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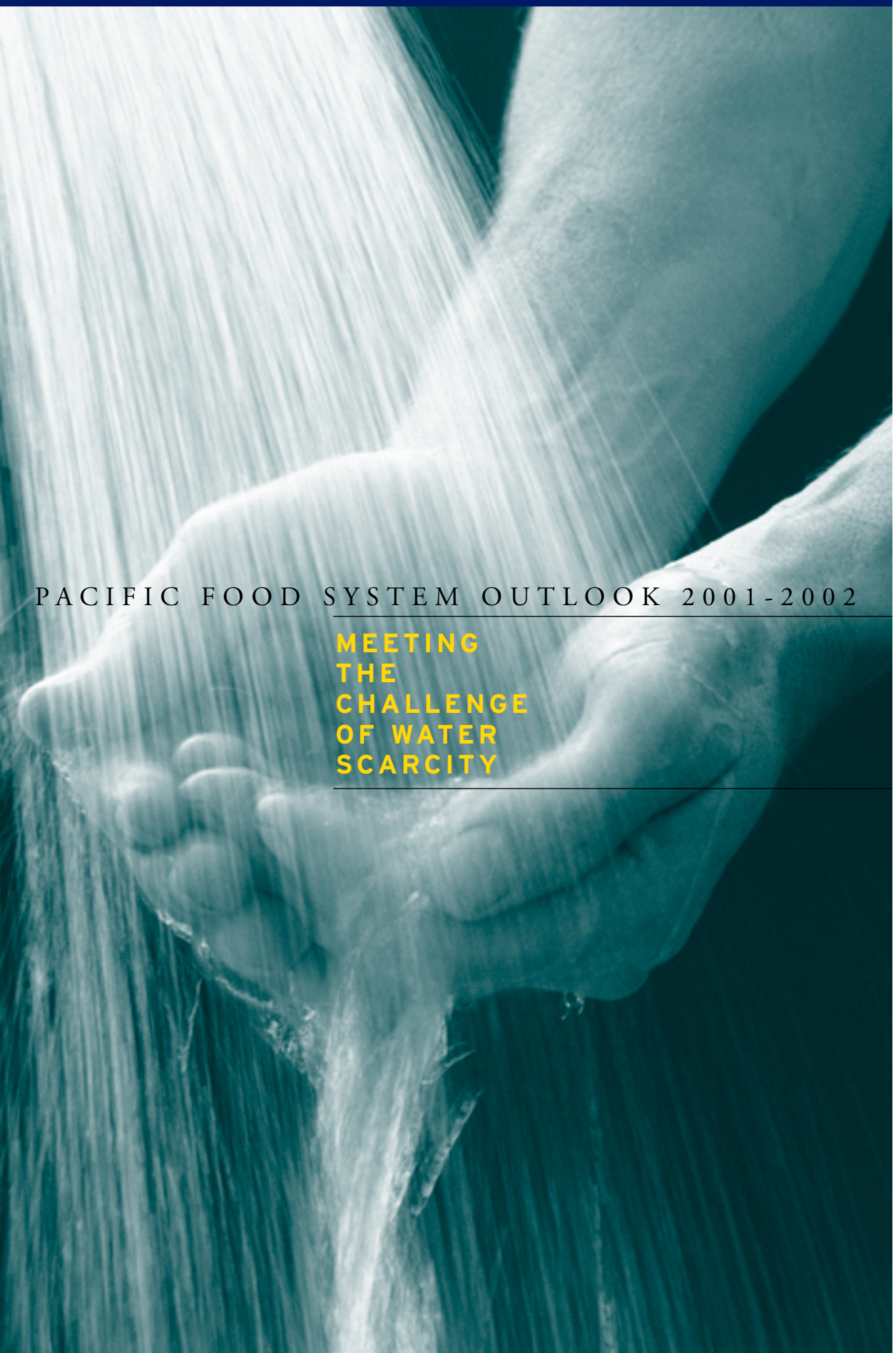

PACIFIC FOOD SYSTEM OUTLOOK 2001-2002

MEETING THE CHALLENGE OF WATER SCARCITY

PACIFIC ECONOMIC COOPERATION COUNCIL

PACIFIC FOOD SYSTEM OUTLOOK 2001-2002

MEETING THE CHALLENGE OF WATER SCARCITY

CONTENTS

Pacific Food System Outlook
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FOREWORD

This year we are doing things a bit differently. We have decided to publish only the summary and overview of our May forecasters' meeting held in Kuala Lumpur. This report contains highlights from that meeting. If you are interested in detailed information, you have full electronic access to the economy-by-economy profiles and accompanying indicator tables on the US PECC website: www.pecc.org/food.

This year's focus is on the critical role of water and water resource management in the region's food system. Some economies in the region are entering an era of water shortage. This is important to the food system because of all water consumers, agriculture is the biggest user of water withdrawals: about two-thirds of total water withdrawals in the PECC region. Six economies in the region have the potential for water shortages unless water control facilities are expanded and/or efficiencies in water use are achieved. More liberalized markets for agricultural products, and pricing of water will assure more efficient and sustainable use of water resources in the region. This will also result in a pattern of food trade that better reflects the relative scarcity of water now existing in different parts of the region.

This report was made possible with the generous support of the Universiti Putra Malaysia. We especially appreciate the efforts of Dr. Mad Nasir Shamsudin, Professor/Head, Department of Agribusiness and Information Systems and Dr. Jinap Selamat, Professor/Director, University Research Park for their leadership in assuring the substantive and organizational success of the forecasters meeting in Kuala Lumpur, May 8-10, 2001. We also appreciate the support of the Malaysian Institute of Strategic and International Studies.

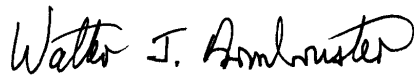
I express my sincere gratitude to Mr. Ahmad Fuad Embi, Deputy Director General, Department of Irrigation and Drainage, Malaysian Ministry of Agriculture for his excellent stage-setting presentation on the role of water resources and water resource management in the region's food system.

I am most grateful to the individual economists representing the 16 economies in the PECC region for their dedication and support for this unique multinational project, now in its fifth year. Brad Gilmour of Agrifood Canada played a key role in developing the water theme presented in this report. A special thanks goes to William Coyle (ERS, USDA) and Constanza Valdes (ERS, USDA) for their continued leadership in producing this report.

I also appreciate the faithful support of the Farm Foundation and the Economic Research Service (ERS), and the special interest and support of Praveen Dixit and Neil Conklin, both of ERS.

Thanks are due to Mark Borthwick, executive director of the US National Committee for Pacific Economic Cooperation, for his continued support; Wilma Davis of ERS, USDA, for statistical support; Kate Sullivan for editorial services; Joseph Yacinski, Carol Hardy and Hal Downs of Yacinski Design for design and production; and Liz Hughes of Beach Brothers Printing.

Finally, I am grateful to the PECC member committees and the PECC International Secretariat for their continued help in supporting and guiding this important project.



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October 2001

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MEETING THE CHALLENGE OF WATER SCARCITY

Water is the most essential substance to life on earth. Yet it is also among the most undervalued resources. When supplies of water have dwindled or access to fresh water declines, environmental degradation, social and political instability, and economic well-being can all be adversely affected. Until fairly recently, policy-makers and analysts have not adequately included water in either their modeling efforts, theories of public choice, or policy discussions. For example, in classical "growth" theory, land, labor and capital are represented as the primary inputs to production. Yet land will produce nothing without water. Most industrial, capital-intensive processes also require water. Perhaps because it is so fundamental, water's availability is often implicitly assumed. But such implicit assumptions may lead to poor policy choices.

At first glance, water might seem to be in abundance; roughly 70 percent of the earth's surface is covered by water. However, less than one percent of the earth's water is both fresh and available. Because of the critical role water plays in the food system—from crop and livestock production, to food processing and food preparation—both at home and in the food services sector—and, of course, as a life-sustaining beverage–it has been selected as the special theme for this year's Pacific Food System Outlook.

Water availability or water endowment in the PECC economies and policy issues relating to the allocation, distribution, and management of water resources are determining factors in the efficiency and competitiveness of each economy's food system. This report supports initiatives endorsed at the 1999 Auckland APEC Ministerial, to provide all member economies with "reliable access to safe, affordable food supplies within an open, environmentally sustainable food system." (National Center for APEC, p. 9). The PECC region is showing signs of water scarcity and unsustainable water use and management practices.

Since agriculture is the biggest user of water in many of the region's economies (figure 1), farm policies can contribute to unsustainable water use. Protectionist farm policies draw land, capital, and water resources into agricultural production when they would be more efficiently used in other economic activities. Eliminating impediments to food trade can help align an economy's food production with its economic and resource endowment, including water availability. Some economies are exporting water-intensive commodities even though their land and water resources are in short supply, while other, resource-rich economies are unable to exploit their food production potential.

"It is widely recognized that many countries are entering an era of severe water shortage." –Seckler et al. WORLD WATER DEMAND AND SUPPLY, 1990 TO 2025: SCENARIOS AND ISSUES, Research Report 19, International Water Management Institute, Colombo, Sri Lanka, 1998, p. v.

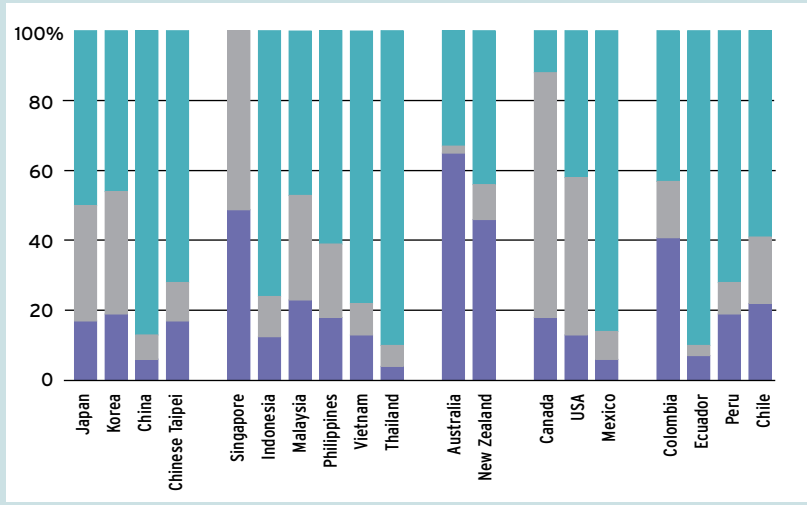
Putting Water Scarcity in Perspective

The International Water Management Institute (IWMI) conducted a comprehensive analysis of the prospects for global water supply and demand. The study covers 18 of the 22 PECC economies. We have used *World Water Demand and Supply, 1990 to 2025: Scenarios and Issues* (Seckler et al.), along with economy profiles (www.pecc.org/food), to assess the outlook for supply and demand of water in the PECC region.

Inadequate data and methodological issues hamper analyses of global and regional water resources. Measuring stocks and flows of water is difficult. For example, data for water use seldom include the direct agricultural use of rainwater—an essential water source for farming in many economies of the PECC region, even in heavily irrigated areas. Globally, about 60 percent of food is produced using rainwater, 40 percent using irrigation. The rainfed crop area in the region varies from 37 percent in Japan to 98 percent in Canada.

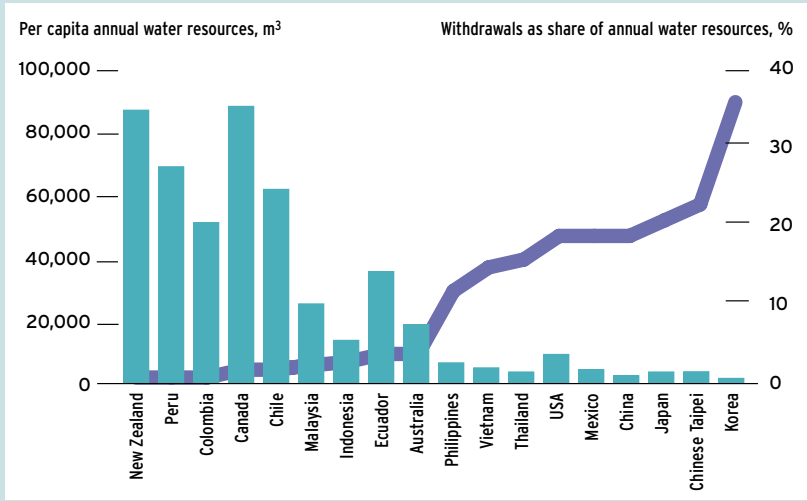
Country aggregate data tend to mask many realities with respect to water resources. The common use of national and annual data dis-

Figure 1 **USE DISTRIBUTION OF WATER WITHDRAWALS IN PECC**



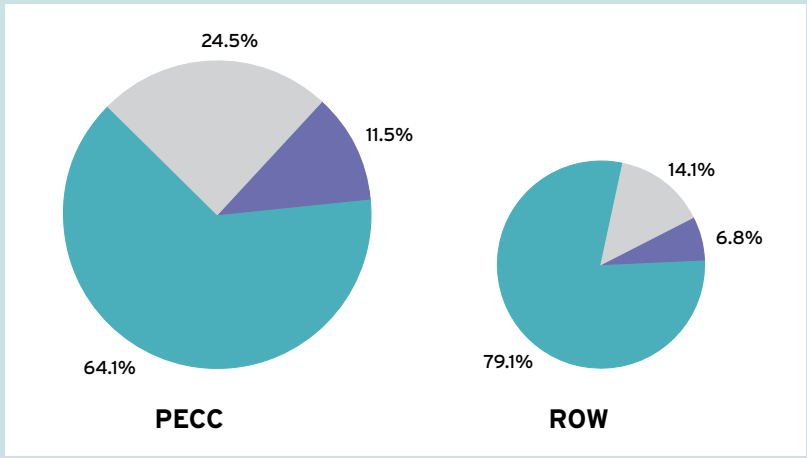
Source: Seckler, David, Upali, Amarasinghe, Radhika de Silva, and Randolph Barker. 1998. WORLD WATER DEMAND AND SUPPLY, 1990 TO 2025: SCENARIOS AND ISSUES, Research Report 19, International Water Management Institute, Colombo, Sri Lanka; and Pacific Food Outlook.

Figure 2 **PER CAPITA ANNUAL WATER RESOURCES (M^3) AND THE SHARE OF WITHDRAWALS**



Source: WRI, (see table. pp. 16-17)

Figure 3 **THE DISTRIBUTION OF WATER WITHDRAWALS**



Source: Seckler, David, Upali, Amarasinghe, David Molden, Radhika de Silva, and Randolph Barker. 1998. WORLD WATER DEMAND AND SUPPLY, 1990 TO 2025: SCENARIOS AND ISSUES, Research Report 19, International Water Management Institute, Colombo, Sri Lanka.

guises significant regional and inter-annual variations. In truth, the most reliable data and information are at the basin level, since that is the level at which water scarcity or abundance can truly be measured. It may also be the level at which water resources are best managed. It may even be that water is scarce, say, within a particular city or locality in a basin. Or it can be scarce for groups, like the poor, within a relatively water-rich area, even if it is in abundance for others within the same area.

Some examples illustrate these enormous regional and temporal variations. Two-thirds of Mexico is arid or semi-arid. The availability of water in the south and southeast is eight times greater than it is in the rest of the economy. Seventy percent of annual rainfall is concentrated during four months of the year. Contrary to what the national numbers show, water use in the arid western United States exceeds half of the renewable water supplies under normal precipitation conditions. In drought years, water use often exceeds renewable flows. Even in Canada, where water availability is generally not a problem, water shortages occur in the semi-arid west. Chile, which has generally favorable water resources, faces cycles of dry and wet periods in northern and central areas. Water demand in Indonesia's Java far exceeds demand on the sparsely populated outer islands, but about two-thirds of the economy's sustainable groundwater supplies are in the sparsely populated areas of Irian Jaya and Kalimantan.

Japan, Korea, Chinese Taipei, and China experience the most intense precipitation during the monsoon season, June through September. In Korea, precipitation during this period accounts for two-thirds of total annual precipitation. A similar share falls during this time in Chinese Taipei; on the other hand, water shortages sometimes occur between February and May.

About 85 percent of the precipitation in northern China and 70 percent in the south falls between June and September. About 60 percent of China's farmland is located in areas where the annual surface runoff is less than 18 percent of total run off. Most parts of northwest China, including the provinces of Xinjiang, Ningxia, Inner Mongolia, Qinghai, Gansu, and Shaanxi, are drought-prone and short of water. With a population of 90 million, northwest China covers about 30 percent of the total land area in China, while its water resources account for only 10 percent of the total.

Malaysia's water supplies are influenced by the southwest (May to September) and northeast (October to March) monsoons. Rainfall varies from 2,420mm/year in Peninsular Malaysia to 3,000-4,000 mm/year in Sabah and Sarawak.

"The three most important priorities are water, water, and water."

–FAO Director General, Jacques Diouf as quoted in George McGovern's THE THIRD FREEDOM, 2001, p. 113.

SIGNS OF WATER SCARCITY IN THE PECC REGION

- **A recent World Bank Report calls for China** to make a "much more significant, comprehensive, and sustained commitment" to addressing the acute water shortage and pollution problems in north China or face serious consequences for future generations (June 2001).
- **Nine years of drought,** with agricultural interests and municipalities from both the United States and Mexico drawing from the Rio Grande, have reduced the river flow to a mere trickle by the time it reaches the Gulf of Mexico. Other rivers–the Yellow River of China and the Colorado River in the US and Mexico--are similarly depleted by the time they reach the ocean for large parts of the year (August 2001)
- **Recent analyses suggest** that Western Canada, and the Pacific Northwest in the United States (and possibly other regions at similar latitudes) may be in for a period of prolonged drought. Rusak et al. (2000) find evidence suggesting that an extended period of "dustbowl" type conditions exceeding the 1930's in severity could occur before 2025.
- **Large areas of Western Canada and the Pacific Northwest** of the United States are experiencing record drought conditions.
- **In North Korea,** a close PECC neighbor, a protracted dry spell, lasting from March to mid-June, has depleted rivers and reservoirs and crippled irrigation systems (July 2001).
- **A prolonged drought in Korea** is threatening its rice harvest (June 2001).
- **Australia's water resources** are under considerable pressure from users, and some land is being damaged by rising salt levels. Government studies have found a third of the nation's groundwater reserves are being overused and 44 million acres of farming land will be hit by salinity within 50 years. (April 2001)

Sources: FAO, Water On Line (www.uswaternews.com/ homepage.html) and Rusak et al.

Abbreviations used in the Pacific Food System Outlook

APEC	Asia Pacific Economic Cooperation Forum
AWR	Annual Water Resources
FAO	Food and Agriculture Organization of the United Nations
GNP	Gross National Product
IMF	International Monetary Fund
IWMI	International Water Management Institute, Sri Lanka
NASA	National Aeronautics and Space Administration
OECD	Organization of Economic Cooperation and Development
PECC	Pacific Economic Cooperation Council
PEO	Pacific Economic Outlook
PFO	Pacific Food Outlook
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	US Department of Agriculture
WRI	World Resources Institute

Water Supply – Scarcity or Abundance?

Many PECC economies—like other regions of the world—are showing signs of water scarcity. Depending on the yardstick employed, there are a number of water-stressed economies within the PECC region (Seckler, et. al. 1998). Using the ratio of water withdrawal to annual water resources as a relative measure of scarcity, the PECC region uses 9 percent of its available water resources, compared to 6 percent in the rest of the world. While this number may not seem high, according to Seckler et al., in six of the PECC economies, water use is nearly 20 percent or more of available supplies. These are: Korea (41 percent), Singapore (33 percent), Mexico (21 percent), China (19 percent), Thailand (19 percent), and the United States (19 percent) (table, column 9). Singapore is an anomaly. As a city-state, it depends on water-rich Malaysia for most of its supplies in much the same way that Hong Kong is dependent on southern China. The study treats China separately both because of its size and because of the dramatic geographic disparities in water supply between the water-poor north and the water-rich south. In the Seckler study, 1996 World Resources Institute data are used. With more recent data from the same source plus our own Chinese Taipei data, we get a slightly different set of relatively "water-scarce" economies: Korea (36 percent), Chinese Taipei (23 percent), Japan (21 percent), China (19 percent), Mexico (19 percent), and the USA (19 percent)(figure 2).

Water supply in the PECC region, as in other parts of the world, comes from net inflows of water from rivers and underground sources minus outflows; changes in stocks such as reservoirs or aquifers; runoff (precipitation minus evaporation); and desalinization. Inflows from outside the PECC region are limited. Few major river systems cross into the PECC region. Six of the economies are islands and thus are self-contained: Australia, New Zealand, Philippines, Indonesia, Chinese Taipei, and Japan. The United States shares a number of important rivers with its neighbors: with Canada, the US shares the Mississippi, Columbia, St. Lawrence, and the Yukon Rivers, and the US shares the Colorado and Rio Grande Rivers with Mexico. Major Chinese river systems are largely contained within China's political boundaries (Yellow, Yangtze, Pearl, Black Dragon, and so forth). Colombia, Ecuador, and Peru provide a relatively small share of the Amazon system's headwaters. The Mekong is the largest river system in the PECC region shared by more than two economies (China, Vietnam, Thailand, Laos, and Cambodia) (Gleick, p. 219-247).

The single most important source of water in the region is runoff from precipitation, which varies from 700 mm/year in Mexico to 3,000 mm/year in the tropical economies of Colombia and Malaysia. Aquifers, underground reservoirs that are fed by infiltrating water from the surface, are also important. The aquifer beneath the Huang-Huai-Hai plain in eastern China supplies drinking water for nearly 160 million people. Some of the largest cities in the PECC region, including Jakarta, Lima, and Mexico

City, depend on aquifers for much of their water supply. Aquifers also supply a significant share of the irrigated area in the United States and China. The Ogallala aquifer is under parts of eight states in the mid-United States (Postel, 59). While the Ogallala still suffers water depletion, use of more efficient irrigation methods has slowed this trend (Postel, 185-89). Worldwide groundwater depletion is estimated at 200 km3 per year, about 10 percent of total water withdrawals for irrigation

Withdrawals include water that is consumed but also "excess" water that is returned to an original source where other users downstream can use it.

In the PECC region, a larger share of water withdrawals is allocated to industrial uses than in the rest of the world, 25 percent compared to 14 percent (figure 3). This is due to the fast pace of economic growth and urbanization in the region.

Nevertheless, production agriculture in the PECC region still

still expanding, but into non-rice production (figure 5).

The dietary shift away from rice in Asia is driven by income growth, which has been rapid in recent years except during the 1997-99 financial crisis. As incomes rise, consumers diversify diets, consuming less rice and more wheat, meats, and other products. While calorie for calorie, wheat requires less water than rice to produce, production of meats requires much more. Thus, the impact of westernizing diets in

"Despite legitimate concerns about whether cropland will be sufficient to meet agricultural demand, the resource base that may pose the most serious threat to future global food supplies is water."

–Mark Rosegrant and Peter Hazell. TRANSFORMING THE RURAL ASIAN ECONOMY: THE UNFINISHED REVOLUTION. ASIAN DEVELOPMENT BANK, Oxford University Press, 2000, p. 294.

(Sampat, p. 11-13).

Desalination capacity in the PECC region represents about one-quarter of the global total, with the United States, Japan, and Korea as the region's leaders. However, this capacity is a very minor source, potentially meeting the water needs of just a few million people (Gleick, p. 288).

Water Demand Situation

Water demand is difficult to estimate: the concept of "withdrawals" is commonly used as a proxy for consumptive use. Consumptive use includes water "lost" to the system, at least in the short run, through evaporation, absorption and transpiration by plants; consumption by people; and loss of water to the ocean. This is a short-run loss because water is constantly being recycled.

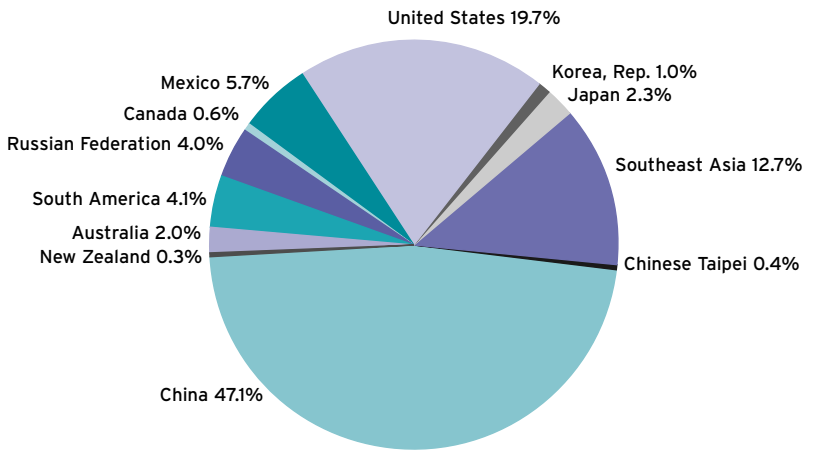
takes the lion's share of the water supply, 64 percent compared with 79 percent in the rest of the world. This varies across the region, tending to be lower in the more developed economies like the United States (40 percent), Canada (7 percent), New Zealand (55), and Japan (64). Withdrawals are higher in Asia, where irrigated rice production is a large user of water. The PECC region accounts for about 40 percent of global irrigated area, about 110 million hectares, with China, the United States, and Southeast Asia accounting for about 80 percent of the region's total (figure 4). Irrigation continues to expand across most of the region with the exception of East Asia, where area in rice production, the predominant user of irrigation, has slowly been declining. In other parts of the PECC region, irrigated area is

East and Southeast Asia has had a mixed impact on water consumption to the extent that foods are produced locally (figure 6). Currently, the North American diet uses more than twice the amount of water of a typical diet in East and Southeast Asia (figure 7). One can expect that the water-intensity of diets in East and Southeast Asia is likely to increase, despite less rice, while in North America, with a leveling off in meat consumption and with some substitution of chicken for beef, the diet is likely to become slightly less water intensive.

Existing Water Resource Management – Publicly Subsidizing Unsustainable Development

In many of the economies discussed, water policy appears to be

Figure 4 **DISTRIBUTION OF IRRIGATED LAND IN PECC REGION**

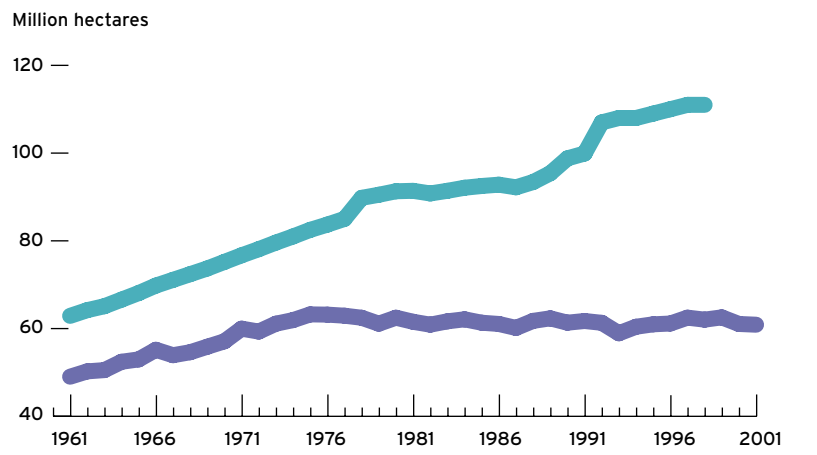


IRRIGATION AREA IN PECC

Asia PECC 63.5%
North America 26.0%
Other 10.5%

Source: FAO,
(see table, column 12, pp 16-17)

Figure 5 **HARVESTED RICE AND IRRIGATED AREA IN PECC**



Source: FAO and USDA

perverse. Leaders and administrators have recognized that water is arguably the most important resource and, in some economies, a scarce resource. Yet, in their efforts to make the resource accessible to all, they have either inadvertently or purposefully priced it as though it were in abundance. Rather than promoting efficient use and the establishment of priorities for water's use, water policy typically encourages overexploitation and exacerbates shortages. The World

Bank estimates that governments recover only about one-third of the cost of providing drinking water services in developing countries. With irrigation, the rate of cost recovery is even worse: typically, only 10 to 20 percent of the cost.

There is often a plethora of institutions from several levels in government involved in dealing with water-related issues, and this may undermine proper governance and accountability. Cooperative management using a

basin-by-basin approach might go some way to ensuring that the incentives are correct and that there is a correspondence between authority and responsibility in managing water resources.

Empirical work suggests that there are environmental payoffs when prices for water use are tied to the volume used, or when prices are applied in incremental tiers. In agriculture, for example, a 10 percent increase in price might trigger a drop in demand between 15 and

20 percent. Cost-conscious farmers are less likely to overuse water, reducing the risk of water erosion, salinization, and waterlogging. The underpricing of water has led to the overexploitation of aquifers, and overapplication of irrigation water in a number of PECC countries, including some of the largest, e.g., Australia, Canada, China, Mexico, and the United States. As a result, some of the aquifers and water systems in question could soon be past the point of no return and, in other areas, problems with salinization have become extreme. For example, 10 percent of the irrigated land in Mexico is damaged by salinity. More than 20 percent of the irrigated land in China and the United States is damaged by salinity.

There is a misconception that water subsidies are necessary to support the poor. Underpricing, when it occurs, typically leads to rationing. When access to publicly funded water is limited, the poor are excluded more often than wealthier members of society.

Work done by The World Bank and others suggests that subsidies for drinking water favor the rich, as they have more ready access to public water supplies. Typically, 80 percent of the richest fifth of the population in a developing economy will have access to the public water supply, compared with only 30-50 percent of the poorest fifth of the population. Similar observations have been made vis-à-vis rich and poor farmers and the availability of publicly funded irrigation water. The consequences are that the rich benefit while the poor still have relatively high water expenses.

These observations do not necessarily mean that water subsidies are bad. Rather, it does indicate that they must be carefully designed if they are to better target the needs of the poor and be more cost-effective. For example, different approaches to targeted microcredit and issuing subsidized water stamps for the poor have worked well in some locations.

Meeting the Challenge of Water Scarcity in the PECC Food System

According to the IWMI report (Seckler, et al.), with significant improvements in irrigation efficiency, projected water demand in the PECC region could be met by a 10 percent increase in supply by 2025. Without those efficiency gains, the increase in supply needed would be much greater, closer to 40 percent more than the 1990 base period. The more efficient scenario in the IWMI study assumes sharp increases in irrigation efficiency in the largest economies in the region—the United States and China—as well as in other heavy irrigators like Mexico, Thailand, Indonesia, and the Philippines (Seckler, et al).

More Efficient Water Use Requires Institutional Change

A key factor to increasing irrigation efficiency in the region is the adoption of market-oriented approaches. If water is a free good, there is little incentive to use it sparingly. With the development of market institutions (such as a system of water rights, tradable water entitlements, and prices reflecting the marginal cost of supplying water), there are greater incentives for more widespread adoption of efficient storage, delivery, and application systems. In some economies, water resources, once controlled by the central government, are being privatized and turned over to local irrigation associations and other entities, which tend to be more efficient in managing water resources.

Water serves many public and private purposes, including drinking, bathing, irrigation, power generation, recreation, and environmental and waste disposal. Applying market principles to water use is not easy, and will vary depending on unique local values and circumstances, but will become more common in areas where competition for its use is most intense. Administration of a water market requires a strong legal tradition with provision for adjudicating disputes, low transaction costs for trading water, and a process to take account of undesirable impacts on those not directly involved. For example, water diverted upstream in a water basin system can adversely affect downstream users by the quality and quantity of water returned to the system.

Around the Pacific Rim, the development of water markets has been slow with a few exceptions. Chile, for example, enacted legislation 20 years ago to create a market system in which water rights could be traded freely under a regulatory framework, a unique system for a developing economy. Chile's system has been studied by many countries in the region and by multilateral organizations such as The World Bank. Water markets have developed much more actively in the river basins where water scarcity is greater. Water rights, which were provided free of charge on the basis of previous uses and auctioned to newcomers, can be traded, transferred, or rented, and there is total freedom in the use of the water under one's

PACIFIC FOOD OUTLOOK 2001-02

Serious drought in the Korean peninsula, northern China, Southeast Asia, and parts of the United States and Canada have raised concerns about the short term impact on agriculture, particularly cereal crop production. Overall grain production in the region is expected to be down 3 percent in 2001. Most of the adjustment will be in lower area and yields for coarse grain and wheat; rice production will remain stable. Declines in China, Canada, and the United States will be partially offset by increases in Russia. As supply and demand balances tighten slightly, international prices for grains, oilseeds, and livestock products will continue their slow recovery.

RICE PRODUCTION

	1999	2000	2001 f
	Million tons		
China	138.9	131.5	130.2
Japan	8.4	8.6	8.5
US	6.5	6.0	6.2
Southeast Asia	78.6	77.4	78.4
Other PECC	12.5	12.9	12.7
Total PECC	245.0	236.5	236.0
World	408.4	395.6	395.7
	Percent		
PECC share	60.0	59.8	59.7

Source: USDA, August 2001

The value of food and agricultural trade is expected to continue its upward trend in the region, with a continuing shift in the composition to consumer-oriented products. North America has become a relatively more important market for food and agricultural products since the Asia financial crisis of 1997-99.

Income growth always has an important influence on the region's food system, particularly away-from-home food services and consumption of income-elastic foods such as meats. After strong growth in 2000, the PECC region is forecast to grow more slowly in 2001 and 2002, driven partly by sluggish performances of the leading economies of the United States and Japan.

Lower demand for consumer durables and residential housing, tighter monetary policy in 1999 and 2000, and high oil and natural gas prices were key factors in the US slowdown from 5 percent in 2000 to a forecasted 1 percent in 2001. High US interest rates enhanced the value of the already appreciating dollar and raised interest rates worldwide. The US economy is serving less as the engine of trade growth for the region; US imports which grew 13.5 percent in 2000, are expected to slow to 3.5 percent in 2001 and 3.8 percent in 2002 (PEO, 9). The second largest economy in the region, Japan, continues to hover close to recession as it has for the past 10 years. Equity markets across the region continue to falter and, with few exceptions, are lower than levels prior to the Asia financial crisis.

TOTAL GRAIN PRODUCTION*

	1999	2000	2001f
	Million tons		
Australia	34.5	31.2	31.9
Canada	53.7	51.1	48.4
Chile	2.4	2.5	2.5
China	390.0	345.1	337.4
Colombia	2.6	2.6	2.6
Ecuador	0.9	0.9	0.9
Indonesia	39.6	37.5	38.5
Japan	9.1	9.5	9.4
Korea	5.8	5.8	5.8
Malaysia	1.3	1.5	1.5
Mexico	29.5	27.6	29.1
New Zealand	0.9	0.9	0.9
Peru	2.7	2.7	2.8
Philippines	12.2	12.6	12.6
Russia	53.2	63.0	66.9
Chinese Taipei	1.5	1.4	1.5
Thailand	20.6	21.4	21.5
US	332.2	341.0	317.4
Vietnam	22.7	22.3	22.8
Total PECC	1015.5	980.7	954.2
World	1872.6	1831.6	1821.4
		Percent	
PECC share	54.2	53.5	52.4

***rice, wheat and coarse grain**

Source: USDA, August 2001

FOOD PRICE INFLATION

	2000e	2001f	2002f
	Food price changes (percent)		
Australia	2.4	2.5	2.5
Canada	1.7	4.5	1.8
Chile	-0.1	1.0	2.0
China	-2.5	1.0	1.2
Japan	0.1	0	0
Korea	0.8	4.5	4.0
Malaysia	1.9	1.6	2.0
New Zealand	3.6	2.5	2.5
Peru	3.0	3.0	na
Chinese Taipei	-0.4	1.5	2.0
Thailand	-1.8	4.8	3.3
United States	2.3	3.2	2.5

e estimate **f** forecast

Source: Pacific Food System Outlook economy profiles.

Food price inflation remains moderate across the region. In economies affected by the Asia crisis, some prices will increase in 2001 and 2002 as economies return to more normal conditions. In the more affluent economies, food price inflation is also expected to rise somewhat in 2001 because of higher energy and logistics costs.

APEC's Ministerial in Shanghai in October and a new round of WTO talks in Qatar in November hold out the prospect for future liberalization of the region's food system. APEC has put considerable emphasis on the urgency of a more efficient food system, through market liberalizing measures and investment in rural development. Nevertheless, farm support levels in Japan, US, Canada, and Mexico have shown an upward trend during 1997-2000 according to the OECD.

For more economy-by-economy analysis, see www.pecc.org/food.

ownership. "Price reforms in Chile reduced the use of irrigated water by as much as 26 percent and saved as US$400 million in new water infrastructure" (WRI, *www. wri.org/press/cheapwater.html*).

Nevertheless, water conflicts still arise in Chile between household users and the economy's large mining sector, and between indigenous populations and hydroelectric plants. The government has introduced a proposal that would impose financial penalties for the non-use of water; it stipulates that rights to water not used within a given time period would be returned to the authorities and reassigned to those who need water. There is strong political opposition to this proposal from farm associations, who consider the proposed changes as a challenge to their private property rights.

Korea, which has the lowest per-capita water supplies of any economy in the region, has established the Comprehensive Project for Rural Water Utilization. The principle of "user pays" for irrigation water was introduced in January 2000 and is expected to raise the efficiency of water resource allocation in the agricultural sector. Prior to 2000, farmers paid for water through a membership fee to the Farmland Improvement Association (FIA), which supplied and managed irrigation water. The government still provides subsidies for irrigation, but the government share is projected to drop and the price of water is expected to rise, more precisely reflecting water supply costs.

In Mexico, water resources are in the public domain. The National Water Commission is the executive agency empowered to manage and oversee water resources. It is directed by the Ministry for the Environment and Natural Resources. Concessions are granted to users, generally for a period of ten years. Legislation allows transmission of water use rights; they can be transferred independently of land. Irrigated areas are generally grouped into *Distritos de Desarrollo Rural* (DDRs), which are geographic areas surrounding water infrastructure. Almost all DDRs are run by the beneficiaries, who are responsible for operating, maintaining, and collecting fees for the irrigation system.

In some economies the preconditions for developing a water market do not exist. Canada and New Zealand, with the highest per-capita water supplies in the region, have little incentive to develop water markets. They have plenty of water. They have legal systems that define and protect water rights and they have a variety of fee systems, but they do not trade water rights. According to *Environment Canada*, most Canadians pay water rates that do not promote conservation (www2.ec. gc.ca/water/en/manage/effic/e_rates.htm). Only 4 percent were charged a progressively higher price with greater volumes. New Zealand has no market for the transfer of water. Local governments provide water to urban areas, while rural areas are self-supporting. Water metering occurs only in the Auckland Region, where it began in the early 1990s.

Irrigation water use in New Zealand is carefully controlled through the use of water rights, granted and controlled by local government bodies. In 1991, the comprehensive Resources Management Act (RMA) was enacted. This act placed into local government hands the responsibility to maintain local water quality and quantity. Along with the decentralization of water management authority came the removal of subsidies associated with irrigation, drainage, and flood control. The role of the national government is now limited to the management of issues associated with coastal waters. With farmers responsible for the funding of their own irrigation projects, water use has become more efficient. The RMA has placed directly upon agriculture the responsibility to reduce all water pollution associated with production agriculture.

In Australia, national and state governments have introduced a more market-oriented system of water allocation and usage. The catalyst for reform was a 1994 agreement by the Council of Australian Governments that included commitments to consumption-based pricing and full cost recovery for water delivery services; clearly specified water property rights separated from the land; formal determination of water allocations to the environment; and the introduction of water trade to maximize economic returns from water use.

While some water trading is taking place in California and Colorado, water costs in the United States still do not reflect their full economic cost; infrastructure development for delivering off-farm surface water is generally publicly subsidized.

Privatization of Malaysia's water supply is expected to be stepped up, along with pressure to increase efficiency. Water tariffs will undoubtedly increase; current rates do not cover costs of production.

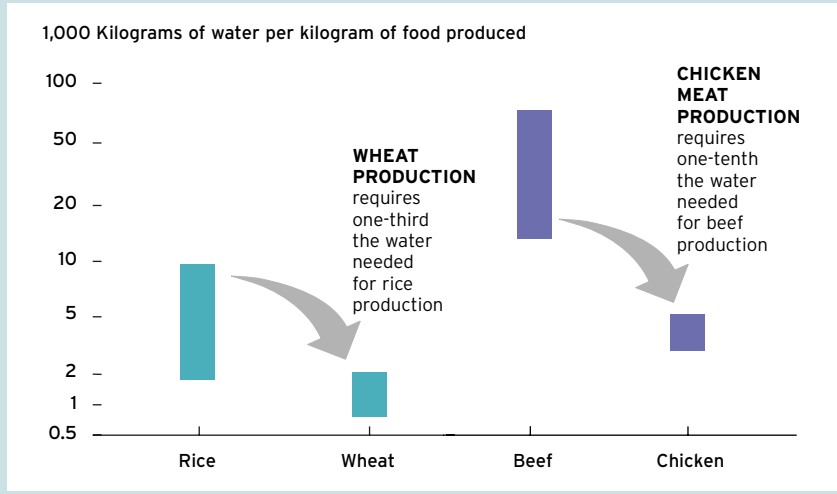
In Peru, the agriculture sector rarely pays for water, with water costs estimated to make up less than one per cent of total agricultural production costs, contributing to poor irrigation practices and low water-use efficiency. Similarly, lack of proper control and inappropriate tariffs for the use of groundwater have resulted in the overexploitation of aquifers and severe environmental problems, such as contamination and salinity. To conserve water resources, the government has called for the creation of a water market that would operate independently of the land market.

Japanese irrigation development and water management are stipulated in the Agricultural Land Improvement Law. Communal Land Improvement Districts (LID) are based on the role of the rural community in the management of the irrigation system. LIDs are responsible for management, maintenance, and investment in the local irrigation system. Despite local control, the central and local governments heavily subsidize the construction of these systems because of the perceived broader societal benefits associated with paddy rice cultivation.

The Critical Challenge Facing China

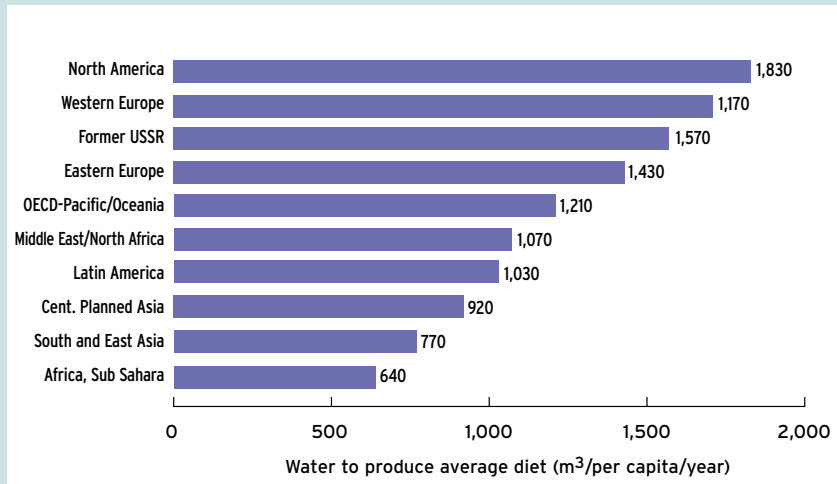
With more than 20 percent of the world's population, limited land area, and rapid economic growth, China faces massive economic

Figure 6 **A CHANGING DIET REDUCES WATER USE**



Source: Pimentel et al.; Tuong and Bhuijan 1994; UNFAO 1999, in Peter H. Gleick, THE WORLD'S WATER, 2000-2001.

Figure 7 **TOTAL WATER REQUIRED TO PRODUCE REGIONAL DIETS, LATE 1980'S**



Differences arise from the variability in consumption of water-intensive meat products, regional climates, technology, and farming practices

Note: Includes both rainfall and irrigation water. Assumes variations in regional irrigation efficiencies and diets. Data on diets come from FAO, 1999. Water requirements per calorie developed from Gleick, 1997. Source: Peter H. Gleick, THE WORLD'S WATER, 2000-2001

challenges. Its annual water supply ranks fifth behind Brazil, Russia, Canada, and Indonesia—but per-capita supplies are among the lowest in the region and world (Crook, p. 25). In the region, only Korea has a lower per capita level.

Plagued by flooding in the south and drought in the north, China hopes to optimize the allocation of its water resources by developing water control facilities, like The Three Gorges (Yangtze River) and Xiaolangdi (Yellow River) Dams and the largest water diversion project in its history: the channeling of water from the Yangtze River to the drought-prone north.

The dams are multi-purpose projects for flood control, industrial and municipal water supply, and hydroelectric power. It is estimated that The Three Gorges Dam will supply 10 percent of the economy's electric power when in full operation. The diversion project includes three lines: the east line, where water from the Yangtze will be lifted up through the Grand Canal to the northern parts of Jiangsu Province, into Shandong Province, and then to the north of the Yellow River; the middle line, where water from a reservoir on a major tributary of the Central Yangtze will be transferred to North China via Henan Province; and the west line, where water from tributaries of the upper reaches of the Yangtze will be diverted to the upper reaches of the Yellow. When the canals are completed, they are expected to deliver 38 to 48 km^3 of water annually from the Yangtze River. About 30 to 35 km3 will be available for industries, urban areas, and irrigation in North China. The government will invest an estimated 130 to 150 billion Yuan (US$15.7 to 18.1 billion) in the first two phases of construction, which include the middle and eastern stretches of the canals, totaling 2,400 kilometers.

Increasing Water Supplies in Other Parts of the Region

Measures are planned by other economies in the region to augment water supplies to meet projected demand. The demand for water resources by Chile's hydroelectric sector in the next 40 years is expected to increase six times, prompting a need to build some 100 new hydroelectric plants. The demand for industrial and mining uses of water should more than double. An additional 500,000 hectares will be needed by agriculture to add to the current 1.8 million irrigated hectares. These large increases in demand for water will be met by a combination of public and private resources. Chile has announced plans to invest US$320 million in the coming years, with financial support from The World Bank and cost recovery from the beneficiaries. Public funding generally will be focused on smaller projects. In 2001, for the first time, a water project will be offered for investment by the private sector, following the policy of concessions to private entities already used for highways and ports. The beneficiaries will pay according to the water used and their income level. Other similar projects, currently in different phases of planning, will follow.

In the central region of Chinese Taipei, the government has approved construction of the Hushan Reservoir, having a total budget of US$0.7 billion and scheduled for completion in 2008. This reservoir will satisfy the water needs of the industrial sector in that region until 2021. The Philippines expects to increase irrigated area from 1.55 million to 1.64 million hectares by 2004. In Malaysia, interbasin and interstate transfers of water like the Pahang-Selangor Raw Water Transfer scheme will become more common in the future. For some time, there has been some discussion in

Table 1 **ECONOMIC AND WATER RESOURCE INDICATORS FOR THE PECC REGION**

	Population 2000 (1) Million	Share in rural areas 2000 (2) Percent	GNP 2000 (3) Billion US$	GNP/capita 2000 (4)=(3)/(1) US $	Share of disposable income on food 2000 (5) Percent	Annual water resources (AWR) 2000 (6) Km^3	Total water withdrawals, various years, see next column (7) Km^3		Withdrawals as a share of AWR 2000 (8)=(7)/(6)*100 Percent	Withdrawals as a share of AWR (9) Percent	Withdrawals for irrigation (10) % of total withdrawals	Per capita water supply 2000 (11)=(6)/(1)*1000 m^3	Irrigated area 1999 (12) 1000 hectares	Share of cropland irrigated (13) Percent
AUSTRALIA	19.2	18.2	381.9	19,891	13.8	352	15.1	(1995)	4	5	70	18333	2251	5
BRUNEI	0.3	na	5	16,667	na		na		na	na	0	0	1	14
CANADA	31.4	22.6	699.5	22,277	14.3	2740	45.1	(1990)	2	2	7	87261	720	2
CHILE	15.2	14.5	70	4,605	27.1	928	20.3	(1987)	2	5	84	61053	1800	55
CHINA	1265.8	63.8	1079.8	853	32.0	2812	525.5	(1993)	19	19	77	2222	53740	38
COLOMBIA	42.2	22.5	82.5	1.955	28	2133	8.9	(1996)	0	1	37	50545	850	24
ECUADOR	12.6	na	12.8	1,016	na	442	17	(1997)	4	2	82	35079	865	na
HONG KONG, CHINA	6.7	0	163.8	24,448	na	na	na		na	na	na	na	na	33
INDONESIA	212.1	60.8 (1998)	153.7	725	62.9 (1999)	2838	74.4	(1990)	3	1	93	13380	4815	16
JAPAN	127	34.9	4759.5	37,476	16.1	430	91.4	(1992)	21	17	64	3386	2659	63
KOREA	47.3	7.4	457.5	9,672	23.7	65	23.7	(1994)	36	41	63	1372	1159	60
MALAYSIA	23.3	41.2	89.3	3,833	33.8	580	12.7	(1995)	2	3	76	24893	365	4
MEXICO	99.6	25.0	574.5	5,768	35.8 (1996)	409	77.8	(1998)	19	21	78	4106	6500	24
NEW ZEALAND	3.8	13.2	50.2	13,211	12.3	327	2	(1995)	1	1	55	86053	285	9
PNG	4.8	na	4.2	875	na	801	0.1	(1987)	0	na	49	166875	na	na
PERU	25.6	28.1	52.3	2,043	45.6 (1997)	1746	19.0	(1992)	1	16	86	68203	1195	42
PHILIPPINES	76.3	62.6	75.2	986	40.3	479	55.4	(1995)	12	13	88	6278	1550	16
RUSSIA	145.5	27.0 (1999)	246.7	1,696	na	4313	77.1	(1994)	2	na	20	29641	4600	4
SINGAPORE	4.0	0	92.3	23,075	13.8 (1999)	na	0.2	(1990)	na	33	na	na	na	na
CHINESE TAIPEI	22.3	25.6	310.2	13,910	18.4	77	17.6	(1996)	23	na	73	3466	480	55
THAILAND	61.9	69.5	121.9	1,969	32.0	210	33.1	(1990)	16	19	91	3393	4750	25
UNITED STATES	275.3	19.8	9962.7	36,189	10.7	2460	471.1	(1995)	19	19	40	8936	22400	16
VIET NAM	78.1	78.2 (1999)	30.1	385	na	367	54.3	(1990)	15	7	86	4693	3000	32
PECC REGION	2600.3	na	19475.6	7,490	na	24508	1641.8		7	9	64	9425	113985	na

na– not applicable

Sources: Column 1: Pacific Food System Outlook and United Nations; Column 2: Pacific Food System Outlook; Column 3: International Monetary Fund; Column 5: Pacific Food System Outlook; Column 6: World Resources Institute; Column 7: World Resources Institute and US Dept. of Agriculture; Column 9: Seckler et al.; Column 10: World Resources Institute; Column 12: The World Bank World Development Indicators; Column 13: Food and Agriculture Organization and US Dept. of Agriculture.

Canada regarding the export of water resources to meet demand in the western United States.

The Other Side of the Equation – Doing More with Less

Increased water demand in water-deficit areas has historically been met by expanding available water supplies. Dam construction, groundwater pumping, and inter-basin conveyance provided the water to meet growing urban and agricultural needs. However, future opportunities for large-scale expansion of supplies in many parts of the region will be more limited due to lack of suitable project sites, reduced funding, and increased public concern for environmental consequences. As a result, meeting future water demands will require some reallocation of existing supplies, better management of water resources, more efficient use of water for irrigation, greater recycling of water, and other measures that will increase the "crop per drop."

In China, more than 24 million rural residents, 20 million hectares of farmland, and 93 million hectares of pasture are in desperate need of water. In 2000, China undertook some major water-saving measures, including more intensive management of water use, water rationing, and charges for excess consumption. Some cities installed newly developed water-saving taps, both in homes and in public places. The government will continue to shut down factories that are excessive polluters and consumers of water, including certain electric power, steel, and paper manufacturing facilities. China intends to encourage research and development in advanced technology, especially in the bioengineering sphere, to treat water pollution, and will apply computer-based information networks for monitoring and better managing water quality in major rivers and lakes.

New Zealand has concentrated on raising water quality over the past 20 years and has achieved great success by treating wastewater at specific pollution points. Over the next 20 years, attention will shift to methods of reducing non-point pollution. Governmental and private efforts in the water industry will focus on continuing to improve water quality and reducing per-capita consumption, rather than on expanding the amount of water available.

In Mexico, there is significant scope for increasing efficiency of water use. Leakage in the water distribution system accounts for a loss of 30 to 50 percent, most from agricultural activities. Only 1.2 million hectares is cultivated with modern, efficient technology.

One way to use water more efficiently is to apply it to the production of higher-value commodities. In Java, Indonesia, development of brackish water ponds for shrimp is likely to continue through conversion of irrigated lands along coastal areas or through new development in the outer islands. Aquaculture in Java is still modest in its use of water, about 2 percent of total agricultural withdrawals. Still, demand for this high-value use of water will increase in the future and will require water untainted by the pesticides and fertilizers often present in irrigation and drainage water. In the coastal areas of Chinese Taipei, fresh-water and brackish-water fishponds use large amounts of groundwater, about ten times the amount used by paddy fields, to regulate salinity, oxygen, and temperature. Seawater intrusion and land subsidence in coastal areas are mainly caused by the withdrawal of groundwater for aquaculture. Nevertheless, aquacultural farming has proved to be more profitable than crops. The government, however, has begun to impose restrictions on expansion of aquaculture, since land subsidence is a growing problem in some coastal areas.

Conservation of water, reducing pollution, and recycling increase water basin efficiency and thus overall water availability. The United States has made great strides in increasing the efficiency of water use in the economy's principal irrigated areas: the Central Valley of California, the Snake River Valley in Idaho, the High Plains from Texas to Nebraska, the Mississippi Delta in Arkansas and adjoining states, and south-central Florida. Irrigated agriculture remains the dominant use of fresh water in the United States, although its share has declined since 1970. Irrigated cropland area has expanded by about 30 percent since 1969, while field water application rates per acre have declined about 15 percent. Increased use of sprinkler systems and other more efficient means of irrigation have resulted in only a 12 percent increase in total irrigation water applications.

The 1972 Clean Water Act in the United States defines quality standards for drinking water, primary contact recreation areas, and support of aquatic life. Water quality criteria established the minimum physical, chemical, and biological parameters required for water to support a beneficial use. Since passage, surface water quality has improved largely through reductions in toxic and organic chemical loadings from point sources. Discharges of toxic pollutants have been reduced by an estimated one billion pounds per year. Rivers affected by sewage treatment plants show a consistent reduction in ammonia between 1970 and 1992. The percentage of the US population served by wastewater treatment plants has increased from 42 percent in 1970 to 74 percent in 1998.

Opportunities and Challenges

Making more efficient use of water requires complex and multifaceted strategies that take account of the communal nature of water; the interdependence of users within a water basin; the competing role of water as an input in agriculture, industry, and the household; its role as a habitat and medium for aquatic life; and its role as a medium for transportation, including waste disposal.

Where water is in scarce supply, creation of market institutions will help to more efficiently allocate water among competing uses. Market institutions are a precondition for promoting the efficiency measures needed to raise the supply of water without large investments in water infrastructure, dams, and diversion channels, which are becoming increasingly unaffordable, from both economic and environmental perspectives.

In the PECC region, the urban population is projected to grow from 1.1 billion to 2.0 billion in 2025, with most of the increase in China and developing Southeast Asia. Such population growth in its cities will put huge stress on the region's infrastructure and its capacity to provide basic services, including water supply. Six economies in the region have the potential for water shortages unless water control facilities are expanded and/or efficiencies in water use are achieved. More liberalized markets for agricultural products, the biggest user of water, and pricing of water will assure more efficient and sustainable use of water resources in the region. This will result in a pattern of food trade that reflects the relative scarcity of water.

The PECC needs to support efforts to collect and develop data to better assess and monitor water supply and use. In the Seckler et al. study, many of the numbers used in the projections are by the authors' admission, rough estimates. Methodological problems arise from the use of annual and national numbers, which mask the significant geographic and temporal disparities that may exist within an economy. Agricultural sector modeling needs to take more explicit account of water as an essential input in food production, processing, and preparation.

Only through rigorous analysis of sound data can realistic alternatives be developed for consideration by policy makers. The time grows short to make wise decisions that will determine the region's future prosperity.

WATER STOCKS AND THE HYDROLOGIC CYCLE

Water is an essential resource in the global food system for food production, processing, and home preparation, as well as being a vital beverage for sustaining human life. While water moves, changes from solid to liquid and gaseous forms, and is consumed by plants and animals, the overall amount of water available to us today has not changed much in millions of years. The stock of the world's water has remained fairly constant throughout the earth's history.

Much of this stock of water is not very useful for supporting human life, however. About 97.5 percent of it is in the oceans, where it is useful for recreation, for ocean shipping, and for food supplies, but is not directly consumable. A fairly small amount is desalinized, a costly process of converting seawater to fresh water. The remaining 2.5 percent of the world's stock of water is fresh water, but even much of this is inaccessible. Two-thirds is captured in ice caps, glaciers, swamps, and deep aquifers. Only one-third is available for human use from fresh groundwater supplies, freshwater lakes, man-made reservoirs, and rivers.

The fresh and saltwater stocks are constantly renewed and depleted by the water cycle. The water cycle consists of the following processes: condensation, the conversion of water vapor to liquid droplets in the form of clouds, which in turn results in precipitation when the conditions are right. Precipitation falls to the surface and infiltrates the soil or flows to the ocean as runoff. Surface water either fresh or salt water evaporates, returning moisture to the atmosphere, while plants return water to the atmosphere through transpiration.

This annual flow of water on the earth's surface amounts to about 40,000 km^3 –– the difference between 110,000 km^3 of annual precipitation that falls on the earth's land surface and the 70,000 km^3 of water that returns directly to the atmosphere as a result of evaporation from open water and the transpiration of water by plants.

While the PECC region accounts for about 40 percent of the world's population, it has access to only one-third of the world's annual water resources.

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WEBSITES ON WATER RESOURCES

- **The Centre for Land Use and Water Resources Research–** www.cluwrr.ncl.ac.uk/
- **Environment Canada–Overview of rates, pricing and public education–** www2.ec.gc.ca/water/en/manage/effic/e_rates.htm;
  Utility rates and policies by municipality–www.ec.gc.ca/water/en/manage/use/e_mun.html;
  Water use and pricing database–www.ec.gc.ca/water/en/manage/use/e_datab.htm
- **The International Commission on Irrigation and Drainage–** www.icid.org/index_e.html
- **International Water Management Institute–** www.cgiar.org/iwmi/
- **National Agricultural Library–** www.nal.usda.gov/wqic/
- **NASA Observatorium: Hydrologic Cycle–** observe.ivv.nasa.gov/nasa/earth/hydrocycle/hydro1.html
- **Scientific American, Safeguarding Our Water, Feb. 2001–** www.sciam.com/2001/0201issue/0201intro.html
- **UNESCO's International Hydrological Programme–** webworld.unesco.org/water/ihp/db/shiklomanov/index.shtml
- **US Department of Agriculture, Economic Research Service–** www.ers.usda.gov/Briefing/wateruse/
- **U.S. Water News Online–** www.uswaternews.com/homepage.html
- **Water Policy for the Asian Development Bank–** www.adb.org/documents/policies/water/default.asp
- **The World Bank: Chile's water reforms–** www-wds.worldbank.org/pdf_content/000009265398101313461 7/multi_page.pdf
  Why water subsidies don't help the poor– www.wsp.org/pdfs/working_subsidy.pdf; www.wsp.org/pdfs/working_subsidy.pdf;
  Series of World Bank Water-RelatedPowerPoint Presentations– wbln0018.worldbank.org/EGFAR/gfsc.nsf/Water+Resources+Management?OpenView&Start=1&Count=30&Expand=7#7
- **World Resources Institute–** www.wri.org/
- **The World's Water: Information on the World's Freshwater Resources–** www.worldwater.org/

PACIFIC ECONOMIC COOPERATION COUNCIL

The Pacific Economic Cooperation Council (PECC) is an independent, policy-oriented organization devoted to promoting economic cooperation in the Pacific Rim. PECC brings together senior government, academic, and business representatives to share perspectives and expertise in search of broad-based answers to economic problems in the Asia Pacific region.

Founded in 1980, PECC now comprises member committees from the economies of Australia; Brunei; Canada; Chile; China; Colombia; Ecuador; Hong Kong, China; Indonesia; Japan; Korea; Malaysia; Mexico; New Zealand; Peru; the Philippines; Russia; Singapore; Chinese Taipei; Thailand; the United States; and Viet Nam as well as the Pacific Island Nations. France (Pacific Territories) and Mongolia were admitted as associate members in April 1997 and April 2000, respectively. The Pacific Basin Economic Council (PBEC) and Pacific Trade and Development Conference (PAFTAD) are institutional members of PECC.

PECC's governing body is the Standing Committee, which meets several times a year and consists of the chairs of PECC committees in each member economy. The day-to-day administrative and coordinating functions are carried out by an International Secretariat based in Singapore. Each member committee sends a high-level tripartite delegation from government, business, and academia to the PECC General Meeting held approximately every two years.

In addition, PECC establishes task forces, forums, and working groups to concentrate on particular policy areas. These groups meet periodically, organize seminars and workshops, conduct studies, and publish their conclusions and recommendations for the benefit of the Pacific community. Task force topics include capital and financial markets, fisheries development and cooperation, human resource development, Pacific Island Nations, and science and technology. PECC also supports regional forums on trade policy, food and agriculture, minerals, energy, telecommunications, and transportation and publishes annual editions of *Pacific Economic Outlook and Pacific Food System Outlook.*

At the regional level, PECC's most important link with government is through APEC. PECC is the only nongovernmental organization among the three official APEC observers. PECC representatives attend APEC ministerial meetings, senior officials meetings, and working group meetings. PECC also works with other international organizations such as the World Trade Organization, the Organization for Economic Cooperation and Development, the Asian Development Bank, The World Bank, and United Nations' agencies.

For more information, contact the PECC International Secretariat, 4 Nassim Road, Singapore 258372, Tel: 65-737 9822/23, Fax: 65-737 9824.

Find economy profiles and more detailed economy-specific discussions of water and water resource management at: www.pecc.org/food

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Economic Research Service

www.ers.usda.gov

The Economic Research Service (ERS) is the main source of economic information and research in the US Department of Agriculture. ERS economists and social scientists develop and distribute a broad range of economic and other social science information and analysis to inform public and private decision making on agriculture, food, environmental, and rural issues.

The ERS's timely reports are distributed to public and private decision makers to assist them in conducting business, formulating policy, and learning about the farm, rural, and food sectors. ERS publications are available to the public and the news media in both print and electronic form.

The agency 's three divisions—Food and Rural Economics, Market and Trade Economics, and Resource Economics—conduct research, perform commodity market and policy analysis, and develop economic and statistical indicators. The executive and legislative branches of the US federal government use ERS information to help develop, administer, and evaluate farm, food, rural, and resource policies and programs.

In addition to research reports and commodity analyses, ERS publishes several nationally recognized periodicals that communicate the findings of the agency's research program: *Agricultural Outlook, Food Review, Rural Development Perspectives,* and *Rural Conditions and Trends.*

Farm Foundation

www.farmfoundation.org

Farm Foundation is a nonprofit organization founded in 1933 to improve US agriculture and the well being of rural people. Farm Foundation acts as a catalyst to increase knowledge about agricultural and rural issues. Program activities stimulate the research agenda, improve educational programming through extension and other outreach education, and sponsor forums to foster policy dialogue on important issues facing agriculture and rural people. Its linkages to agricultural economists and social scientists bring disciplinary knowledge to bear on priority areas. The foundation's programs promote the interaction of business and policy leaders, government officials, and educators in exploring strategies and policy options. The results provide a solid basis for informed private and public sector decisions.

Institute of Strategic and International Studies

www.jaring.my/isis

The Institute of Strategic and International Studies (ISIS) was established in 1983. As an autonomous and nonprofit organization, ISIS Malaysia is engaged in a wide range of activities focusing on objective and independent policy research and fostering dialogue and debate between the public sector, the private sector and academia. Its programs are directed toward five central areas of national interest: defense, security and foreign affairs; national and international economic affairs; strategies for nation-building and national unity; policies on energy and natural resources; and science, technology and industry.

Universiti Putra Malaysia

www.upm.edu.my

Universiti Putra Malaysia (UPM), once a traditional agricultural university, has grown into one of Malaysia's largest academic centers of science and technology, with about 4,300 staff and 33,500 students. Its primary function is training of human resources at the tertiary level. Programs of study are offered at three levels: diploma, bachelor and post-graduate. The courses offered are tailored for on-the-job, hands-on experience and practical training in the public and private sectors. Besides teaching, UPM places great emphasis on research. About 1,210 researchers with Ph.D.'s and Master's degrees and more than 5,000 postgraduate students are exploring the frontiers of science in efforts to expand fundamental knowledge of human nature, society, industry and the natural world.

The *Pacific Food System Outlook* represents the first regionwide coordinated effort to provide the outlook for the Pacific food system. The food system includes not just production agriculture, but also the whole complex of economic relationships and linkages that tie the region's food consumers to producers. The goal of the *Pacific Food System Outlook* is to help increase knowledge about the diverse components of this vital segment of the global economy.