UNITED STATES DEPARTMENT OF AGRICULTURE
Economic Research Service

THE ENVIRONMENT AND AGRICULTURE

Talk by T. C. Byerly
Assistant Director of Science and Education
at the 1970 National Agricultural Outlook Conference
Washington, D. C., 3:30 P.M., Tuesday, February 17, 1970

This paper is about the environment. In it I have undertaken to answer the following questions.

1. What is it?
2. What are the major factors and interactions determining the quality of the environment?
3. What is its present condition?
4. What is agriculture's contribution, actual and potential, beneficial and detrimental, to the quality of the environment?
5. What is being done to improve the quality of the environment?
6. What kind of environment do we want?

1. What is the environment?

Simply, it is the aggregate of surrounding things, conditions, and influences. But surrounding what? Surrounding me; surrounding you; surrounding us. Our primary concern is with the environment of which we are a part, of that of which our progeny for generations to come will be a part.

President Nixon, in his State of the Union Message, phrased it this way: "The truly significant environment for each of us is that in which we spend eighty percent of our time--that is, our homes, our places of work and the streets over which we pass."

But while each of our micro-environments may add up to the global environment, it is not likely that we can understand the global environment by limiting our studies to the niches in which we live.

The "space ship earth" analogy has some conceptual significance. The National Research Council's Geophysical Research Board, in a report of a summer study of the role of ground based research describes the earth as "a giant spin-stabilized spacecraft."[1]

2. What are the major factors and interactions determining the quality of the environment?

Whether urban or rural, global, terrestrial, aquatic, macro, meso, or micro, environments in which people live do have some common parameters. Somehow we must use measurements of these parameters in developing an index of quality.

A National Academy of Sciences-National Research Council Environmental Studies Board report[2] just issued suggests that we must monitor and take account of changes in at least the following:

1. Physical and chemical properties of land, air, and water.

2. Distribution of plants and animals in land, air, and water.

3. Land use, including diversity of purpose.

4. Construction.

5. Noise.

6. Epidemiology of man, animals, and plants.

7. Evidence of environmental stress such as tranquilizer consumption and asocial behavior.

8. Aesthetic.

Major determinants of the quality of the environment--in addition to the objective parameters and interactions--include perception of the environment by its inhabitants, perception of specific environments--or habitats--by others--and especially the perception of his own identity by each habitant.

The words aspiration, arrogance, expectation, jealousy, cooperation, conflict, anomia, and frustration describe ways man senses his environment and his part in it. Perception of the environment by any individual, his estimate of himself, the opinion of others, are all-important to the individual's estimate of the quality of the environment.

I commend to your reading an article in the current issue of Agricultural Science Review by Sarah Shoffner of the University of North Carolina at Greensboro: "Self Concept: Its Role in Breaking the Poverty Cycle."[3]

What is good environment? Eric Hoffer relates that he bought a copy of Montaigne's essays, a thousand pages, second hand for a dollar, in anticipation of being snowbound for a winter in the Sierras. He was. He read the book three times. That, he infers, is how he learned to write--in a good environment."[4]

I like the way Hoffer says things. Consider: "The uniquely human fact that discontent is at the root of the creative process, that the most gifted members of the human species are at their creative best when they cannot have their way, and must compensate for what they miss by realizing and cultivating their capacities and talents." Will, in this time of discontent, the environment, the quality of life, provide the challenge required to bring together people of all ages, races, opinions, economic levels, and cultures?

3. What is the present condition of the environment?

The NAS-NAE Environmental Studies Board report of its Environmental Study Group states: "The quality of our lives is directly related to the quality of our environment and the quality of that environment has deteriorated as our national affluence has increased."[5]

There is no gain saying the fact that our air is polluted, and increasingly so, with gaseous and particulate pollutants from burning fossil fuels in automobiles and other transport vehicles, in generation of electricity and household heating. Burning crop wastes, forest wastes, forest fires, trash and garbage, gases and fly ash from factory stacks and refineries add their burden. Odors, too, pollute the air, some from agricultural activities.

Our waters are over burdened with sewage wastes, sediments eroded from roads, construction sites, and poorly managed farm, range, and forest lands. Some nitrogen is leached from farm and forest lands, some pesticide chemicals are carried in runoff water and on sediment into our lakes and streams.

Our land is pocked with abandoned, worked out surface mines--more than three million acres of them. Junk and other solid wastes pollute our landscapes. And residues of pesticide chemicals--arsenic, lead, copper, mercury, organo-chlorines and others pollute our soils. Under and about feedlot areas, nitrogen in excess of any possible usage by growing plants becomes a pollutant to soil, air, plants, and water.

Noise and heat are pollutants growing in importance- as yet they are chiefly of local and urban origin.

Pollution is not a new thing. In many cases, pollution is simply over concentration at particular times and places. Pollution is a function of activity per unit area, of people, animals, industry. It is equally obvious that rapid industrialization of agriculture and the concomitant accelerated urbanization have resulted in deterioration of many urban and rural environments. Shift in traffic patterns, growth in automobile and air traffic, have impaired the quality of life.

4. What is agriculture's contribution to the quality of the environment?

Agriculture in the United States, and in other industrial countries, has increased yields through increasingly effective development and application of technology in crop and livestock production so that; e.g., corn acre yields have gone up three times during the past 35 years (slide 1).

We have $>$600 million acres of Class I-III land. We harvested crops from less than half. The rest is used for trees and grass and living space--some, unfortunately, goes under pavement every year.

It is only because agriculture is efficient that we may hope to improve the quality of the environment, the quality of life. The productivity of the land, the harvest, and use of water have increased.

On the positive side of the environment, opportunities exist for the wise use of land not needed for farming to provide continuing open space near our cities. Of equal importance is the opportunity for planning the new communities which will be needed for the 100 million additional citizens who will be here in year 2000.

New cultural centers, locations for new industry, new service centers, new recreational centers can be planned to serve both local communities, the States, and the Nation. In addition to assuring land requirements for production of food, fiber, and forest products, we will continue to need coordinated programs for land and urban and industrial development, transportation, outdoor recreation, flood prevention, water harvest, wildlife habitat, and natural beauty (slides 2 and 3).

5. Systems to improve the environment.

In the broadest sense the RC&D multicounty approach, buttressed with every available program, Federal, State, local, public, and private, should be used to improve the quality of the environment, improve the quality of life.

We have the technology to do it. Do we have the determination and dedication?

Narrower in scope, important and urgent, is the development and application of systems which will (1) protect our crops, livestock, ourselves, and our environment from pests without hazardous pollution of the environment, and (2) which will utilize new and efficient technologies for production of meat, milk, poultry, and eggs while recycling the wastes from such operations.

Pollution of the environment with agricultural chemicals--and I do include nitrates in amounts in excess of crop needs as pollutants--can be reduced or avoided. Our systems for doing so are imperfect; they will require more sophistication in their application; they may provide constraints on monoculture.

May I begin with reference to the U.S.D.A. Policy on Pesticides, Secretary's Memorandum No. 1666. Its observance in programs of the USDA is mandatory. The Policy stated is commended to everyone. The memo states that the Department will "practice and encourage the use of those means of effective pest control which provide the least potential hazard to man, his animals, wildlife and other components of the natural environment."

There is ample evidence that integrated control of pests will work. Application of minimal effective dosage of a pesticide only when needed to forestall imminent destruction of the crop will permit predators and parasites to keep many insects in check. Someday we will have effective biological control for many pests but now we have it only for a few.

The application of a pesticide to the target area so that it reaches that area, not downwind fields and woodlands, not left hanging dispersed in the air to drift--and drift--perhaps eventually to fall out in rain or snow, is essential to the limitation of pesticide pollution of the environment. Altitude, flight pattern, speed, wind, all affect the amount of pesticide reaching the target area by aerial application. Licensing and supervision of application is a State and local responsibility. USDA has statutory authority only for supervision in its own programs.

Every farmer is an ecologist of sorts. He manages an ecosystem, an agro-ecosystem, or several of them. As Kellogg and Orvedal have succinctly put it: "Each farmer makes his own arable soil from either a natural soil or an old arable soil. He may change it only a little or he may change it drastically by reshaping the surface for water control, by adding fertilizers to correct plant nutrient deficiencies, by adding other materials to correct acidity or alkalinity or to improve the structure of the soil, or by tilling in depth."[6/] The soil is a living system; treated wisely, it may sustain man and his living associates, plant and animal, generation after generation, with steadily improving productive capacity.

The cotton agro-ecosystem is dominated by a rather uniform population of a single species.

Highest cotton yields are obtained in sunny, long season, irrigated areas. They require abundant, well managed water, suitable soil, adequate fertilization, good genetic stocks, timely tillage, and pest control. Included in the cotton ecosystem are weeds, trash, trees, ditches, ditch banks, roads, fence rows, turn rows, farmsteads, and frequently, intermingled areas of other crops and woodlands and wastelands. The area included must be large enough so that the more significant populations can complete their life cycles within it. There is likely to be substantial movement of species into, within, and out of the system.

Integrated control of cotton pests does include chemical pest control when necessary, that is, when severe crop damage from a particular pest is imminent. The preferred pesticide should be as nearly specific for the particular pest insect as possible.

In the San Joaquin, early pesticide treatment for lygus bugs may be followed by explosive bollworm infestations. Alfalfa strips and delay in lygus bug treatments permit parasites to help keep lygus bug populations in check without bollworm explosion.

In the Lower Rio Grande, bollworms and the tobacco budworm have developed resistance to pesticide chemicals. Omission of early season chemical pesticide treatment in 1969 was followed by yield increases of 20 percent. Pesticide application was halved.

Concentrated pesticide treatment of boll weevils late in the season when they are ready for diapause with very limited use of chemicals in the following season has been reported to control both boll weevil and bollworms on substantial Delta test areas with savings of $4 to $8 per acre.

Because cotton is so heavily dependent on insecticides, because the insect pests of cotton require a variety of chemicals for their control, because chemicals effective against one insect pest may kill the parasites and predators of another pest against which it is not effective; for all these reasons scientists seek to improve and apply integrated control methods for cotton pests.

Integrated systems vary from area to area dependent upon the kind of pests present. The old rainfed areas, from Texas east have the boll weevil, from Texas west to the Imperial Valley, the pink bollworm is a principal pest, and in the San Joaquin, the lygus bug is a continual threat. And the ribiquitous tobacco budworm and cotton bollworm, Heliothis sp., threaten everywhere.

Some weeds can also be controlled by insects. The alligator weed choked many of the water ways in Florida and Louisiana. A flea beetle brought from South America where the weed came from has cleaned up some of the Florida infested area (slides 4, 5, and 6).

Agro-ecosystems in the United States are highly varied--don't let the word throw you. You've thought in terms of types of farming all your lives; dairy--fruit--cash--grain--corn--hog--cotton. Our thinking has focussed on commodities, not systems. But the systems were there. We've been busy building large scale, highly mechanized commodity production systems without sufficient regard for the agro-ecosystems in which commodities are produced and with little regard for waste disposal which is a necessary part of commodity production.

The old McLean County hog system minimized the waste disposal problem. Farrowing houses were distributed over the pasture area--the pasture was part of the system; so was the manure; and so were the worms the pigs recycled. Very often, when pigs reached feeder size, they were placed in the cattle feedlot to glean their food from the cattle droppings.

Now we have confinement systems, feeder pig systems, pathogen-free systems. The trend is toward larger and larger units, continuous production; concentrations of large amounts of waste.

One of our most urgent needs is effective waste disposal systems which do not contaminate air, soil, and water. Lagoon systems, even when they work, discharge nutrient laden effluent into streams.

Let's look briefly at the animal waste load in the U. S. Consider only the more concentrated portions--the following table assumes continual occupancy on "large scale" operations.

DISPOSAL PROBLEM FOR LIVESTOCK WASTES EQUIVALENT TO THE HUMAN WASTE DISPOSAL PROBLEM

Kind of Livestock	Total (January) (Million)	"Large Scale" Operation (Million)	"Large Scale" Human Waste Equivalent Per Head of Livestock	"Large Scale" Human Waste Equivalent Total (Million)
Feedlot cattle	12	5	10	50
Milk cows	14	7	15	105
Laying hens	320	100	0.1	10
Turkeys (raised)	125	50	0.1	5
Broilers	2,600	400	0.05	20
Pigs	54	10	1	10
Lambs on feed	3	2	0.5	1
Total				201

1. Calculated as average through the year

This crude table indicates a disposal problem for livestock wastes equivalent to the human waste disposal problem. I have eliminated all consideration of wastes from city birds, dogs, cats. I have assumed that all livestock dispersed on farms and ranges and all wildlife even more scattered do not constitute a waste disposal problem. It is the most conservative estimate of our waste disposal problem known to me. I estimate that the quantity of animal waste subject to mass disposal methods will double by 1980.

The several solutions include:

1. Composting and ultimate return to the soil.

2. Settling, flocculation, dehydration, or other means of concentration with ultimate return to the soil.

3. Recycling, perhaps selectively, with or without processing as animal feed.

4. Incineration.

5. Laizzez faire.

All of these methods have defects. In many cases, the cost of waste disposal will exceed the value of the waste to the user. These costs may be reflected in price of product or in taxes.

Systems with which we are concerned include the energy system. One burgeoning component of the energy system is electricity. The Office of Science and Technology estimates that 255 new plants will be needed by 1990. They will have a capacity of one million megawatts, three times the capacity of the 3,000 plants now existing. It is probable that 160 plants will have cooling towers by 1990.

Thermal pollution will become a major issue. Location of new plants and burial of transmission lines are issues now. They are environmental issues. Economic and social costs and benefits will be debated throughout the land. This will inevitably be one of the major environmental issues in rural as well as in urban America and in the world.[7/]

The Unesco Chronicle for November 1969 quotes (page 40) Moscow University Professors Kalinin and Bykov as follows: "Power is now generated and consumed by industry at such an accelerating rate that this will seriously affect the earth's heat budget.

"If power generated increased annually by ten percent, in 100 years it will have an effect comparable to that of solar radiation."

5. What is being done to improve the quality of the environment?

The following table shows estimated Federal expenditures on pollution related to agriculture in 1969.

ESTIMATED EXPENDITURES ON AGRICULTURAL POLLUTION[8/]

(Million Dollars)

Pollutant	USDA			DOD			DHEW			USDI		
	R&D	Action	Loan	R&D	Action	Loan	R&D	Action	Loan	R&D	Action	Loan
Sediment	4.0	289.3	7.0	0.2	186.8	--	--	--	--	1.3	51.6	--
Animal Waste	1.5	0.8	--	--	--	--	0.5	--	--	0.4	0.7	--
Processing Wastes	1.8	0.9	2.0	--	--	--	0.5	--	--	0.3	12.0	--
Plant Nutrients	1.6	1.2	--	--	--	--	0.1	0.1	--	2.6	2.4	--
Forest and Crop Residues	1.4	24.3	0.1	--	--	--	--	--	--	--	0.3	--
Inorganic salts & minerals	1.2	1.6	14.0	--	--	--	--	--	--	1.7	--	--
Pesticides in the environment	45.9	15.0	--	--	--	--	7.5	2.5	--	1.9	1.9	--
Air pollution related to Agriculture	1.4	10.0	--	--	--	--	3.6	2.0	--	--	--	--
TOTAL	58.8	343.1	23.1	0.2	186.8	--	12.2	4.6	--	8.2	67.9	--

A joint USDA-State Task Force reviewed current research programs, needs, and opportunities in 1968. Aside from the very large continuing research effort on pest control, the Task Force identified a total of about 660 scientist-man-years (SMY's) devoted to research on other forms of pollution in 1966 as shown in the following table. They projected a need for 1,336 SMY's in 1977, more than double the 1966 effort.[9/]

Pollution Research in the USDA, SAES, and Cooperating Forestry Schools (SMY's)

Pollution or subject area	1966	1977
Animal and domestic wastes	27	140
Processing wastes	30	133
Infectious agents, toxins, and allergens	197	270
Sediment	96	254
Plant nutrients	200	275
Mineral and other inorganic substances	44	95
Radioactive wastes	0	10
Airborne chemicals and particulates	41	114
Noise	1	7
Socioeconomic aspects	2	32
Systems analysis	2	6
Total	640	1,336

The Task Force clearly saw the need for systems analysis in solving pollution problems. It also noted a deficiency which still limits the application of systems analysis--a monitoring network such as that proposed under the International Biological Program, a global network of environmental monitoring and local monitoring to guide the systems analysis of local problems. The report quotes Bineck and Taylor,[10/] "When the general problem of waste management and environmental quality is viewed in total, it becomes obvious that solutions to one resource pollution problem may intensify other resource problems--Transfers of pollution problems to other subject matter areas, or legal or bureaucratic jurisdictions are not solutions in any relevant sense."

6. What kind of environment do we want?

Dreams of utopia founder for lack of definition and agreement. It is simple to identify an environmental defect; sensory perception takes care of that. The blind can smell. It is difficult, probably, hopefully, impossible to describe an environment all people would consider ideal.

Criteria and standards for important environmental parameters; e.g., for air quality and water quality, are useful and feasible. But may not focus on such specifics divert us from consideration of the quality of the aggregate environment of which each of us is a part?

Data on ratio of green open space to that covered by buildings and pavement are useful--but again this is a reductionist approach to the environment which can be misleading. Green open space can be a helpful Sirvk for CO_2, for other products of industry. But in the city, green plants may be made hideous by pollutants.

Josh Lederberg, in his January 24 column in the Washington Post quotes Karl Popper,[11] who wrote: "Social life is so complicated that few men, or none at all, could judge a blueprint for social engineering on a grand scale. . . accordingly, adopt the method of searching for and fighting against, the greatest and most urgent evils of society, rather than searching for, its greater ultimate good."

Lederberg goes on: "Today we have just one reason to voice an exception, [from Popper's argument] the survival of the human community on earth may be utopian ideal.

"For its realization, we have little experience, tools, training, or organization. We lack even the will to proceed with the long range global planning to meet the realities of today's poverty and tomorrow's revolution of hunger and unfulfilled expectations." This is indeed a sobering indictment.

But let us look at our proven competence; at our way of doing things. With all Americans, perhaps with all people, I am proud that "we," the people of the U. S., her scientists, engineers, politicians, and especially her astronauts fulfilled the commitment made by President Kennedy that we would land a man on the moon before 1970.

"Between now and the year 2000, over 100 million children will be born in the U. S. When they grow up--and how--will, more than any one thing, measure the quality of American life in these years ahead."

We have a goal; a goal for each of us. Goals and roles; we in agriculture have played and must continue to play an essential role with respect to the quality of the environment, ergo the qualify of life. Agriculture in the U. S. in its role of supplier of food, fiber, and forest products, is technology dependent. Land and labor have become junior partners, a reversal of traditional relations and a reversal which must take place in all the world.

President Nixon said, "The argument is increasingly heard that a fundamental contradiction has arisen between economic growth and the quality of life, so that to have one, we must forsake the other.

"The answer is not to abandon growth but to redirect it."

Elvis Starr,[12] President of the National Audobon Society, put it another way in his speech to the San Francisco Conference of the U. S. National Commission for Unesco. He said: "The value choices must be made first, and then the technologists and engineers brought into play, in support of these choices. Technologists and engineers are people, too, and as people have responsibility for sharing in those value choices."

Of course, we've been making value choices and achieving them in Agriculture since that art began; we planted in order to harvest. We cared for brood stock in order to harvest the offspring. We managed forest and range in order to achieve sustained yield.

Our record of goal achievement--and over achievement--is remarkable.

Conclusion

The efficiency of agriculture is a major determinant in the quality of our environments--rural, urban, local, global. For as agriculture produces food, fiber, and forest products efficiently, land and associated resources are released for other uses and for enjoyment.

Agricultural pollution can be resolved by development and application of systems which are technologically effective and socially and economically acceptable.

REFERENCES

1/ NAS-NRC. 1970. Report on Physics of the Earth in Space: The Role of Ground-Based Research. Office of Information Memo of January 2[illegible], 1970.

2/ Goldberger, M. L. and G. J. F. MacDonald. 1970. Institutions for the Effective Management of the Environment. 62 pp. NAS-NAE. Washington, D. C.

3/ Shoffner, Sarah H. 1970. Self Concept: Its Role in Breaking the Poverty Cycle. Agricultural Science Review, Vol. 7, pp. 123-129.

4/ Hoffer, Eric. 1964. The Temper of Our Time, pp. 28-29. Harper and Rowe, New York.

5/ Goldberger, M. L. and G. J. F. MacDonald. 1970. Institutions for the Effective Management of the Environment. 62 pp. NAS-NAE. Washington, D. C.

6/ Kellogg, C. E. and C. Orvedal. 1969. Potentially Arable Soils of the World and Critical Measures for Their Use Advances in Agronomy Vol. 21, pp. 109-170. Academy Press, New York.

7/ Resources for the Future. Some Highlights of 1969. Resources for the Future, Inc. Washington, D.C. 20036

8/ From USDA-OST Report. 1969. Control of Agriculture Related Pollution.

9/ Joint Task Force 1968. Environmental Quality: Pollution in Relation to Agriculture and Forestry. USDA, Science and Education, Washington, D.C.

10/ Bineck, J. P. and G. C. Taylor. 1967. Economics of Water Pollution. Workshop on Water Research Needs, University of Florida, Gainesville, Florida, May 8-9, 1967.

11/ From Karl Popper: The Open Society and Its Enemies.

12/ Starr, E. J. 1969. Remarks at the 13th National Conference of the U. S. National Commission for Unesco. San Francisco, California, November 23-25, 1969. Unpublished.