

Ethical Implications of Carrying Capacity

by Garrett Hardin (1977)

It should be clear by now that the idea of the commons did not suddenly arise out of nothing in the year 1968. Passing references to the problem occur as far back as Aristotle, and Lloyd certainly saw it clearly in 1833. H. Scott Gordon's work in 1954 saw the beginning of a new concern with the problems presented by this politico-economic system. Yet the fact remains that a widespread recognition of these problems did not develop until after 1968. Why the delay? Two reasons are apparent.

First, a favorable climate of opinion was needed for remarks about the commons to be noticed. This was created in the 1960's by the rapid growth of the environmental movement, which alerted people to the consequences of distributional systems. Second, it was necessary that the properties of the commons be stated in no uncertain terms if people were to consider the matter seriously. It was necessary that the human tragedy of adhering to a commons-type distribution be emphasized. A good, solid fortissimo minor chord had to be sounded. Before 1968 most of the sounds were either mere grace notes or extended passages played pianissimo. The down-playing was for good reason, of course: the clear message of the commons threatened cherished beliefs and practices. Abandoning any traditional practice requires a political upset (though revolution may be too strong a word).

We have seen how the problem of the commons has been evaded in the exploitation of ocean fisheries. Understandably, it is evaded even more in the question of human populations. Both problems require for their rational resolution a clear understanding of the concept of carrying capacity and a willingness to fashion laws that take this concept into account.

Let us first look at the concept as it applies to other animals and plants, to the non-human populations we would like to exploit for our own benefit.

The carrying capacity of a particular area is defined as *the maximum number of a species that can be supported indefinitely by a particular habitat, allowing for seasonal and random changes, without degradation of the environment and without diminishing carrying capacity in the future*. There is some redundancy in this definition, but redundancy is better than inadequacy. Using deer as an example, the true carrying capacity of a region must allow for the fact that food is harder to get in winter than in summer and scarcer in drought years than in "normal years." If too many head of deer are allowed in the pasture they may overgraze it to such an extent that the ground is laid bare, producing soil erosion followed by less plant growth in subsequent "years. Always, by eating the grasses that appeal to them, herbivores selectively favor the weed grasses that are not appealing, thus tending to diminish the carrying capacity for themselves and for their progeny in subsequent years.

The concept of carrying capacity is a time-bound, posterity-oriented concept. This is one of the reasons that it threatens the "conventional wisdom" (Galbraith's term) of the present time, which leans heavily on short term economic theory. The theory of discounting, using commercially realistic rates of interest, virtually writes off the future. [1] The consequences have been well described by Fife and Clark. Devotion to economic discounting in its present form is suicidal.

How soon is it so? "In the long run," an economist would say, since disaster is more than five years off. "In the short run," according to biologists, since disaster occurs in much less than the million or so years that is the normal life expectancy of a species. Here we see a standing issue of dispute between economists and biologists, with their different professional biases reckoning time.

Game management methods of maintaining the carrying capacity of a habitat impinge upon ethical theory. Officially, Judeo-Christian ethics is absolutist in form, rich in proscriptions such as "Thou shalt not kill." Can we base game management on such principles? Obviously we cannot. Time after time, in an area where men have eliminated such "varmints" as coyotes and wolves, prey species (e.g., deer) have multiplied far beyond the carrying capacity of their habitat, which they then severely damage thus reducing its carrying capacity in the future. [2] Taking for granted the legitimacy of human desire to maximize gains from the deer-pasture, is "Thou shalt not kill" a good ethical rule? *It depends*. If the herd size is less than the carrying capacity we might insist on this rule; but if the herd has grown beyond carrying capacity we should deliberately kill animals, until the size of the herd is brought to a safe level.

For the maximum yield of venison we should keep the herd at that level at which the first derivative of the population function is a maximum; but for safety, allowing for unforeseen random fluctuations, the population level should be kept a bit above the point of fastest population growth.

This analysis was focused wholly on the interests of man, the exploiter of nature. Much the same conclusion is reached if we focus entirely on the species being exploited. Whenever there are too many animals in a habitat the animals themselves show all the signs of misery, if our empathic projections are to be trusted at all. The animals become skinny and feeble; they succumb easily to diseases. The normal social instincts of the species become ineffectual as starving animals struggle with one another for individual survival.

In a state of nature the unsavory consequences of exceeding the carrying capacity are prevented by natural predation. Putting entirely to one side the exploitative goals of animal husbandry, whenever men maintain a population of animals free of predators they should, if they are humane, pursue a regular program of killing animals so as to keep the herd size below the carrying capacity of the habitat.

We see that the ethics of game management is not an absolutist ethics but a relativistic or situational ethics. [3] The foundation of situational ethics is this: *The morality of an act is determined by the state of the system at the time the act is performed*. Ecology, a system-based view of the world, demands situational ethics.

Unfortunately, situational (ecological) ethics creates difficult problems for the law. It is difficult to write statute law if we are deprived of the simplicity of flat, unqualified *dos* and *don'ts*. Qualifications can be written into law, but it is hard to foresee all the particularities of future situations. Our insufficiently informed efforts leave "loopholes" for rascals to crawl through. When found, loopholes can be plugged, of course; but that takes time. The legislative process is a slow one. Situational ethics seems almost to demand an administrative approach; by statute,

administrators can be given the power to make instant, detailed decisions within a legally defined framework. Rules promulgated by an administrative agency are called administrative law.

On paper, the system may look fine, but the general public is understandably afraid of it. Administrative law gives power to administrators, who are human and hence fallible. Their decisions may be self serving. John Adams called for "a government of laws, and not of men." We rightly esteem this as a desirable ideal. The practical question we must face is how far can we safely depart from the ideal under the pressure of ecological necessity? This is the harrowing *Quis custodies* problem; [4] it has no easy solutions. [5]

When a well-defined problem is virtually ignored as long as the commons problem was -- more than a hundred years -- we naturally suspect the interference of taboo. This plausible supposition is by its very nature, nearly unprovable. Taboo is a composite thing: [6] there is "the primary taboo, surrounding the thing that must not be discussed; around this is the secondary taboo, a taboo against even acknowledging the existence of the primary taboo."

A taboo may be sustained in part for good tactical reasons: breaking it may open up a nest of problems not yet ripe for productive discussion. We may speculate--we can hardly know--that the long avoidance of the commons problem was due to a subconscious awareness of the intractable *Quis custodies* problem, which would have been activated by any attempt to depart from the system of the commons.

Moreover, the theory on which the commons problem is based rests on the concept of carrying capacity, which so far we have assumed is static. This is a justifiable assumption when we are speaking of a deer pasture in the wild, a habitat we propose to leave wild for esthetic reasons. But when we talk about cattle pastures, fish culture in fresh water ponds, and oyster culture in estuaries, we are talking about areas in which it is possible to increase the carrying capacity by technological intervention. Much of what we have called progress in the last two centuries has resulted from increasing the carrying capacity of the earth by technological means. Agricultural productivity, for instance, has increased by more than an order of magnitude since the time of Malthus, whose theory clearly assumed a static carrying capacity. Malthus' historical failure has understandably made many intelligent people very skeptical of any theory founded on the idea of a static carrying capacity.

Thus has it come about that many of the decisions made at the present time (insofar as they are explicitly rational) are based on balancing today's demand against tomorrow's supply, a type of bookkeeping that is frowned upon by certified public accountants. For the past two centuries we've gotten away with this practice because Science and Technology have generated miracles. But can such progress continue without end? The chorus of those who say it must come to an end grows ever larger. [7,8] Whom shall we believe: the Technological Optimists, or the Limits Lobby? If we are wrong, which way of being wrong is more dangerous? What is the proper policy for the true conservative? [9]

The concept of carrying capacity calls for the conservative, balanced equation type of thinking that has led to the triumphs of thermodynamics [10] and modern chemistry. But applied to human problems connected with exploiting the environment the concept of carrying capacity has

been perceived as a threatening one. As regards populations of non-human animals and plants, we are just now beginning to grapple with the implications of carrying capacity. When it comes to humanity itself, it is doubtful if we yet have the courage to systematically examine all possibilities, as the following report by Nicholas Wade, from *Science* (1974) makes clear.

The famine that struck the six Sahelian zone countries of West Africa last year is thought to have killed some 100,000 people and left 7 million others dependent on foreigners' food handouts. The same or worse may happen again this year. The essence of the tragedy is that the famine was caused not by dry weather or some putative climatic change but, primarily, by man himself. Could not Western skills, applied in time, have saved the primitive nomads and slash-and-burn farmers from destroying their own land? Western intervention in the Sahel, Western science and technology, and the best intentioned efforts of donor agencies and governments over the last several decades, have in fact made a principal contribution to the destruction.

"One of the basic factors in the situation is overpopulation, both human and bovine, brought about by the application of modern science," says a former Food and Agricultural Organization (FAO) sociologist. According to a recent in-house report on the Sahel prepared by the Agency for International Development (AID), "To a large extent the deterioration of the subsistence base is directly attributable to the fact that man's interventions in the delicately balanced ecological zones bordering desert areas have usually been narrowly conceived and poorly implemented." "Too many of our projects have been singularly unproductive and . . . we have tediously reintroduced projects which ought never to have been attempted in the first place," says Michael M. Horowitz, a State University of New York anthropologist who has studied the nomad peoples of Niger. And, to quote the AID report again, "It must be recognized that assistance agencies have ignored the principles [of effective resource management], and the consequence of indiscriminate support has produced negative results or, on occasion, disaster."

The symptoms of distress in the Sahel are easier to perceive than the underlying causes of the disaster. The six countries concerned -- Senegal, Mauritania, Mali, Upper Volta, Niger, and Chad -- are former French colonies that stretch along the southern edge of the Sahara desert. [See Figure 13.1.] The land is mostly semidesert that enjoys only 4 months of rainfall a year. But the grasses are sufficient to support the herds of cattle tended by the nomads, and in the southern regions millet and sorghum are grown, together with cash crops such as peanuts and cotton. By 1970, just before the collapse, the fragile steppe and savannah ecology of the six countries was supporting some 24 million people and about the same number of animals. This burden amounted to roughly a third more people and twice as many animals as the land was carrying 40 years ago.

The agent of collapse was a drought -- the third of such severity this century -- which began in 1968 and cannot yet be said to have ended. The grasslands started turning to desert, the rivers dwindled to a trickle, and by 1972, the fifth year of the drought, people, cattle, and crops began to die. "Our country is already half desert and our arable lands left are extremely reduced," the director of Chad's water and forestry resources told the FAO. By last year, Lake Chad had in places receded 15 miles from its former shorelines and split into three smaller lakes. The ancient cultural center of Timbuktu, a port fed by an inlet of the Niger river, was completely cut off and boats lay in the caked mud of its harbor. The nomads, forced to sell the surviving cattle that

afforded their only means of subsistence, were reduced to the status of aimless refugees in camps around the major cities. Probably 5 million cattle perished, the staple grain crops produced low harvests, and nearly a third of the population faced a severe food shortage which, but for a massive infusion of relief supplies from the United States and other donors, would have ended in widespread famine.

Drought has clearly been the precipitating cause of the ecological breakdown in the Sahel, but attempts to blame the desiccation of the land wholly on the dry weather, or a supposed southward movement of the Sahara desert, do not quite hold water. A global weather change may indeed have squeezed the Sahel's usual rain belts southward, as climatologists such as H. H. Lamb argue, or, as others believe, the drought may be no more than an extreme expression of the Sahel's notoriously variable climate. The Sahara desert may indeed appear to be advancing downward into the Sahel—at the rate of 30 miles a year, according to a widely quoted estimate (which works out at 18 feet per hour). But the primary cause of the desertification is man, and the desert in the Sahel is not so much a natural expansion of the Sahara but is being formed in situ under the impact of human activity. "The desertification is man caused, exacerbated by many years of lower rainfall," says Edward C. Fei, head of AID's Special Task Force on Sahelian Planning. According to the French hydrologist Marcel Roche, "The phenomenon of desertification, if it exists at all, is perhaps due to the process of human and animal occupation, certainly not to climatic changes."

Perhaps the most graphic proof of man's part in the desertification of the Sahel has come from a curiously shaped green pentagon discovered in a NASA satellite photograph by Norman H. MacLeod, an ergonomist in American University, Washington, D.C. MacLeod found on a visit to the site of the pentagon that the difference between it and the surrounding desert was nothing more than a barbed wire fence. Within was a 250,000-acre ranch, divided into five sectors with the cattle allowed to graze one sector a year. Although the ranch was started only 5 years ago, at the same time as the drought began, the simple protection afforded the land was enough to make the difference between pasture and desert.

The physical destruction of the Sahel was not an overnight process. Its beginning can be traced to the French colonization of the late 19th century, when the Sahelian peoples lost with their political power the control over their range and wells which was vital to the proper management of their resources.

The Sahel -- a term derived from the Arabic word for border--was once one of the most important areas of Africa. In the middle ages it was the home of the legendary trading empires of Ghana, Mali, and Songhai.

The key to the Sahelian way of life was a remarkably efficient adaptation to the semidesert environment. Although the nomads' life-style may seem enviably free to those who dwell in cities, there is nothing random about their migrations. The dry season finds them as far south as they can go without venturing within the range of the tsetse fly. Between the nomads and the sedentary farmers who also inhabit this area there is a symbiotic arrangement: The nomads' cattle graze the stubble of the crops and at the same time manure the fields. In exchange for manure the nomads receive millet from the farmers. With the first rains, the grass springs up and the herds

move northward. The rains also move north and the cattle follow behind in search of new grass. According to Lloyd Clyburn of AID, "The migration continues as long as the grass ahead looks greener than that at hand, until the northern edge of the Sahelian rain belt is reached. When that grass is eaten off, the return to the south begins. This time the cattle are grazing a crop of grass that grew up behind them on their way north, and they are drinking standing water remaining from the rainy season." Back in their dry-season range the cattle find a crop of mature grass that will carry them for 8 or 9 months to the next growing season.

The traditional migration routes followed by the herds, and the amount of time a herd of given size might spend at a particular well, were governed by rules worked out by tribal chiefs. In this way overpasturage was avoided. The timing of the movement of animals was carefully calculated so as to provide feed and water with the least danger from disease and conflict with other tribal groups.

By virtue of what one writer has called "the essential ecological rationality of the nomadic pastoral regime," the herders made probably the best possible use of the land. The settled part of the population, the farmers, had an equally capable understanding of their environment. They knew to let the land lie fallow for long periods -- up to 20 years -- before recropping, and they developed an extraordinary number of varieties of their main staples, millet and sorghum, each adapted to different growing seasons and situations. Within the limits of their environment and technology, the peoples of the Sahel have, over the past centuries, demonstrated what University of London anthropologist Nicholas David calls "an impressive record of innovation . . . which is quite at variance with the common negative criticism of the African as unduly conservative." In fact, when the Sahelian peoples have been conservative and resisted changes advocated by Western experts, it has often been with reason.

It could be absurd to blame the collapse of this intricate social and ecological system solely on Western interference, and yet rather few Western interventions in the Sahel, when considered over the long term, have worked in the inhabitants' favor. Those who have studied the farmers' and herders' traditional methods, says an FAO report on the Sahel, believe that the destructive practices that are now frequent are due to the cumulative effects of "over-population, deterioration of the climatic conditions and, above all, the impact of the Western economic and social system."

Western intervention has made itself felt in many ways, some inadvertent, some deliberate. Introduction of a cash economy had profound effects on the traditional system. The French colonial division of the Sahel into separate states has faced the nomad tribes with national governments which have tried to settle them, tax them, and reduce their freedom of movement by preventing passage across state boundaries. Curiously, however, it has been the West's deliberate attempts to do good that seem to have caused the most harm. The West in this case means the French, up until 1960, when the Sahelian countries were granted independence, and the French, Americans, and others thereafter. The French should probably not be held particularly to blame; they were only following conventional wisdom, and there is little reason to believe that other donor countries would have handled the situation very differently.

The salient impact is of course the increase in human and animal population that followed the application of Western medicine. The people of the Sahel are increasing at a rate of 2.5 percent a year, one of the highest rates of population increase in the world. If the nomads could have been persuaded to kill more of their cattle for market, the animal population might have been kept within bounds. Not foreseen was the fact that cattle are the nomads' only means for saving, and it in fact makes good sense -- on an individual basis -- for a nomad to keep as many cattle on the hoof as he can.

As a result herd numbers increased hand over fist in the decade following independence, aided by 7 years of unusually heavy rains. According to the FAO, the number of cattle grew from about 18 to 25 million between 1960 and 1971. The optimum number, according to the World Bank, is 15 million.

While the herders were overtaxing the pastures, the farmers were doing the same to the arable land. Population increase led to more and more people trying to farm the land. An even sharper pressure was the introduction by the French of cash crops to earn foreign exchange. With the best lands given up to the cultivation of cotton and peanuts, people had to bring the more marginal lands into use to grow their own food crops. In many cases these ecologically fragile zones could not take the strain of intensive agriculture. The usual process is that the fallow periods of 15 to 20 years are reduced to five or even one. Fertility declines, slowly at first, and then in a vicious spiral. Poor crops leave the soil exposed to sun and wind. The soil starts to lose its structure. The rain, when it falls, is not absorbed but runs off uselessly in gulleys. Desertification has begun. "Let us be under no illusion," President Leopold Sedar Senghor of Senegal told a symposium on the African drought held in London last year, "the process of desertification had been precipitated since the conquest of Senegal [by the French], since the introduction of growing peanuts without either fallow or crop rotation."

What cash crops have done for the Sahelian farmland, deep borehole wells have done for the pasture. A thousand feet or more beneath the Sahel lie vast reservoirs of water that can be tapped by deep wells. Thousands of these boreholes, costing up to \$200,000 apiece, have been drilled across the Sahel by well-intentioned donors. The effect of the boreholes was simply to make pasture instead of water the limiting factor on cattle numbers, so that the inevitable population collapse, when it came, was all the more ferocious. "Few sights were more appalling at the height of the drought last summer," according to environmental writer Claire Sterling in a recent article in *The Atlantic*, "than the thousands upon thousands of dead and dying cows clustered around Sahelian boreholes. Indescribably emaciated, the dying would stagger away from the water with bloated bellies and struggle to fight free of the churned mud at the water's edge until they keeled over.... Enormous herds, converging upon the new boreholes from hundreds of miles away, so ravaged the surrounding land by trampling and overgrazing that each borehole quickly became the center of its own little desert forty or fifty miles square."

Overgrazing of the Sahelian pasturelands was a consequence of too many cattle having too little place to go. As the farmers spreading out from the towns took more land under cultivation, they tended to squeeze the nomads and their herds into a smaller strip of space. Moreover, the nomads' ability to manage their own resources was slowly slipping away. Government interference reduced their freedom of movement, and the boreholes threw into chaos the

traditional system of pasture use based on agreements among tribal chieftains. With all the old safeguards in abeyance, the cattle numbers began to chew up the ecology across the whole face of the Sahel. First the perennial grasses went. These usually grow up to 6 feet tall and put down roots as deep. If the plant is heavily grazed, its roots make a shallower penetration and, in dry periods, may fail to strike water. The perennial grasses are replaced by coarse annual grasses, but these, under heavy grazing and trampling, give way to leguminous plants that dry up quickly and cannot hold the soil together. Pulverized by the castles' hooves, the earth is eroded by the wind, and the finer particles collect and are washed by rains to the bottom of slopes where they dry out into an impermeable cement.

Desertification has been hastened by the heavy cutting of trees for firewood. Trees recycle nutrients from deep in the soil and hold the soil together. Slash-and-burn techniques--the only practical method available to the poor farmer for clearing land--are the cause of numerous fires which, according to a World Bank estimate, kill off 50 percent of the range grass each year.

Under these abuses, the Sahel by the end of the 1960's was gripped by a massive land sickness which left it without the resilience to resist the drought. A whole vast area which might with appropriate management have become a breadbasket providing beef for half of Africa instead became a basket case needing more than \$100 million worth of imported food just to survive.

The future prospects for the Sahel and its people are not very bright. Sahelian governments and the various donors have not reached any kind of agreement on long-term strategy for rehabilitation. Some donors--AID excepted--are still digging boreholes. Most of the development projects now under consideration were drawn up before the drought struck and are based on the unlikely assumption that when the rains return everything can go on as before. (A recent meeting of American climatologists concluded that planners should assume drought conditions in 2 years out of every 3.)

Much of the development money for the Sahel will have to come from the United States and France, but there seems to be little coordination or exchange of ideas between the two countries. Nor is there any general agreement on how the Sahel can be restored to self-sufficiency. Optimists, such as William W. Seifert of MIT, who heads a \$1million long-term development study for AID, believe that the Sahel could support its present human population provided that cattle numbers were reduced by a half or more. Unfortunately, there is no way, short of a major social upheaval, that the nomads will consent to reduce their herds. Projects involving controlled grazing, such as in the Ekrafane ranch, are impractical because there is not enough land to go around. AID plans to open up the lands to the south of the Sahel by clearing them of tsetse fly, but this would benefit only 10 percent of the population. Others are not so hopeful. "I don't think there is much optimism that significant improvements can be expected in the short term. All you can do is to try to increase their margin for survival and hope that something turns up," says an agricultural specialist conversant with both the AID and MIT development plans.

"Neither the leverage of modern science and technology," concludes an in-house AID report on the Sahel, "nor the talents and resources of large numbers of individuals and institutions currently being applied to relevant problems has occasioned more than minor progress in combatting the natural resource problems and exploiting the undeveloped potential." Which is

another way of saying that Western ideas for developing the Sahel have not proved to be a spectacular success. Its ecological fragility and the vagaries of its climate make the Sahel a special case. But there are many other areas in the world where unchecked populations are overloading environments of limited resilience. The Sahel may have come to grief so soon only because mistakes made there show up quickly. Other Western development strategies, such as the Green Revolution, are, one may hope, more soundly based in ecological and social realities. If not, the message of the Sahel is that the penalty for error is the same Malthusian check which it is the purpose of development to avoid, except that the crash is from a greater height. [\[11\]](#)

A curious feature of this excellent report is that nowhere does it specifically point out that the tragedy in the Sahel is precisely the tragedy of the commons, though the detailed account could hardly be improved upon as an illustrative example. The omission is especially curious because the report was published in *Science*, the journal in which "The Tragedy of the Commons" was published six years earlier.

The significance of Wade's report did not escape bioethicist Van Rensselaer Potter, who wrote in a letter to the editor: [\[12\]](#)

The report on the Sahelian drought by Nicholas Wade . . . is a dramatic illustration of "the tragedy of the commons" as described by Hardin.

When I first read Hardin's article, I wondered if the users of the early English commons weren't prevented from committing the fatal error of overgrazing by a kind of "bioethics" enforced by the moral pressure of their neighbors. Indeed, the commons system operated successfully in England for several hundred years. Now we read that, before the colonial era in the Sahel, "overpasturage was avoided" by rules worked out by tribal chiefs. When deep wells were drilled to obtain water "the boreholes threw into chaos the traditional system of pasture use based on agreements among tribal chieftains." Thus, we see the tragedy of the commons not as a defect in the concept of a "commons" but as a result of the disastrous transition period between the loss of an effective bioethic and its replacement by a new bioethic that could once again bring biological realities and human values into a viable balance. [\[13\]](#)

The distinction between the old way of treating common property in the Sahel and the new way can be seen in terms of the political responsibility table given in Chapter 9 (Table 9.1). In the old days, the Sahelian environment was managed approximately according to the system of Case II, using informal sanctions ("an effective bioethic," in Potter's words). Then, as a result of intervention by well-meaning men of the European culture, part of the environment -- the grazing land -- was changed to Case III management, with the usual tragic results.

Mind-boggling photographs of the earth from space played an important role in bringing home this tragedy. There is no necessary logical connection between a mere photograph and the idea of conservation; but, as Marshall McLuhan has said, "The media is the message" and in our visually oriented society a striking photograph can become the symbol of an idea or a program.

In 1965, shortly before his death, while he was the U.S. Ambassador to the United Nations, Adlai Stevenson made a most memorable statement:

We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work and, I will say, the love we give our fragile craft.

The "we" of this statement is presumably all of the earth's inhabitants. It became a cliche of environmental activism to place Stevenson's statement alongside a blow-up of a NASA photograph of the earth as seen from space. The message implicit in this justification was evidently something of this sort: "This little blue ball, this unity, this Earth must surely be treated as a unity." What the activists did not realize was that they were calling for treating the earth as a commons -- with all the perils that implies.

The atmosphere and the seas are certainly global commons, but (as we have seen) global methods for managing them have not yet been devised. As regards environmental problems generally, Raymond Dasmann has remarked that "Those of us in international organizations are likely to assume a globalist viewpoint." Dasmann, who is himself a member of such an organization, then goes on to point out that "only a few environmental problems are really global in nature." When one realizes this, one is apt to ask rather interesting questions about the motivation of people who insist on treating nonglobal questions globally.

Faint beginnings of a shift in public attitude could be detected following the reproduction of the NASA photograph that showed the green hexagon in west Africa referred to in Wade's article. The resolution of this photograph from space was not very good, but its meaning was clear. The green part was restricted to the area protected (as private property) from uncontrolled grazing, while the dead-looking area around it was an unmanaged commons. Follow-up ground surveys verified this interpretation and noted the effect of environmental degradation on the grazers, the cattle. As William Forster Lloyd had cogently asked in 1833: "Why are the cattle on a common so puny and stunted? Why is the common itself so bare-worn, and cropped so differently from the adjoining inclosures?"

For more than three centuries intellectual and emotional fashions have increasingly veered toward the global outlook. Our thoughts have been significantly molded by John Donne's "No man is an island . . ." and Karl Marx's ". . . to each according to his needs." The thoughts engendered by these banners are generous thoughts, whereas speaking of local responsibility for local environments seems to many to be a miserly and selfish way of looking at the world's problems. There are a thousand to praise generosity for every one who has a kind word to say for selfishness. Yet biology clearly tells us that survival requires a respect for carrying capacity, and points to the utility of territorial behavior in protecting the environment and insuring the survival of populations. Surely posterity matters. Surely there's something to be said for selfishness.

Altruism versus selfishness: It is all too easy to polarize the argument, to maintain the univalence of facts. But the facts are ambivalent, as wise men have recognized for millennia. A Talmudic saying puts the matter rather well:

If I am not for myself, who will be for me?
If I am for myself only, what am I?
If not now -- when?

Notes

1. Garrett Hardin, 1974. "The rational foundation of conservation." *North American Review*, 259 (4) :14-17.
2. David R. Klein, 1968. "The introduction, increase, and crash of reindeer on St. Matthew Island." *Journal of Wildlife Management*, 32:350-367.
3. Joseph Fletcher, 1966. *Situation Ethics*. Philadelphia: Westminster Press.
4. Garrett Hardin, 1972. *Exploring New Ethics for Survival The Voyage of the Spaceship Beagle*. New York: Viking. (Chap. 16)
5. P. MacAvoy, ed. 1970. *The Crisis of the Regulatory Commissions*. New York: Norton.
6. Garrett Hardin, 1973. *Stalking the Wild Taboo*. Los Altos, Calif.: Kaufmann. (p xi)
7. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, and William W. Behrens III, 1972. *The Limits to Growth*. New York: Universe Books.
8. Mihajlo Mesarovic and Eduard Pestel, 1974. *Mankind at the Turning Point*. New York: Dutton. Unlike the "first report to the Club of Rome" (note 7 above), the "second report" does not aggregate the world's natural resources but seeks to deal with them on a regional basis. In going from facts to implications, however, this second report is not always consistent. See Garrett Hardin, 1975. "Will humanity learn from nature?" *Sierra Club Bulletin*, 60 (8):41-43.
9. It is one of the ironies of history that those who are generally labeled as economic "conservatives" at the present time are people who believe in limitless growth and hence see no need for what scientists regard as truly conservative thinking, that is, thinking in which the variables are conserved, and in which equations balance. For a particularly emotional defense of the conventional wisdom see Melvin J. Grayson and Thomas R. Shepard, Jr., 1973. *The Disaster Lobby: Prophets of Ecological Doom and Other Absurdities*. Chicago: Follett.

A book with a similar message, by the editor of the English journal *Nature*, is more sophisticated but scarcely better: John Maddox, 1972. *The Doomsday Syndrome*. New York: McGraw-Hill. For the most intellectual criticism of the limits to growth thesis see H. S. D. Cole, Christopher Freeman, Marie Jahoda and K. L. R. Pavitt, 1973. *Models of Doom: A Critique of The Limits to Growth*. New York: Universe Books. This, the American edition of the "Sussex Report", has the merit of including a postscript by the Meadows, et al. that throws much light on the nature of the controversy.
10. Nicholas Georgescu-Roegen, 1971. *The Entropy Law and the Economic Process*. Cambridge, Mass.: Harvard University Press. This is the only book published to date that sets economic theory on a firm foundation of thermodynamics, thus bringing together economics and ecology. (Etymologically, this is as it should be, since both words use the Greek root *oikos*, home. Both are concerned with the management of the "home," which classical economics sees almost

entirely as made up of men only, with other organisms and the physical environment playing the role of "givers" -- to which little attention is *given*. In the perspective of ecology, however, all organisms, as well as nonliving elements of the environment, are viewed as coexisting and interacting variables in this earthly home of ours.)

11. Nicholas Wade, 1974. "Sahelian drought: no victory for Western aid." *Science*, 185:234-237. Copyright 1974 by the American Association for the Advancement of Science.
12. Van Rensselaer Potter, 1974. "The tragedy of the Sahel commons." *Science*, 185:183. Copyright 1974 by the American Association for the Advancement of Science.
13. Van Rensselaer Potter, 1971. *Bioethics: Bridge to the Future*. Englewood Cliffs, N.J.: Prentice-Hall.