DIMENSIONS *of* WORLD FOOD PROBLEMS

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PREFACE

*D*imensions of World Food Problems was written as part of a complete package of student materials designed especially for independent study at home. Through a joint project of the University of Mid-America and the World Food Institute of Iowa State University, and with the financial assistance of the Lilly Endowment, Inc., world food problems are addressed in this volume and in the companion materials in a way which avoids simplistic and overemotional responses to world food crises. This approach is evident throughout the study package, which includes also a self-instructional text and a series of television programs, in addition to this reference source written by seventeen of the nation's foremost experts in world food issues.

This volume was written and edited so that it could stand alone as a reference for the range of world food concerns in such diverse fields as population, food and nutrition, food production and distribution, and institutions affecting world food problems. The variety of opinion and knowledge represented in this book provides the reader with a comprehensive survey of many of the factors that must be considered in any study of this complex topic.

The complete multidisciplinary course on world food problems was designed and produced by a team of academic media specialists whose expertise was combined with that of the scholars commissioned to write the chapters of this volume. This team approach is exemplary of that employed by the University of Mid-America in its design and production of educational materials for independent study.

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The contributions of several persons must be recognized in preparing this book for publication:

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The advice and counsel of many others in conceptualizing the original dimensions of the problems to be incorporated into the book. The final selection of the subjects found in this book was the coordinating editor's alone.

INTRODUCTION

A Focus on the Situation

THE PROBLEM of feeding hungry people is not new or unique to our times; indeed, the history of humanity is essentially a story of peoples' attempts to feed themselves. Most major wars have been fought to gain and secure territory so that people could eat and live with some assurance of security. Until recently, food supplies generally increased with the increases in population, though vagaries of weather and diseases resulted in scattered and periodic shortages. But starting in the decade of the 1940s, a new factor was forced into the equation, that of a very rapidly expanding population caused largely by falling death rates and a rapid increase in the number of young people in the population. This situation is unique in human history.

When agriculture first started some 10,000 to 8,000 B.C., the population of the earth was probably about 8 million people, a number similar to the population of Buenos Aires or London but smaller than that of New York City or Paris. It may have required a million years to accumulate that many people. Today, however, there are more than 400 times that many people, and the population is increasing at the rate of 80 million per year. To put it another way, in less than three years there will be as many more people in the world as now live in the entire United States. There were an estimated one billion people in the world in 1830; by 1930 there were two billion. Thirty years later, in 1960, there were three billion, and 15 years later, in 1975, there were about four billion. Seven billion is estimated for the year 2000.

Authorities estimate the number of malnourished at between 400 and 800 million in the 1970s, and this is many more than any time in the past. Unfortunately, most of the malnourished are found in the developing nations where population growth is highest and food production per capita is lowest. Even if food were available in many countries, a large percentage of the people would not have the money to purchase it. Malnutrition affects young children most since they must have a known minimum of nutrition for normal mental and physical development.

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Authorities do not agree on whether there was enough food in the world in 1976 to take care of all hunger and malnutrition, even if the food were properly distributed. If this assessment even approximates the situation now, what then will be the situation if the world's population doubles early in the next century?

The productive land area of the world is finite, as are the energy sources as we know them today. We are approaching the maximum sustainable level of aquatic harvest from the oceans. Vagaries of weather increasingly limit the genetic gains possible with crops and livestock in the short run. Higher fuel and food costs have reduced the foreign exchange available in most developing nations and have severely limited their internal development.

The considerable known technology available in the developed nations could be transferred to the developing nations. If applied, this technology would significantly increase and sustain new levels of food production. Unfortunately, any new technology has a cost. In this instance, the costs may range from changes in land tenure and ownership, changes in attitudes toward risk and uncertainty, infrastructure development, and changes in government policy toward agriculture to education for farmers.

World food demand (needs) has two principal components: population and per person consumption. Per person consumption, in turn, is related to income levels, prices, tastes, preferences, and dietary requirements.

World food supply consists of crops, animals and their products, seafoods, and manufactured products. Weather and economic factors at times influence food supply more than the more basic factors; energy may become a limitation in the years ahead.

Of the total foods produced in the world each year perhaps more than 30 percent is lost before, during, or after harvest. Plant diseases, birds, and rodents are part of the problem before harvest; lack of knowledge, skills, equipment, and rodents are sources of losses during harvest; while poor storage, rodents, insects, spoilage, spillage, and carelessness cause losses after harvest. Not only are physical losses involved in these processes; nutritional losses also occur.

Many constraints limit changes in existing methods and systems, especially in the developing nations. Some are social, some are economic, others are political, and all are made more difficult to eliminate by a low level of literacy that will take years to correct even with vigorous government action.

Among the self-appointed "authorities" addressing the population and food problems of the world today, opinions range from highly optimistic to discouragingly pessimistic. Some believe simple, effective solutions are available while others believe no solutions exist at all. Development of internal institutions, communications, and education are pressing problems. Cooperation within and between countries is essential

but difficult to achieve. Nationalism and protectionism have always presented problems in cooperation between nations; with many new nations, the situation is even more difficult in the mid-1970s.

It is becoming increasingly apparent that no nation can exist for long above the subsistence level without products or other assistance from other nations. Throughout the written history of the world, famines, plagues, and political difficulties have periodically occurred. As the world population grows, we might expect the frequency of these events to increase. For the short run by historical reckoning, perhaps for the next 50 to 100 years, the outlook is not bright, but over the longer term we can be more optimistic.

The world has a large land area not now cultivated that can produce crops when we learn how, but costs will be higher. New sources of energy will be found; the sun, the wind, and the oceans are a vast potential; we must learn how to use them. Population will be stabilized at a manageable level, diseases will be reduced or eliminated, and incomes will rise so that the essentials of life will be available to most. We must, however, recognize that those things considered potentials today are far from realities. Technology can move rapidly; most of us can think back 25 years when 150 bushel maize and wheat yields, computers, moon walks, and progress in control of certain diseases would have been beyond the imagination. Similar progress can be made in the next 25 years. People and their institutions have not moved as rapidly, and there is no reason to expect that they will in the future.

It is entirely possible that the world of convenience and relative affluence that we know today may not hold even to the year 2000. The rising prices from 1974 to 1976, the high rate of inflation, reduced crop yields, shortage of fossil fuels, and high unemployment all serve to remind us that all changes are not favorable. News of droughts, hunger, malnutrition, starvation, and military takeovers also remind us that problems of other nations are more serious than those in the United States. Ours is a relatively fortunate situation as we move toward the year 2000.

The focus of this book is on the several principal dimensions of population and food problems and their interactions as they appear in 1976. The authors, all recognized authorities, present the problems in a factual, unbiased, and unemotional manner. They view the present situation as difficult and urgent, but certainly not as impossible. The emphasis of this book is on agriculture and providing food to hungry people to gain time for stabilizing the human population at a manageable level.

We believe this book can provide the reader with an informed background for understanding the world food problems and shows that there are no simplistic solutions to the complex problems.

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Dimensions of World Food Problems

A young Nigerian couple with their "farm equipment."

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A Review of Population and Trends

E. R. DUNCAN

THE PROBLEMS of food and population cannot be separated; each affects the other. The most obvious relationship is that as population increases the total need for food also increases. The less obvious relationship is that when food is plentiful and people are well fed, death rates decline and life expectancy increases, which in turn also results in a greater total need for food.

Ever since 1798 when Malthus wrote his "Essay on the Principle of Population" there have been warnings that population would eventually outstrip food production. Indeed, this may eventually be true, but recent history shows that while the situation is precarious it is not disastrous except in a few instances. In the past two decades, world agricultural production in both the developed and the developing countries has actually increased by an average of 2.6 percent per year. In the developing countries, however, production has barely kept ahead of the increasing demand for food caused by the increasing population. In some countries and in some years it has lagged behind. Thus the developing countries are particularly vulnerable to any disruption in food supplies such as those caused by unfavorable weather and natural disasters. Their vulnerability is even more evident when we consider that almost all the developing countries depend on grain imports from a few countries, mainly the United States, Canada, and Australia.

Still another relationship between food and population is even less obvious. Some authorities believe that increasing local agricultural production, particularly in the developing countries, may be the best means of raising per capita incomes and thereby paving the way for the greater economic security and education that appear to result in a decline in population growth rates.

This chapter first examines the history of population, defining the terms needed to understand population statistics and pointing out what

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factors determine population growth rates. Next, the dimensions of the problem are presented along with how the problem affects people's lives. The chapter then examines the differences in developed and developing countries and concludes with a discussion of the prospects of feeding more people.

POPULATION HISTORY. The world's history has been and continues to be a record of increasing population growth. Much of our information on prehistoric populations has been, at best, an educated guess. Even today population figures are estimates, which cannot be precise, especially for countries in which there is no census.

Census enumeration is not new. The first recorded census was taken more than 600 years ago in China for the purpose of relating numbers of people to needed food. Regular counts are comparatively recent. Sweden has had a regular census since 1750, the United States since 1790, England since 1800, and India since 1870. Russia has had irregular counts since 1897.

Today many countries still have no census information at all and among those who do inaccuracies persist. Coale suggests that population estimates in the eighteenth century erred by about 20 percent (3). The last census in the United States probably had errors in the range of 2 to 3 percent (10). Nigeria's careful census in 1974 showed that either their 1963 estimate was very poor or their actual count in 1974 was inaccurate. Political and social overtones will continue to limit census accuracy into the future.

Demographers (those who study population statistics) have compiled considerable data on population trends and estimates of population numbers for the past, present, and future, and these will be summarized briefly. Many of the statistics are presented in terms of *population growth rates,* which refers to births minus deaths plus migration. Demographers also use the term population increase, which refers simply to births minus deaths. If a growth rate is 4.4 per 1,000 per year, it may also be expressed as 0.44 percent per year.

PAST, PRESENT, AND FUTURE. Archaeologists recently unearthed evidence in the Rift Valley of southern Ethiopia and in Kenya that shows that a type of human being *(Homo erectus)* lived on the earth well over a million years ago. Prehistoric people and their offspring were forced to live by hunting and gathering edible berries, fruits, and plant parts. The sources of food and methods of obtaining it did not change until the beginning of agriculture (sometime between 10,000 and 8000 B.C.). As a result, population growth in the first 99 percent of human history was very slow with perhaps 8 million people on earth in 8000 B.C. With the advent of agriculture people could grow and store food thereby reducing the risk of starvation and hazards of hunting, and the population in-
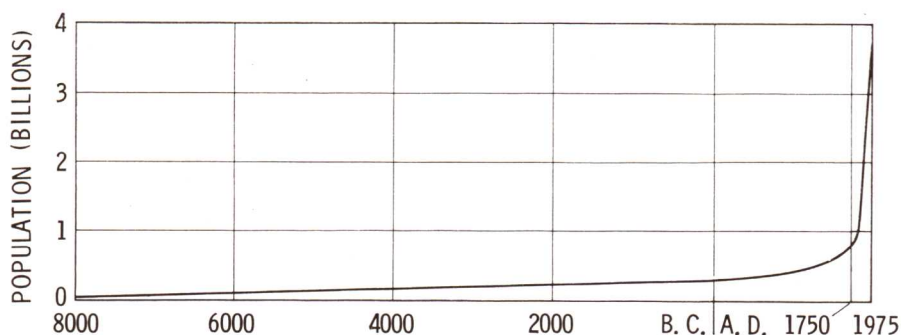
FIG. 1.1. Population growth from 8000 B.C. to 1975. Development of agriculture (about 8000 B.C.) resulted in a modest increase in population growth, but the Industrial Revolution starting about 1750 had a much greater effect.

creased somewhat more rapidly (Fig. 1.1). During the last 200 years of human history, however, population has increased very rapidly mainly because of improved medical knowledge and the ability to control disease epidemics. Durand estimated population growth rates of the four 50-year periods between 1750 and 1950 as approximately 4, 5, 5, and 8 per 1,000 per year (6). From 1950 to 1974 the growth rate was 18 per 1,000 per year—more than double that of the previous 50 years. The most recent growth rate estimate for the world is 22 per 1,000 per year.

Table 1.1 summarizes the current annual rate of increase for several countries based on United Nations' information (7). The Environmental Fund (10) has also reported estimates of current growth rates for the

TABLE 1.1. CURRENT (1973) POPULATIONS BASED ON UNITED NATIONS' ESTIMATES. (7)

Area	People	Crude Birth Rate	Crude Death Rate	Annual Rate of Natural Increase
	(millions)	*(per 1,000 population per year)*	*(per 1,000 population per year)*	*(%)*
World	3,860	33	13	2.0
Developed countries	1,120	17	9	0.8
Underdeveloped countries	2,740	39	14	2.5
Africa	375	46	19	2.7
Asia (except Japan)	2,100	38	14	2.4
Latin America (tropical)	265	38	8	3.0
U.S.	210	15	9	0.6
Japan	108	19	7	1.2
Europe	472	16	11	0.5
U.S.S.R.	250	18	8	1.0
Others: Canada, Australia, New Zealand, Latin America (temperate)	80	22	8	1.4

Source: Scientific American

world and for individual countries, and these estimates are presented in Table 1.2. Note that columns three and four (birth rate and death rate) are United Nations' figures, and those in columns one and two (population estimates and growth rates) are from the International Program Center, U.S. Bureau of the Census. Exceptions are noted. This table is included because it is the most comprehensive and current source of population information available. Population numbers for individual countries may be less precise than the comparisons between countries, but both are interesting and can be helpful. Some of the numbers shown in Tables 1.1 and 1.2 differ, in part because they represent different sources and different dates. This chapter uses the figures shown in Table 1.2 except when data are quoted from different sources.

Most reliable authorities believe that the number of people in the world will continue to increase for many years to come. Freedman and Berelson suggest three reasons for believing this (7). First, they point out that fertility itself is greatly resistant to change. Anyone who has been close to families and cultures in developing nations can understand why change will take place very slowly. Second, intervention in a family's fertility plan does not yet have a valid basis. Some may claim successes with family planning, but there is no evidence of mass adoption and at best the time needed for effective change is considerable. Third, population issues are changing. In some developing countries governments delay taking significant positive and effective policy action because the issue has become a political matter, especially when suggestions of need to limit population growth come from developed nations.

Few authorities are willing to admit that the increase in population will level out before 2050; the question is what level population will have reached by that time.

FACTORS AFFECTING POPULATIONS. The size of world population depends on two main factors: (1) birth rate and (2) death rate. The population increase is the amount by which the birth rate exceeds the death rate.

BIRTH AND FERTILITY RATES. When demographers study birth rates they usually examine, among other things, the general fertility rate, which is the number of live births in a designated year per 1,000 females of childbearing age (usually defined as 15 to 44 years).

Differences in fertility among women are due to two factors: differences in exposure of women of childbearing age to the risk of childbirth through contact with a sexual partner and differences in rates at which live births occur among women having sexual contact. Among the many elements that influence fertility are age of marriage for both men and women, whether a woman marries, type of diet, and availability of fertility control measures.

Birth control measures of varying kinds were widely used in preliterate societies, and similar methods may still be used in remote tribes of

TABLE 1.2. 1976 WORLD POPULATION ESTIMATES (10).

	Population Estimates (Millions) Mid 1976[1]	Growth Rate (%)[2]	Birth Rate (Per 1,000 Population)[3]	Death Rate (Per 1,000 Population)[3]	Number of Acres of Arable Land Per Person[4]	1974 Production Cereal Grains (1,000 Metric Tons)[5]	1948-1952 Net Exports Cereal Grains (1,000 Metric Tons)[6]	1974 Net Exports Cereal Grains (1,000 Metric Tons)[7]
WORLD[8]	4,240.7	2.2	35	14	0.8	1,333,864		
AFRICA	431.9	2.8	46	21	1.2	67,921	−370	−6,936
NORTH AFRICA	99.4	3.0	44	17	0.7	17,940	35	−6,249
Algeria	16.2	3.3	39	17	1.0	1,346	183	−1,774
Egypt[9]	37.9	2.3	44	16	0.2	7,909	−561	−2,860
Libya	2.5	4.1	46	16	2.3	173	−20	−401
Morocco	18.0	3.0	50	17	1.0	4,849	321	−856
Sudan	18.9	3.2	49	18	0.9	2,527	−15	−61
Tunisia[10]	5.9	2.4	41	13	§ 1.9 §	1,137	127	−297
WEST AFRICA	137.5	2.5	49	24	1.4	14,701	−264	−2,079
Benin (Dahomey)	3.2	2.4	51	26	§ 1.2 §	400	(−5)	−15
Cape Verde Islands	0.3	2.3	29	9	0.3	13	−11	−35
Gambia	0.5	1.9	43	23	§ 1.0 §	107	−4	−11
Ghana	10.3	3.0	47	18	0.2	877	−27	−153
Guinea	4.5	2.3	47	25	§ 0.8 §	765	−4	−63
Guinea-Bissau	0.5	1.1	41	30	1.2	65	1	−34
Ivory Coast	5.0	2.5	46	23	3.9	560	−26	−185
Liberia	1.6	3.1	50	21	0.2	208	−3	−47
Mali	5.8	2.3	50	27	§ 4.9 §	891	—	−232
Mauritania	1.3	2.2	44	23	0.5	34	—	−126
Niger	4.7	2.9	52	23	7.9	847	(−1)	−167
Nigeria[11]	83.8	2.5	50	25	§ 0.6 §	7,806	−12	−354
Senegal	4.5	2.5	46	23	§ 3.1 §	635	(−167)	−464
Sierra-Leone	3.1	2.4	45	23	2.9	556	−3	−95
Togo	2.3	2.6	51	26	2.3	238	−2	−23
Upper Volta	6.1	2.0	49	29	2.2	699	(0)	−75
EAST AFRICA	119.1	2.9	46	22	1.1	18,569	−155	−1,164
Burundi	4.1	2.4	48	25	0.6	552	—	−7
Comorros	0.3	2.6	31	20	§ 0.7 §	16	0	−15
Ethiopia[12]	29.9	2.6	46	25	1.1	5,545	39	−85
Kenya	14.1	3.7	48	18	0.3	2,118	43	65
Madagascar	7.7	2.2	46	25	§ 0.9 §	2,093	2	−161
Malawi	5.1	2.3	49	25	1.4	1,347	−1	25
Mauritius	0.9	1.8	28	7	§ 0.3 §	1	−63	−163
Mozambique	9.3	2.3	43	23	0.7	901	−21	−119
Reunion	0.5	2.0	28	7	0.3	12	−34	−88
Rhodesia	6.6	3.4	48	14	§ 0.7 §	2,369	−76	−61
Rwanda	4.4	2.9	52	23	0.3	167	—	−7
Somalia	3.2	2.4	46	24	§ 0.7 §	325	−6	−24
Tanzania	16.0	3.0	47	22	2.3	1,031	−9	−430
Uganda	11.9	3.3	43	18	0.8	1,261	0	−35
Zambia	5.1	3.2	50	21	§ 2.3 §	831	−29	−59
MIDDLE AFRICA	47.1	2.6	45	25	1.5	2,833	107	−634
Angola	6.6	1.8	50	30	§ 0.3 §	570	107	−51
Cameroon	6.6	2.4	43	23	2.5	692	−10	−74
Central African Republic	1.8	2.6	46	25	8.0	119	—	−14
Chad	4.3	2.4	48	25	§ 4.0 §	577	−8	46
Congo	1.4	2.7	44	23	1.1	14	—	−62
Equatorial Guinea	0.3	1.9	35	22	§ 1.8 §	—	—	−2
Gabon	0.5	1.2	33	25	§ 0.6 §	3	—	−5
Zaire[13]	25.6	2.8	44	23	§ 0.7 §	858	18	−380
SOUTH AFRICA	28.8	3.0	41	17	1.2	13,878	−93	3,228
Botswana	0.6	1.9	44	23	2.1	55	—	−44
Lesotho	1.1	2.1	39	21	0.8	211	—	−64
Namibia	0.7	2.1	44	25	2.3	119	−8	0
South Africa	25.9	3.1	40	17	1.2	13,390	−85	3,347
Swaziland	0.5	3.2	52	24	0.8	103	—	−11

TABLE 1.2. 1976 WORLD POPULATION ESTIMATES. *(Continued)*

	Population Estimates (Millions) Mid 1976[1]	Growth Rate (%)[2]	Birth Rate (Per 1,000 Population)[3]	Death Rate (Per 1,000 Population)[3]	Number of Acres of Arable Land Per Person[4]	1974 Production Cereal Grains (1,000 Metric Tons)[5]	1948-1952 Net Exports Cereal Grains (1,000 Metric Tons)[6]	1974 Net Exports Cereal Grains (1,000 Metric Tons)[7]
ASIA	**2,475.9**	**2.5**	**40**	**15**	**0.5**	**513,867**	**−5,845**	**−47,078**
SOUTHWEST ASIA	**90.4**	**2.9**	**43**	**16**	**1.1**	**24,179**	**135**	**−4,880**
Bahrain	0.3	3.3	30	[9]	0.005	—	—	−14
Cyprus	0.7	0.9	23	8	1.3	216	−47	−155
Gaza	0.4	3.6	44	8	—	—	—	—
Iraq	11.4	3.4	49	16	1.1	2,175	330	−626
Israel	3.5	2.1	28	7	0.2	350	−230	−1,472
Jordan	2.7	3.6	48	16	1.0	261	−29	−169
Kuwait	1.1	6.1	43	7	0.002	•0	—	−203
Lebanon[14]	2.7	2.6	40	10	0.2	72	−141	−356
Oman	0.8	3.1	[50]	[19]	0.05	—	—	—
Saudi Arabia[18]	9.2	3.0	50	23	0.2	556	(−101)	−693
Syria	7.6	3.4	48	15	1.8	2,335	191	−336
Turkey	41.3	2.6	40	15	1.5	17,014	174	−587
U. A. Emirates	0.2	3.6	[50]	[18]	§ 0.2 §	—	—	—
Yemen Arab Republic	6.8	2.9	50	23	§ 0.4 §	1,105	—	−146
Yemen Dem. Republic	1.7	3.0	50	23	§ 0.4 §	95	−12	−123
MIDDLE SOUTH ASIA	**893.8**	**2.7**	**44**	**17**	**0.6**	**154,657**	**−4,164**	**−10,470**
Afghanistan	19.7	2.5	51	27	1.0	4,702	(0)	−16
Bangladesh	82.9	2.7	[46]	[17]	0.3	17,401	—	−1,667
Bhutan	1.2	2.4	[44]	[20]	§ 0.01 §	396	—	15
India[15]	652.7	2.6	43	17	0.6	108,199	−3,576	−5,374
Iran	36.0	3.1	45	17	1.1	6,348	−50	−1,948
Nepal	12.9	2.3	45	23	§ 0.4 §	3,351	(35)	43
Pakistan[16]	74.2	3.6	51	18	§ 0.7 §	12,315	(39)	−559
Sikkim[17]	0.2	2.0	29	16	§ 0.1 §	33	—	−11
Sri Lanka	14.0	2.0	30	8	0.2	1,912	−612	−953
SOUTHEAST ASIA	**338.4**	**2.7**	**44**	**16**	**0.5**	**73,455**	**1,413**	**−2,744**
Burma	31.9	2.4	40	17	1.4	8,613	1,230	204
Indonesia (Inc. W. Irian)	143.4	2.3	48	19	§ 0.3 §	25,560	−464	−1,714
Khmer Republic	8.7	3.2	45	16	0.5	705	0	−223
Laos	3.5	2.7	42	17	§ 0.7 §	930	0	−88
Malaysia	12.7	2.7	38	11	0.2	2,062	−642	−1,000
Philippines[18]	45.9	3.3	45	12	§ 0.5 §	7,883	−278	−794
Portuguese Timor	0.7	2.1	43	25	0.3	35	0	−3
Singapore[19]	2.3	1.4	20	5	0.003	—	—	−414
Thailand	42.7	3.1	43	10	0.4	15,855	1,291	3,547
Vietnam, Dem. Rep. of[20]	25.3	2.9	38	16	§ 0.2 §	4,450	(110)	−1,808
Vietnam, Republic of	21.3	2.6	43	8	0.4	7,362	(166)	−451
EAST ASIA	**1,153.3**	**2.3**	**35**	**12**	**0.3**	**261,572**	**−3,229**	**−28,882**
China[21]	964.4	2.4	37	9	§ 0.3 §	226,723	(299)	−2,825
Hong Kong	4.4	2.1	19	5	0.006	7	(−282)	−654
Japan	112.2	1.1	19	7	0.1	16,480	−2,731	−19,222
Korea, Dem. Rep. of	17.0	3.2	39	11	§ 0.3 §	6,533	(−55)	−531
Korea, Republic of	37.1	2.2	36	11	0.1	8,057	(−543)	−2,676
Macau	0.3	2.2	[25]	[7]	§ 0.002 §	—	−25	−25
Mongolia	1.5	3.1	42	11	1.3	358	(−1)	−27
Taiwan[22]	16.4	2.0	[23]	[5]	0.2	3,414	109	−2,922
NORTH AMERICA	**245.3**	**1.3**	**14**	**8**	**2.3**	**235,958**	**22,481**	**76,374**
Canada	23.1	1.3	16	7	§ 4.7 §	31,478	8,492	11,658
U.S.A.[23]	222.2	1.3	14	9	2.1	204,480	13,989	64,716
LATIN AMERICA	**333.5**	**2.6**	**39**	**10**	**0.8**	**76,840**	**1,160**	**−443**
MIDDLE AMERICA	**80.3**	**2.6**	**45**	**9**	**0.9**	**16,353**	**−448**	**−3,296**
Costa Rica	2.0	2.3	29	5	0.3	178	−23	−93
El Salvador	4.3	3.1	40	8	0.3	520	−21	−50
Guatemala	6.2	2.8	42	13	0.5	723	−23	−139
Honduras	3.3	3.7	49	17	§ 0.6 §	319	−6	−56

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