

Is There an Optimum Level of Population?

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We have become so conditioned to the inevitability of population increase that almost all concern has been to decrease the rate of increase. Only occasionally has the question been raised [J. J. Spengler in *The 99th Hour*, Daniel O. Price, Ed. (University of North Carolina Press, 1966)] as to whether we have attained or even passed an optimum level of population.

To start with, is the question itself meaningful? We need to define the word "optimum" and spell out "optimum for what?" This itself becomes a valid subject for discussion, but perhaps we can sidestep this point for the time being by redefining "optimum" as the situation in which the population, as a whole, enjoys the highest quality of life. This means, of course, that each person receives an adequate amount of food; is adequately supplied with the necessary raw materials to make the things and devices he needs (including such non-renewable resources as metals); that there is an adequate supply of energy, as well as water and air of high quality. But, in addition to the so-called "necessities of life," there are other requirements: adequate medical care to insure good health; recreational facilities, especially outdoors; and cultural outlets. Then there are sociological and psychological requirements, including a requirement for space and privacy.

Heuristic arguments can be a guide in arriving at a meaningful discussion. Take, for example, a town. If the pop-

ulation is too small, then it cannot provide all the necessary services which produce a good life: cultural facilities, hospitals, and so on. And we are all familiar with the consequences of too large a population in a city, or at least in the present, overcrowded city. Intuitively, then, one feels that there must be an optimum, perhaps a broad optimum, of population, and one feels that this concept could also apply to a region and to a country, and perhaps to the world.

For the purposes of the present discussion, let us confine our attention entirely to the United States, since we are interested only in investigating a methodology. It is not necessary, therefore, to involve ourselves in foreign problems.

In the United States, the production of food does not really provide a meaningful upper limit to the population. In other words, the upper limit is so high that other considerations would give a lower value. (While hunger is a very serious matter, it is due to a poor distribution system and to poverty of a segment of the population, rather than to the ability to produce food.) Rather than to ask the question: "How large a population can agricultural production support?" one can reverse the question by inquiring how few people it would take to feed a population of a given size, now and in the future. One would find, I imagine, that as the level of population increases, the fraction of people involved in agriculture would

drop down to an asymptotic limit, all other factors being equal. One could show the economies of scale allow one to manufacture food more efficiently in larger quantities. On the other hand, there comes a point when high-quality agricultural lands are exhausted and further production has to be carried on at a lower level of efficiency. A determining factor, of course, is advance in technology and in agricultural science: the former providing such essentials as water, fertilizer, and perhaps even CO₂ at lower cost; the latter developing plants that more efficiently convert the essential raw materials into food.

From a similar point of view, one could discuss the limitations introduced by mineral and other resources, and by manufacturing, and by the problems of air and water pollution which depend, not only on level, but also on concentration of population. Fairly well defined limits can be set, for example, to the capacity of streams to support the acceptance of treated chemical wastes and of thermal wastes. Furthermore, costs increase rapidly with the higher degree of treatment which becomes necessary as the population density rises.

One of the most important subjects is energy, since it forms the base for many of the other considerations. For example, with cheap and abundant energy, it is possible to produce food by non-conventional means, or to purify air and water economically to a very high degree. Social and health services can also be discussed in a fairly quan-

titative manner. Demographic trends can be documented, such as a lowering of the average age of the population, and a relative increase in poor people, who tend to have a higher birth rate. These trends can lead to important consequences in our society, which depend not only on the absolute level but also on the rate of increase of population; this should be especially true for a national social welfare program of the type proposed by President Nixon. Adequate educational and health services may provide a significant bond to achieving a full and healthy life for an ever-increasing population. Perhaps there arise also fundamental biological problems as the level of population goes beyond certain limits.

Other factors, such as sociological and psychological requirements can probably be discussed only in a semi-quantitative way. But no one can deny the existence of a human need for cultural outlets and for recreation, much of it out-of-doors, or the need for space and privacy, again with an emphasis on outdoor natural environments.

Which of the factors provide a "lowest upper limit" to the level of population? How do these various factors interact with each other? What research needs exist? Can at least portions of the problem be handled by mathematical simulation? What are some of the philosophical, ethical, and political considerations in striving for an optimum population level?

A discussion of such questions cannot do much more than open up the problem. It is clear that it will not answer the question of what is an optimum level of population. However, we can hope for at least the development of a methodology which will allow us to pursue the major question in a fruitful way. It will also lay the groundwork for the considerations of the Commission on Population Growth and the American Future which has been proposed by President Nixon to conduct an inquiry into the consequences of population growth in the United States and into the policies which the government should adopt.

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THE FATE OF OUR LAND?

Program Notes appear on pages 261-267. Registration forms for the meeting, hotels, and tours appear on pages 268 and 269. Reports on symposia appear in the following issues: 19 September, "Tektite: A Study of Human Behavior in a Hostile Environment"; 26 September, "Expanding Horizons in Medical Education"; and 3 October, "Education of the Infant and Young Child."