duction and starvation in sub-Saharan Africa.

Poor weather and droughts have hit sub-Saharan Africa repeatedly over the last 2500 years without the massive and disastrous effects of recent years. The latest droughts (in the early 1970s and 1980s) have been exacerbated by overexploitation and mismanagement of a fragile resource base. Two-thirds of Africa's land area is arid, semiarid, or subhumid. The soils are generally thin, have low fertility, and are easily eroded and compacted. Ground-water reserves are limited, and droughts lower water tables temporarily. Even more serious is the removal of trees and other vegetative cover, which has suppressed the water table permanently in some places.

However, given these limitations, indigenous cultures long ago developed production systems that were well adapted to the limits imposed by these fragile and arid conditions. "Shifting cultivation" allows fields to rest and recover nutrients and moisture for lengthy periods after two or three seasons of crop production. Other traditional systems combine farming practices with livestock production, feeding livestock on crop residues and tree fodder, while the animals' natural fertilizers are used for fields and gardens. Unfortunately, these traditional production systems have been increasingly disrupted by rapid population growth; changing social, political, and economic policies; and inappropriate Western-style development schemes.

The indiscriminate transfer of technology from temperate zones to tropical soils has seriously accelerated soil erosion. Cash crops such as cotton, tobacco, and peanuts consume large amounts of nutrients, reduce soil fertility, and increase soil erosion. In addition, with large areas of "good" land utilized for cash crops, farmers are forced to cultivate increasingly marginal and vulnerable lands. At the same time, pastoralists are pushed off their traditional grazing land and end up overgrazing the limited and more fragile rangeland.

Closely tied to Africa's agricultural problems is the continent's acute energy shortage. Many African countries depend on fuelwood and other forms of biomass for more than 90% of their energy and construction needs. Devegetation of the land for fuelwood and charcoal production is degrading millions of hectares of Africa's watersheds, causing severe soil erosion, and disrupting the delicate water balance. Every year about 3.6 million hectares of forests are being lost in Africa (*1*), but these continent-wide rates underestimate the severe regional pressure on forest resources.

A fragile ecosystem exploited beyond its carrying capacity eventually breaks down. Whether in the U.S. dust bowl or in some parts of Africa, the results can be tragic. Figures for soil erosion as high as 450 tons per hectare per year are not unusual, and in Ethiopia's highlands 1 billion tons of valuable soil are stripped by erosion every year (*2*).

Future strategies for helping sub-Saharan Africa increase its agricultural productivity must include the development of new agricultural systems and technologies designed for Africa's soils and climate and appropriate to its cultural, educational, and financial conditions. Broad land-use problems cannot be resolved by investing in one sector alone. An integrated approach to agriculture, forestry, energy, and rural development is needed, combined with economic incentives and a strong educational program. Resource management must become a high priority among development planners if we are to reverse the current trend of resource degradation and human suffering in Africa.

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REFERENCES

1. *Tropical Forest Resources* (Food and Agriculture Organization of the United Nations, Rome, 1982).
2. *Rehabilitation of Forest, Grazing and Agricultural Lands* (Food and Agriculture Organization of the United Nations/World Food Programme, Rome, 1981).

The article by Mellor and Gavian was excellent, but I wish to point out one omission. They dismiss overpopulation as a cause of famine very casually, saying, "family planning seems to accompany or follow the processes of agricultural growth and commercialization" (p. 543). This appears to be a statement of the long-discredited demographic transition theory. Even if that theory did apply to the underdeveloped world, we cannot wait several centuries for it to work.

High population that follows high birthrates reduces land available for agriculture as it increases the demand for food. Famine prevention such as the authors recommend does not solve the problem.

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The article "Famine: Causes, prevention, and relief" is an excellent discussion of the famines that are the result of "force majeure," that is, such causes as drought, civil unrest, and so forth. As pointed out in the article, such famines can usually be prevented or ameliorated if appropriate steps are taken in time.

Unfortunately not all famines can be prevented. This is especially so in the case of famines that are deliberately created by a government in order to exterminate a troublesome class or tribe. The famous famine in the Ukraine under Stalin is a classic example. The Ethiopian famine seems to be another case, at least from this distance. The famines in Afghanistan and Kampuchea may be other examples.

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Response: We agree with the seriousness of the problems raised by each of the three correspondents. How to solve these problems is less clear. We agree with the technological solution suggested by El-Ashry, but have three comments. We noted the "out of sight, out of mind" phenomena in our article—famine in the past has not been very visible in Africa, but it nevertheless has a much larger historical base than implied by El-Ashry and hence the problems are much less new and current. The technological solution involves increased intensification of production in better areas and allows reduction in the intensity in more fragile areas. This can occur most rapidly, if the full range of opportunities to intensify is availed of, including export crops and particularly including perennial crops that so much better preserve fragile soils. Thus, the rather general attack on cash crops and, by implication, commercialization and trade, as a way of reducing the assault on fragile environments is counterproductive. Note that African countries with good growth records in export crops have good growth records in food crops, and vice versa. The two are far more complementary to sustainable resource use and higher income generation than they are competitive.

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Macintosh Software

Trevor Robinson (Letters, 1 May, p. 508) states that, as far as he knows, no commercially produced bibliographic program exists for the Apple Macintosh. The Professional Bibliographic System has been available from us since August 1985 and is in use by thousands of researchers worldwide.

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