" in respect of the various FEEEP components. The development of a user-friendly inventory could also allow APEC fora to more broadly and easily take into account FEEEP issues. For example, the Economic Committee's Task Force on Food could more easily take into account rural development issues not explicitly concerned with food production, but nevertheless programs that influence farm populations' decision-making, such as non-agricultural employment opportunities.

Most importantly, there appears to be an opportunity for APEC to take a leadership role on FEEEP and the integrated assessment approach required. In many respects, APEC is uniquely structured to effectively undertake this challenging task. APEC has the organizational flexibility to simultaneously develop analytical capacity in the component parts of FEEEP as well as the cross-component linkages. APEC also has the potential to co-ordinate and draw upon the analytical work of a range of expert organizations that individually lack the mandate to fully address FEEEP.

[14] For example, while an extremely sensitive political issue, population-planning assistance could be reviewed. The dynamics of FEEEP are such that there can be no "holy cows", all controversial issues no matter how politically sensitive, require critical dialogue stimulating timely action.

Annex 1

Natural Ecosystems:
Summary of Major Causes and Consequences of Ecosystem Change

Natural Ecosystem	Causes	Consequences
Forests	• Increasing population • Conversion to farmland • Conversion to higher yield monoculture • Excessive felling • Low success rate of reforestation	• Flooding, siltation of rivers • Loss of biodiversity, loss of quality of life • Long-term shortages of forest products • Soil erosion
Grasslands/Steppe	• Conversion to farmland • Overgrazing • Increasing population • Poor use of water resources	• Desertification • Loss of biodiversity • Increase in soil erosion, siltation • Increase in floods and droughts • Salinization
Rivers/Lakes	• Untreated urban industrial effluent • Increase in agricultural runoff • Untreated disposal of domestic waste water • Dam construction	• Pollution of fresh water supply • Health hazard • Decreasing aquatic resources • Siltation
Coastal Wetlands/ Marshlands	• Often seen as "wastelands" • Reclamation for agricultural use • Drainage for disease control • Conversion to fish ponds • Drained and filled for industrial use or urban sprawl • Pollution from industry or agricultural runoff	• Decreasing wetlands area • Siltation • Increased flooding • Decreased water quality • Loss of biodiversity and wildlife resources

Source: Editorial Board, China Conversation Strategy, Boulder: Lynne Reimer Publishers, 1994 and the World Bank, "China Environmental Strategy Paper," Report No. 9669-CHA, 1992.

Annex 2

FEEEP Illustrative Indicators –- Developing Countries

	Brunei Darussalam	Indonesia	Republic of Korea	Malaysia	Philippines	Singapore
Food Security						
Food production per capita index, (1979-81=100) 1993	100	19	94	203	88	47
Food consumption as % of total household production 1980-1985	N/A	48	35	23a	51	N/A
Employment						
Labour force as % of total population, 1990	41	44	46	39	40	49
% of labour force in agriculture 1960,1990	34.2	75.55	61.18	63.27	64.46	7.0
% of labour force in industry 1960,1990	35.24	8.14	10.35	12.23	14.15	23.36
% of labour force in services 1960,1990	31,74	18,31	28,47	25,50	22,39	70,64
Real earnings per employee annual growth rate, 1980-92	N/A	4.3	8.4	0.4	5.2	5.1
Demographic Profile						
Estimated population, (millions), 1960,1993,2000	0.1,0.3,0.3	96.2,191.7,212.7	25.0,44.1,47.1	8.1,19.2,22.3	27.6,64.8,74.6	1.6,2.8,3.0
Annual population growth rate, (%), 1960-93,1993-2000	3.7,1.9	2.1,1.5	1.7,0.9	2.6,2.1	2.6,2.0	1.6,0.9
Natural resource balance sheet						
Land area (1000 ha) 1993	577	190,457	9,902	32,975	30,000	62
Forest and woodland (as % of land area) 1993	78.0	58.7	65.2	67.6	45.3	4.8
Arable land (as % of land area) 1993	0.5	9.9	19.0	3.2	18.4	1.6
Irrigated land (as % of arable area) 1993	33.3	24.3	71.1	32.7	28.6	N/A
Deforestation (1000 ha per year) 1980-89	N/A	920	N/A	310	143	N/A
Annual rate of deforestation (%) 1980-89	N/A	0.8	N/A	1.5	1.5	N/A
Reforestation (1000 ha per year) 1980-89	40	131	67	20	50	N/A
Internal renewable water resource per capita (1000 m3 per year) 1992	21.0	13.2	1.5	24.3	5.0	0.2
Fresh water withdrawals as % of water resources 1980-89	3	1	17	2	9	32
Fresh water withdrawals per capita (m3) 1980-89	1,042	95	299	768	693	84
Energy Consumption						
Commercial energy production average annual growth rate (%) 1971-80,1980-93	N/A	8.4	5.8	19.12	31.6	N/A,N/A
Commercial energy consumption average annual growth rate (%) 1971-80,1980-93	N/A	13.8	11,10	8,10	5.4	8.8
Commercial energy use per capita (kilograms per capita) 1971,1993	N/A	71,321	507,2863	436,1529	222,328	1396,5563
Commercial energy use, GDP output per kilogram (US$) 1971,1993	N/A	1.4,5.4	0.6,2.6	0.9,2.2	0.9,2.5	0.8,3.6
National income accounts						
GDP (US$ billions) 1993	N/A	144.7	330.8	64.4	54.1	55.2
Agriculture (as % of GDP) 1993	N/A	19	7	N/A	22	(..)
Industry (as % of GDP) 1993	N/A	39	43	N/A	33	37
Services (as % of GDP) 1993	N/A	42	50	N/A	45	63
Exports (as % of GDP) 1993	N/A	23.2	24.9	73.1	20.5	134.2
Imports (as % of GDP) 1993	N/A	19.4	25.3	70.8	34.7	154.5
Trends in economic performance						
GNP annual growth rate (%) 1980-93	N/A	6.0	8.7	6.4	1.7	7.6
GNP per capita annual growth rate (%) 1965-80,1980-93	N/A	5.2,4.2	7.3,8.2	4.7,3.5	3.2,-0.6	8.3,6.1
Average annual rate of inflation (%) 1980-93,1993	-5.1,N/A	8.5,19.3	6.3,4.6	2.2,1.8	13.6,6.8	2.5,4.0
Exports as % of GDP, annual growth rate (% annual growth rate) 1980-93	N/A	-1.9	2.3	4.2	2.5	2.9

SOURCE: Human Development Report 1996

a data refers to a year or period other than that specified in the column heading

b includes beverages and tobacco

(.) less than half the unit shown

(..) Less than one-tenth the unit shown

*Human Development Report did not provide data for Chinese Taipei

Annex 2

FEEEP Illustrative Indicators –- Industrial Countries

	Australia	Canada	Japan	New Zealand	USA
Employment					
Labour force as % of total population, 1990	50	53	52	48	50
% of labour force in agriculture 1990	6	3	7	10	3
% of labour force in industry 1990	26	25	34	25	34
% of labour force in services 1990	68	71	59	65	59
Real earnings per employee annual growth rate, 1980-92	0.5	0.1	1.9	0.1	0.4
Demographic Profile					
Estimated population, (millions), 1960,1993,2000	10.3,17.6,19.2	17.9,28.8,31.0	94.1,124.5,126.5	2.4,3.5,3.8	180.7,257.9,275.1
Annual population growth rate, (%), 1960-93,1993-2000	1.6,1.3	1.5,1.1	0.9,0.2	1.2,1.1	1.1,0.9
Natural resource balance sheet					
Land area (1000 ha) 1993	771,336	997,614	37,780	27,099	980,943
Forest and woodland (as % of land area) 1993	18.8	49.5	66.4	27.2	29.2
Arable land (as % of land area) 1993	6.0	4.6	10.7	9.0	18.9
Irrigated land (as % of arable land area) 1993	4.6	1.6	69.1	11.6	11.1
Internal renewable water resource per capita (1000 m3 per year) 1992	19.5	106.0	4.4	114.9	9.7
Fresh water withdrawals as % of water resources 1980-89	5	2	16	N/A	19
Fresh water withdrawals per capita (m3) 1980-89	1,280	1,684	733	585	1,952
Energy Consumption					
Commercial energy production average annual growth rate (%) 1971-80,1980-93	5,6	3,4	3,5	5,8	1,1
Commercial energy consumption average annual growth rate (%) 1971-80,1980-93	3,2	4,2	3,3	3,5	2,1
Commercial energy use per capita (kilograms per capita) 1971,1993	4079,5316	6233,7821	2533,3642	2434,4299	7633,7918
Commercial energy use, GDP output per kilogram (US$) 1971,1993	0.9,3.1	0.7,2.4	0.9,9.3	1.1,2.9	0.7,3.1
Environment and pollution					
Greenhouse gas emissions (thousands of tons), 1993a	286,283	459,390	1,146,360	30,220	5,128,734
Greenhouse gas emissions as share of world total, 1993a	1.3	2.1	5.3	0.1	23.5
Major protected areas (as % of national territory), 1993b	7.7	8.9	7.3	22.8	10.6
Spent fuel produced (metric tons of heavy metal), 1993	N/A	1,690	876	N/A	2,400
Hazardous waste production (1000 metric tons), 1991-94	426	7,786	N/A	110	276,000
Municipal waste generated (kg per person), 1992	690	660	410	N/A	730
Population served by municipal waste services (%), 1993a	N/A	100	100	N/A	100
Paper and cardboard recycling (as a % of apparent consumption), 1990-93	50	32	51	N/A	34
Glass recycling (as a % of apparent consumption), 1990-93	36	75	56	N/A	22
National income accounts					
GDP (US$ billions) 1993	289.4	477.5	4214.2	43.7	6259.9
Agriculture (as % of GDP) 1993	3	3	2	7	2
Industry (as % of GDP) 1993	29	32	41	26	28
Services (as % of GDP) 1993	67	64	57	67	70
Exports (as % of GDP) 1993	15	30	9	24	7
Imports (as % of GDP) 1993	15	28	6	22	10
Trends in economic performance					
GNP annual growth rate (%) 1980-93	2.7	2.2	3.6	1.8	2.4
GNP per capita annual growth rate (%) 1965-80,1980-93	2.2,1.6	3.3,1.4	5.1,3.4	1.7,0.7	1.8,1.7
Average annual rate of inflation (%) 1980-93,1993	6.1,1.1	3.9,1.2	1.5,0.8	8.5,0.9	3.8,2.0
Exports as % of GDP, annual growth rate (% annual growth rate) 1980-93	3.9	3.2	1.6	2.3	2.8

SOURCE: Human Development Report 1996

a data refers to a year or period other than that specified in the column heading

b includes beverages and tobacco

(.) less than half the unit shown

(..) Less than one-tenth the unit shown