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DRAFT

As of June 18, 1991

PRESIDENT'S COUNCIL OF ADVISORS
ON
SCIENCE AND TECHNOLOGY

JULY 11-12, 1991
AGENDA

THURSDAY, JULY 11, 1991

OPEN SESSION 9:00 AM - 11:15 AM
CONFERENCE ROOM
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, NW

8:30 - 9:00	ARRIVAL AND COFFEE	
9:00 - 9:15	OPENING REMARKS	DR. BROMLEY
9:15 - 10:00	THE HUMAN GENOME PROJECT	DR. WATSON
10:00 - 10:15	DISCUSSION	
10:15 - 10:45	CRADAs - COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS - An Overview	MR. ALLEN
10:45 - 11:00	DISCUSSION	
11:00 - 11:15	CLOSING REMARKS AND MOVE TO INDIAN TREATY ROOM, ROOM 474, OLD EXECUTIVE OFFICE BUILDING	DR. BROMLEY

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THURSDAY, JULY 11, 1991 Continued...

CLOSED SESSION 11:00 - 1:00 PM
INDIAN TREATY ROOM
ROOM 474
OLD EXECUTIVE OFFICE BUILDING

CLOSED SESSION 1:00 - 5:00 PM
ROOM 476
OLD EXECUTIVE OFFICE BUILDING

11:15 - 11:45	NATIONAL SECURITY AND TECHNOLOGY PANEL - A Progress Report	DR. BUCHSBAUM
11:45 - 12:15	HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS PANEL - A Progress Report	DR. BUCHSBAUM
12:15 - 1:00	LUNCH	
1:00 -	-- Move to Room 476, OEOb --	
1:00 - 1:30	GLOBAL ENVIRONMENT AND NATURAL RESOURCES PANEL - A Progress Report	DR. LOVEJOY
1:30 - 2:00	PANEL ON MEGAPROJECTS IN THE SCIENCES - A Progress Report	DR. McTAGUE DR. RATCHFORD
2:00 - 2:30	BIOSCIENCE AND BIOTECHNOLOGY PANEL - A Progress Report	DR. NATHANS
2:30 - 3:00	THE PRESIDENT'S NATIONAL SECURITY STRATEGY	GENERAL SCOWCROFT
3:00 - 3:15	BREAK	
3:15 - 3:45	COMPETITIVENESS AND S&T	SECRETARY BRADY
3:45 - 4:00	DISCUSSION	
4:00 - 4:30	THE S&T BUDGET - FY 1992 - FY 1993	MR. GRADY
4:30 - 5:00	DISCUSSION OF AUGUST AGENDA AND CLOSING REMARKS	DR. BROMLEY

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FRIDAY, JULY 12, 1991

**CLOSED SESSION 9:00 AM - 12:00 NOON
ROOSEVELT ROOM
WEST WING
WHITE HOUSE**

8:30 - 8:50	ARRIVAL AND COFFEE <u>(DR. BROMLEY'S OFFICE, ROOM 358, OEOB)</u>	
8:50 - 9:00	MOVE TO ROOSEVELT ROOM	
9:00 - 9:15	PREPARATION FOR THIS MORNING	DR. BROMLEY
9:15 - 9:45	EDUCATION AND HUMAN RESOURCES PANEL - A Progress Report	DR. LIKINS
9:45 - 10:00	PANEL ON INTERNATIONAL ECONOMIC COMPETITIVENESS - A Progress Report	DR. GOMORY DR. SHAPIRO
10:00 - 11:00	OTHER BUSINESS	
11:00 - 11:30	THE FEDERAL COORDINATING COUNCIL FOR SCIENCE, ENGINEERING, AND TECHNOLOGY - An Update on Budget Crosscuts and Other Initiatives	MS. BACH
11:30 - 12:00	OTHER BUSINESS AND CLOSING REMARKS	DR. BROMLEY

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Ref to UNCED

(Study Notes)

{Melissa
Howdershelt}

Initiatives

Status of the science base

• where are we now

• pop'n growth

• contraceptive res.

• health issues / impacts

• res. on improved delivery of f. plan. services

"status" - "family planning"

• needs - new evidence

"women's health"

• Expand the edu of ♀♀ / ♀ literacy

Health

Food Initiative

Initiative

{Lopez - Sales}

Fam. planning programs - inc. support

- [a] (1) nat'l
(2) internat'l

- [b] Research Program - contraceptive res.
- (1) Child's health
 - (2) g's
 - (3) " literacy
 - (4) contraceptives
 - (5) delivery of cont. res.

Popin Res. Agenda for the 90's

- ① Improved Contract Techs.
- ② Res. to Improve Delivery of Family Services
- ③ Role of Popin suite in Civil Detm
- ④ Role of " " in Polt Destabi

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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

July 5, 1991

MEMORANDUM FOR BERNADINE P. HEALY

FROM: NANCY G. MAYNARD *NM*
SUBJECT: PCAST Paper on Population

On behalf of Tom Lovejoy (who is still in Brazil), attached is another copy of the PCAST paper on population for your review and comment. We sent one to you a couple of weeks ago but I wanted to be sure that you had received it and that you have had an opportunity to review it before the PCAST meeting this week.

In case he has not been able to reach you, Tom asked that I convey to you that this is a first draft of a paper by the panel on the population issue (Lovejoy, Drake, Borlaug, Packard, Healy plus D. A. Henderson). The paper constitutes a summary of the main points from several discussions among the panel members and he would really appreciate it if you would give it a thorough review and make any changes you think appropriate.

If you have any questions or need further information, please do not hesitate to call. (202) 456-6202.

DRAFT

PCAST paper on population

Burgeoning population growth is an important underlying and driving force behind many of the topics PCAST has responsibility to review. Agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase. So are environmental pollution and the magnification of social ills associated with movement of population into urban centers particularly in the developing countries. The National Academy report on the Policy Implications of Climate Change cited human population growth as a key driving factor. Much of the effect of our foreign aid has been undercut by population growth.

In our lifetimes we have seen the second third, fourth and fifth billionth person added to the world's population. This year the increase will exceed ninety million and before the end of this decade we will add the sixth billion. At this rate world population growth will double in 39 years. Over ninety percent of the growth is occurring in the less developed countries. Those are the least capable of coping with such numbers. Redistribution of people is not a realistic solution. It is unlikely this country would be willing to accept another 100 million people - essentially just a single year of world population increase.

[graph]

We wish to point out the importance and magnitude of the factor of human population growth and that it is easier and cheaper to address it in appropriate ways now rather than later. Further we wish to draw the clear distinction between population control (better word?) achieved voluntarily through family planning, and other approaches including abortion. Abortion is properly viewed as the failure of family planning.

1. Population Growth and World Food Supply

Since 1940, in many parts of the world where modern production technology has been used, yields per unit area have increased spectacularly. The "Green Revolution" enabled Indian wheat production to increase from 11 million tons in 1966 to 54.5 tons in 1989; that country has been self sufficient in cereals since 1975 despite a population increase from 450 million in 1965 to 850 million in 1990. Between 1961 and 1988 the world per capita food supply increased from 335 kg (of what?) per year to 440 kg per year. In this country the production of the 17 most important food, feed and fiber crops increased from 252 million metric tons in 1940 to 610 million tons in 1980, with only a 3 percent increase in cultivated area. Had yield per area not increased, 177 million hectares of additional agricultural land (equivalent to all land east of the Mississippi excluding Illinois, Wisconsin and Michigan) would have been necessary to generate the increased food

production. Increasing agricultural productivity by bringing additional land under cultivation is no longer possible in many of the densely populated areas of Asia and Latin America. In other areas, increasing land under cultivation could be achieved only at the price of serious land use problems such as watersheds and biological diversity.

2. A Population Research Agenda for the 1990s

Health alone is a notable factor. Unsafe patterns of childbearing (i.e., too early, too late, or too closely spaced in a woman's reproductive life) are very important in high maternal and child mortality. These factors, together with unsafe medical conditions at childbirth, result in about 400,000 deaths each year in developing countries. An additional 100,000 deaths result from unsafe illegal abortion procedures. It is estimated that good family planning services could eliminate as many as half of the maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning alone could probably cut infant and child mortality by 20 percent, saving some 3 million children each year in the Third World.

a. Research to Improve Delivery of Family Planning Services

Delivery of family planning services in all countries is

much higher

hampered by inadequate resources and inefficient approaches to getting the necessary information and services to those who need them. An expanded program of field research could serve to develop and evaluate innovative approaches such as distribution of contraceptives through local community organizations, subsidized commercial retail sale of contraceptives, and improving client satisfaction with long term use of contraception.

b. Improved Contraceptive Technology

The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater certainty, safety and economy of cost. By the end of this century about a billion couples will need birth control but only \$15 million per year is available from government funds (AID and NIH) for applied research on contraceptive development. The U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability lawsuits, has largely abandoned contraceptive development research. At the same time, fundamental discoveries in basic research now offer the prospect for anti-fertility vaccines and for other interventions such as those which would block fertilization of the egg. Such new contraceptive

technologies, especially those which women themselves could use to moderate fertility, would make a significant contribution to the moderation of population growth.

c. The Role of Population Growth in Environmental Deterioration

The relative contribution of population growth to environmental stress has never been quantified. Human numbers along with consumption patterns and technology levels all play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help assess the relative contributions of these various causative agents could help us focus corrective efforts most effectively. Most urgent are studies of the related effects of population pressure and environmental degradation on future food production capacity in regions of the world already subject to periodic drought and famine.

d. The Role of Population Growth in Political Destabilization

Rapid population growth places enormous strains on political institutions. It complicates governance by contributing to massive urbanization, to an imbalanced age

structure, and to labor force expansion which outstrips job creation, especially for urban youth. Additional knowledge of these interrelationships is urgently needed.

3. Examples of Success Stories

Although many social and economic factors influence desired family size, direct efforts to lower birthrates through family planning programs are generally more successful than indirect efforts through other development programs. Reducing child mortality, expanding female education and increasing family incomes are desirable in their own right and are associated with lower birthrates in the long run. These efforts do not, however, always lower birthrates in the short run. They also tend to cost more than family planning. Over time, family planning and social and economic changes are mutually supportive: female education and family planning, for example, have a powerful combined impact on both family size and women's status.

Over the past 15 years a combination of indigenous efforts and donor assistance for population and family planning programs have achieved dramatic success in lowering birthrates in a number of important countries. These fertility declines have occurred not only in economically successful countries, such as Taiwan and South Korea, but also in lower income countries

with lower levels of education such as Indonesia and Zimbabwe. Moreover, the declines in fertility have taken place much faster than demographers would have expected given the example of earlier demographic transitions in Europe and North America. For example, it took 58 years for average family size in the United States to decline from 6 children to about 3.5 children. The same transition took just 27 years in Sri Lanka and Indonesia; and 12 years in Colombia and South Korea.

- a. Mexico. In 1973 its population was growing at 3.3 percent annually and expected to double in 21 years. In 1974 the government launched an extensive family planning outreach program. Average family size has dropped from about six to fewer than four children; population growth is at 2.4 percent annually.
- b. Thailand. In the early 1970's Thailand also had an annual population growth rate, of 3.3%. Thailand's public and private sectors have worked in partnership to provide community based family planning services in virtually every village. Contraceptive prevalence rose by 150 percent between 1975 and 1981. Despite low levels of education and income, average family size has dropped to 2.7 children and its annual rate of population growth in 1.7%.
- c. Brazil. In the early 1970's Brazil's population was

growing at 2.8% (a doubling time of 25 years). The rate is now 2.0% due to the work of commercial sector and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action

- a. increased support for international family planning programs
- b. support for a population research agenda



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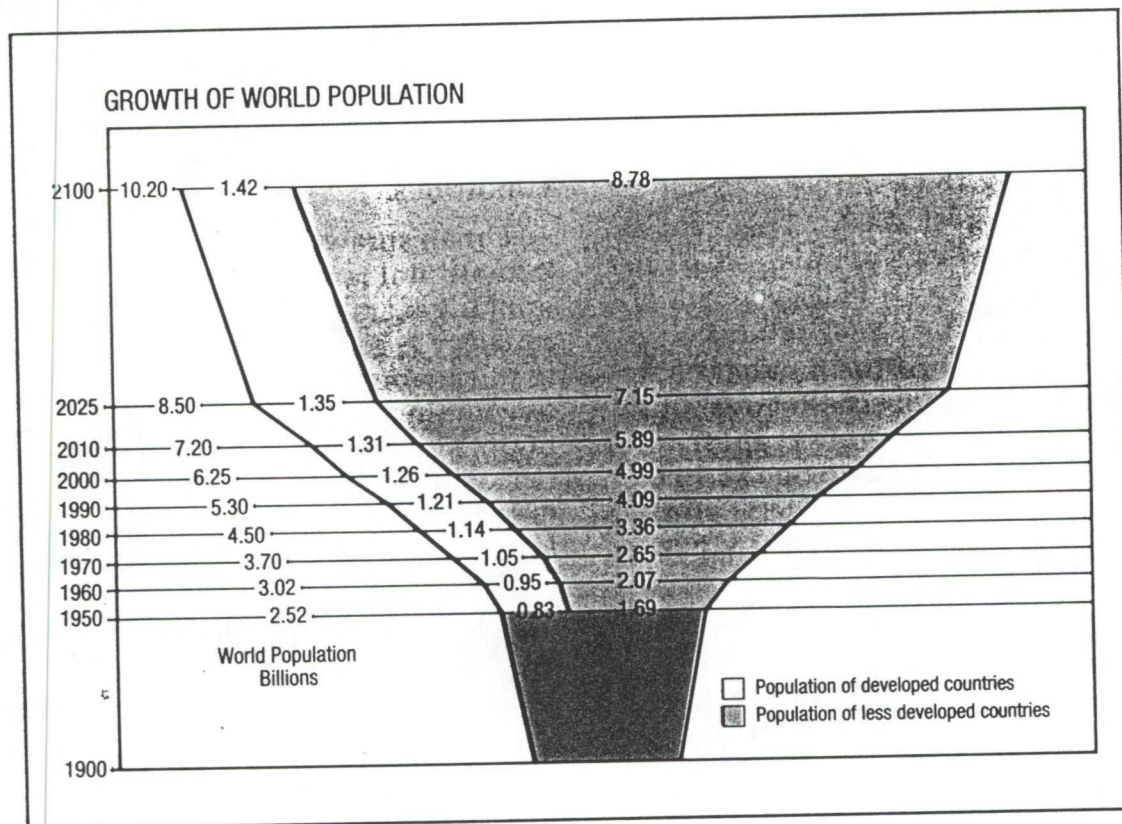
June 10, 1991

MEMORANDUM

TO: Nancy Maynard
FROM: Thomas E. Lovejoy
RE: PCAST paper on population

He is a first crack at it, stitched together from various discussions plus contributions from Packard, Borlaug & Drake. I thought you and Don Henderson should have a first look at it before it goes any farther; also we should bring in Bernardine early on. Then I think it can go to other panel members, and full PCAST in July. Do you think we should get any more specific re recommended courses of action?

Over 90% of the growth in world population is taking place in the developing world – those countries least able to cope with the resource consequences.





THE JOHNS HOPKINS UNIVERSITY
SCHOOL OF HYGIENE AND PUBLIC HEALTH

CENTER FOR COMMUNICATION PROGRAMS

July 2, 1991

Dr. Nancy Maynard
Office of the Science Advisor
The White House
Washington, DC 20500

Dear Nancy,

I am sorry we have not been able to get together recently. We have been very busy here with our third annual workshop on Advances in Family Health Communication and I have also been sick. I hope still at some point when I am in Washington to be able to get together with you again. In the meantime, I am enclosing a copy of an article on the degree to which human activities utilize net primary productivity in the world. While this is a new concept, it is an interesting way to look at the impact of human population on the environment and may be useful to your committee.

With best wishes,

Sincerely yours,

Phyllis T. Piotrow, Ph.D.
Director
Center for Communication Programs

PTP/cb

Human Appropriation of the Products of Photosynthesis

Nearly 40% of potential terrestrial net primary productivity is used directly, co-opted, or foregone because of human activities

Peter M. Vitousek, Paul R. Ehrlich, Anne H. Ehrlich, and Pamela A. Matson

Homo sapiens is only one of perhaps 5–30 million animal species on Earth (e.g., Erwin 1982), yet it controls a disproportionate share of the planet's resources. Evidence of human influence is everywhere: land-use patterns are readily visible from space, and the concentrations of carbon dioxide, methane, nitrous oxide, and other trace gases in the atmosphere are increasing as a consequence of human activities. Human beings are mobilizing a wide array of minerals at rates that rival or exceed geological rates.

We examined human impact on the biosphere by calculating the fraction of net primary production (NPP) that humans have appropriated. NPP is the amount of energy left after subtracting the respiration of primary producers (mostly plants) from the total amount of energy (mostly solar) that is fixed biologically. NPP provides the basis for maintenance, growth, and reproduction of all heterotrophs (consumers and decomposers); it is the total food resource on Earth. We are interested in human use

of this resource both for what it implies for other species, which must use the leftovers, and for what it could imply about limits to the number of people the earth can support.

Throughout this analysis, we treat NPP as the process responsible for input of organic material and calculate human uses as output. In most cropland, input and use (harvesting) occur in the same year. In a given area of forest or other ecosystems dominated by perennials, however, human-caused output can temporarily exceed NPP input (in the year a forest is harvested, for example). If the spatial scale is large enough, we can nevertheless calculate the fraction of forest NPP used by humans as the amount of organic material humans harvest or destroy divided by the total NPP of forests worldwide.

We calculated human influences in three ways. Our low estimate is simply the amount of NPP people use directly—as food, fuel, fiber, or timber. Our intermediate estimate includes all the productivity of lands devoted entirely to human activities (such as the NPP of croplands, as opposed to the portion of crops actually eaten). We also include here the energy human activity consumes, such as in setting fires to clear land. Our high estimate further includes productive capacity lost as a result of converting open land to cities and forests to pastures or because of desertification or overuse (overgrazing, excessive erosion). The high estimate seems a reasonable statement of human impact on the biosphere.

The substantial international effort

that has gone into understanding human effects on the global carbon cycle greatly contributed to our calculations. Fossil fuel combustion is currently the primary cause of rising carbon dioxide levels in the atmosphere, although the importance of land clearing and forest regrowth as a source or sink of carbon dioxide is still being debated (Bolin 1977, Broecker et al. 1979, Houghton et al. 1983). Efforts to resolve this issue have produced massive reviews and compilations of data on global NPP, organic matter storage, land use, and land conversion rates (Ajtay et al. 1979, Armentano and Loucks 1984, Houghton et al. 1983, Olson et al. 1983). In addition to these sources, we used the Food and Agriculture Organization's (FAO) summaries of agriculture and forestry (FAO 1982, 1983, 1984).

For our calculations, we use a petagram (Pg) of organic matter, equivalent to 10^{15} grams or 10^9 metric tons, as our basic unit of measure. Where our sources express results in terms of carbon, we have converted to organic matter by multiplying by 2.2 (see Olson et al. 1983); where they use kilocalories, we have converted to dry organic matter by dividing by 5. We have also rounded all our estimates and generally accepted intermediate or conservative (rather than extreme) estimates from the literature.

Global primary production

Several ecologists have attempted to calculate NPP on a global scale by classifying the earth's land surface

Peter M. Vitousek is associate professor of biological sciences, Paul R. Ehrlich is professor of biological sciences and Bing Professor of population studies, and Anne H. Ehrlich is senior research associate in the Department of Biological Sciences, Stanford University, Stanford, CA 94305. Pamela A. Matson is research scientist, Ecosystem Science and Technology Branch, NASA-Ames Research Center, Moffett Field, CA 94035. Their research concerns interactions between population biology and ecosystem processes. © 1986 American Institute of Biological Sciences.

into biomes or other functional units and then using a few detailed measurements of above- and below-ground productivity within each biome (Ajtay et al. 1979, Lieth and Whittaker 1975, Whittaker and Likens 1973). We use the calculations of Ajtay et al. (1979), which yield a biomass of 1244 Pg and an annual NPP of 132.1 Pg (Table 1), as the basis for our discussion because they classify land use in detail. Their overall values for terrestrial productivity are nearly identical to those of Olson et al. (1983), but the former's estimate for forest biomass may be high. Successive revisions of forest biomass information have yielded decreasing estimates (Brown and Lugo 1984, Olson et al. 1983). Additionally, all the summaries may underestimate the magnitude of belowground NPP. For NPP in marine and freshwater ecosystems, we use De Vooys's (1979) estimate of 92.4 Pg (Table 1). The estimate for marine systems may be low because the production of extremely small phytoplankton may have been systematically excluded by the widely used carbon-14 method (Li et al. 1983).

The low calculation

Our low calculation simply estimates how much organic material is used directly by people or domestic animals (Table 2).

Human consumption of plants. We assumed a current human population of 5.0 billion people and an average caloric intake of 2500 kcal/person/day (FAO 1980). These assumptions yield an annual consumption of 0.91 Pg of organic material. Approximately 17% of the calories people consume (and 33% of the protein) derive from animal products (FAO 1983), so we calculate that humans directly consume 0.76 Pg of vegetable material.

Alternatively, we can calculate the global production of human food. The annual grain harvest in the early and mid-1980s has been about 1.7 Pg (FAO 1983, USDA 1984), about two-thirds of which (1.1 Pg) is intended for direct human consumption and about one-third for livestock feed. The water content of harvested grain averages about 20% (Spedding et al.

Table 1. Surface area by type of cover and total net primary production (from Ajtay et al. 1979 and De Vooys 1979).

Type	Surface area ($\times 10^6$ km ²)	Net primary production (Pg)
Forest	31	48.7
Woodland, grassland, and savanna	37	52.1
Deserts	30	3.1
Arctic-alpine	25	2.1
Cultivated land	16	15.0
Human area	2	0.4
Other terrestrial (chaparral, bogs, swamps, and marshes)	6	10.7
Subtotal terrestrial	147	132.1
Lakes and streams	2	0.8
Marine	361	91.6
Subtotal aquatic	363	92.4
Total	510	224.5

1981), so the annual amount of dry material produced for human consumption is about 0.85 Pg. People also eat nongrain materials, which account for roughly an additional 0.3 Pg in dry material (FAO 1982). Overall, this gives about 1.15 Pg of plant material harvested annually, compared with 0.76 Pg for direct human consumption. Thus, about 0.39 Pg (34%) of the human food harvest from plants appears to be wasted or lost to pests or postharvest spoilage. This estimate is high but not out of line with other estimates (e.g., FAO 1984). We have not included this lost material in our estimate of the NPP used directly by humans.

Consumption by livestock. Estimates of how much food livestock consumes annually vary substantially. Wheeler et al. (1981) reported that in

the late 1970s the world's livestock consumed 8.71×10^{15} kcal, or 1.74 Pg, of usable dry organic material per year, 75% derived from pasture, 17% from grain, and 8.5% from other agricultural products. FAO (1983) estimated that about 0.5 Pg (in dry weight) of grain and roughly 0.15 of other agricultural products annually were fed to livestock worldwide in the early 1980s. If the fraction of livestock food derived from grain is slightly less than 17% (Wheeler et al. 1981), the overall consumption of dry organic material by livestock would amount to 2.8 Pg. Pimentel extended his calculation for livestock consumption in the United States (Pimentel et al. 1980) to estimate that 3.2 Pg of forage and grain is fed annually to livestock in developed countries and 1.8 Pg in developing countries, for a total of 5 Pg worldwide.¹

We cannot explain the discrepancies among these figures; we use a low estimate of 2.2 Pg of dry organic material to represent livestock consumption of plants. This rate yields an efficiency of 6.8% for conversion of plant materials into human food by livestock (the quantity of animal products humans consume divided by the plant biomass livestock consumes, or 0.15/2.2 Pg).

Forests. Excellent information is available on the volume of wood har-

Table 2. Amount of net primary production (NPP) used directly by humans and domestic animals.

Source	NPP used (Pg)
Cultivated land, food	0.8
Domestic animal fodder	2.2
Wood products	1.2
Construction and fiber	1.0
Firewood	1.0
Fisheries (0.020 dry wt harvested)	2.0
Total	7.2
Percent NPP (7.2/224.5)	3.2

¹David Pimentel, 1985, personal communication. Cornell University.

vested for construction and fiber, but less exists on firewood harvesting, especially in the tropics. Armentano and Ralston's summary (1980) makes it possible to calculate that in the early 1970s 1.65×10^9 m³ of wood for construction and fiber was harvested annually in the north temperate zone (including China), assuming that wood harvest per unit of forest area in eastern Europe outside the Soviet Union is similar to that in western Europe. Assuming (with Armentano and Ralston) an average density of 0.6 g/cm³, this corresponds to 0.99 Pg of organic material. Houghton et al. (1983) estimate 1.0 Pg for all temperate and boreal forests. Wood harvests in tropical areas add another 0.2–0.3 Pg of so-called industrial wood (FAO 1984, Seiler and Crutzen 1980).

Firewood harvests, mostly in developing countries, were estimated at 0.6 Pg/year by Hampicke (1979). Myers (1984), in contrast, estimated 1.2–2.4 Pg, but some of these figures represent wet weight. Seiler and Crutzen (1980) estimate that 1.0–1.2 Pg of fuelwood is used; the FAO (1984) estimate is 0.9–1.0 Pg, and Armentano and Loucks (1984) use 0.9–1.5 Pg. Hampicke's figure seems low, given the pervasiveness of wood as a fuel and the inefficiency of most wood-burning stoves, so we use 1.0 Pg in our calculations. Altogether, we estimate that humans use 2.2 Pg of wood each year.

Aquatic ecosystems. The total annual fish catch is approximately 0.075 Pg wet weight (FAO 1983, 1984), which converts to a dry weight of 0.013–0.024 (Royce 1972); we use 0.02 Pg. If we assume that the average fish caught fed on the second trophic level above primary producers, this harvest could represent the yield from approximately 2 Pg, or 2.2%, of marine production.

Overall. We estimate that humans use approximately 7.2 Pg of organic material directly each year—about three percent of the biosphere's total annual NPP.

the intermediate calculation

Our intermediate computation includes the NPP co-opted by humans.

By *co-opted* we mean material that human beings use directly or that is used in human-dominated ecosystems by communities of organisms different from those in corresponding natural ecosystems. This estimate also includes organic material that is killed (or dead organic material that is burned) by human beings during land clearing or conversion. Where these activities lead to net changes in land use, they represent a reduction in future production as well as an appropriation of NPP. In this section, we consider only the appropriation of organic material and land; we consider losses of productivity in the next section.

Cropland. Ajtay et al. (1979) estimate the NPP of the world's croplands at 15 Pg/year; several other estimates are similar. Olson et al. (1983), however, calculate 26.6 Pg/yr in croplands and towns. This seems high, so we use Ajtay et al.'s more conservative estimate. We consider all cropland NPP as co-opted by humans because it all occurs in human-controlled ecosystems.

Pastureland. In this calculation, we include all the NPP of pastures that have been converted from other ecosystem types, mostly forests, to human-controlled grazing ecosystems. Ajtay et al. estimate that this amounts to 233,000 km²/year, but this appears excessive; Seiler and Crutzen (1980) calculate that 60,000 km² of forest are now being converted to grazing land annually, mostly in Latin America, and Houghton et al. (1983) report similar results.

Most evidence suggests that at most 2 million km² have been converted in the past 30 years. Substantial areas of human-created savanna exist in Africa (Rosswall 1980) and elsewhere in seasonally dry tropical areas, however, and many temperate grazing lands have been established by clearing forest (e.g., Huenneke 1986). An overall estimate of 7 million km² of forest permanently converted to grazing during human history seems reasonable. If the average productivity of this derived grazing land is the same as that of woodlands, grasslands, and savanna (Table 1), then the NPP on derived grazing land amounts to 9.8 Pg per year, or 18.8%

of the total annual NPP in all grazing lands.

We must also take into account the energy consumed by livestock on natural grazing land. Of the estimated 2.2 Pg of NPP eaten by livestock, 1.5 Pg come from natural and derived grazing lands (Wheeler et al. 1981). We assume that grazing is more intensive on derived pastures and that half the forage livestock consumes is obtained from such pastures. This leaves about 0.8 Pg from natural grazing land (Table 3).

In this calculation, we also account for the biomass killed or consumed by anthropogenic fires on natural grazing land. Seiler and Crutzen (1980) estimate that 6 million km² of savanna and grassland is burned annually, mostly in human-caused fires, and that the aboveground biomass in the herb-grass layer of the burned areas is between 1.8 and 2.9 Pg. This material is almost wholly consumed in fires (75%), and the remainder is killed back to ground level. (In this case, we include only aboveground biomass; belowground biomass in grasslands largely survives fires and regenerates

Table 3. Intermediate calculation of net primary productivity (NPP) co-opted by humans.

Source	NPP co-opted (Pg)
Cultivated land	15.0
Grazing land	
Converted pastures	9.8
Consumed on natural grazing lands	0.8
Burned on natural grazing land	1.0
Subtotal	11.6
Forest land	
Killed during harvest, not used	1.3
Shifting cultivation	6.1
Land clearing	2.4
Forest plantation productivity	1.6
Forest harvests	2.2
Subtotal	13.6
Human occupied areas	0.4
Subtotal terrestrial	40.6
Aquatic ecosystems	2.0
Total	42.6
Percent terrestrial co-opted (40.6/132.1)	30.7
Percent aquatic co-opted (2.0/92.4)	2.2

aboveground tissues.)

We assume that burning, like grazing, happens more often on derived than on natural grazing lands and that fires on derived pastures account for half the area and biomass burned each year. Fires on natural grazing lands, then, consume 0.9–1.5 Pg of organic material annually; we use an estimate of 1.0 Pg (Table 3).

Overall, we calculate that human beings co-opt 11.6 Pg of NPP on grazing lands: the total NPP (9.8 Pg) from derived pastures, 0.8 Pg consumed by livestock on natural grazing land, and 1.0 Pg in fires on natural grazing land. This represents 22.6% of the total annual NPP in woodlands, grasslands, and savannas (Tables 1 and 3).

Forest use and conversion. In addition to the organic material people use directly, we now include the forest biomass killed during harvesting but not used, the biomass killed or burned in shifting cultivation or by more permanent land conversion, and the NPP of plantation forests.

Forest harvesting destroys nonmerchantable portions of forest biomass while the valuable stemwood is extracted. Armentano and Loucks (1984) estimate that the overall ratio of total forest biomass to the merchantable fraction is 1.96; Johnson and Sharpe (1983) measured a ratio of 2.7 in temperate deciduous forests, which can be adjusted to 2.3 by excluding forest detritus. We use 2.1, applying this figure to harvests of industrial wood only. (The ratio for firewood is probably considerably smaller.) Accordingly, we calculate that in harvested forests, 1.3 Pg of forest biomass is destroyed but not used each year.

Forest clearing and associated fires consume or destroy large amounts of biomass and, in the process, transfer organic carbon to the atmosphere as CO₂. Considerable effort has gone into estimating this net carbon flux (loss in cleared land minus the accumulation in regrowing vegetation elsewhere). We are more interested in estimating the gross loss of biomass caused by clearing land because that gross loss reflects current human appropriation of photosynthetic products. If present cutting rates in the tropics continue, the organic matter

now accumulating in regrowing forests—plus much of the remaining intact forests—will be appropriated by humans in the future.

Wong (1978) estimates that 6 Pg of organic material is consumed each year in fires associated with shifting cultivation and another 3 Pg in fires during permanent forest clearing. Seiler and Crutzen (1980) calculate that similar amounts of material are destroyed (3.1–9.1 Pg by shifting cultivation, mostly in secondary forests, and 2.0–3.4 Pg in more permanent clearing for cropland or pasture), but point out that less than half this material is actually burned.

Whether the material is consumed in fires or decomposes in cultivators' plots or cattle pastures rather than in forests, it represents human co-option of photosynthetic products. We use estimates of 6.1 Pg for shifting cultivation and 2.7 Pg for forest land conversion. Some of this material becomes firewood and hence has already been counted. Seiler and Crutzen (1980) estimate that 30% of the total firewood demand, or 0.3 Pg, is met by land clearing and shifting cultivation, so the net addition to co-opted NPP is 8.5 Pg.

Ajtay et al. (1979) estimate that tree plantations produce 2.6 Pg of organic material per year. We regard this NPP as functionally equivalent to that of cropland and count it as appropriated by *Homo sapiens*. Harvested products and waste during harvesting of tree plantations have already been counted; we estimate these fluxes at 1 Pg, assuming that 25% of the wood humans use comes from tree plantations (which represent only 4.8% of total forest area). Plantation forests therefore represent a net addition of 1.6 Pg to the NPP humans co-opt each year (Table 3).

The total amount of NPP directly used or co-opted annually on forest lands is estimated to be 13.6 Pg, some 27.9% of global forest NPP. Of this, 2.2 Pg is used directly for construction, fuel, or fiber; 1.3 Pg is "wasted" during harvesting; 8.5 Pg is destroyed in land clearing; and 1.6 Pg is produced in human-dominated plantation forests. The loss from land clearing is the largest, and efforts like that of Melillo et al. (1985) to reconcile disparate definitions and estimates of rates of land clearing are useful.

Other areas. Productivity in areas occupied by people—residential lawns and gardens, urban parks, golf courses, etc.—amounts to some 0.4 Pg/year (Ajtay et al. 1979). Human impact on alpine and true desert areas can be locally devastating but is unlikely to affect global NPP substantially since these areas are both relatively unproductive and little used. Desertification, on the other hand, is important on a global scale; we will consider it in our high estimate below. Human impact on marine ecosystems remains unchanged.

Overall. By these calculations, we estimate that humans co-opt 42.6 Pg of NPP each year. This amounts to 19.0% (42.6/224.5) of total net primary production—30.7% on land and 2.2% in the seas. If we accept Olson et al.'s (1983) higher estimate of cropland NPP, the amount co-opted rises to 54.2 Pg, which represents 37.8% of the then somewhat higher total terrestrial NPP of 143.7 Pg.

The high estimate

This computation includes both the NPP humans have co-opted and potential NPP lost as a consequence of human activities. Many effects on NPP must be considered, including the possible roles of acid deposition and oxidant air pollution in forest decline, the significance of soil erosion in decreasing crop productivity, and reduced estuarine productivity due to sedimentation and toxic pollution. These can be countered by possible enhanced productivity from nitrogen deposition in forests, cultural eutrophication of lakes, or the rising carbon dioxide concentration in the atmosphere.

Our discussion is confined to four relatively well-defined changes in land use that can cause declines in NPP: replacement of natural ecosystems with agricultural systems, the permanent conversion of forests to pastures, desertification, and conversion of natural systems to areas of human habitation (Table 4).

Cropland. We believe that average NPP in agricultural systems is lower than in the natural systems they replace, largely because most plants in agricultural systems are annuals

Table 4. High calculation of net primary productivity (NPP) co-opted by humans: additions to Table 3 from processes that opt or degrade NPP.

Process	Amount (Pg)
Previous terrestrial total (Table 3)	40.6
Decreased NPP in agriculture	9.0
Conversion of forest to pasture	1.4
Desertification	4.5
Loss to human areas	2.6
Total terrestrial	58.1
Percent terrestrial co-opted or lost (58.1/149.8)	38.8
Percent terrestrial plus aquatic co-opted or lost [60.1/(149.8 + 92.4)]	24.8

(Mitchell 1984). Longer-lived or perennial crops, multiple cropping, nutrient subsidies, and especially irrigation can offset or reverse this difference in some settings, but traditional agriculture almost always produces less than natural systems. Ajtay et al. (1979) and others estimate that average agricultural productivity worldwide is below that of natural systems (Table 1). If we assume that the productivity of land now under crops would have been similar to averages for savanna-grassland or forest (depending on a site's original vegetation), we can estimate that the 16 million km² of cropland would have had an NPP of 24 Pg under natural vegetation. Potential global NPP therefore has been diminished by 9 Pg as a consequence of converting land to agriculture. This calculation may be conservative since the best (most productive) land is preferentially converted to agriculture (Mooney and Gulmon 1983).

In contrast, Olson et al. (1983) assume that average agricultural NPP exceeds that of natural ecosystems. If we use their estimates, converting land to agriculture does not decrease NPP—but the amount of potential NPP co-opted by humans increases.

Forest conversion to pasture. As estimated in the previous section, approximately 7 million km² of forest land has been converted to more or less permanent pasture. Assuming that this land would be as productive as average forest land had it not been converted, we calculate that the conversion represents another 1.4 Pg of

NPP lost because of human activities (Ajtay et al. 1979).

Desertification. Mabbutt (1984) estimated that 35 million km² of land—75% of the total dry land area in his classification—is at least moderately desertified. Desertification is severe (defined as at least a 25% decline in productivity) on 15 million km². Assuming that natural NPP on these severely affected lands was average for dry savanna and that productivity has declined by 25%, desertification has reduced global NPP by 4.5 Pg.

Areas occupied by people. Approximately 2 million km² of land is classified as human occupied (under cities, highways, etc.); most of it would otherwise be relatively productive. Assuming an average productivity equivalent to that in natural forests, 3 Pg of NPP is foregone in this way. Since 0.4 Pg in these areas has already been counted as co-opted (Table 3), we remove a net 2.6 Pg.

Overall. These land-use changes contribute 17.5 Pg of organic matter to the total humans affect each year, yielding a final sum of 58.1 Pg on land. The losses raise the calculated potential NPP of terrestrial ecosystems to 149.6 Pg (132.1 + 17.5 here). Thus, humans now appropriate nearly 40% (58.1/149.6 Pg = 38.8%) of potential terrestrial productivity, or 25% [60.1/(149.8 + 92.4) Pg = 24.8%] of the potential global terrestrial and aquatic NPP. If we use Olson et al.'s base and leave out losses of NPP from converting land to cropland, estimated human appropriation of NPP on land rises to 62.7 Pg, or about 41% (62.7/152.4 = 41.4%) of potential terrestrial NPP. Furthermore, humans also affect much of the other 60% of terrestrial NPP, often heavily.

Discussion

Estimates of any heterogeneous process on a global scale are certain to be based on inadequate data and hence to contain errors, and our calculations are no exception. Since all our estimates are based on international efforts designed to evaluate the status of food and agriculture and to understand human-caused alteration in the

global carbon cycle, we anticipate they will be refined as these efforts continue. Nonetheless, we believe that our calculations accurately reflect the magnitude of human appropriation of the products of photosynthesis, and we believe some reasonable conclusions can be drawn from these estimates.

First, human use of marine productivity is relatively small. Although even this low level may not be sustainable (CEQ and Department of State 1980), it is unlikely to prove broadly catastrophic for oceanic ecosystems. Human influence on the lowest trophic levels in the oceans (outside severely polluted areas) is minimal, and human exploitation of marine resources therefore seems insufficient by itself to alter on a large scale any but the target populations and those of other species interacting closely with target species.

On land the situation appears very different. We estimate that organic material equivalent to about 40% of the present net primary production in terrestrial ecosystems is being co-opted by human beings each year. People use this material directly or indirectly, it flows to different consumers and decomposers than it otherwise would, or it is lost because of human-caused changes in land use. People and associated organisms use this organic material largely, but not entirely, at human direction, and the vast majority of other species must subsist on the remainder. An equivalent concentration of resources into one species and its satellites has probably not occurred since land plants first diversified.

The co-option, diversion, and destruction of these terrestrial resources clearly contributes to human-caused extinctions of species and genetically distinct populations—extinctions that could cause a greater reduction in organic diversity than occurred at the Cretaceous-Tertiary boundary 65 million years ago. This decimation of biotic resources will foreclose numerous options for humanity because of the loss of potentially useful species and the genetic impoverishment of others that may survive (Ehrlich and Ehrlich 1981, Ehrlich and Mooney 1983).

The information presented here cannot be used directly to calculate

Earth's long-term carrying capacity for human beings because, among other things, carrying capacity depends on both the affluence of the population being supported and the technologies supporting it (Ehrlich et al. 1977). But our results do indicate that with *current* patterns of exploitation, distribution, and consumption, a substantially larger human population—half again its present size or more—could not be supported without co-opting well over half of terrestrial NPP. Demographic projections based on today's human population structures and growth rates point to at least that large an increase within a few decades (Demeny 1984, Frejka 1981) and a considerable expansion beyond that. Observers who believe that limits to growth are so distant as to be of no consequence for today's decision makers (Simon and Kahn 1984) appear unaware of these biological realities.

Acknowledgments

We are grateful to the numerous people who have done the massive and mostly thankless job of compiling the productivity and use information on which this analysis is based. We also thank Bruce Peterson (Ecosystems Center, Woods Hole); John Harte and John Holdren (University of California, Berkeley); Laura Huenneke, Sharon Long, Harold McGee, and Harold Mooney (Stanford); John Pastor (Oak Ridge National Laboratory); David Pimentel (Cornell); Tomas Schlichter (University of Buenos Aires); Kirk Smith (East-West Center); and an anonymous reviewer for reading and commenting on the manuscript. This work was supported in part by a grant from the National Aeronautics and Space Administration through the Ecosystem Science and Technology Branch, Ames Research Center, to PMV and one from the Koret Foundation of San Francisco to PRE and AHE. This paper is a contribution from the Center for Conservation Biology, Stanford University.

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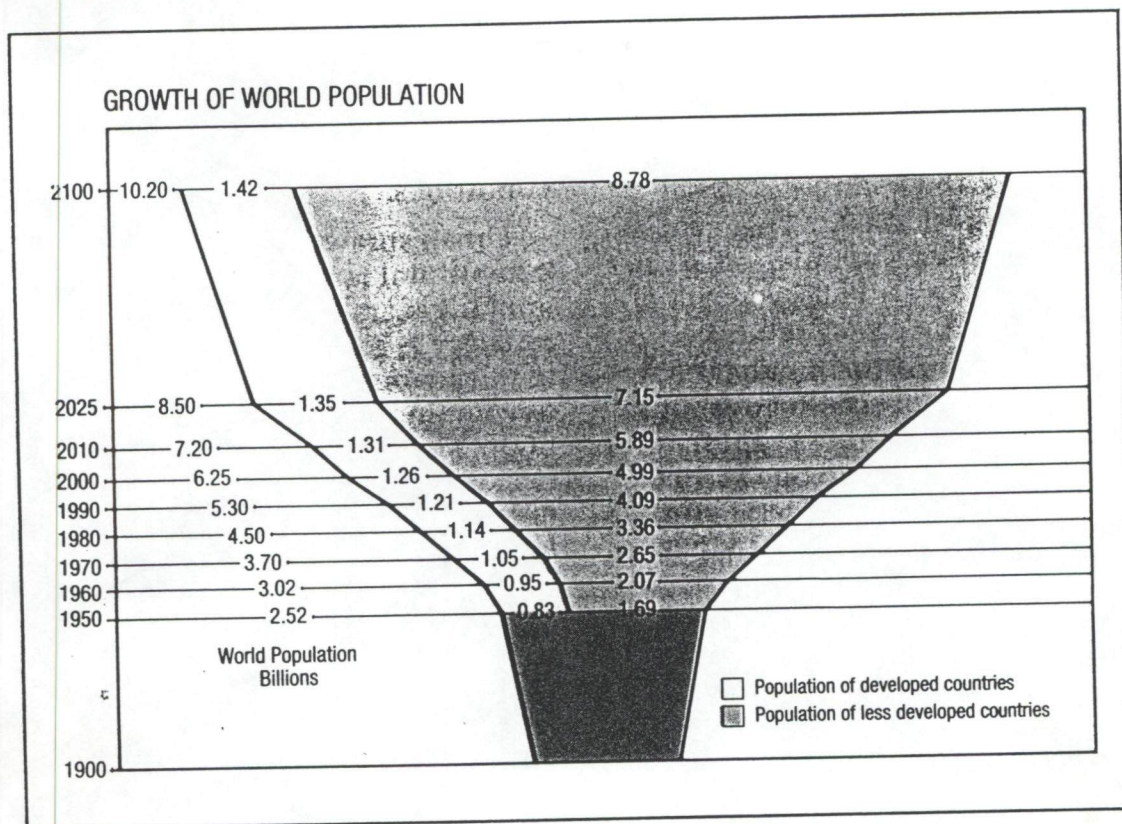
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Over 90% of the growth in world population is taking place in the developing world – those countries least able to cope with the resource consequences.







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CHARLES L. DRAKE
Chairman

July 15, 1991

Dr. Thomas E. Lovejoy
Assistant Secretary for External Affairs
The Smithsonian Institution
1000 Jefferson Drive, S.W., Room SI-230
Washington, D.C. 20560

FAX: 202-786-2304

Dear Tom:

I have been brooding about the population paper some more, largely as a result of the information that Nancy dug up about Mr. Bush's comments on the subject in earlier times. The recommendations he made in 1968 seem to me to be identical to those that were made in your draft. I have written a few things down. Let me know what you think.

There is an article in the August issue of Scientific American that indicates that the current ruling that prohibits federally funded family-planning clinics from providing women with any information about abortion has international implications. It is discouraging.

Regards,

Charles L. Drake

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Despite the slowing of growth in some countries, global population predictions have certainly not erred on the side of extremism; instead they have turned out to be conservative. The slowing of (non-immigration) growth in the United States has been the result of family planning which is an active practice in this country and is viewed with enthusiasm in many other parts of the world as well, especially by women. There have been attempts to equate family planning with abortion, but they are at opposite ends of the spectrum. Abortion is not family planning; it represents a failure in family planning.

Recommended Course of Action

Some Proposals

Abroad

I propose that we totally revamp our foreign aid program to give primary emphasis to population control and agricultural improvement.....At the same time we should continue research into better means of birth control - such as injections and male contraceptives - which can spur future, more effective population control drives and eventually turn up wholly new methods for combating the problem.

At Home

I propose we increase and earmark appropriations for our already existing family-planning services in all areas: the dispensing of birth control information, the training of family planning caseworkers, and the distribution of birth control devices if the patient requests them. Money spent toward family planning is a good investment, since in the long run it will save on such costs as aid to dependent children. But let me emphasize again that this is a preponderantly human problem, and compassion more than fiscal conservatism demands such action.

Our states and cities should be encouraged to pass legislation increasing the scope of their own efforts in family planning. A sort of central bank of information in the area, offering the latest news of advances in research and in private and governmental services, should be set up and used by these sub-Federal agencies.

Hon. George Bush, Representative from Texas, July 30, 1968

PCAST AND POPULATION

"I have come to believe that the population explosion is the world's most critical problem."

President Dwight D. Eisenhower

"Next to the pursuit of peace, the really great challenge to the human family is the race between food supply and population increase. That race (today) is being lost."

President Lyndon Johnson

"Today, the population problem is no longer a private matter. In a world of nearly 4 billion people increasing by 2% more, every year, population growth and how to restrain it are public concerns that command the attention of national and international leaders. The per capita income gap between developed and developing countries is increasing, in large part as a result of higher birth rates in the poorer countries."

George Bush, U.S. Representative to the UN

Through advances in agriculture and better control of water, agricultural production has shown great increases in the last 40 years. At the same time, through advances in medicine and improved social conditions, longevity has increased and infant mortality has been reduced. While there have been significant reductions in the rate of population increase in some regions, in others there has been little. As a result, global population, which stood at 4 billion in 1974 has exceeded 5 billion and should reach 6 billion before the end of this decade [Fig. 1].

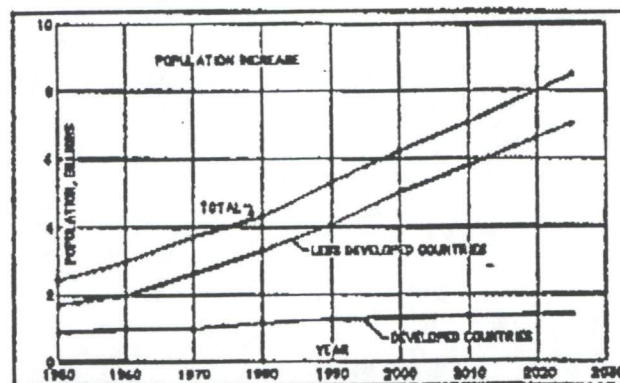


Fig. 1. Population growth since 1950

When John Winthrop gave his sermon in 1630 on the Puritan vessel, *Arabella*, his vision was one of a wilderness to be conquered. The early inhabitants did their best to protect themselves against a nature viewed as hostile and savage and to populate this wilderness. One hundred and fifty years ago it was the manifest destiny of the United States to develop and populate the West and this was done with enthusiasm. A few generations ago families in this country were quite large. Among the reasons for this was the realization that many children [and women] died in childbirth and many children succumbed from various infectious diseases while quite young. Large families ensured that at least some would make it to maturity. Populations were largely rural, much of the farm work required hand labor and if most did survive, there was usually enough to eat and there were more hands to carry out the chores. As society has further developed we have come to view the wilderness as fragile and helpless against our numbers and our capabilities; we must now think about protecting the natural world against us.

Now, infectious diseases have been for the most part effectively controlled; now, through the expensive magic of medicine, longevity has increased and infant mortality has been reduced. As of the last census, the US population is more urban than rural, a trend also witnessed in many other countries [Fig. 2]. Accompanying these changes has been a reduction of family size, more marked among that part of the population that is reasonably well off, less so among the deprived.

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CHARLES L. DRAKE
Chairman

September 15, 1991

Dr. Thomas E. Lovejoy
Assistant Secretary for External Affairs
The Smithsonian Institution
1000 Jefferson Drive, S.W., Room SI-230
Washington, D.C. 20560

Dear Tom:

You did a terrific job with the population document. It is the right length and it makes its points well. As we polish it we should not expand it very much. You should already have Norman's scribbles. Let me add a few of my own.

I think we should take advantage of the recently released National Security Strategy and cast our document in its terms. It is difficult for me to see how we can be internationally, or even nationally, secure if population is allowed to get out of hand.

1. For starters, why don't we change the title to something like Global Population and a National Security Strategy or maybe the other way around, National Security Strategy and Global Population. It seems pretty clear that many of the problems, immediate or future, impinge upon the objectives of this strategy.

2. It might be nice to begin with some quotes from the preface; i. e.:

"A new world order is not a fact; it is an aspiration - and an opportunity. We have within our grasp an extraordinary possibility that few generations have enjoyed - to build a new international system in accordance with our own values and ideals, as old patterns and certainties crumble around us."

"For America, there can be no retreat from the world's problems. Within the broader community of nations, we see our own role clearly. We must not only protect our citizens and our interests, but help create a new world in which our fundamental values not only survive but flourish. We must work with others, but we must also be a leader."

3. Then I would go on with the heart of our document, with some rewording and additions.

PAGE 1. I think I would turn the first sentence around so it leads from the problem to the cause.

Most of the topics PCAST has responsibility to review are relevant to national security as well as to the prospect of a new world order. Among these is burgeoning global population growth. Everyone would agree that there is an eventual limit to the ability of the planet to support a human population, but long before that limit is reached deterioration in the human condition will have effects counter to the objectives of the national security strategy. Agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase. So are environmental pollution and the magnification of social ills associated with the movement of population into urban centers particularly in developing countries. The root cause of much of the international strife and much of the human misery in the world lies in population pressures.

In our lifetimes.....

We wish to point out that the importance and magnitude of the factor of human population growth and that it is easier and more economical to address it..... [cheaper sounds a little sleazy]

I would rearrange pages 2-5 to separate the problems and the perceived solutions as follows:

- A. Population Growth and the Human Condition
 - 1. Population Growth and World Food Supply
 - 2. Population Growth and Health
 - 3. The Role of Population Growth in Environmental Deterioration.

4. The Role of Population Growth in Political Destabilization.
- B. A Population Research Agenda for the 1990s
 1. Research to Improve Delivery of Family Planning Services.
 2. Research to Improve Contraceptive Technology.
 3. Research to Assess Causative Agents of Environmental Deterioration.
 4. Research to Improve Understanding of the Role of Population Growth and Demography on Political Institutions.
- C. Examples of Success Stories.
- D. Recommended Courses of Action

This seems a little more orderly with the problems leading to the suggested agenda. One could add a lot of words to the recommendations, but I think their strength is in their simplicity. I would keep them as they are.

Let's not add a whole lot words. If the document gets much longer, the only people who will read it are us.

Regards,

Charles L. Drake

DARTMOUTH COLLEGE
DEPARTMENT OF EARTH SCIENCES
FAIRCHILD SCIENCE CENTER
HANOVER, NH 03755

FAX: 603-646-3922

COVER SHEET

DATE: 30 Sept 1991

TO: Tom Welch
ACAST
Washington, DC 20506

FAX#: (202) 395-1314

SUBJECT/COMMENTS:

Tom has included my comments. Suggested change on page 8.
NOTE: TELL YOUR PEOPLE TO USE FAX# 603-646-3922. THE ONE THEY
ARE USING GOES TO ANOTHER BUILDING

___ PAGE(S) FOLLOW. IF ALL PAGES NOT RECEIVED PLEASE CALL
SENDER IMMEDIATELY.

SENT BY: CHARLES C. DRAKE

TIME SENT:

TELEPHONE: 603-646-3338

SENT BY: Xerox Telecopier 7021 : 8-27-91 : 4:35PM :

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rate is now 2.0 percent due to the work of commercial sector and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action

with no action, we are faced with the prospect that
a. ~~Without strong U.S. leadership,~~ the World's population will more than double in the twenty first century. We recommend our government ~~offer~~ *take a leadership position by offering* support for promising voluntary family planning programs in Latin America, Africa and Asia. Support should include financial assistance, and help in planning and evaluating programs.

b. We recommend relevant US. agencies encourage research in reproductive biology related to controlling population growth, development of contraceptives suitable for large populations, effective delivery of family planning services and the role of population growth in environmental deterioration and political instability.

System Name: H:\DATA\COMMON\ENV\WP50\91\11-8-91P.DOC
System Filetype: WP5.1
Document Name: pop.tel
Document Type:

Creation Date: 07-20-92 10:48a
Revision Date: 07-20-92 10:48a

Author: RHD
Typist: RHD
Subject:
Account:
Keywords:

Abstract: P.C.A.S.T. Paper on Population ; Burgeoning population growth is an important underlying and driving force behind many of the topics PCAST has responsibility to review. Agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase.

P.C.A.S.T.

National Security and Population

As part of its vision of a new world order to promote international security, the United States must confront the issue of global population growth. PCAST has the responsibility to review topics in science and technology relevant to the nation's quality of life and prosperity, to national security, and to the prospects of a new world order. We realize that population is a complex and sensitive issue, but believe it is our responsibility to highlight the problem.

Burgeoning population growth now threatens the capacity of nations to achieve important objectives. The root cause of much international strife and misery lies in population pressures. Rapidly growing population is an underlying and driving force that could threaten agricultural and fishery productivity, the adequacy of energy and raw materials, and environmental quality. Social ills are magnified by the resultant movement of population into urban centers particularly in developing countries. Much of the benefit of the "Green Revolution" and our foreign aid has been undercut by population growth.

In our lifetimes we have seen the second, third, fourth and fifth billionth person added to the world's population. This year the increase will exceed ninety million and before the end of this decade we will add the sixth billion. At this rate, world population growth will double to ten billion in 39 years. Over ninety percent of the growth is occurring in the less developed countries, the least capable of coping with such

numbers.

We wish to point out the importance and magnitude of the factor of human population growth and that it is easier and more economical to address it in appropriate ways now rather than later. Further we wish to draw the clear distinction between limiting population voluntarily through family planning, as contrasted to other approaches including abortion. Abortion is properly viewed as the failure of family planning. Rational means of family planning include education, development and use of contraceptives and raising the status of women.

1. Population Growth and the Human Condition

- a. Population Growth and World Food Supply

Since 1940, in many parts of the world where modern production technology has been used, yields per unit area have increased spectacularly. For example, the "Green Revolution" has enabled India to be self sufficient in cereals since 1975 despite a population increase from 450 million in 1965 to 850 million in 1990. While some unexploited potential of the Green Revolution remains, it is not likely that further major leaps in productivity per unit area are possible. Increasing agricultural productivity by bringing additional land under cultivation is no longer possible in many of the densely populated areas of Asia and Latin America. In other areas, increasing land under cultivation could be achieved only at the price of serious environmental degradation and land use problems.

b. Population Growth and Health

Health alone is a notable factor. Unsafe patterns of childbearing (i.e., too early, too late, or too closely spaced in a women's reproductive life) are very important in high maternal and child mortality. It is estimated that good family planning services could eliminate as many as half of the maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning alone could probably cut infant and child mortality by 20 percent, saving some 3 million children each year in the Third World.

c. The Role of Population Growth in Environmental
Deterioration

The relative contribution of population growth to environmental stress has never been quantified. The numbers of humans along with consumption patterns and technology levels all play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help assess the relative contributions of these various causative agents could help us focus corrective efforts most effectively.

d. The Role of Population Growth in Political
Destabilization

Rapid population growth places enormous strains on political institutions. It complicates governance by contributing,

for example, to massive urbanization, to an imbalanced age structure, and to labor force expansion which outstrips a nation's capacity in job creation, especially for urban youth. Additional knowledge of these interrelationships is urgently needed.

2. A Population Research Agenda for the 1990's

a. Research to Improve Delivery of Family Planning Services
Delivery of family planning services in all countries is hampered by inadequate resources and inefficient approaches to getting the necessary information and services to those who need them. An expanded program of field research could serve to develop and evaluate innovative approaches.

b. Research to Improve Contraceptive Technology

The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater certainty, safety and economy of cost. By the end of this century about a billion couples will need birth control but only \$15 million per year is available from government funds (AID and NIH) for applied research on contraceptive development. The U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability lawsuits, has largely abandoned contraceptive development research. At the same time, fundamental discoveries in basic research now offer the prospect for anti-fertility vaccines and for other interventions such as those which would block fertilization of the egg.

c. Research to Assess Causative Agents of Environmental Deterioration

d. Research to Improve Understanding the Role of Human Population Dynamics on Political Institutions

3. Examples of Success Stories

Although many social and economic factors influence desired family size, direct efforts to lower birthrates through family planning programs are generally more successful than indirect efforts through other development programs. Reducing child mortality, expanding female education and increasing family incomes are desirable in their own right and are associated with lower birthrates in the long run. Over time, family planning and social and economic changes are mutually supportive: female education and family planning, for example, have a powerful combined impact on both family size and women's status. Fertility declines have occurred not only in economically successful countries, such as Taiwan and South Korea, but also in lower income countries with lower levels of education such as Indonesia and Zimbabwe.

a. Mexico. In 1973 its population was growing at 3.3 percent annually and expected to double in 21 years. Population growth is now at 2.4 percent annually.

b. Thailand. In the early 1970's Thailand also had an annual population growth rate of 3.3 percent. Thailand's public and private sectors have worked in a family planning partnership and despite low levels of education and income, its

annual rate of population growth has dropped to 1.7 percent.

c. Brazil. In the early 1970's Brazil's population was growing at 2.8 percent (a doubling time of 25 years). The rate is now 2.0 percent due to the work in family planning of commercial sector and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action [DAH'S VERSION of 4a]

a. Strong U.S. leadership is required if World population growth is to be contained within manageable levels. The problem needs to be an integral part of foreign policy. To the extent possible, added foreign support should be provided to promising voluntary family planning programs in Latin America, Africa and Asia.

4. Recommended Courses of Action [C. DRAKE'S VERSION of 4a]

ONLY CHANGES TO TEXT INCLUDED

a. With no action, we are faced with the prospect that the World's population will more than double in the twenty first century. We recommend our government take a leadership position by offering increased support for promising voluntary family planning programs in Latin America, Africa and Asia.

b. We recommend relevant US. agencies expand research in reproductive biology related to controlling population growth, development of contraceptives suitable for large populations, effective delivery of family planning services and the role of

population growth in environmental deterioration and political instability.

It^m brand fax transmittal memo 7871

of pages = 1

From	TAN Bromley	From	TOM Lovejoy
Date	8-14-91	To	
Dept.		Phone #	786-2263
Fax #	395-3261	Fax #	" - 2304

E HOUSE

INGTON

, 1991

AUG 02 1991

① DAB
② ~~Victor S.~~
Tom Welch

MEMORANDUM FOR MEMBERS OF THE PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

FROM:

D. ALLAN BROMLEY
CHAIRMAN

Duan

SUBJECT:

September PCAST Meeting

The various advisory groups and panels under PCAST in which you are participating are now in the final stages of formation. Because we have decided not to have an August meeting, I trust you will have time to focus on the substantive discussions underway in your respective panels.

The September meeting should provide us with an excellent opportunity to begin preliminary, substantive discussions on the issues currently underway in the various panels. It will also afford us an opportunity to become familiar with the issues, and receive initial feedback and guidance from our colleagues. To provide each of you with adequate preparation before the next meeting, and to maximize our productivity, I am requesting of the panel chairs: 1) a brief, one page summary giving the status of their panel's work; 2) lists of issues that should be discussed at the September meeting, and 3) draft documents that could serve as the basis for discussion within PCAST in September and with the President at later meetings.

Please send this material to the PCAST office by August 26. This will allow sufficient time to review and distribute the material and make any necessary changes to the agenda. I only remind you that the documents should be marked as draft and for limited official use only.

Thank you.

8/14

1. I want to wrap up the population paper and start to plan one on Biological diversity
2. Population
3. I am finishing up this draft with Nancy Maynard

Tom

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PCAST paper on population

Burgeoning population growth is an important underlying and driving force behind many of the topics PCAST has responsibility to review. Agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase. So are environmental pollution and the magnification of social ills associated with movement of population into urban centers particularly in the developing countries. The National Academy report on the Policy Implications of Climate Change cited human population growth as a key driving factor. Much of the effect of our foreign aid has been undercut by population growth.

In our lifetimes we have seen the second third, fourth and fifth billionth person added to the world's population. This year the increase will exceed ninety million and before the end of this decade we will add the sixth billion. At this rate world population growth will double in 39 years. Over ninety percent of the growth is occurring in the less developed countries. Those are the least capable of coping with such numbers. Redistribution of people is not a realistic solution. It is unlikely this country would be willing to accept another 100 million people - essentially just a single year of world population increase.

[graph]

SEE LAST PAGE

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We wish to point out the importance and magnitude of the factor of human population growth and that it is easier and cheaper to address it in appropriate ways now rather than later. Further we wish to draw the clear distinction between population control (better word?) achieved voluntarily through family planning, and other approaches including abortion. Abortion is properly viewed as the failure of family planning.

1. Population Growth and World Food Supply

Since 1940, in many parts of the world where modern production technology has been used, yields per unit area have increased spectacularly. The "Green Revolution" enabled Indian wheat production to increase from 11 million tons in 1966 to 54.5 tons in 1989; that country has been self sufficient in cereals since 1975 despite a population increase from 450 million in 1965 to 850 million in 1990. Between 1961 and 1988 the world per capita food supply increased from 335 kg (of what?) per year to 440 kg per year. In this country the production of the 17 most important food, feed and fiber crops increased from 252 million metric tons in 1940 to 610 million tons in 1980, with only a 3 percent increase in cultivated area. Had yield per area not increased, 177 million hectares of additional agricultural land (equivalent to all land east of the Mississippi excluding Illinois, Wisconsin and Michigan) would have been necessary to generate the increased food

production. Increasing agricultural productivity by bringing additional land under cultivation is no longer possible in many of the densely populated areas of Asia and Latin America. In other areas, increasing land under cultivation could be achieved only at the price of serious land use problems such as watersheds and biological diversity.

2. A Population Research Agenda for the 1990s

Health alone is a notable factor. Unsafe patterns of childbearing (i.e., too early, too late, or too closely spaced in a woman's reproductive life) are very important in high maternal and child mortality. These factors, together with unsafe medical conditions at childbirth, result in about 400,000 deaths each year in developing countries. An additional 100,000 deaths result from unsafe illegal abortion procedures. It is estimated that good family planning services could eliminate as many as half of the maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning alone could probably cut infant and child mortality by 20 percent, saving some 3 million children each year in the Third World.

a. Research to Improve Delivery of Family Planning Services

Delivery of family planning services in all countries is

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hampered by inadequate resources and inefficient approaches to getting the necessary information and services to those who need them. An expanded program of field research could serve to develop and evaluate innovative approaches such as distribution of contraceptives through local community organizations, subsidized commercial retail sale of contraceptives, and improving client satisfaction with long term use of contraception.

b. Improved Contraceptive Technology

The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater certainty, safety and economy of cost. By the end of this century about a billion couples will need birth control but only \$15 million per year is available from government funds (AID and NIH) for applied research on contraceptive development. The U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability lawsuits, has largely abandoned contraceptive development research. At the same time, fundamental discoveries in basic research now offer the prospect for anti-fertility vaccines and for other interventions such as those which would block fertilization of the egg. Such new contraceptive

technologies, especially those which women themselves could use to moderate fertility, would make a significant contribution to the moderation of population growth.

c. The Role of Population Growth in Environmental Deterioration

The relative contribution of population growth to environmental stress has never been quantified. Human numbers along with consumption patterns and technology levels all play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help assess the relative contributions of these various causative agents could help us focus corrective efforts most effectively. Most urgent are studies of the related effects of population pressure and environmental degradation on future food production capacity in regions of the world already subject to periodic drought and famine.

d. The Role of Population Growth in Political Destabilization

Rapid population growth places enormous strains on political institutions. It complicates governance by contributing to massive urbanization, to an imbalanced age

structure, and to labor force expansion which outstrips job creation, especially for urban youth. Additional knowledge of these interrelationships is urgently needed.

3. Examples of Success Stories

Although many social and economic factors influence desired family size, direct efforts to lower birthrates through family planning programs are generally more successful than indirect efforts through other development programs. Reducing child mortality, expanding female education and increasing family incomes are desirable in their own right and are associated with lower birthrates in the long run. These efforts do not, however, always lower birthrates in the short run. They also tend to cost more than family planning. Over time, family planning and social and economic changes are mutually supportive: female education and family planning, for example, have a powerful combined impact on both family size and woman's status.

Over the past 15 years a combination of indigenous efforts and donor assistance for population and family planning programs have achieved dramatic success in lowering birthrates in a number of important countries. These fertility declines have occurred not only in economically successful countries, such as Taiwan and South Korea, but also in lower income countries

with lower levels of education such as Indonesia and Zimbabwe. Moreover, the declines in fertility have taken place much faster than demographers would have expected given the example of earlier demographic transitions in Europe and North America. For example, it took 58 years for average family size in the United States to decline from 6 children to about 3.5 children. The same transition took just 27 years in Sri Lanka and Indonesia; and 12 years in Colombia and South Korea.

- a. Mexico. In 1973 its population was growing at 3.3 percent annually and expected to double in 21 years. In 1974 the government launched an extensive family planning outreach program. Average family size has dropped from about six to fewer than four children; population growth is at 2.4 percent annually.
- b. Thailand. In the early 1970's Thailand also had an annual population growth rate of 3.3%. Thailand's public and private sectors have worked in partnership to provide community based family planning services in virtually every village. Contraceptive prevalence rose by 150 percent between 1975 and 1981. Despite low levels of education and income, average family size has dropped to 2.7 children and its annual rate of population growth in 1.7%.
- c. Brazil. In the early 1970's Brazil's population was

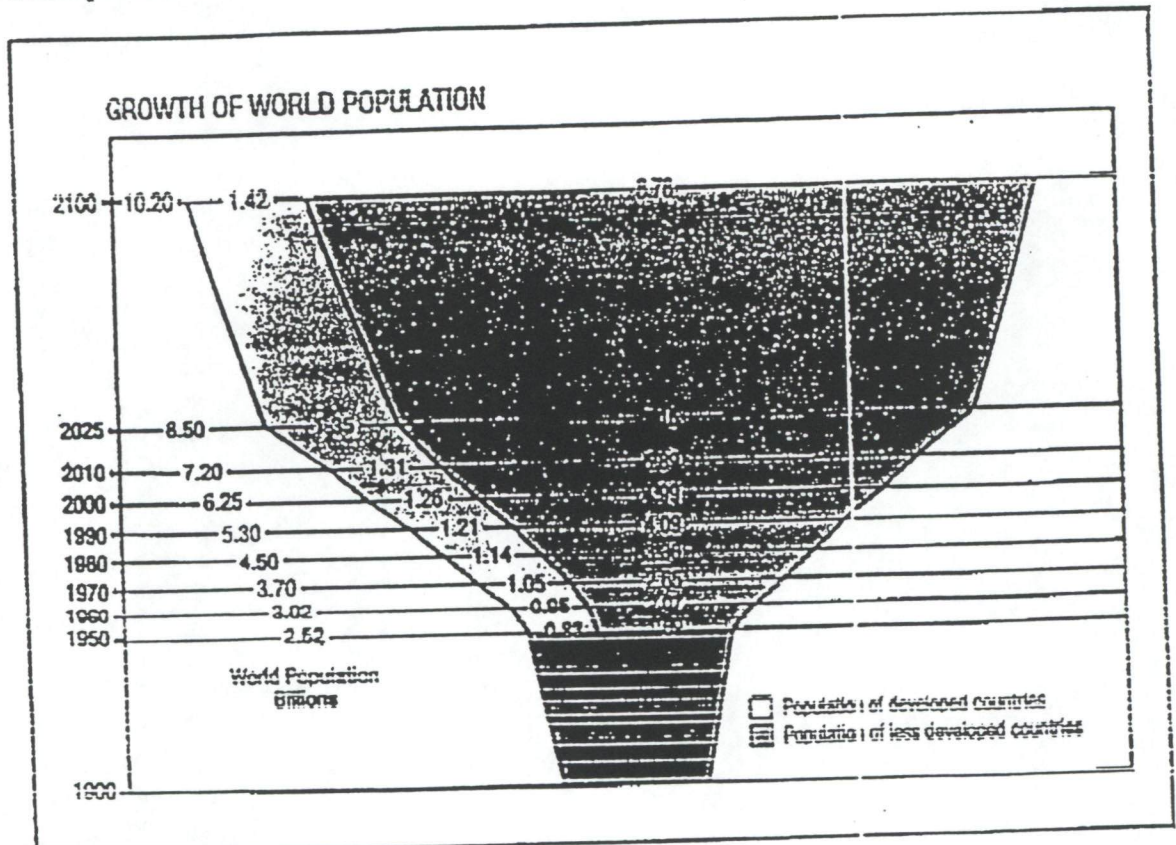
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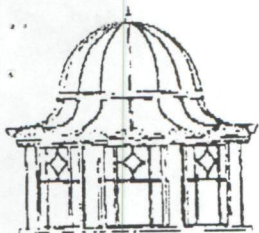
growing at 2.8% (a doubling time of 25 years). The rate is now 2.0% due to the work of commercial sector and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action

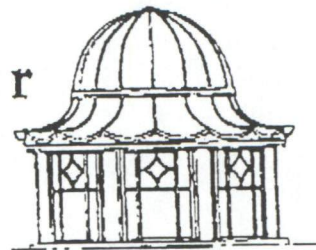
- a. increased support for international family planning programs
- b. support for a population research agenda

Over 90% of the growth in world population is taking place in the developing world — those countries least able to cope with the resource consequences.





International Center Smithsonian Institution



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FAX TRANSMISSION FORM (202) 786-2557

Date: 9/13/91

TO: Tom Welch

Affiliation: PCAST

FAX #: 395 3261

Addressee's Phone: _____

FROM: Ryan Dwight

Sender's Phone: 357 4797

Number of pages including cover sheet 102

Comments:

P.C.A.S.T.Paper on Population

Burgeoning population growth is an important underlying and driving force behind many of the topics PCAST has responsibility to review. Agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase. So are environmental pollution and the magnification of social ills associated with movement of population into urban centers particularly in the developing countries. The National Academy report on the Policy Implications of Climate Change cited human population growth as a key driving factor. Much of the effect of our foreign aid has been undercut by population growth.

In our lifetimes we have seen the second, third, fourth and fifth billionth person added to the world's population. This year the increase will exceed ninety million and before the end

of this decade we will add the sixth billion. At this rate world population growth will double in 39 years. Over ninety percent of the growth is occurring in the less developed countries, the least capable of coping with such numbers.

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2. A Population Research Agenda for the 1990s

Health alone is a notable factor. Unsafe patterns of childbearing (i.e., too early, too late, or too closely spaced in a women's reproductive life) are very important in high maternal and child mortality. It is estimated that good family planning services could eliminate as many as half of the maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning

alone could probably cut infant and child mortality by 20 percent, saving some 3 million children each year in the Third World.

a. Research to Improve Delivery of Family Planning Services

Delivery of family planning services in all countries is hampered by inadequate resources and inefficient approaches to getting the necessary information and services to those who need them. An expanded program of field research could serve to develop and evaluate innovative approaches.

b. Improve Contraceptive Technology

The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater certainty, safety and economy of

cost. By the end of this century about a billion couples will need birth control but only \$15 million per year is available from government funds (AID and NIH) for applied research on contraceptive development. The U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability lawsuits, has largely abandoned contraceptive development research. At the same time, fundamental discoveries in basic research now offer the prospect for anti-fertility vaccines and for other interventions such as those which would block fertilization of the egg.

c. The Role of Population Growth in Environmental

Deterioration

The relative contribution of population growth to environmental stress has never been quantified. Human numbers along with consumption patterns and technology

levels all play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help assess the relative contributions of these various causative agents could help us focus corrective efforts most effectively.

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Destabilization

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3. Examples of Success Stories

Although many social and economic factors influence desired family size, direct efforts to lower birthrates through family planning programs are generally more successful than indirect efforts through other development programs.

Reducing child mortality, expanding female education and increasing family incomes are desirable in their own right and are associated with lower birthrates in the long run.

Over time, family planning and social and economic changes are mutually supportive: female education and family planning, for example, have a powerful combined impact on both family size and women's status.

Fertility declines have occurred not only in economically successful countries, such as Taiwan and South Korea, but also in lower income countries with lower levels of education such as Indonesia and Zimbabwe.

08-10-81 07:40 202 100 100

a. Mexico. In 1973 its population was growing at 3.3 percent annually and expected to double in 21 years. Population growth is now at 2.4 percent annually.

b. Thailand. In the early 1970's Thailand also had an annual population growth rate of 3.3 percent. Thailand's public and private sectors have worked in partnership and despite low levels of education and income, its annual rate of population growth has dropped to 1.7 percent.

c. Brazil. In the early 1970's Brazil's population was growing at 2.8 percent (a doubling time of 25 years). The rate is now 2.0 percent due to the work of commercial sector and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action

a. Increased support for international family planning programs.

b. Support for a population research agenda.

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 18, 1991

MEMORANDUM FOR PCAST SPECIAL PANEL MEMBERS

FROM: NANCY G. MAYNARD 
SUBJECT: PCAST Paper - Final Comments

On behalf of Tom Lovejoy, this is a gentle reminder that he needs your comments, changes, and additions to the PCAST population paper by c.o.b. Monday, September 23. It is critical that he receive all comments no later than Monday so that he may provide Dr. Bromley with a final paper for use as discussed. The telephone and fax numbers for Tom are: Phone: (202) 786-2263, Fax: (202) 786-2304

If you have any questions or need further information, please do not hesitate to call or fax either Tom or me. My numbers are as follows: Phone: (202) 456-6202, Fax: (202) 395-3719.

called
oic

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
ENVIRONMENTAL DIVISION
WASHINGTON, D.C. 20506

DATE: September 18, 1991

TO: Dr. Norman E. Borlaug
ORGANIZATION: Soils and Crop Science Department
Texas A&M University
TELEPHONE: (409) 845-8247
FAX: (409) 845-0456

FROM: Nancy G. Maynard
TELEPHONE (202) 456-6202
FAX: (202) 395-3719

NUMBER OF PAGES, INCLUDING COVER PAGE: 2

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called
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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
ENVIRONMENTAL DIVISION
WASHINGTON, D.C. 20506

DATE: September 18, 1991

TO: Dr. Charles L. Drake

ORGANIZATION: Dartmouth College

TELEPHONE: (603) 646-2373

FAX: (603) 646-3922

FROM: Dr. Nancy G. Maynard

TELEPHONE (202) 456-6202

FAX: (202) 395-3719

NUMBER OF PAGES, INCLUDING COVER PAGE: 2

SPECIAL INSTRUCTIONS:

TRANSMISSION REPORT

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**EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
ENVIRONMENTAL DIVISION
WASHINGTON, D.C. 20506**

DATE: September 18, 1991

TO: David Packard

ORGANIZATION: Hewlett-Packard Company

TELEPHONE: (415) 857-3327

FAX: (415) 857-4012

=====

FROM: Dr. Nancy G. Maynard

TELEPHONE (202) 456-6202

FAX: (202) 395-3719

NUMBER OF PAGES, INCLUDING COVER PAGE: 2

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SPECIAL INSTRUCTIONS:

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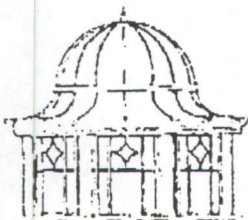
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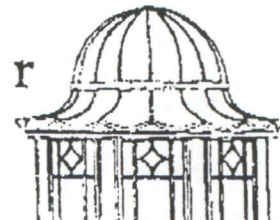
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Office of International Relations
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Council of American Overseas Research Centers

Quincentenary Programs
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International Gallery

FAX TRANSMISSION FORM (202) 786-2557

Date: 9/27/91

TO: Nancy Maynard

Affiliation: PLAST

FAX #: 395-3719

Addressee's Phone: _____

FROM: Ryan H. Dwight % Tom Lovejoy

Sender's Phone: 357-4282

Number of pages including cover sheet 10

Comments:

Following are two copies of the PLAST population paper. The double space version is for editorial comments and can be faxed back to me for a quick revision. If no further comments, then the single space version will be the final draft.

Thank you for your time,

Roger
7.11



SMITHSONIAN INSTITUTION

Washington, D.C. 20560
U.S.A.

M E M O R A N D U M

TO: Nancy Maynard
Tom Welch

FROM: Tom Lovejoy *Tom*

DATE: September 27, 1991

SUBJECT: PCAST Paper On Population

Herewith the latest version of the population paper. Let me know if you want any other changes. Basically it is the paper we have had modified and reordered slight according to various PCAST suggestions. Chuck Drake suggested the new title. I am open to changing it if someone thinks it is a mistake.

Thanks for all your help

P.C.A.S.T.

National Security and Population.

Most of the topics PCAST has the responsibility to review are relevant to national security and the prospects of a new world order. Burgeoning population growth is an important underlying and driving force: agricultural and fishery productivity, supplies of energy and raw materials all have economic implications and are seriously affected by human population increase. So are environmental pollution and the magnification of social ills associated with movement of population into urban centers particularly in the developing countries. The root cause of much international strife and human misery lies in population pressures. Much of the benefit of the "Green Revolution" and our foreign aid has been undercut by population growth.

In our lifetimes we have seen the second, third, fourth and fifth billionth person added to the world's population. This year the increase will exceed ninety million and before the end of this decade we will add the sixth billion. At this rate, world population growth will double in 39 years. Over ninety percent of the growth is occurring in the less developed countries, the least capable of coping with such numbers.

We wish to point out the importance and magnitude of the factor of human population growth and that it is easier and more economical to address it in appropriate ways now rather than later. Further we wish to draw the clear distinction between limiting population voluntarily through family planning, as contrasted to other approaches including abortion. Abortion is properly viewed as the failure of family planning. Rational means of family planning include education, development, use of contraceptives and raising the status of women.

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b. Population Growth and Health

Health alone is a notable factor. Unsafe patterns of childbearing (i.e., too early, too late, or too closely spaced in a women's reproductive life) are very important in high maternal and child mortality. It is estimated that good family planning services could eliminate as many as half of the maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning alone could probably cut infant and child mortality by 20 percent, saving some 3 million children each year in the Third World.

c. The Role of Population Growth in Environmental Deterioration

The relative contribution of population growth to environmental stress has never been quantified. Human numbers along with consumption patterns and technology levels all play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help assess the relative contributions of these various causative agents could help us focus corrective efforts most effectively.

d. The Role of Population Growth in Political Destabilization

Rapid population growth places enormous strains on political institutions. It complicates governance by contributing to massive urbanization, to an imbalanced age structure, and to labor force expansion which outstrips job creation, especially for urban youth. Additional knowledge of these interrelationships is urgently needed.

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The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater certainty, safety and economy of cost. By the end of this century about a billion couples will need birth control but only \$15 million per year is

available from government funds (AID and NIH) for applied research on contraceptive development. The U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability lawsuits, has largely abandoned contraceptive development research. At the same time, fundamental discoveries in basic research now offer the prospect for anti-fertility vaccines and for other interventions such as those which would block fertilization of the egg.

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a. Without strong U.S. leadership, the World's population will more than double in the twenty first century. We recommend our government offer support for promising voluntary family planning programs in Latin America, Africa and Asia. Support should include financial assistance, and help in planning and evaluating programs.

b. We recommend relevant U.S. agencies encourage research in reproductive biology related to controlling population growth, development of contraceptives suitable for large populations, effective delivery of family planning services and the role of population growth in environmental deterioration and political instability.

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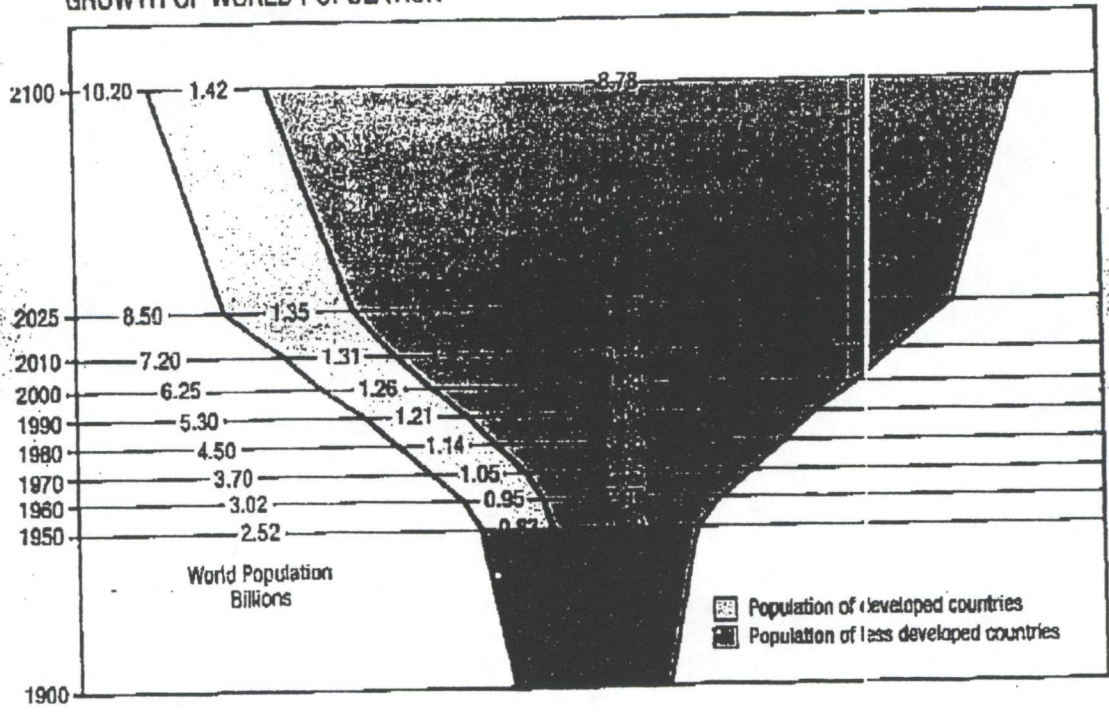
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GROWTH OF WORLD POPULATION



Maynard

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

September 27, 1991

MEMORANDUM FOR THE ASSOCIATE DIRECTORS
THE ASSISTANT DIRECTORS
CHIEF OF STAFF

FROM: TOM WELCH / *Tom*
SUBJECT: Comments on Draft Issue Paper

We received today the attached draft issue paper for Tom Lovejoy. We have begun staffing the draft within the PCAST. Due to the necessary time constraints (also attached), we ask that you provide handwritten comments on this document and FAX them to the PCAST office, (202) 395-1314, no later than 12:00 Noon on Monday, September 30.

We also ask that you treat this document as close hold and do not reproduce it.

Thank you very much for you help.

Attachments

cc: D. Allan Bromley

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

Issue Paper on National Security and Population

Milestones

September

- 27 Draft issue paper submitted for staffing within OSTP and PCAST. Comments must be accommodated and necessary actions completed before September 30.
- 30 Updated draft submitted for EOP staffing. Comments should be accommodated and necessary actions completed by October 4.
- Visit request submitted for October 9 or 10.
(Dr. Bromley and the President)

October

- 7 Final issue paper submitted to the President.
- 9 or 10 Dr. Bromley meets with the President.
- 10 or 11 PCAST meets with the President.

DRAFT

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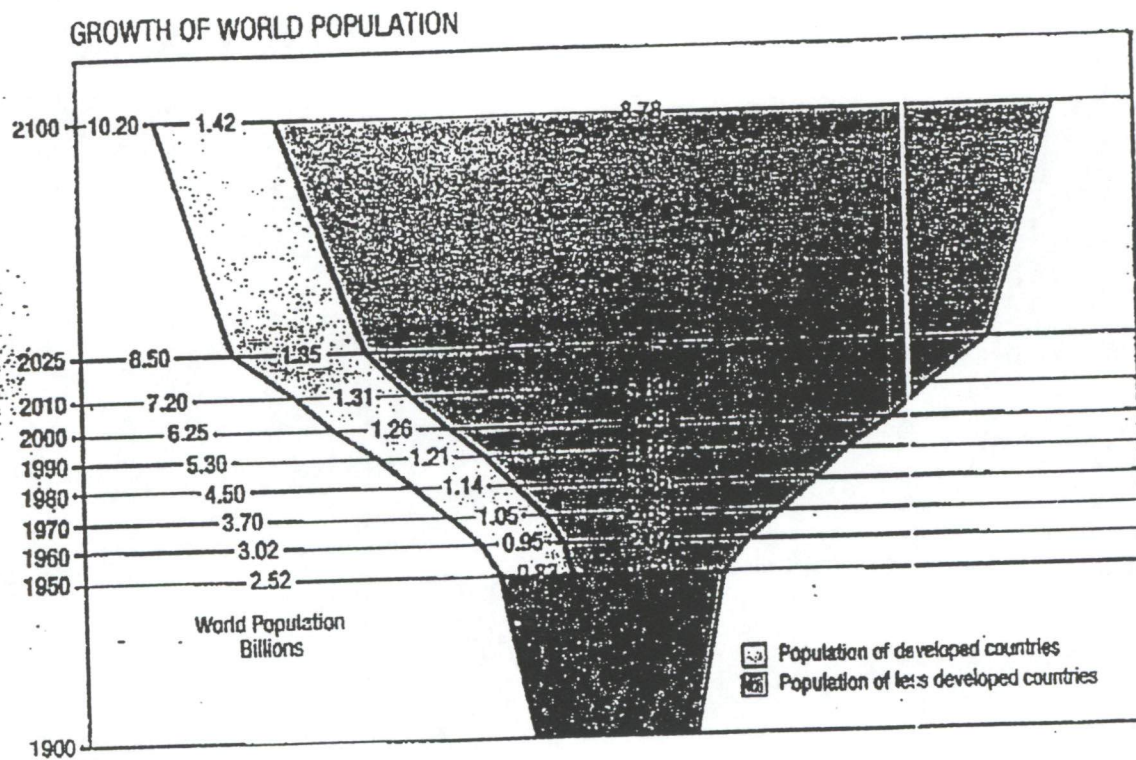
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DRAFT

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Nathans

Howard Hughes Medical Institute
Research LaboratoriesThe Johns Hopkins University School of Medicine
725 N. Wolfe Street
Baltimore, Maryland 21205Daniel Nathans, M.D.
Senior Investigator
(301) 955-8445Date: 9/30/91To: Dr. Tom WelchFAX Phone: 202-395-1575

Office Phone: _____

From: Daniel Nathans

FAX Phone: (301) 955-9124 (Effective Nov. 1, 1991 new Area Code will be "410")

Number of Pages Including Cover Sheet: 2

Please call if entire transmission is not received or is routed to wrong location.

SPECIAL INSTRUCTIONS:

Re: Draft report on Population Growth

Please see attached suggestion for a new first paragraph. I like the rest.

Suggested first paragraph for "National Security and Population Growth" (new parts underlined)

As part of its vision of a new world order to promote international security, the United States must confront the issue of global population growth. The root cause of much international strife and human misery lies in population pressures. In a large part of the world burgeoning population growth is an important driving force underlying social and environmental deterioration and political instability. Much of the benefit of the "Green Revolution" and our foreign aid has been undercut by population growth.

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9/82

Princeton University

Princeton, New Jersey 08544 0015
President's Room

Shapiro

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MARCIA SNOWDEN
609 258-6100



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DRAFT*to achieve their most important strategic objectives.*National Security and Population

Most of the topics ~~which~~ ^{that} have the responsibility to review ~~the nation's economic prosperity and~~ are relevant ~~to national security and the prospects of a new~~ ^{It appears to us that the world's} world order. ~~Burgeoning population growth is an important~~ ^{rapidly growing population as on} underlying and driving force ~~agricultural and fishery~~ ^{that could threaten} productivity, ~~supplies of energy and raw materials all have~~ ^{the adequacy of} economic implications ~~and are seriously affected by human~~ ^{possibilities for all nations} population increases ~~So are environmental pollution and the~~ ^{that are too rapid} magnification of social ills associated with ~~movement of~~ ^{the resultant} population into urban centers particularly in the developing countries. The root cause of much international strife and human misery lies in population pressures. Much of the benefit of the "Green Revolution" and our foreign aid has been undercut by population growth.

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Faint
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why
here?

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- As a result of what?

b. Thailand. In the early 1970's Thailand also had an annual population growth rate of 3.3 percent. Thailand's ~~public and private sectors have worked in partnership and~~ ^(a family planning?) despite low levels of education and income, its annual rate of population growth has dropped to 1.7 percent.

c. Brazil. In the early 1970's Brazil's population was growing at 2.8 percent (a doubling time of 25 years). The

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rate is now 2.0 percent due to the work ^{in family planning?} of commercial sector ^{for these activities?} and nongovernmental organizations which receive support from AID.

4. Recommended Courses of Action

a. Without strong U.S. leadership, the World's population will more than double in the twenty first century. We recommend our government offer support for promising voluntary family planning programs in Latin America, Africa and Asia. Support should include financial assistance, and help in planning and evaluating programs.

b. We recommend relevant US. agencies encourage research in reproductive biology related to controlling population growth, development of contraceptives suitable for large populations, effective delivery of family planning services and the role of population growth in environmental deterioration and political instability.

DAVID PACKARD
CHAIRMAN OF THE BOARD

Packard

September 30, 1991

Dr. Tom Welch
PCAST
Washington, D C 20506

RE: Draft Issue Paper from Tom Lovejoy

Dear Tom:

On Page 1

I do not think paragraph 1 should start with national security. I think this is an important part of the issue and I would prefer to have it introduced at the end of the first paragraph.

For example the last sentence of that paragraph could read - -

Population control is a very important determinant in developing the future of our national security and for a new world order.

On Page 2

The sentence "Rational means of family planning include etc" should read

Rational means of family planning include education, the development and use of contraceptives, and raising the status of women.

Sincerely,

David
David Packard

DP/nmp

One July

TV

**David Packard's Comments on the Statement for the President:
Called into Dr. Nancy G. Maynard's Office by Mr. David Packard
to be transmitted to Dr. Thomas Lovejoy**

The U.S. Government must provide strong leadership in controlling the world's population.

Without strong US leadership the World's population will more than double in the twenty-first century.

There is absolutely no way that the world can feed that many people.

Failure to control the population by rational means will result in the death of millions of people each year by starvation and disease.

Rational means of population control include education, development and use of contraceptives and raising the status of women in every country in the world.

We must begin immediately with this important endeavor

This is our enduring response to the future generation of mankind.

Wang -
Comment?
p2

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PPerralle 9/30/9
version

POPULATION AND THE NEW WORLD ORDER

National security and the prospects of a new world order are the underlying concerns of most of the scientific and technological topics being reviewed by PCAST. World population growth is among those issues.

In our lifetimes we have seen the second, third, fourth and fifth billionth person added to the world's population. This year alone the increase will exceed 90 million and, before this decade is out, six billion people will inhabit the earth. At the present rate, that number would double again in 39 years. Over ninety per cent of the growth is occurring in the less developed countries, those least capable of coping with such growth.

More than any other human or natural phenomenon, world population growth will affect the shape of the new world order and, in turn, the national security of the United States.

Such economic factors as agricultural and fishery productivity, supplies of energy and raw materials are all seriously affected by human population increase. Environmental degradation and the exacerbation of social ills are also associated with the growth and movement of population into urban centers, particularly in the developing countries. The root cause of much international strife and human misery lies in population pressures. In addition, many of the benefits of the "Green Revolution" and of development assistance have been undercut by population growth.

As we flag the significance and magnitude of human population growth in shaping the new world order, we wish to stress two important points. First, it is far easier and more economical to address world population growth now rather than later. Second, limiting population voluntarily through rational family planning approaches is essential if we are to pre-empt such undesirable alternatives as abortion and involuntary sterilization. Rational approaches to family planning include education, the use of contraceptives and raising the social and economic status of women.

Population Growth and the Human Condition

Population Growth and World Food Supply

Since 1940, in many parts of the world where modern agricultural technology has been used, yields per unit area have increased spectacularly. For example, the "Green Revolution" has enabled India to be self-sufficient in cereals since 1975 despite a population increase from 450 million in 1965 to 850 million in 1990. While some unexploited potential of the Green Revolution remains, it is not likely that further major leaps in productivity per unit area are possible. Bringing additional land under cultivation is no longer possible in many of the densely populated areas of Asia and

Latin America. In other areas, increasing land under cultivation could be achieved only at the price of serious environmental degradation and land use problems.

Population Growth and Health

Health considerations alone justify concern with population issues. Unsafe patterns of childbearing (i.e. too early, too late or too closely spaced in a woman's reproductive life) are very important causes of high maternal and child mortality. It is estimated that good family planning services could eliminate half of maternal deaths from childbirth and abortion. In addition, widespread use of effective family planning alone could probably cut infant and child mortality by 20 per cent, saving some 3 million children each year in developing countries.

Population Growth and Environmental Degradation

The relative contribution of population growth to environmental stress has yet to be quantified. But increasing numbers of human beings along with their consumption patterns unmistakably play a part in the progressive deterioration of the earth's atmosphere, oceans, waterways, forests, agricultural land and biodiversity. Studies which help us assess the impact of population growth and related causative agents on the various components of our environment could help focus corrective and mitigating efforts most effectively.

Population Growth and Political and Economic Destabilization

Rapid population growth places enormous strains on political and economic institutions. Unrestrained growth typically contributes to such related demographic phenomena as massive urbanization, to rapid changes in the size and composition of labor forces, and an imbalanced age structure. These changes affect housing, employment, capital formation on such a scale that political institutions are overwhelmed and destabilized. A better understanding of the economic and political consequences of rapid population growth is urgently needed as we seek to anticipate and guide the shape of the new world order.

Some Success Stories

[COMMENT: I'm not certain this section adds much to the arguments. The three cases say the same thing. Examples could be woven in elsewhere.]

Although many social and economic factors influence family size, direct efforts to lower birth rates through family planning programs have generally been more successful than indirect efforts through broader economic development programs. In addition, lower birth rates lead to other desirable outcomes such as reducing child mortality, increasing

family incomes and facilitating opportunities to increase the education of women. Ultimately, family planning and social and economic development are mutually reinforcing.

Fertility declines have occurred not only in economically successful countries such as Korea and Taiwan, but also in countries of lower income and educational levels such as Indonesia and Zimbabwe. Three striking success stories are the following:

- Mexico:** In 1973 the population was growing at a rate of 3.3 per cent annually and was expected to double in 21 years. As a result of family planning programs, growth has now dropped to 2.4 per cent annually.
- Thailand:** In the early 1970's Thailand also had an annual population growth rate of 3.3 per cent. Since that time, Thailand's public and private sectors have worked in partnership and, despite low levels of education and income, have succeeded in lowering the annual rate of population growth to 1.7 per cent.
- Brazil:** In the early 1970's, Brazil's population was growing at 2.8 per cent (representing a doubling time of 25 years.) The rate is now 2.0 per cent due to the efforts of the private sector and non-governmental organizations which receive support from U.S.A.I.D.

Recommendations

Strong U.S. leadership is essential to mitigating excessively high rates of population growth. If the U.S. does not assume a leadership role, the world's population will more than double before the middle of the twenty first century. We recommend the following two-pronged approach:

1. Our government should offer support for promising voluntary family planning programs in Latin America, Africa and Asia. Support should include both financial assistance and expert help in planning and evaluating programs.
2. Relevant agencies of the government should encourage, support or conduct research in four areas related to population growth:

a. research in reproductive biology and contraceptive technology

The National Research Council's Institute of Medicine, in a 1990 study, documented the role that new, improved contraceptives could play in helping couples control their fertility with greater reliability, safety and economy. By the end of this century about a billion couples worldwide will need to rely on contraceptive technology. Government expends only about \$15 million per year on contraceptive development and the U.S. pharmaceutical industry, faced with a problematic regulatory climate and product liability litigation, has largely abandoned contraceptive research and development. At the same time, fundamental discoveries in basic research offer major new prospects for anti-fertility vaccines and other interventions such as those which would block fertilization of the egg.

b. research to improve delivery of family planning services

Delivery of family planning services in all countries is hampered by inadequate resources and inefficient approaches to getting the necessary information and services to those who need them. An expanded program of field research, to include research on human behavior in different social and cultural settings could serve to develop, evaluate and diffuse innovative and effective delivery approaches.

c. research to assess the human causative agents of environmental deterioration

The extent and nature of environmental stress caused by high concentrations of population with rising consumption patterns as well as the factors which might mitigate such stress needs to be better understood. Demographic and economic study of this set of problems should receive close attention.

d. research to improve understanding of the impact of population dynamics on economic and political institutions

The effect of rapid population growth and urbanization on economic systems and on the stability and nature of political institutions is not well understood. Yet the potential impacts on the global economy and on the stability of the world order of population dynamics are significant. New economic and political research related to population dynamics could have practical importance to the formulation of effective international economic and national security policy for the United States.

Here are some points that were not made in the issues paper that could be added or put into an introductory, cover memo.

Current Administration policies.

The overall context of the importance of population planning for sustained development and economic growth in the Third World. (Current U.S. law, Sec. 104 (a) of the Foreign Assistance Act, states that voluntary population planning programs can make a substantial contribution to economic development, higher living standards, and improved health and nutrition.)

The general U.S. support for international family planning programs based on the principles of volunteerism and informed choice, and against any kind of coercion.

The history of restrictions and other conditions on U.S.-assisted family planning programs overseas.

Concerns that current restrictions have not gone far enough to limit U.S. participation in what some see as undesirable family planning programs.

The status of the "Mexico City Policy", which sought to place tighter restrictions on U.S. population assistance programs.

The cause of reductions in the rates of population growth in certain third world countries (contraception was not the principle cause of the reduction in high birth rates in the Philippines).

Current Congressional activity.

U.S. policy towards the United Nations Population Fund.

*Current
Adm. Policies*

Maynard

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

A. Carter

September 30, 1991

**MEMORANDUM FOR THE ASSOCIATE DIRECTORS
THE ASSISTANT DIRECTORS
CHIEF OF STAFF**

FROM: TOM WELCH
SUBJECT: Comments on Draft Issue Paper

We received today the attached draft issue paper from Ash Carter. We have begun staffing the draft within the PCAST. Due to the necessary time constraints (also attached), we ask that you provide handwritten comments on this document and FAX them to the PCAST office, (202) 395-1314, no later than 12:00 Noon on Tuesday, October 1.

We also ask that you treat this document as close hold and do not reproduce it.

Thank you very much for you help.

Attachments

cc: D. Allan Bromley

PRESIDENT'S COUNCIL OF ADVISORS ON SCIENCE AND TECHNOLOGY

**Issue Paper on Science, Technology,
and National Security**

Milestones

September

- 27** Draft issue paper submitted for staffing within OSTP and PCAST. Comments must be accommodated and necessary actions completed before September 30.
- 30** Updated draft submitted for EOP staffing. Comments should be accommodated and necessary actions completed by October 4.
- Visit request submitted for October 9 or 10.
(Dr. Bromley and the President)

October

- 7** Final issue paper submitted to the President.
- 9 or 10** Dr. Bromley meets with the President.
- 10 or 11** PCAST meets with the President.

HARVARD UNIVERSITY

CENTER FOR SCIENCE AND INTERNATIONAL AFFAIRS

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and
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September 30, 1991

For immediate fax delivery to:

Dr. John S. Foster
Dr. Solomon Buchsbaum
Dr. Tom Welch, PCAST
Dr. Charles Herzfeld, PCAST

Here is a draft of the interim memorandum for your editing and submission to Dr. Bromley. I erred on the long side (five pages) to include all our thinking to date and to allow you to edit by lining out text rather than having to compose text. I hope this is a good start.

-- Ash

DRAFT

MEMORANDUM TO: You Know Who

SUBJECT: Preliminary focus of the President's Council of Advisers on Science and Technology (PCAST) Panel on Science, Technology, and National Security

Background

The President's National Security Strategy of the United States, first outlined in his Aspen, Colorado speech of June, 1990 [check references] identifies America's superior ability to apply science and technology as one of the linchpins of U.S. national security. For nearly half a century, America used technological superiority to offset the numerical superiority of Soviet military power. More recently, the spectacular performance of U.S. defense and intelligence technology in Operation Desert Storm graphically demonstrated to the world an American technological lead that no other nation can match. Leadership in technology thus made American leadership in world affairs effective at a critical juncture. Science and technology have thus accompanied a strong economy, democratic institutions, and favorable geography in ensuring of U.S. national security.

Because of the key role science and technology have played in U.S. national security, the Assistant to the President for Science