chapter 5

Environment and Technology

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Agriculture is an important area for the application of biotechnology. Genetic engineering techniques have created several new products-e.g., herbicide-resistant plants and microorganisms designed to reduce the temperature at which frost can form on a plant—that could become important in agriculture. Because the use of these products requires the deliberate release of the genetically engineered organisms into the environment, concerns about environmental risks have been raised.

These concerns about technology and the environment could significantly influence public opinions about biotechnology and its environmental applications. The environmental movement proved a potent social force during the 1960s and 1970s. In order to assess the role of current public perceptions of technology and environment as a possible factor in biotechnology issues in the 1980s, the OTA survey briefly explored the American public's feelings towards technology and the environment.

DIRECTION OF ENVIRONMENTAL QUALITY

The OTA survey found that the public has mixed feelings about the direction of environmental quality in the United States. A third (32 percent) of the public think the overall quality of the environment is "getting better" compared to 10 years ago. Another 28 percent of the public feel that the quality of the environment is "about the same" today as it was a decade ago. However, nearly 4 out of 10 Americans (39 percent) believe the overall quality of the environment is "getting worse." **Overall, 60 percent of American people believe the quality of the environment has been stable or improved during the past 10 years (table *19).* Nevertheless, widespread concern about deteriorating environmental quality persists.**

Table 19.—Direction of Environmental Quality

Question (Q12):[a] Compared to 10 years ago, do you think the overall quality of the environment in the United States is getting better, getting worse, or is about the same?

		Getting better	About the same	Getting worse	Not sure
Total	(1,273)[b]	32%	28%	39%	1%
Age:					
18 to 34	(546)	34	28	37	<1
35 to 49	(343)	37	25	37	1
50 to 64	(252)	26	29	44	
65 and over	(127)	30	28	40	2
Education:					
Less than high school	(165)	34	30	35	1
High school graduate	(458)	28	30	42	1
Some college	(300)	37	23	39	1
College graduate	(347)	35	25	40	1
Science understanding:					
Very good	(236)	37	28	34	<1
Adequate	(707)	34	27	38	1
Poor	(316)	26	29	45	1
Science orientation:					
Observant	(626)	34	29	36	1
Nonobservant	(647)	30	27	42	1

aThe code number of the question in the survey instrument (see aPP B.)
bPercentages are presented as weighted sample estimates. The unweighed sample base is presented in parentheses so that the sampling variance fOr these estimates can be calculated

SOURCE Office of Technology Assessment, 1987

AWARENESS OF ENVIRONMENTAL ISSUES

To examine public awareness of associations between technology and adverse environmental consequences, the survey presented five types of environmental problems that might have a technological origin: radioactive discharge from nuclear powerplants, acid rain, the greenhouse effect, antibiotic-resistant bacteria, and agricultural use of genetically altered microbes.

The vast majority of the public (85 percent) says it has read or heard about radioactive discharges from nuclear powerplants. Yet even after Three Mile Island and Chernobyl, almost one in six Americans admits to having heard or read little about radioactive discharges from nuclear powerplants (table 20).

The issue of acid rain is another now-familiar environmental issue. More than three-fourths of the public (76 percent) say they have heard or read about acid rain. In contrast, fewer than half of American adults (45 percent) say they have heard about the greenhouse effect. Education and science observance are key determinants of this awareness. Nearly twice as many college graduates (69 percent) as high school graduates (35 percent) say they are aware of the greenhouse effect. Similarly, exposure to the issue is found among only a third (34 percent) of science nonobservants compared to better than half of science observant (56 percent). As expected, the separating factors of education and science observance produce far less dramatic differences in awareness of acid rain, a topic that has received wider public exposure (table 20).

Antibiotic-resistant bacteria and agricultural use of genetically engineered microbes are two other environmental issues for which the public reports low exposure. Approximately 4 of 10 Americans (39 percent) say they have heard or read about antibiotic-resistant bacteria. Three of 10 Americans (30 percent) report they have heard or read about the agricultural use of genetically altered microbes (table 20). (Agricultural use of genetically altered microbes, unlike the other four issues, represents a potential environmental problem rather than a current problem.)

Table 20.—Awareness of Some Environmental Issues

Question (Q13a):~ Have you heard or read much about (READ ITEM)?

		Have heard or read about				
		Radioactive discharge from nuclear powerplants	Acid rain	Greenhouse effect	Antibiotic-resistant bacteria	Agricultural use of genetically altered microbes
Total	(1,273*)	850/0	76%	45%	39%	3 %
Education:						
Less **than high school**	(165)	82	73	36	37	29
High school graduate	(456)			35	30	
Some college	(300)	86	81	52	46	33
College graduate	(347)	92	89	69	54	45
Science understanding:						
Very **good**	*(236)*	*90*	*81*	*65*	*53*	*46*
Adequate	(707)	87	79	48	41	31
Poor	(316)	77	67	27	26	18
*Science **orientation:***						
Observant	(626)	89	82	56	50	40
Nonobservant	(647)	81	71	34	29	21
Rate of growth of science and technology:						
.too fast	*(309)*	*85*	*72*	*36*	*38*	
About right	(549)	84	70	46	38	28
Too slow	(371)	85	79	50	42	34
Voters:	*(935)*	*86*	*79*	*48*	*41*	*33*

[a] The code number of the question in the survey instrument (see app. B.)
[b] Percentages are presented as weighted sample estimates. The unweighted sample base Is presented in parentheses so that the sampling variance fOr these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

Education, science orientation, and science understanding are factors in public recognition of lesser known environmental issues. For example, awareness of the issue of genetically altered microbes increases from 21 percent among science nonobservants to 40 percent of science observant (table 20). Although these issues receive higher recognition among the more interested and knowledgeable sections of the populace, **awareness and concern about environmental risks of technology are by no means restricted to science observant% Recognition of and exposure to many environmental issues of science and technology seem to be pervasive in this country.**

CONCERN ABOUT ENVIRONMENTAL ISSUES

Separate from the issue of awareness of environmental issues is concern about the problems. Survey participants were asked how concerned they currently are about each of the five environmental issues of which they were aware. The OTA survey found about half of the public (46 percent) state they are "very concerned" about radioactive discharges from nuclear powerplants. A third (34 percent) report they are "very concerned" about acid rain, but less than half that proportion say they are "very concerned" about antibiotic-resistant bacteria (16 percent), the greenhouse effect (13 percent), or agricultural uses of genetically altered microbes (9 percent) (table 21).

This relatively low level of public concern is accurate in the short term, but misleading for the long term. In large part, the low percentage of individuals who say they are very concerned about some of these issues results from a lack of awareness of the topic. On face value, the low level of concern reported by the public is an accurate gauge of current public sentiment on such issues. However, for long-range planning, public awareness of these problems is likely to grow. This increase could expand the size of the populace who are very concerned with these issues.

To obtain a more detailed picture of the degree of the American public's concern about environmental issues, the proportion of those who report they are very concerned among those who say they have heard or read much about the issue was calculated. The issue of radioactive discharge produces the greatest concern: 54 percent of those who say they have heard about it are "very concerned. " The levels of concern about acid rain and antibiotic-resistant bacteria are somewhat lower: 45 and 41 percent of those who report they have heard of them, respectively, are "very concerned." Only 29 and 30 percent, respectively, of those who say they have heard of the greenhouse effect and agricultural use of genetically altered microbes are very concerned.

Table 21.—Level of Concern About Some Environmental Issues[a]

Question (Q13b):[b] How concerned are You at the present time about (ITEM)—very concerned, somewhat concerned, not too concerned, or not at all concerned?

	Very concerned	Somewhat concerned	Not too concerned	Not at all concerned	Never heard	Very concerned and heard of issue
Radioactive discharge from nuclear powerplants	46%	24%	11%	4%	15%	54%
Acid rain	34		11	2	24	45
Greenhouse effect	13	20	8	2	55	29
Antibiotic-resistant bacteria	16	16	5	1	61	41
Agricultural use of genetically altered microbes	9	11	6	2	70	30

[a] Number of individuals in sample varies based on who had heard or read about the issue. See table 20.
[b] The code number of the question in the survey instrument (see app. B.)

SOURCE: Office of Technology Assessment, 1987.

ENVIRONMENTAL ACTIVISM

Although there is widespread concern about the quality of the environment and certain environmental consequences of technology, relatively few Americans say they are politically active on environmental issues. Just over 1 in 20 adults (6 percent) reports being active in environmental groups or organizations. This is slightly more than the 4 percent who report being active in consumer groups and organizations and about the same as the percentage active in scientific groups and organizations (6 percent) (table 22).

The survey found greater environmental activism among college graduates (10 percent) than other educational groups (4 to 6 percent). Science observant also have higher environmental activism (7 percent) than do nonobservants (4 percent). And those with a very good understanding of science report that they are more likely (9 percent) than those with only an adequate or poor understanding of science (5 percent each) to be active in environmental groups or organizations. In short, scientific interest and environmental involvement are positively correlated. The survey found that **Americans active in environmental concerns are not particularly opposed to technological development, and are equally likely to feel the current rate of technological growth is too slow (8 percent) as to feel it is too fast (7 percent).**

Table 22.—Profile of Population Active in Environmental Organizations

Question (QF7a):[a] Are you active in any environmental groups or organizations?		Active
Total	**(I,273)[b]**	**6%**
Age:		
18 to 34	**(546)**	**5**
35 to 49	**(343)**	**6**
50 to 64	**(252)**	**5**
65 and over	**(127)**	**7**
Education:		
Less than high school	**(165)**	**4**
High school graduate	**(456)**	**5**
Some college	**(300)**	**6**
College graduate	**(347)**	**10**
Science understanding:		
Very **good**	**(236)**	
Adequate	**(707)**	**9**
Poor	**(316)**	**5**
Science orientation:		
Observant	**(626)**	**7**
Nonobservant	**(647)**	**4**
Party affiliation:		
Republican	**(435)**	**4**
Independent	**(334)**	**6**
Democrat	**(441)**	**6**
Voters:	*(935)*	*6*
Rate of growth of science and technology:		
	(309)	*7*
About right :	**(549)**	
Too slow	**(371)**	**8**

[a]The code number of the question in the survey instrument (See aPP. B.)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

ENVIRONMENTAL SPOKESPERSONS

The American public expresses mixed feelings about the leaders of the environmental movement. On the one hand, a majority of the American people (57 percent) believes that the leaders of the environmental movement are "out of touch with the public." About one-third (35 percent) say that the leaders of the environmental movement "reflect public feeling" (table 23).

On the other hand, a majority (56 percent) believes that, on the whole, the leaders of the environmental movement are "reasonable in their criticism and demands." Only 33 percent of the public feel environmental leaders are "unreasonable in their criticism and demands." Thus, the public appears to say that while the leadership of the environmental movement is not in touch with public feelings, environmental spokespersons present valid criticisms and reasonable demands (table 24).

This reported ambivalence is not new to the OTA survey. In a 1981 Harris survey, the same mixed picture of public opinions about environmental leadership emerged, and a similar pattern is found in Harris studies of public perceptions of the consumer movement (1). In both cases, the public appears to be happy to have an external voice to present reasonable concerns in a respon-

Table 23.—Opinions About Environmental Leaders

Question (Q14a):[a] On the whole, do you think that the leaders and spokesmen of the environmental movement (READ EACH PAIR OF PHRASES)?		Reflect public feeling	Are out of touch with the public	Not sure
Total 1986	**(1,273)[b]**	**35%**	**570/0**	**7%**
1981[c]	**(1,254)**	*37*	*54*	**9**
Age:				
18 to 34	*(546)*	**40**	**54**	**6**
35 to 49	*(343)*	**35**	**60**	**5**
50 to 64	*(252)*	**31**	**58**	**11**
65 and over	*(127)*	**28**	**62**	**10**
Education:				
Less than high school	**(165)**	**30**	**59**	11
High school graduate	**(456)**	**34**	**61**	**5**
Some college	(300)	**39**	**56**	**6**
College graduate	**(347)**	**42**	**49**	**8**
Science understanding:				
Very good	*(236)*	*38*	**48**	**13**
Adequate	*(707)*	*38*	**58**	**5**
Poor	*(316)*	*30*	**62**	**8**
Science orientation:				
Observant	*(626)*	**33**	*58*	**8**
Nonobservant	*(647)*	**37**	*57*	**6**
Party affiliation:				
Republican	*(435)*	*43*	**51**	*6*
Independent	*(334)*	*35*	**58**	*7*
Democrat	*(441)*	*29*	**62**	*9*
Voters:	*(935)*	*35*	**58**	*7*

[a] The code number of the question in the survey instrument (See app. B)
[b] Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parenthesesso that the sampling variance for these estimates can recalculated,
[c] Unpublished Harris survey.

SOURCE Office of Technology Assessment, 1987,

sible fashion-even when the public does not nec - essarily subscribe to the entire value structure of the advocate.

The better educated have a more positive assessment of both measures of opinions about environmental leaders (reflect public feeling and rea - sonable in demands). Science orientation and understanding, however, do not have any consistent effect on perceptions of the environmental movement.

TECHNOLOGICAL DEVELOPMENTS AND THE ENVIRONMENT

As stated, OTA investigated public perceptions of the environment to learn whether environmental orientation and concern indicate the possibility of opposition to technological development. OTA found that most Americans (65 percent) believe the overall effect of technological developments on the environment is positive: 14 percent feel that technological innovations have a "very positive" effect, while 51 percent believe technological developments have a "somewhat positive" effect (table 25).

Only a third of the public think that technological developments have a "somewhat negative" (26 percent) or '(very negative" (6 percent) effect on the environment. This negative assessment of the effect of technology on the environment appears to be unrelated to age, education, or science orientation, Rather, all population groups express a base level of concern with the environmental consequences of technology across all population groups. Like the earlier concern with the risks of science, the OTA survey does not reveal the

Table 24.—Reasonableness of Demands of Environmental Leaders

Question (Q14b):[a] On the whole, do you think that the leaders and spokesmen of the environmental movement (READ EACH PAIR OF PHRASES)?

		Are reasonable in their criticism and demands	Are unreasonable in their criticism and demands	Not sure
Total 1986	(1273)	88%	33%	11%
1981	(1,254)	52	36	10[c]
Age:				
18 to 34	(546)	63	30	7
35 to 49	(343)	56	37	
50 to 84	(252)	53		17
86 and over	(127)	42	40	18
Education:				
Less than high school	(165)	44	40	16
High school graduate	(456)	58	33	9
Some college	(300)	64	27	9
college graduate	(347)	61	32	7
Science understanding:				
Very good	(236)	55	36	8
	(707)	58	34	
Poor	(316)	56	31	15
Science orientation				
	(626)	57	35	13
Nonobservant	(647)	56	32	13
Party affiliation:				
Republican	(435)	57	34!	9
independent	(334)	55		9
Democrat	(441)	57	31	12
Voters:	(935)	55	35	10

[a]The code number of the question in the survey instrument (see app. B.)
[b]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated,
[c]Unpublished Harris survey.

SOURCE: Office of Technology Assessment, 1987.

Table 25.—Effects of Technology on the Environment

Question (Q11):[a] Overall, what kind of effect do you think technological developments have on the environment-very positive, somewhat positive, somewhat negative, or very negative?

		Very positive	Somewhat positive	Somewhat negative	Very negative
Total	(1,273)[b]	14%	61%	28%	6%
Age:					
18 to 34	(546)	13	54	26	5
35 to 49	(343)	15		22	5
50 to 64	(252)	16	43	27	
65 and over	(127)	11	45	29	6
Education:					
Lees than high school	(165)	15	44	27	8
High school graduate	(458)	14	55	24	4
Some college	(300)	11	53	25	6
College graduate	(347)	13	46	29	6
Science *understanding:*					
very good	(236)	19	45	25	7
Adequate	(707)	14	54	23	5
Poor	(316)	9	49	31	5
Science orientation:					
Observant	(626)	18	47		
Nonobservant	(647)	10	54	27	5
Party Affiliation:					
Republican	(435)	11	58	24	4
Independent	(334)	14	47	30	
Democrat	(441)	16	49	25	4
voters:	(935)	13	51	26	5

[a]The code number of the question in the survey instrument (see app. B.)
[b]Percentages are presented as weighted sample estimates. The unweighed sample base is presented in parentheses SO that the sampling Variance for these estimates can be calculated.

SOURCE: Office of Technology Assessment, 1987.

source of the concern over the effect of technology on the environment.

Interestingly, concern about environmental effects of technology appears to be unrelated to the perceived risk-benefit trade-offs of scientific growth. Those who believe that technology has a negative impact on the environment are about as likely to believe the current rate of technological growth is '(too fast" (31 percent), '(too slow" (3 I percent), or "about right" (33 percent) (table 26).

Similarly, the relationship between the perceived effect of technology on the environment and perceptions of the overall risk-benefit ratio of continued technological innovation is surprisingly weak. Among those who believe the benefits of continued technological innovation will outweigh the risks, 28 percent believe technology has a negative impact on the environment. Only a slightly higher 35 percent of those who believe the benefits of technological innovation "do not outweigh the risks" believe that technology has a negative effect on the environment (table 27).

Thus, the OTA survey does not demonstrate that the perceived impact of technology on the environment is a major component of public perceptions of scientific growth and technological development. In general, the benefits of science appear to outweigh the risks of science in most people's minds. Although not tested directly by the OTA survey, the personal benefits ascribed to science—better health, longer life, easier work, more income—might be more important factors influencing opinions than the less personal consequences of environmental impact.

Table 26.-Comparison of Rate of Technological Growth and Effects of Technology on the Environment

Effects of technology on the environment	Continued technological innovation		
	Too fast	**About right**	**Too slow**
	(309)[1]	(549)	(371)
Very positive	13%	12%	18%
Somewhat positive	52	52	47
Somewhat negative	22	29	27
Very negative	9	4	4
Both	1	2	1
No effect	1	<1	<1
Not sure	2	1	3

[a]Percentages are presented as weighted sample estimates. The unweighted sample base is presented in parentheses so that the sampling variance for these estimates can be calculated,

SOURCE Office of Technology Assessment, 1987.

Table 27.—Comparison of Effects of Technology on the Environment and Weighing the Benefits of Science v. Risks[a]

Effects of technology on the environment	*Continued technological innovation*	
	Benefits outweigh risks	**Benefits do not outweigh risks**
Very positive	15%	12%
Somewhat positive	54	47
Somewhat negative	25	26
Very negative	3	9
Both	1	2
No effect	<1	
Not sure	1	2

[a]Percentages are presented as weighted sample estimates, The unweighed base from which the sampling variance can be calculated is 1,273.

SOURCE: Office of Technology Assessment, 1987.